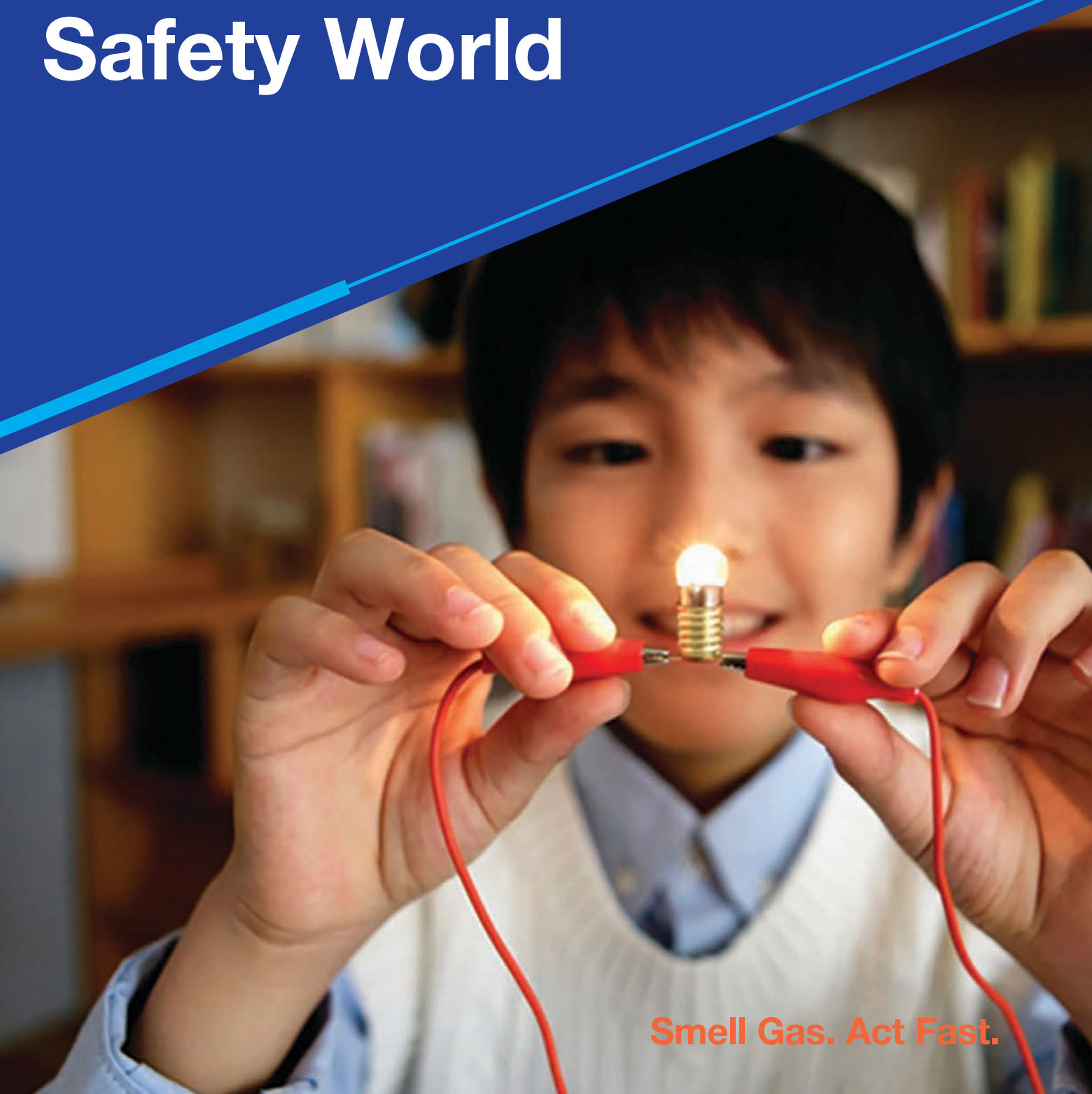
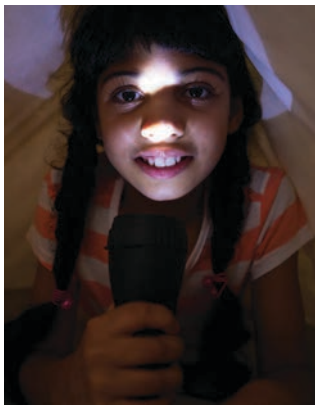
Energy
Education World

nationalgrid

Electrical & Natural Gas Safety World





Can you survive without using energy?

You need energy to work or play, and you get your energy from food. Appliances like refrigerators, ovens, heaters, TVs, computers and air conditioners need energy to work, too, but they get their energy from sources like electricity or natural gas.

ENERGY USE CHART

List all the ways you've used energy today.
Some sources of energy you might have used are electricity, natural gas, fuel oil, charcoal, wood, propane, gasoline or solar. An example is done for you.

What I Did	*What Appliance/Equipment I Used*	*Energy Source*
read a book	light bulb	electricity

What do you think?

Could you survive for a day without using any energy sources? Write or explain how you would keep warm or cool, what you would eat, and what you would do for transportation. Bonus: What would you do for fun?

ENERGETIC WORDS

Here are some electric and gas vocabulary words. See if you can find them in the puzzle.

ATOMS: Tiny particles that make up everything around us. Atoms are so small that 12 trillion of them can fit in a grain of sand.

CIRCUIT: A closed path or loop that is needed for electricity to flow. Electricity will not flow if a circuit is open.

CONDUCTOR: A material that allows electricity to flow through it easily. Water and metal are good conductors. So is your body!

CURRENT: The flow of electrical charge, measured in amperage ("amps" for short). The amperage in an electric circuit is like the amount of water that comes out when you turn on a faucet.

ELECTRICITY: A type of energy carried by the movement of electrons.

ELECTRON: A particle that travels around the nucleus at the center of an atom.

ENERGY: A property of many substances that is associated with heat, light, electricity, mechanical motion and sound.

INSULATOR: A material that does not allow electricity to flow through it easily. Special rubber and special glass are used as insulators.

Q. What did the baby light bulb say to the mommy light bulb?

A. I love you watts and watts!

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

MERCAPTAN: A chemical with the smell of rotten eggs, which is added to natural gas so people will know if gas is leaking.

NATURAL GAS: A form of energy that is found deep in the earth and flows through pipes to homes, schools and businesses.

VOLTS: Short for "voltage," a measure of the force with which electricity flows. The voltage in an electric circuit is like the pressure that pushes water out when you turn on a faucet.

WATTS: A measure of the work that electricity does. **Watts = Amps x Volts.**

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How electricity

Electricity starts with atoms, the tiny particles that make up everything around us. Even tinier particles called electrons orbit the center of atoms. When electrons move from atom to atom through a wire, electricity results.

Electricity is typically produced at power plants where various energy sources are used to turn turbines. The turbines turn electromagnets that are surrounded by heavy coils of copper wire.

The moving magnets cause the electrons in the copper wire to move from atom to atom, generating electricity.

Turbines at a power plant

Which are renewable?

Renewable fuels can be replenished in a short period of time, so they will never be all used up.

Nonrenewable fuels can someday be used up.

Here are some different fuels used to generate electricity. Put an X in the correct circle to show whether each one is renewable or nonrenewable. On a separate sheet of paper, explain why you think so.

FOSSIL FUELS

Fossil fuels (coal, oil and natural gas) were formed from the fossilized remains of creatures that lived long ago. Most electricity used in the world is generated from power plants that burn fossil fuels to heat water and make steam. The highly pressurized steam is directed at turbine blades to make them spin.

○ RENEWABLE ○ NONRENEWABLE

NUCLEAR POWER

Nuclear power plants use heat released from splitting atoms to convert water into the steam that turns turbines. They rely on uranium, a type of metal that is mined from the ground.

○ RENEWABLE ○ NONRENEWABLE

happens

HYDROPOWER

Hydroelectric plants use the power of falling water to generate electricity. Water that is stored behind a dam is released and directed to flow against turbine blades, making them turn.

○ RENEWABLE ○ NONRENEWABLE

BIOMASS

Biomass includes wood chips and bark left over from lumber production, farming and food wastes, and garbage. Biomass can be burned to heat water, producing steam that turns a turbine. It can also be converted into a gas, which can be burned to do the same thing.

○ RENEWABLE ○ NONRENEWABLE

GEOTHERMAL ENERGY

Steam (or hot water that has been converted to steam) from deep inside the earth is piped to the surface, where it is used to turn turbines.

○ RENEWABLE ○ NONRENEWABLE

SOLAR ENERGY

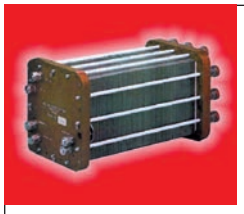
Solar energy is generated without a turbine. Special panels of photovoltaic cells capture light from the sun and convert it directly into electricity, which is stored in a battery.

○ RENEWABLE ○ NONRENEWABLE

WIND POWER

The force of the wind is used to spin many small turbines. Most wind power is produced at wind farms, which are large groups of turbines in very windy locations.

○ RENEWABLE ○ NONRENEWABLE



FUEL CELLS

Fuel cells produce electricity through a chemical reaction. Some types of fuel cells can be used at power plants. Others can be used to run cars or appliances.

○ RENEWABLE ○ NONRENEWABLE

Go with the flow!

Electricity travels in a closed path called a circuit. When you switch on an appliance, you complete a circuit for electricity. Here is how it works:

Electricity flows from **overhead power lines** (1), or **underground power lines** (2), through a **transformer** (3)(3) where the voltage is reduced. From the transformer, electricity travels through **service wires** (4) to your home's **electrical panel** (5). This panel has **circuit breakers** (6) or **fuses** (7) that turn off the electricity if there is an electrical problem. From the panel it flows through your **home wiring** (8) to a **switch** (9) or an **outlet** (10), and then through a **power cord** (11) to the **appliance** (12) where it does its job.

To complete the return part of the circuit, electricity flows back through a different wire in the power cord to your home wiring, and back through the service wires to the transformer and the power lines.

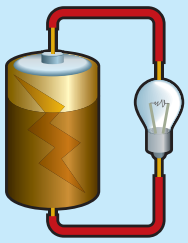
Choose three words in the text above that are new to you, and look up their definitions. Then write them out on a separate piece of paper.

WHICH BULBS WILL LIGHT?

Which of these circuits are closed paths that will allow electricity to travel in a loop and make the bulb light? Show whether each circuit is closed or open by putting an X in the correct circle. Write why you think so.

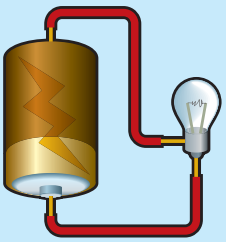
OPEN CLOSED

WHY? _____



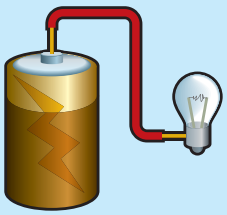
OPEN CLOSED

WHY? _____



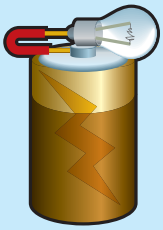
OPEN CLOSED

WHY? _____



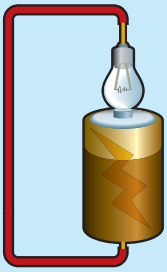
OPEN CLOSED

WHY? _____



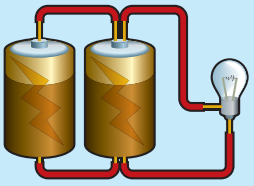
OPEN CLOSED

WHY? _____



OPEN CLOSED

WHY? _____



Did you guess right?

Get two D batteries, a flashlight bulb, and four pieces of insulated copper wire stripped at the ends. Set up the materials as they are shown in the illustrations. (Hint: use tape to hold your circuit together.) Were you right about which circuits were closed and which were open?

Conductors & Insulators

CONDUCTORS are materials that allow electricity to flow easily through them.

Water, metal and your body are good conductors. So if you contact electricity from a power line, power cord or appliance, you risk serious injury or electrocution (fatal shock).

INSULATORS are materials that do not allow electricity to flow easily through them.

Specially tested rubber and glass are insulators. People who work around electricity use tools and equipment made of insulators to help prevent shock in case they contact electricity.

Which object in each pair is more likely to be used by people who work around power lines?

A

B

Why?_____

_____

A

B

Why?_____

_____

A

B

Why?_____

_____

What do you think?

Does a big metal object (like a ladder) conduct electricity differently than a small metal object (like a scissors)? Explain your prediction. If you have a battery/wire/bulb circuit, use it to test some big and little metal objects to see if your prediction was correct.

STRUCK BY LIGHTNING

Carissa from Petaluma, California

I was struck by lightning when I was 15. It was raining. I was in my high school parking lot about to get into my Mom's car. I had just closed my umbrella. All of a sudden I saw a bright light and I felt lightning go through my body. I got extremely warm and started shaking. My Mom saw the whole thing. She said I just lit up.

The umbrella conducted the lightning into my arm. The metal tip at the top of the umbrella got indented and burnt. My arm got tingly, sore and weak. I had some nerve damage in my arm and I needed physical therapy to get it working right again.

I consider myself really lucky to be alive and okay. If it's storming I don't go out in the thunder and lightning anymore. I don't want it to ever happen again.

Lightning can hurt or kill you

Plan ahead so you don't get caught outside during a storm. If you see lightning or hear thunder, go indoors immediately. Lightning can travel through phone and electrical wiring and water pipes, so stay away from bathtubs, sinks, phones and anything that uses electricity – like TVs, computers or video games.

If you can't get indoors

- **You'll be safer in a hardtop car with the windows up.** Keep out of convertibles, golf carts, tractors or other open vehicles.
- **Stay away from trees, tall objects and anything metal.** Lightning is drawn to them.
- **Stay away from rivers, lakes and swimming pools.** Lightning likes water.
- **Avoid wide-open areas**, including sports fields, golf courses and parks.
- **If you are caught in the open, squat or kneel.** Bend forward with your hands on your knees. **Do not lie down.**

What do you think?

The electricity in most homes is 120 volts. A lightning bolt can carry up to 30 million volts!
If you could harness the electricity from one lightning bolt, how many homes would it light up?

A shocking scene

In the movie *Like Mike*, one stormy night young Calvin Cambridge climbs a tree to get a pair of athletic sneakers that are hanging from a nearby power line. ***(How unsafe is that?!)***

As Calvin yanks at the sneakers, a bolt of lightning strikes the power line, the shoes and him. The boy falls to the ground with the sneakers, which have been energized with the athletic powers of Michael Jordan. Calvin survives the electrical shock, unhurt. ***(Nope!)***

If Calvin had done this in real life, he would have been badly hurt or electrocuted. Never climb trees near power lines, and don't ever try to get anything hanging from a power line! Call your local utility for help instead. And please don't throw shoes – or anything else – at power lines.

Have you ever seen a "SHOCKING" SCENE?

Have you ever seen a movie, video game, TV commercial or book that shows someone breaking electrical safety rules? Write about it or describe it to your class. Include what the character did wrong, and what could happen if a real person were to do the same thing.

Electricity is always looking for the easiest path to the ground. Electricity will stay in power lines unless someone, or something, gives it a path to the ground. If you touch a power line while standing on the ground, or on something resting on the ground, like a ladder or a tree, you could give electricity a path to the ground. Anyone who touches a power line is in danger of being hurt or killed.

What do you think?

Metal conducts electricity. So why doesn't electricity travel down metal utility poles? _____

_____

_____

_____

_____

FOLLOW THESE OUTDOOR SAFETY TIPS

If you fly kites or climb trees…

Do it far from power lines. Kites in power lines can cause outages or fires. Climbing trees near power lines is risky business – trees have lots of water in them and can conduct electricity.

If you play with high-power water squirters…

Keep them away from power lines. If you shoot water at a power line, electricity can travel down the stream of water, right back to you!

If someone you know is planning a digging project…

Make sure they call the local underground utility locator service at 811 several days before digging. Underground utilities are everywhere, even in your yard. Digging into them can be hazardous.

If you see a fallen power line…

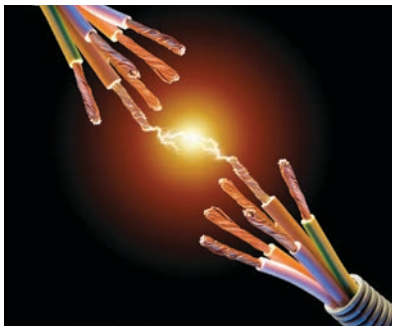
Stay far away. Even if the line is not sparking or humming, it could be carrying electricity. Don't touch the line or anything it is touching, like a tree or fence. Instead, call 911 to report the fallen line.

If you're in a car with a power line on or near it…

- **Warn people to stay away; ask them to call for help.**
- **Stay there until rescue workers arrive.** You are safer inside the car because the rubber tires help prevent electricity from going to the ground.
- **If you must leave because of fire or other danger, do not step out of the car.** If you touch the car and the ground at the same time, you will be shocked. **Instead, jump clear, land with your feet together, and shuffle away with small steps, keeping your feet close together and on the ground at all times.**

GET CREATIVE! **Pick one of these power line safety tips. Make a poster, rap song, mini-book or oral presentation to explain this tip and what could happen if people don't follow it.**

Indoor electrical safety



1 **Unscramble these sentences to learn some indoor electrical safety tips:**
toaster the first unplug _____ _____ _____ _____.
frayed a use don't cord _____ _____ ___ _____ _____.
water near radio a use battery-powered _____ ___ _____-_____
_____ _____ _____.

2 **Circle the conductors in each picture.**

3 **Explain why each of these situations is dangerous. What terrible thing could happen next?** _____

_____

_____

_____

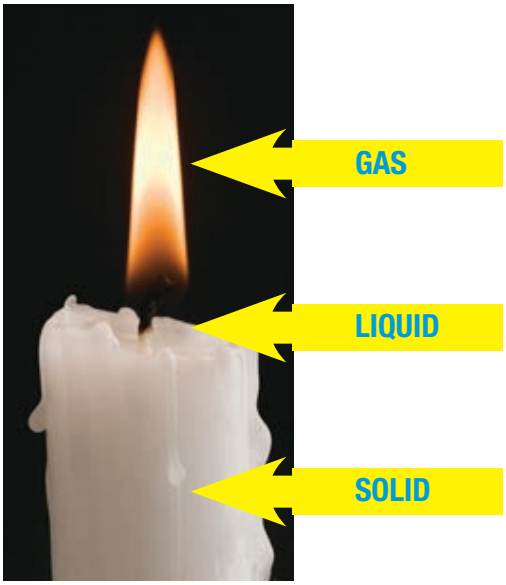
Don't overload electrical outlets. Overloaded outlets are a fire hazard.

Use this space to write some other indoor electrical safety tips that you know, and why it's important to follow them. _____

_____

_____

THE THREE STATES OF MATTER



Everything in the world exists in one of three different states. These aren't states like Massachusetts or California. They are the three states of matter – solid, liquid and gas.

Some things change from one state to another when they are heated or cooled. For instance, when you light a candle, the solid wax around the base of the wick gets hot and becomes a liquid. When this liquid wax gets hot enough, it turns to a gas and burns.

Can you think of other things that change states when they are heated or cooled? _____

_____

_____

Match the word to the sentence that describes it.

SOLID ***GAS*** ***LIQUID***

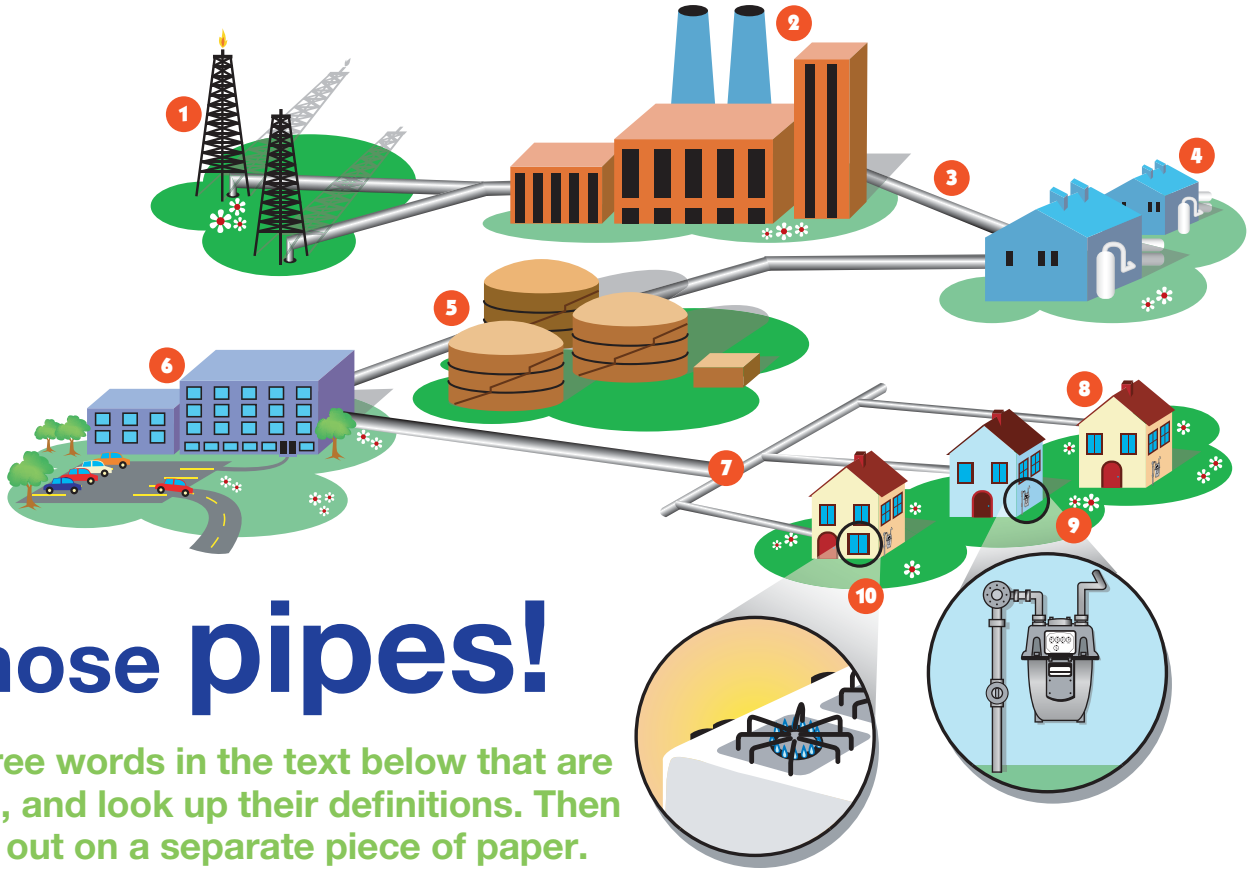
This substance is shapeless. It will take on the shape of (and fill up the space of) whatever container it's in, like a jar or a room.	This substance will take on the shape of its container, but fills the same amount of space no matter what container it's in.	This substance keeps its shape and always takes up the same amount of space.

What do you think?

Coal, oil and natural gas are known as fossil fuels because they were formed from the fossilized remains of plants and animals that lived hundreds of millions of years ago. Which of these fuels is a liquid? Which is a gas? Which is a solid? _____

_____

_____



All those pipes!

Choose three words in the text below that are new to you, and look up their definitions. Then write them out on a separate piece of paper.

Natural gas from deep in the earth is pumped up through a **well** (1). A **processing plant** (2) removes impurities. Then the gas goes through **transmission pipes** (3) to a **compressor station** (4), where it is pressurized so it will flow quickly through many miles of pipes.

Some natural gas goes into **storage tanks** (5) for future use. Some moves on to a **natural gas utility** (6) – a company that delivers natural gas to homes and businesses. The utility adds a chemical called mercaptan that makes gas smell like rotten eggs so people will know if it is leaking.

From the utility, gas travels through an underground pipe called a **distribution main** (7). **Service lines** (8) lead from the distribution main to houses. Next the gas flows through a **gas meter** (9), which measures how much gas is used. Small pipes inside the house carry the gas to **appliances** (10).

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

DIG SAFELY **If people dig into natural gas pipelines, the gas can leak out and become a fire hazard. So if someone you know is planning a digging project, remind them to call the underground utility locator service at 811 several days before digging. They will make sure underground gas pipelines and other utilities are clearly marked so people can dig a safe distance away.**

ALWAYS FOLLOW THESE NATURAL GAS SAFETY TIPS

Gas appliances use a flame. So it's important to **keep papers, toys, curtains and flammable liquids (like paint thinner) away from them** to prevent fires.

If you smell natural gas, tell an adult. (Remember, it smells like rotten eggs.) If no adult is home, get everyone out of the house. **Do not use a light switch, candle, flashlight, phone, or even a cell phone** – a spark could ignite the gas. Go to a trusted neighbor or a pay phone to report the leak to your local natural gas utility.

If the burners on top of the range have a blue flame, they are working correctly. **If your flame is large, yellow and flickering, ask an adult to have the range checked** by a qualified repair person.

Don't play with gas appliances or pipes. Make sure younger sisters or brothers don't play with oven knobs – they could turn the natural gas on by mistake. Also make sure they don't play with gas pipes or the connectors that run between the gas range and the wall.

Gas Pipeline Safety

Leaks from natural gas pipelines, although rare, can be a fire hazard. It is important to know how to recognize them and what to do in case one occurs in your community.

Recognizing pipeline leaks

- A distinctive, sulfur-like odor
- A hissing, whistling or roaring sound
- Dirt spraying or blowing into the air from a hole in the ground
- Continuous bubbling in water
- Grass or plants dead or dying (in an otherwise moist area) over or near a pipeline

What to do

- **Do not use electricity or fire.** Even the tiniest spark from a cell phone, flashlight or match could ignite the gas.
- **Go far away from the area and do NOT go back** until safety officials say it is safe.
- **Ask a trusted adult to report the leak to 911** and your local natural gas utility.

Electrical & Natural Gas
home safety inspection

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

Look for

1. **Overloaded outlets.**
   ◯ None ◯ Needs fixing ◯ Fixed
2. **Worn or frayed power cords.**
   ◯ None ◯ Needs fixing ◯ Fixed
3. **Power cords under rugs or furniture legs.**
   ◯ None ◯ Needs fixing ◯ Fixed
4. **Kids playing near natural gas appliances or pipes.**
   ◯ None ◯ Needs fixing ◯ Fixed
5. **Electric or natural gas heaters close to anything that can burn.**
   ◯ None ◯ Needs fixing ◯ Fixed
6. **People digging without having called the underground utility locator service.**
   ◯ None ◯ Needs fixing ◯ Fixed
7. **Plug-in radios, CD players or other electric appliances used near bathtubs, hot tubs or pools.**
   ◯ None ◯ Needs fixing ◯ Fixed

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