History of Electricity Reading Comprehension Sheets

In modern life, we use electricity on a daily basis and do not think anything of it. We take it for granted. However, for most of human history electricity was not known about so how and why did that change? Read on!

We Ancient Greeks knew that rubbing amber would make light objects attract to it. We thought it became magnetic.

What they were actually observing was static electricity!

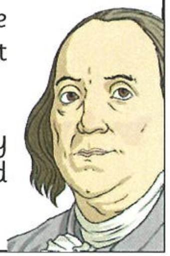
While we did not know that electric currents existed, we were aware of shocks from a fish. We called it 'Thunderer of the Nile'.

Ancient Egyptians thought that electric fish were 'protectors' of other fish. Electric fish were written about by the Ancient Greeks, Romans and Arab Scholars.

Benjamin Franklin was the first person to study electricity in depth. One of his most important findings was proving that lightning was electrical (it had been thought of as different up until then). He flew a kite during a storm, to which he had attached a key. When the kite was indeed hit by lightning, he felt electric sparks from the key.

He was very fortunate not to be electrocuted! This is not an experiment that needs to be repeated!!

He was also the first to store electricity and knew it consisted of positive and negative charges.

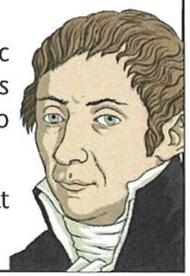


Alessandro Volta invented the first battery – which was known as the 'voltaic pile' as it was made of layers of zinc and copper which was either combined with sulphuric acid or saltwater brine to create an electric current.

Volta's name was also the basis for the following words:

Voltage: This is the electric force that causes free electrons to move from one atom to another.

Volt: Is the unit of measurement for Voltage (written as V).



It was not until hundreds of years later in the 1600's that **William Gilbert** studied and distinguished between magnetism of metals and static electricity. He used the Greek word for amber – 'elektron' – and invented a new Latin word – electricus.

The voltaic pile was hugely important as it allowed an electric current to be released steadily and efficiently. Therefore it was now possible to use an electric current as a form of power for other objects.

Michael Faraday used Volta's discoveries and was able to make an electric current move by using a magnet inside a wired coil. He was able to build an electric motor and generator!

Thomas Edison invented the modern lightbulb. While lightbulbs were not a new idea, he did improve on the previous designs which were not useful as they did not stay lit for very long.

Lewis Latimer worked for Edison and invented a filament (the metal part that you can see in lightbulbs, through which the electric current passes) which enabled Edison's lightbulb to stay lit for a long time.

From these electrical inventions, many others followed and changed the way we live our everyday lives!

History of Electricity Reading Comprehension Questions

I can explain the importance of the major discoveries in electricity.

Read each question carefully and answer questions in **sentences**.

1. What does the word 'electricus' mean?

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2. What key discoveries did the following scientists make? (Pick only **one**)

William Gilbert ____

Alessandro Volta ____

Michael Faraday ____

Thomas Edison ____

Lewis Latimer ____

3. What did Franklin's kite experiment prove?

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4. Thomas Edison designed the modern lightbulb. Does this mean he invented it?

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5. What modern electrical appliances use a motor? (Give **two** examples)

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6. The voltaic pile ensured a steady electric current. Why did this lead to the wider use of electricity?

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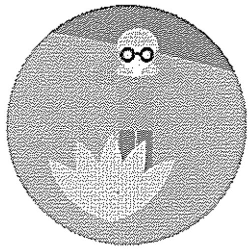
Hydro Québec

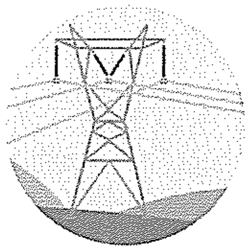
Electricity word search

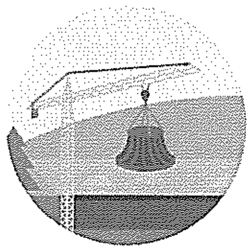
Find the mystery word hiding in the word puzzle.

First, find all of the words listed below in the puzzle and cross them out.
Use the remaining letters to solve the word puzzle. Hint: It's a renewable energy source!

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







DAM
CIRCUITBREAKER
CONDUCTOR
CONSUMPTION
CURRENT
DANGER
ELECTRICITY
ENERGY
HOUSE
HYDROQUEBEC
INSULATOR
LIGHT
LINEWORKER
METER
NETWORK
POWERHOUSE
RENEWABLE
RESERVOIR
RIVER
SECURITY
SHOCK
SUBSTATION
TOWER
TRANSFORMER
TURBINE
VOLTAGE
WATER
WATT
WIRE
WOODENPOLE

Answer: Hydroelectricity

Name ______________________ Date: __________

Current Electricity

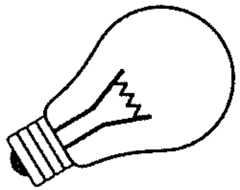
Electricity is an important part of your life. This morning, you probably shut off your alarm clock (unless your alarm clock is your mom waking you up), and turned on your bedroom light. You might have used a toaster while making breakfast and you probably opened your refrigerator at least once. Maybe you flipped on the TV to watch a few minutes before you finished getting ready for school. Without electricity, you would have had to rethink quite a few parts of your morning routine.

While electricity is extremely useful, it does need a few things to work. For example, it needs to travel. An electric current is the flow of electric charge, and a vital part of making sure that electricity makes it into our homes and into our fridge, hair dryer and television.

In order to successfully get electricity to travel to another place, it needs a power source and a circuit. The power source provides the steady flow of electrons that is needed to make your appliance or toy work. An example of a power source might be a battery or a main breaker in your home.

Once you have a power source, you need a way for all those electrons to get moving. You need a circuit, or a path, for the electricity to move on. The circuit needs to ultimately be a giant circle, leading from the power source, around the circuit, and back to the power source. The electrons move out of the power source and on the circuit, creating current electricity. This current can flow through your home, or through your battery operated remote control. As long as there is a circuit that leads to and from a power source, electricity will move along the path. A circuit that meets all of these requirements and allows electricity to move is known as a closed circuit. If there is a break in the circuit or if the circuit is incomplete, the circuit is known as an open circuit.

Next time you turn on your light in the morning or watch your favorite television show, remember that current electricity makes that possible.



Name ______________________ Date: __________

Current Electricity: Comprehension Questions

1. What is the purpose of the power source in a circuit? What are some examples of power sources mentioned in the text?

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2. According to the text, why is it important for the path of a circuit to be circular?

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3. Compare and contrast open and closed circuits.

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4. According to the author, what is an electric current and why is it so important?

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ACTIVITY 5 ♦ ENERGY USAGE IN THE HOME

Figure 9.4 shows where energy is used in an average household. Use it to answer the questions.

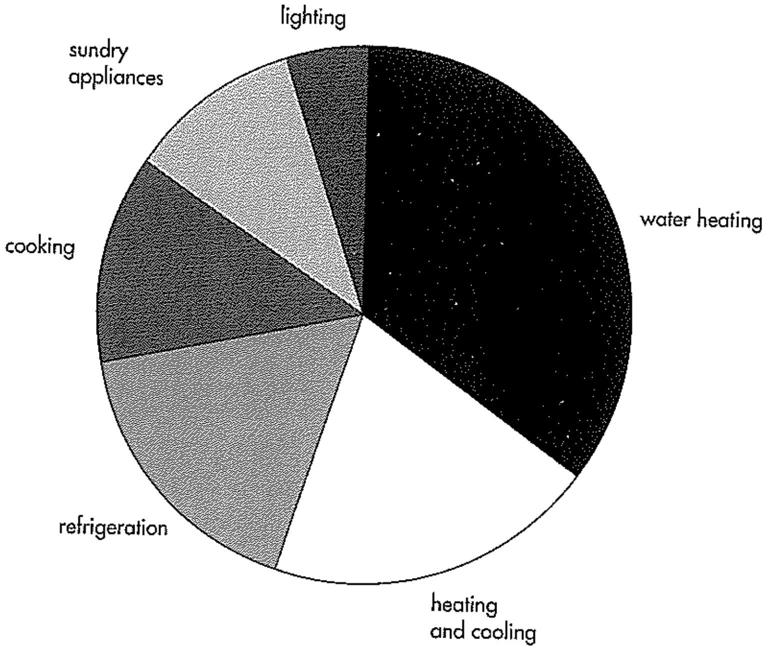


FIGURE 9.4 *Energy usage in a typical home*

QUESTIONS

1 What is the main energy user in the average home?

2 What uses the least energy?

3 Draw up a table to show these relative uses of energy as percentages.

4 What sorts of things does this information suggest would be best to do to save electricity?

5 make a list of the things in your home that use electricity. Estimate how long each thing uses electricity to the nearest hour.

6 Which of the things on your list from (5) could have been used more economically, or the task done a different way so that electrical energy might have been saved?

7 See if you can get your family to trial some of the energy saving ideas on your list over the next electricity billing period (three months). See if you can all contribute to lowering your family's electricity bill by a significant amount.

8 If each household in Australia could reduce their energy bill by just 10%, the savings would be enormous. Obviously each family would benefit by having more money to spend on other things, but how would Australia benefit? Make a list of your ideas and share them with the class

Name ______________________________ Date: __________

Static Electricity

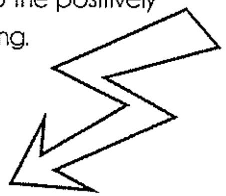
Have you ever been shocked when you touched someone? Or, have you ever had a sock stick to your t-shirt? If you have experienced these things, you have had a first-hand meeting with static electricity. In order to know why your hair flies out of control in the winter months, or why that sock is sticking to your pants, you need to know a little bit about the charge of atoms.

Atoms are the foundations of matter, super small things made up of protons, electrons and neutrons. Each atom has a center, or nucleus, that is made up of protons and neutrons. Hanging out and circling around the nucleus are electrons. Protons and electrons have a unique relationship - they are attracted to each other. Not in a boyfriend-girlfriend way, but more in an electrical charge type of way. You see, the protons have a positive charge and the electrons have a negative charge. These two charges are opposite, and attract one another. The positive protons in the nucleus keep the negative electrons circling nearby.

In a typical atom, the number of protons and electrons are neutral. This makes sure that the atom carries no charge because all of the positive protons cancel out the charge that the negative electrons have. However, sometimes electrons want to leave the atom and check out other atoms that are hanging around. When an electron jumps ship, it can leave the atom unbalanced and charged up. Electrons jump to other atoms and this causes a spark of static electricity.

Static electricity can show itself in small or large ways. If you shuffle your feet on carpet, electrons jump ship from the carpet to you. Then, when you touch a doorknob, the extra electrons jump from you to the knob and cause a spark. This spark is relatively small compared to what static electricity can do in a larger way. Lightning is probably the best, and biggest, example of static electricity that you can easily see. Lots of extra electrons moving from negatively charged clouds to the positively charged earth can cause a big burst of static electricity - lightning.

The next time you get shocked from a doorknob, you will now know to thank jumping electrons for the spark.



Name ______________________________ Date: __________

Static Electricity Comprehension Questions:

1. Define the concept of static electricity and provide an example from the text.

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2. What is the connection between electrons and protons?

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3. Why does the author say that the reader should thank electrons for the "spark" of static electricity?

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4. Explain the meaning of this sentence used by the autho; "Static electricity can show itself in small or large ways."

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Name ______________________ Date: __________

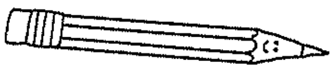
Insulators and Conductors

When materials come in contact with electricity, some allow the electricity to continue flowing and some stop the electric current or hinder it. Materials that allow an electric current to flow are known as conductors. Materials that do not allow the electric current to flow as easily are known as insulators. Both types of materials serve their purpose in our world of electricity.

Conductors are made of materials that let electricity flow through them easily. The best electrical conductors are often metals. In fact, the metal copper is most commonly used in electric wiring and circuits. Aluminum, silver, gold, and platinum are other metal conductors. Water is also a conductor of electricity. Since our bodies are made up of mostly water, people are also conductors of electricity! We are not the best conductors, but an electric current can pass through our bodies.

Unlike conductors, insulators are materials that do not allow electricity to easily flow. Some examples of insulators are rubber, plastic, and glass. Rubber or plastic are commonly used on electrical cords to keep the electricity safely flowing through the wire. This is why we are always cautioned about touching exposed wires. Exposed wires are wires were the insulator has been removed or broken. If we touch the wire, the electricity may stop its current path and flow through our bodies instead.

Can you figure out which one of these objects is a conductor and which is an insulator?



Name ______________________ Date: __________

Insulators and Conductors: Comprehension Questions

1. Determine the meaning of the word "hinder" as used in the text.

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2. According to the text, why are people conductors of electric currents?

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3. Explain the meaning of this sentence, "Both types of materials serve their purpose in our world of electricity."

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4. Based on what you read in the text, infer why insulators are important.

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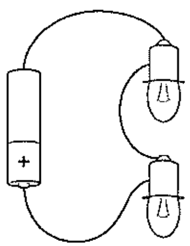
Name ______________________ Date: __________

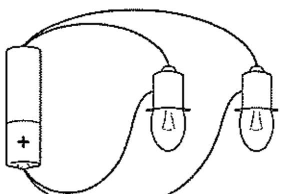
Circuits

Electricity needs a path to follow. Circuits are paths that allow electrons to flow through, creating electricity. Simple circuits have three main parts: a power source, a path, and a load. A power source can be a battery or an outlet. The path must be made out of a conductor, which is a material that allows electrons to flow through easily. A load is the object that will use the electricity. Some circuits include switches, to allow or stop the flow of electrons.

There are two types of circuits: series circuits and parallel circuits. Series circuits only have one pathway for the electrons or electric current to flow. If the path of electricity is broken, the flow of electricity is stopped. Parallel circuits have more than one pathway for the current to flow. If the path of electricity is broken in a parallel circuit, the electrical current can choose another path to take. Think of lights used to decorate Christmas trees. If the lights are on a series circuit and one lightbulb burns out, this will stop the flow of electrons. When this happens, the path has been broken and none of the lights will light up. On the other hand, if the lights are on a parallel circuit and one light goes out, the flow of electrons will find another path to take. The other lights will remain lit because of the additional path.



Series Circuit



Parallel Circuit

Name ______________________ Date: __________

Circuits: Comprehension Questions

1. Based on the information in the text, why is a circuit needed?

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2. What is a load, and what is an example load mentioned in the text?

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3. Why does the author use the example of Christmas lights in the text?

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4. If you were stringing lights on your balcony, which circuit would you prefer your lights to have: a series or parallel circuit? Explain your choice.

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Insulator or Conductor?

Name ______________________ Date: __________

Directions: Determine if the materials are insulators or conductors.

1.

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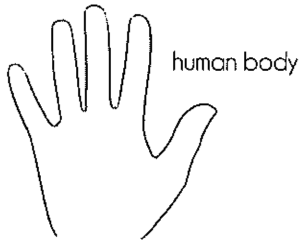
2.



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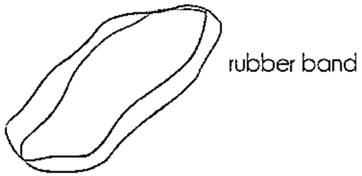
3.



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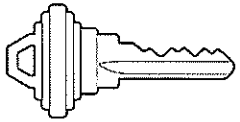

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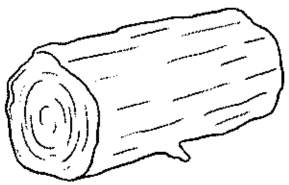

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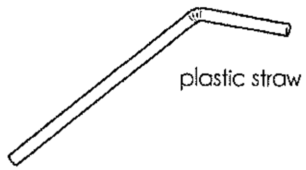
6.



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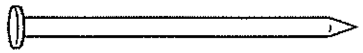

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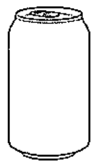

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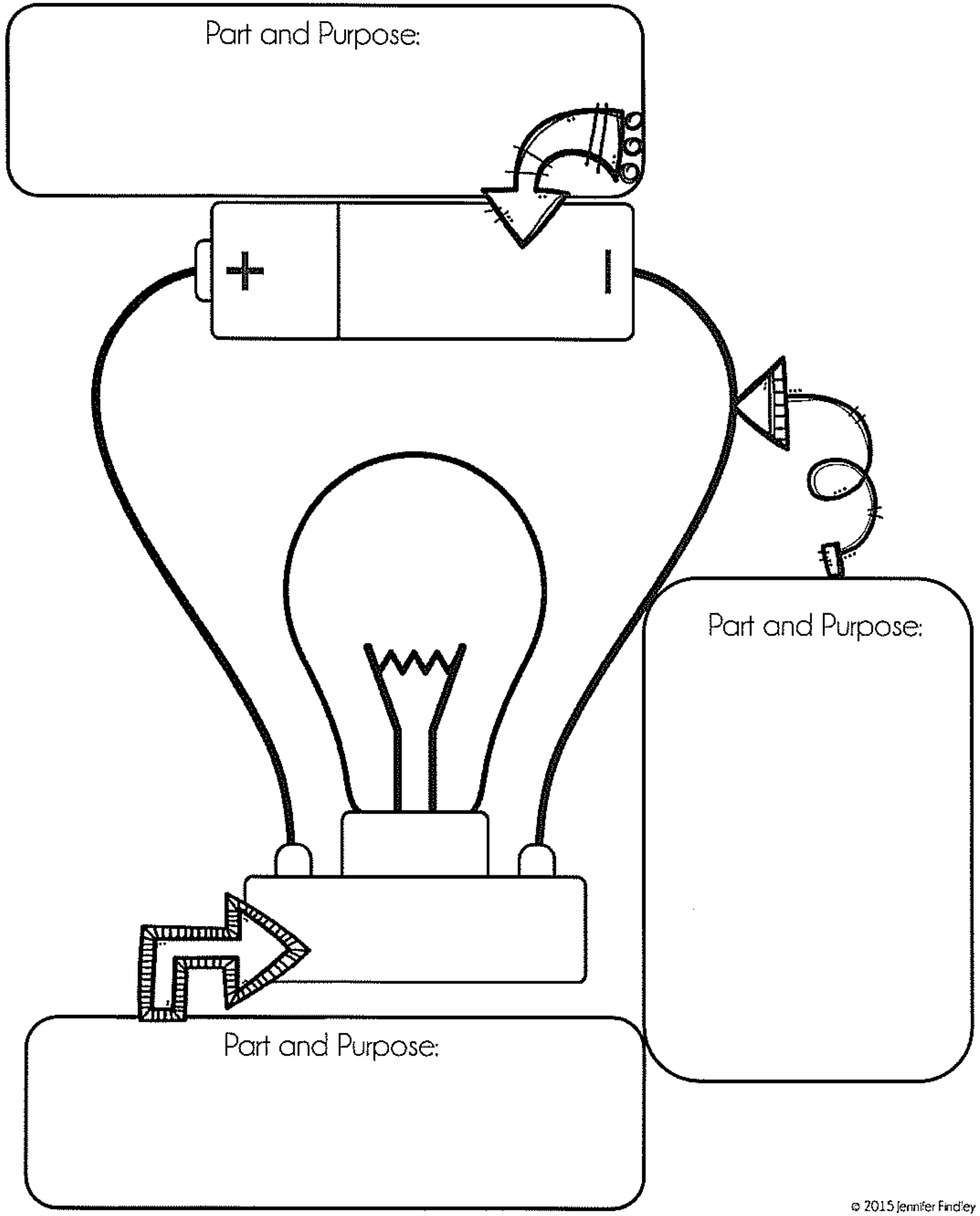
Parts of a Circuit

Name: ______________________

Date: __________________



ELECTRICAL CIRCUITS

OUTCOMES

- increased understanding of electrical circuits
- improved analytical skills

ACTIVITY ♦ ON OR OFF?

Figure 55.1 shows a number of electrical circuits. Use it to answer the questions.

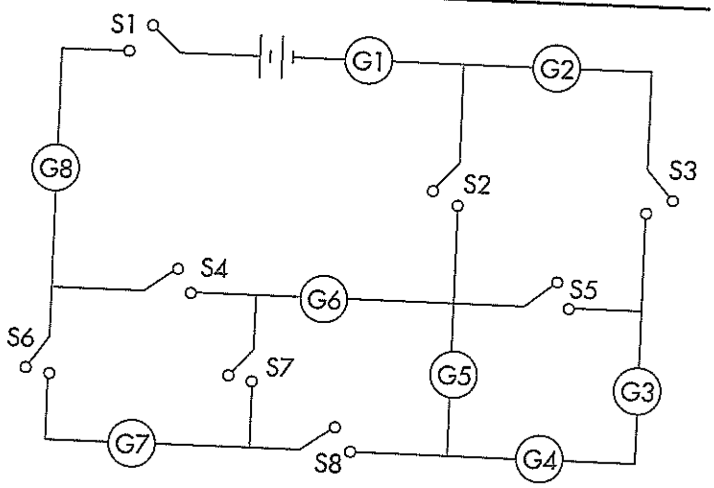


FIGURE 55.1

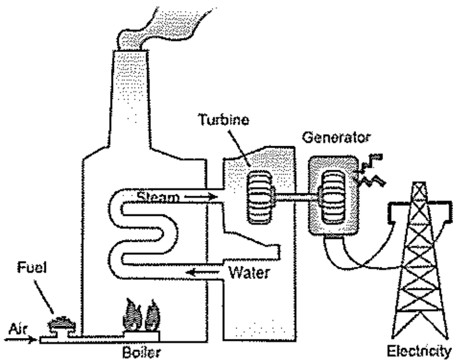
QUESTIONS

1. Which globes will be on if switches S1, S2 and S4 are closed?
2. Which globes will be on if switches S2, S8 and S6 are closed?
3. Which globes will be on if switches S1, S3, S5 and S7 are closed?
4. Which globes will be on if all switches are closed? Explain your answer.
5. Which switches need to be closed so that only globes 1, 5, 7 and 8 are on?
6. Which switches need to be closed so that only globes 1, 2, 3, 4, 5, 6 and 8 are on?
7. Consider your answer to 6. What would happen if S5 was closed also? Explain your answer.
8. Can **only** globes 1, 3, 4 and 8 be on? Explain your answer.

Worksheet 3

Generating Electricity

In most power stations, electricity is generated by burning fuels. Coal, oil and natural gas are the common fuels for generating electricity.



Major parts of a power station

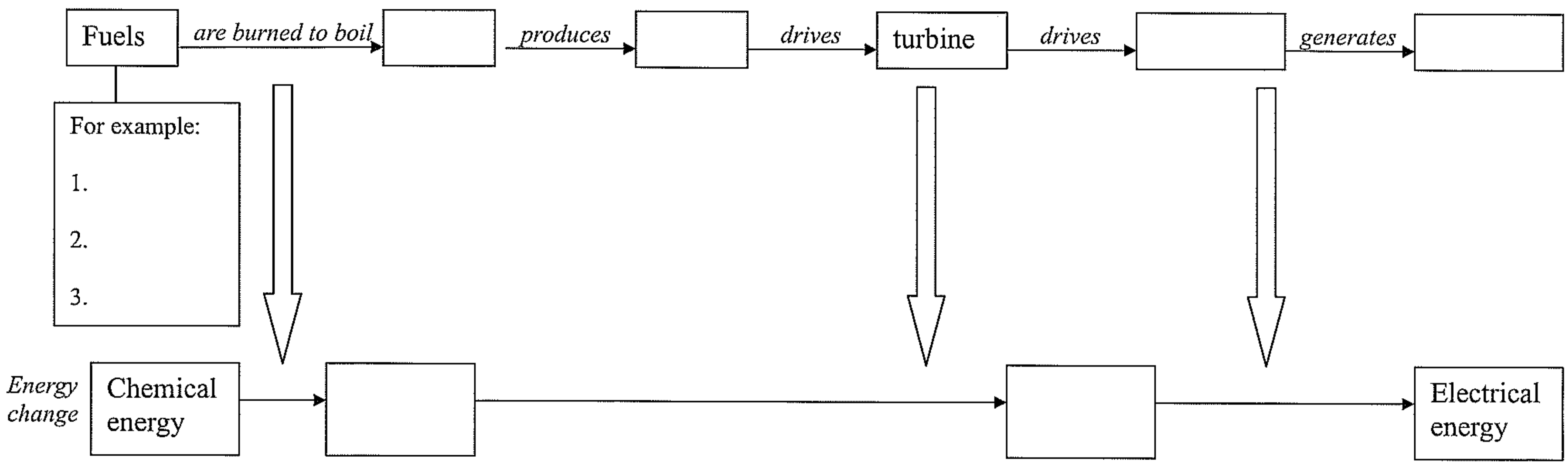
A power station has three major parts: a boiler, a turbine and a generator. Fuels are burnt in the boiler to boil water. The boiling water produces steam. The steam drives the turbine. The turbine rotates and drives the generator. Electricity is produced when the generator rotates. During this process, energy is converted from one form to another. The chemical energy of the fuels is changed into heat energy, which boils the water. The heat energy in steam is changed into kinetic energy in the turbine. Then the kinetic energy is changed into electrical energy by the generator.

Generating electricity causes pollution. When fuels are burnt in power stations, sulphur dioxide, nitrogen oxides and carbon dioxide are given out. Sulphur dioxide and nitrogen oxides then dissolve in rainwater and form acid rain. Acid rain damages buildings, affects the growth of living things in lakes and rivers, and destroys forests. Carbon dioxide traps heat in the atmosphere. This effect is called the greenhouse effect. Too much carbon dioxide in the atmosphere will increase the average air temperature of the Earth and cause global warming. Global warming will speed up the melting of ice at the Poles, causing a rise in sea level.

(Worksheet 3)

I. Use the information of Paragraphs 1 and 2 to complete the diagram below.

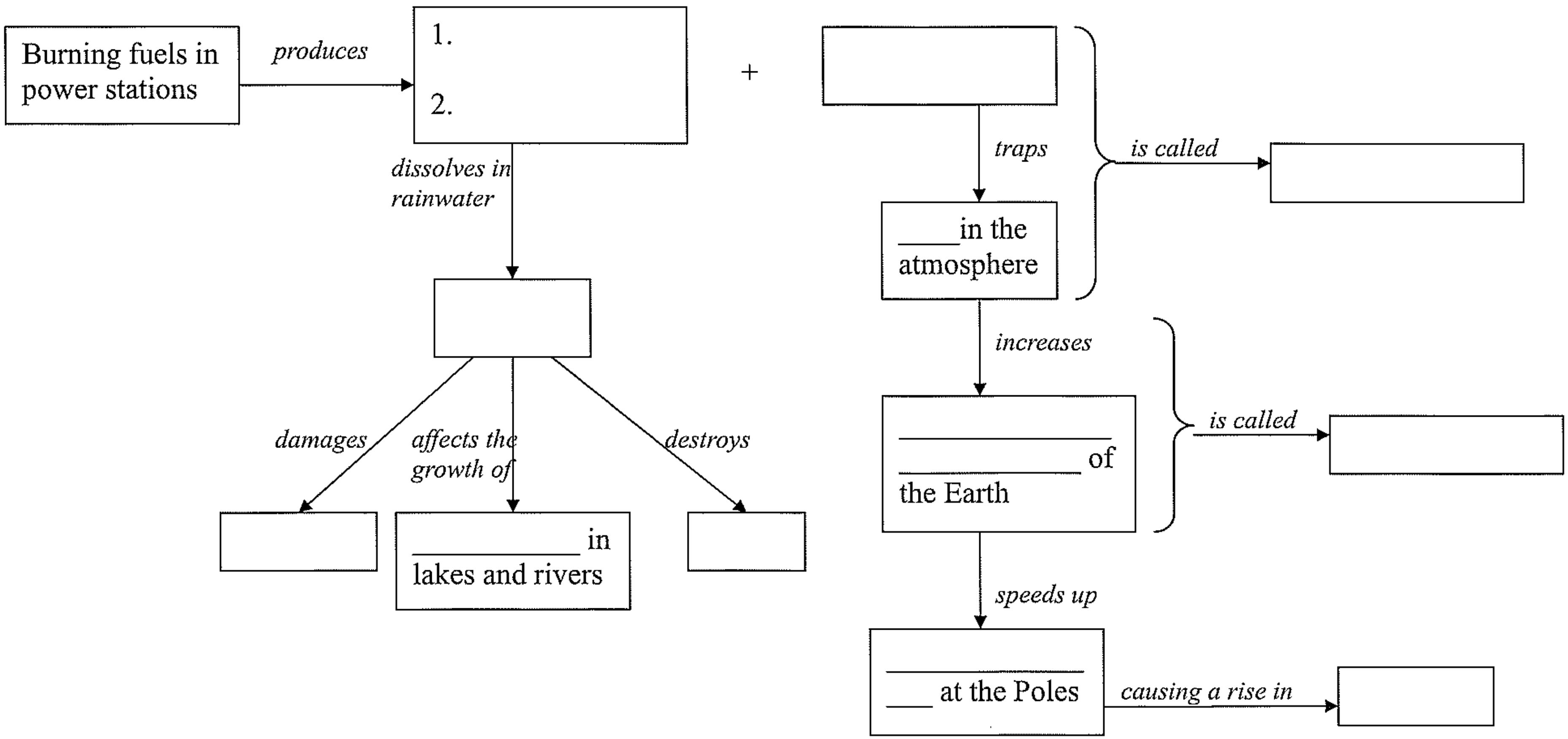
Diagram 1: How is electricity generated?



(Worksheet 3)

II. Use the information of Paragraph 3 to complete the diagram below.

Diagram 2: What problems arise from electricity generation?



Name ______________________ Date ______________________

(Key # 1 - 665858)

Alternative Energy Word Search

Find each of the following words.

GEOTHERMAL
TURBINE
ALTERNATIVE
SOLAR ENERGY
NUCLEAR
FUELS
WIND POWER
BIOMASS
ENERGY
WATER POWER
SUSTAINABLE ENERGY
SOLAR POWER
RENEWABLE
ETHANOL
BIODIESEL
RESOURCES
PETROLEUM
BIOFUEL
GASOLINE
HYDROGEN
SUSTAINABILITY
ENVIRONMENT
HYBRID
ELECTRICITY

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

ENERGY SOURCES OF THE WORLD!

energy4me
energy4me.org

Presented by **Society of Petroleum Engineers**

Did you know there are at least 12 different energy sources?

Although oil, natural gas, and coal will remain the primary energy sources for the foreseeable future, a variety of resources will be needed to meet the world's growing demand. All energy sources have benefits, as well as challenges to overcome to produce, deliver, and use them on a wide-scale and efficient basis. Costs are an important consideration. How much will the capital/set-up costs be, and what are the ongoing operating costs? Will the final product be too expensive for the average consumer? Does the energy source require storage or other additional infrastructure? Is it possible to produce it on a large scale? Also, think about how its production will impact the environment.

RENEWABLE

Renewable resources can be replenished at a comparable rate to the rate of consumption. Energy sources like hydroelectric power, solar energy, and wind power are considered "perpetual resources" because they run no risk of depletion.

NONRENEWABLE

Nonrenewable resources are energy sources like petroleum, propane, natural gas, coal, and nuclear energy that take millions of years to form and cannot be regenerated in a short time period.

PETROLEUM

PETROLEUM is formed from animals and plants that lived millions of years ago when heat and pressure turned decayed matter into crude oil. It is a part of the fossil fuels family, found underground or under seabed floor by drilling. It is then transported to refineries and distilled into fuel or base chemical products.

PROS
- Transportation fuel for the world
- Basis of many products, from prescription drugs to plastics
- Economical to produce, easy to transport

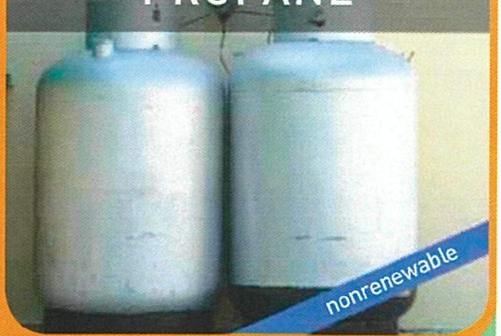
CONS
- High CO_2 emissions
- Found in limited areas
- Supply may be exhausted before natural gas and coal resources
- Possible environmental impact from drilling and transporting

PROPANE

PROPANE (LIQUEFIED PETROLEUM GAS or LPG) is produced as a byproduct from natural gas processing and crude oil refining. A part of the fossil fuels family, the components recovered during processing include ethane, propane, and butane as well as heavier hydrocarbons. Propane has been made safer by adding artificial odor, so people can easily smell the gas if it leaks. It burns hotter and more evenly than other fuels.

PROS
- Yields 60–70% less smog-producing hydrocarbons than gasoline/diesel fuel or propane exhaust
- Nontoxic and insoluble in water
- Doesn't spill, pool, or leave a residue
- Appliances pay for themselves via energy savings more quickly

CONS
- Uses some fossil fuels in conversion
- Highly flammable
- Costs prone to seasonal price fluctuations that complicate fuel cost budgeting
- Less energy in a gallon of propane than in a gallon of gasoline or diesel fuel



NATURAL GAS

NATURAL GAS consists primarily of methane but includes significant quantities of ethane, butane, propane, carbon dioxide, nitrogen, helium, and hydrogen sulfide. It is a part of the fossil fuels family and found underground by drilling. It is then transported by tankers or pipelines as liquefied natural gas.

PROS
- Widely available
- Burns more cleanly than coal or oil
- Often used in combination with other fuels to decrease pollution in electricity generation

CONS
- Transportation costs are high; lack of infastructure makes gas resources unavailable from some areas
- Burns cleanly, but still has emissions
- Pipelines impact ecosystems

COAL

COAL is formed from trees and plants in vast primeval forests, when heat and pressure turned decayed matter into coal. Coal is a part of the fossil fuels family.

PROS
- Abundant supply
- Currently inexpensive to extract
- Reliable and capable of generating large amounts of power

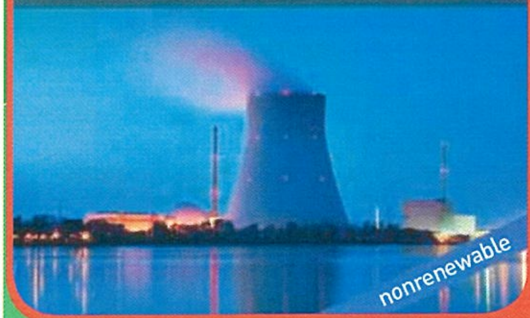
CONS
- Emits major greenhouse gases/acid rain
- High environmental impact from mining and burning, although cleaner coal-burning technology is being developed
- Mining can be dangerous for miners

H1c

ENERGY SOURCES OF THE WORLD!

Turn over to see more energy sources

NUCLEAR ENERGY



NUCLEAR ENERGY is generated in reactors, when nuclear fuel fission (using uranium) heats water, and the steam turns turbines to run the generators that convert energy into electricity.

PROS
- No greenhouse gases or CO_2 emissions
- Very efficient at transforming energy into electricity compared to coal plants
- Uranium reserves are abundant (but costly to mine)
- Refueled yearly unlike coal plants that need trainloads of coal every day

CONS
- Higher capital costs due to safety, emergency, containment, radioactive waste, and storage systems
- Problem of long-term storage of radioactive waste
- Heated waste water from nuclear plants harms aquatic life
- Potential nuclear proliferation issue

SOLAR ENERGY

SOLAR ENERGY is generated when photovoltaic (PV) cells convert heat from the sun directly into electricity.

PROS
- Nonpolluting
- Most abundant energy source available
- Systems last 15–30 years

CONS
- High initial investment
- Dependent on sunny weather
- Supplemental energy may be needed in low sunlight areas
- Requires large physical space for PV cell panels
- Limited availability of polysilicon for panels

HYDROELECTRIC POWER

HYDROELECTRIC POWER is generated when flowing water turns turbines to run generators that convert energy into electricity.

PROS
- No emissions
- Reliable
- Capable of generating large amounts of power
- Output can be regulated to meet demand

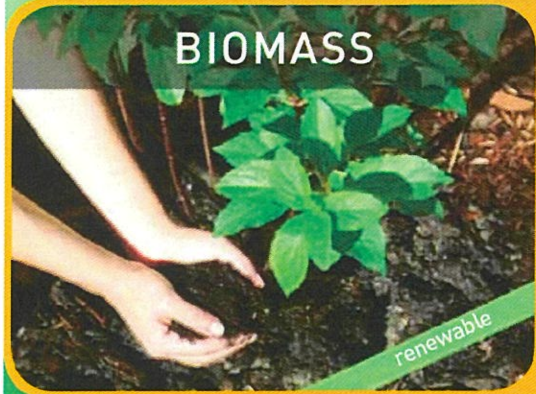
CONS
- Environmental impacts by changing the environment
- Hydroelectric dams are expensive to build
- Dams may be affected by drought
- Potential for floods

WIND POWER

WIND POWER is generated when wind turns turbines to run the generators that convert energy into electricity, which is then stored in batteries.

PROS
- No emissions
- Affordable
- Little disruption of ecosystems
- Relatively high output

CONS
- Output is proportional to wind speed
- Not feasible for all geographical locations
- High initial investment and ongoing maintenance costs
- Extensive land use
- Can be unsightly and noisy
- Can pose a threat to birds



BIOMASS is produced from vegetable oils, animal fats, recycled restaurant greases, and other byproducts of plant, agricultural, and forestry processing or industrial/human waste products. It is converted to electricity in a process similar to converting fossil fuels to heat or electricity.

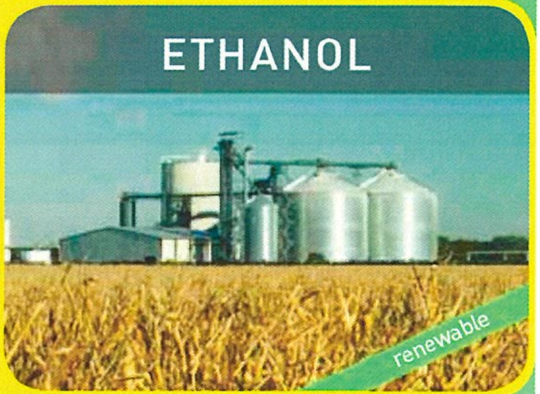
PROS
- Abundant supply
- Fewer emissions than fossil fuel sources
- Can be used in diesel engines
- Auto engines easily converted to run on biomass fuel

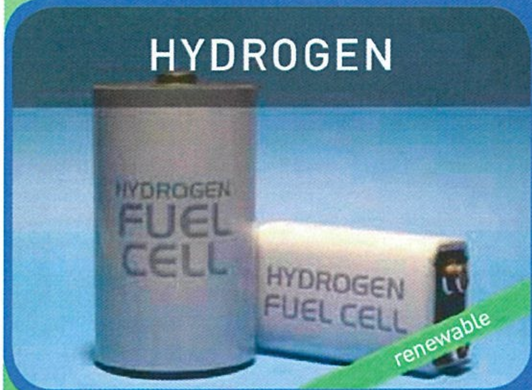
CONS
- Source must be near usage to cut transportation costs
- Emits some pollution as gas/liquid waste
- Increases nitrogen oxides, an air pollutant emissions
- Uses some fossil fuels in conversion

ETHANOL is a subset of biomass that is manufactured from alcohols, ethers, esters, and other chemicals extracted from plant and tree residue. It can be made from corn, sugar, wheat, and barley.

PROS
- Easily manufactured
- Fewer emissions than fossil fuel sources
- Carbon-neutral (CO_2 emissions offset by photosynthesis in plants)

CONS
- Source must be near usage to cut transportation costs
- Extensive use of cropland
- Less energy in a gallon of ethanol than in a gallon of gasoline and diesel fuel
- Costs more than gasoline to produce
- Currently requires government subsidy to be affordable to consumers
- Requires engine conversion to be used as fuel





HYDROGEN is found in combination with oxygen in water, but it is also present in organic matter such as living plants, petroleum, or coal. Hydrogen fuel is a byproduct of chemically-mixing hydrogen and oxygen to produce electricity, water, and heat. It is stored in a "cell" or battery.

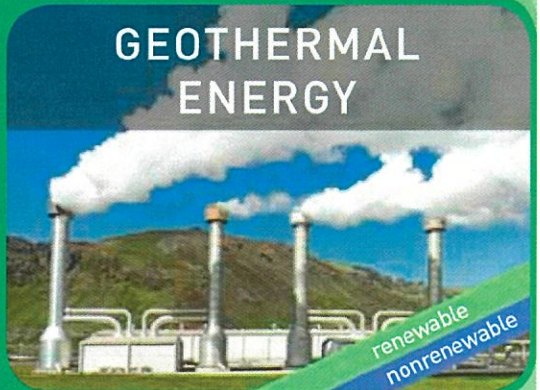
PROS
- Abundant supply
- Water vapor emissions only
- Excellent industrial safety record

CONS
- More expensive to produce than fossil fuel systems
- Currently uses a large amount of fossil fuels in the hydrogen extraction process
- Storage and fuel cell technology still being developed

GEOTHERMAL ENERGY is generated by heat in the earth's core. It is found underground by drilling steam wells (like oil drilling). There is a global debate as to whether geothermal energy is renewable or nonrenewable.

PROS
- Produces about 1/6 the CO_2 that a power plant using natural gas emits
- Efficient
- Minimal environmental impact

CONS
- Geothermal fields found in few areas around the world
- Wells could eventually be depleted
- Expensive start-up costs



RENEWABLE OR NONRENEWABLE ENERGY SOURCES

1. Read each of the energy sources on the attached page
2. Put each in the appropriate column: Renewable or Nonrenewable.
3. Select one in each column by CIRCLING IT and describe what it is; how it works, and the advantages and disadvantages. You may use your reading packet now.

RENEWABLE ENERGY	NONRENEWABLE ENERGY
Describe what it is:	Describe what it is:
Describe how it works:	Describe how it works:
Advantages:	Advantages:
Disadvantages:	Disadvantages:

ENERGY USAGE

OUTCOMES

- increased understanding of energy usage
- improved skills in interpreting diagrams and graphs
- improved skills in transposing information
- increased awareness of ways to save energy

ACTIVITY 1 ♦ WHO USES MOST?

The graph in Figure 9.1 shows the relative electricity usage of some areas of the world compared to their relative populations.

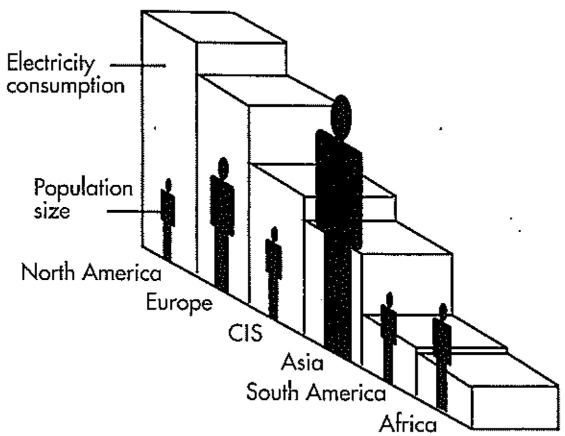


FIGURE 9.1 *Population size and electricity consumption*

According to this information:

a Which area has the largest population?
b Which has the highest electrical energy usage?
c Which area has the smallest population?
d Which has the smallest electrical energy usage?
e Which people use the most energy per head of population?
f Which people use the least energy per head of population?
g For each of your answers to (e) and (f), explain your reasoning.

ACTIVITY 2 ♦ HOW FAR FOR HOW MUCH?

The diagram in Figure 9.2 shows the relative efficiency of various forms of transport for carrying people. Use this information to answer the questions.

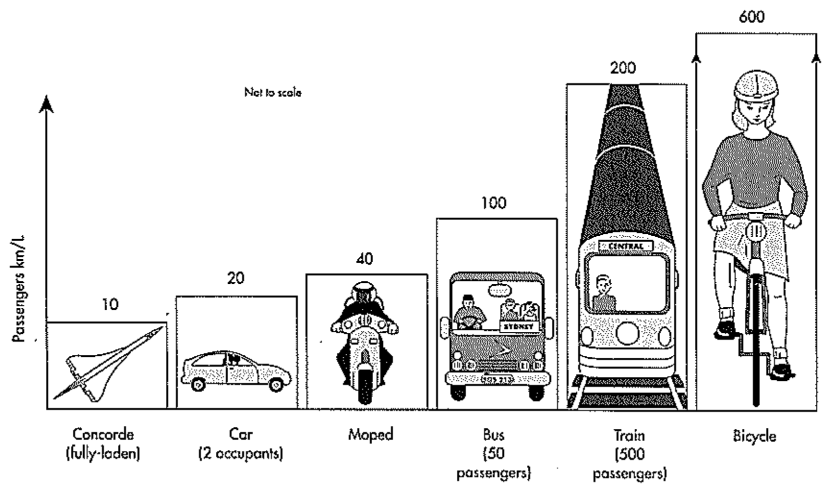


FIGURE 9.2 *Carrying people efficiently — a comparison*

QUESTIONS

1 Consider the information in Figure 9.2 about the car. Does this mean that a car with one passenger can go 40 km on 1 L of fuel? Explain your answer.

2 Assuming that extra passengers made no difference to the carrying efficiency of the car, what would the passenger km/L figure be if the car carried four people?

3 Obviously, in a real situation, the more passengers in a car the more fuel it will use. Which of the forms of transport shown in Figure 9.2 will be least affected in this way? Explain your reasoning.

4 When fully laden, the Concorde carries 148 people. How many litres of fuel does it use to travel 10 km?

5 Which form of transport is the most energy efficient? Explain your answer.

6 Public transport is much more energy efficient than private cars. List reasons why we don't use public transport more often?

7 Should we use public transport more often? Why, or why not?

8 Who gets the energy savings made if people travel by public transport instead of by their own cars?

9 What changes could be made in your town/city to encourage more people to use public transport?

ACTIVITY 3 ♦ EXPRESSING IT IN DIFFERENT WAYS

The statements below relate to the fuel used in transporting goods by various means. While the various forms of transport use different fuels, all the energy figures are given as per litre of petrol equivalents.

- A plane can carry 12 t of goods a distance of 0.1 km on 1 L of fuel.
- A truck can carry 10 t of goods 6.4 km using 4.5 L of fuel.
- A train can travel 4 m using 10 L of fuel and carry 200 t of goods.
- River barges can carry 120 t of goods 4.8 km on 2 L of fuel.

1 What is meant by 'per litre of petrol equivalent'?

2 According to this information, which form of transport is the most energy efficient? Explain how you got your answer.

3 Rewrite these statements so that each tells us how many tonnes each form of transport could carry a distance of 1 km using 1 L of fuel.

4 What can you say about these new statements compared to the original ones?

5 Draw a diagram similar to Figure 9.2 to show your answers.

6 What implications does this have for a society which wants to be as energy efficient as possible?

7 Considering these figures, why do we transport so much by truck when rail is much more efficient?

ACTIVITY 4 ♦ AN ENERGY GRAPH

The graph in Figure 9.3 shows past and predicted production and consumption of oil in Australia. Use the graph to answer the questions.

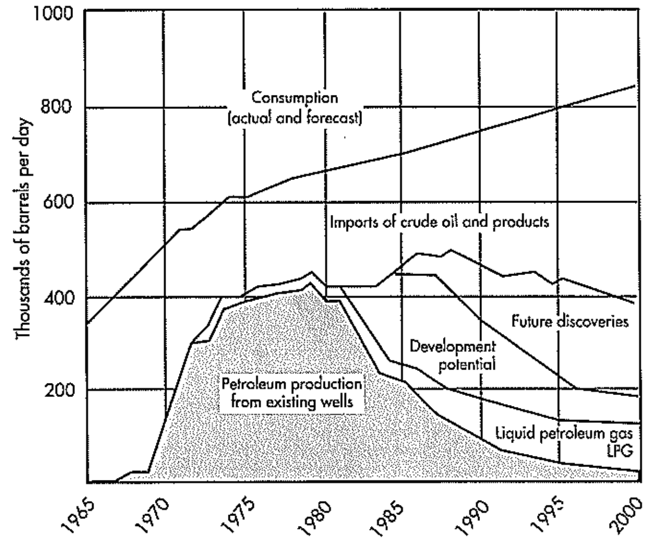


FIGURE 9.3 *Consumption and production*

QUESTIONS

1 When do you think this graph was drawn? What evidence do you have for this?

2 How much of the oil products used in 1975 were produced in Australia?

3 How much was imported in 1975?

4 What percentage of oil used in Australia in 1980 was produced by Australia?

5 What percentage was imported in 1980?

6 Draw a graph to show how the percentage of oil produced and imported has varied from 1965 to the present. Include the predicted figures for the year 2000 on your graph.

7 In a different colour, show what these percentages would be if no new discoveries had been made between 1984 and the year 2000.

8 What implication would this (no new discoveries) have on Australia and Australians?

9 Write down at least three things the shape of your graph tells you?

10 Why was there a huge jump in the amount of Australian produced oil used between 1968 and 1972?

11 What do you think is meant by 'development potential'?

ENERGY EFFICIENCY

OUTCOMES

- increased understanding of energy efficiency
- improved comprehension skills
- improved skills in interpreting tables of information
- improved calculation skills
- improved skills in transposing information
- increased awareness of ways to save energy

ACTIVITY 1 ♦ HOW USEFUL IS ENERGY?

Read the information then answer the questions.

When energy is changed from one form to another, unwanted energy forms are also produced. The useful energy we get from burning fuel in a car is kinetic — the car moves. However, although we use some of the heat energy to warm us on cold days, we also get heat and sound energy which are not useful to us in that energy conversion system.

The amount of useful or intended energy we get out of a system compared to the amount of energy we put into the system is expressed as the **efficiency** of the system. For instance, most commercial solar cells have an efficiency of about 12%. This means that only about 12% of the sun's energy to which they are exposed is converted into electrical energy.

We can use the following formula to calculate the efficiency of a system:

$$\text{EFFICIENCY} = \frac{\text{USEFUL ENERGY OUTPUT}}{\text{TOTAL ENERGY INPUT}} \times 100\%$$

When we talk about the efficiency of a system it is important to define the limits of that system. This allows all the energy conversion occurring in the system to be taken into consideration.

For example, the overall energy efficiency (thermal and mechanical) of a car engine is about 20.6%. This means that about 20.6% of the energy in the fuel is converted into kinetic energy.

However, if we expand the system to include the extraction of crude oil from the ground, its refining to petrol, the transport of the petrol and its use in the car engine, the efficiency is less than 5%. Most of the available energy has been 'wasted' in production and transport.

Electrical lighting is an area where enormous energy wastage occurs, mostly because lights are left on when not needed, but the efficiency of the conversion from electrical energy to light energy is also a factor. Lighting is less efficient if:

- low efficiency lamps are used
- lamp connections and fittings get dirty
- high power globes are used when less would be sufficient
- more globes are used than needed (often for aesthetic reasons)
- lights are not positioned in the best places

QUESTIONS

1 A modern coal or oil fired power station is about 33% efficient. Most of the 'wasted' energy is removed from the system as warm water and then released into the atmosphere through cooling towers, or into streams, lakes or the ocean.
   - a Suggest some alternative uses for this 'wasted' energy.
   - b Given that most Australian power stations are near their source of fuel and near large, natural water supplies, how practical are your suggestions? As a class, talk about some of your ideas.

2 Comment on each of the following situations, and discuss, as a class, what should be done, or could be done.
   - a People drive very short distances to shop at their local corner store.
   - b Four piece toasters are often used to make just one or two pieces of toast.
   - c Most people drive to work alone in their car.
   - d Many people drive to the opposite side of the city to work.
   - e Buses and trains often run trips with very few passengers in them.
   - f Planes capable of carrying 250 people often fly with only 50 passengers.
   - g Every person in the home has their own electric toothbrush.
   - h We often sort our dirty clothes into small heaps and wash them in separate loads where one load could do the lot.

3 Closely examine the lighting in your home and write how its efficiency could be improved. outline:
   - a What the situation is at present (diagrams could be useful).
   - b Whether or not you think each aspect of the current situation is as efficient as it could be.
   - c What changes you would suggest.

Worksheet 5

Energy Sources

Energy sources are either renewable or non-renewable. Renewable energy sources are those that can be replaced faster than they are used. Non-renewable energy sources are those that are used faster than they can be replaced. Therefore, non-renewable energy sources could be used up eventually.

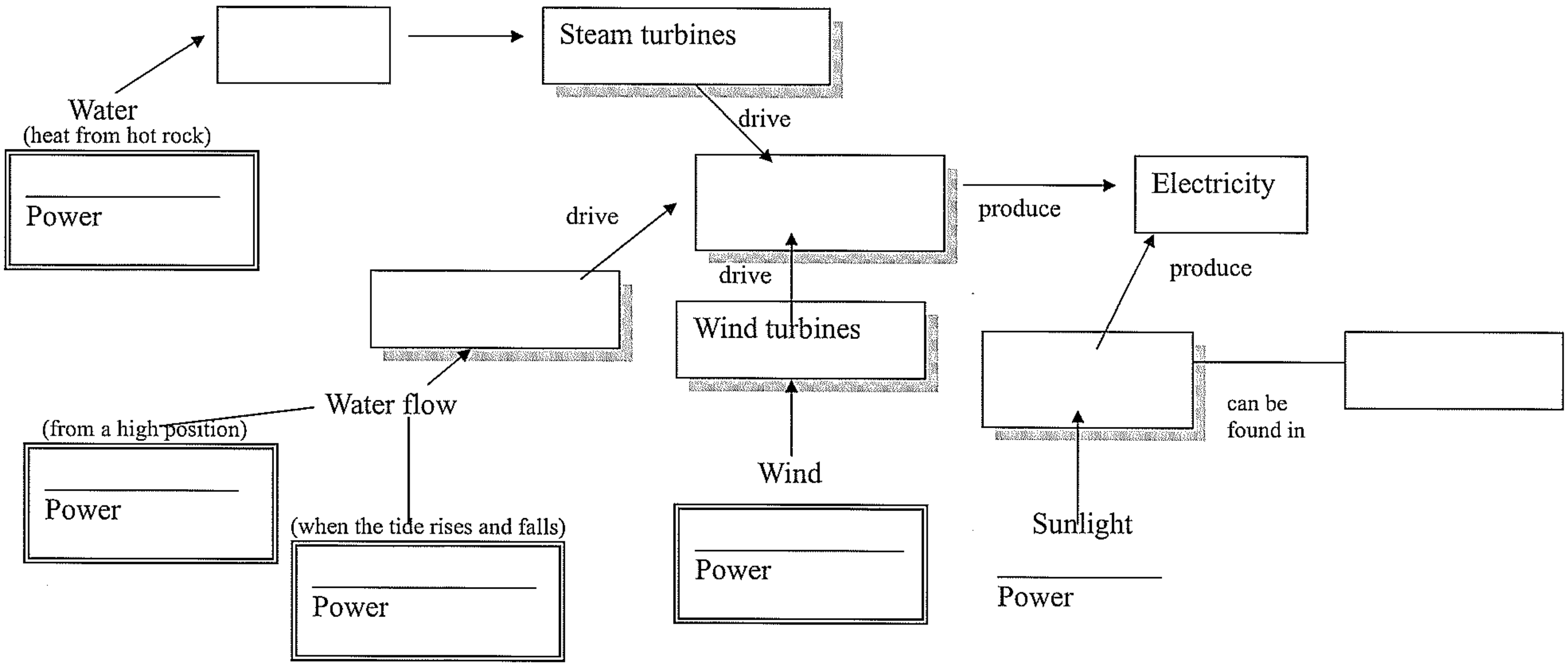
Renewable energy sources include solar power, wind power, tidal power, hydroelectric power and geothermal power. They can be used to generate electricity:

1. Solar power is the light and heat energy from the sun. Solar cells convert sunlight into electrical energy. Solar cells can be found in calculators.
2. Wind power is the kinetic energy of the wind. Wind turns large wind turbines. The wind turbines then drive generators to generate electricity.
3. Tidal power is found in the rise and the fall of tide. A dam is built across a river mouth. When the tide rises and falls, water flows through water turbines in the dam. The water turbines then drive generators to produce electricity.
4. Hydroelectric power is found in the water when it flows down from a high position. A dam is built at a high position in a mountain to hold water. When water is released from the dam, water flows down quickly and drives water turbines at the base of the dam, which in turn drive generators to produce electricity.
5. Geothermal power is the heat energy in hot rocks under the surface of the earth. Water is pumped down to the hot rocks. The heat turns water into steam. Steam is then used to turn steam turbines for producing electricity.

The non-renewable energy sources include fossil fuels and nuclear fuels. Fossil fuels are coal, oil and natural gas. They were formed from dead plants and animals that were buried millions of years ago. Nuclear fuels are materials that can release a large amount of heat energy when the particles of the fuels break down. In power stations, fossil fuels or nuclear fuels are used to produce heat energy for boiling water. The water then produces steam to drive steam turbines. Steam turbines then drive generators to produce electricity.

(Worksheet 5)

Diagram 3: Renewable Energy Sources for Generating Electricity



Lesson 1: Household use and billing

In this topic you will be looking at the use of electricity in our modern society.

How much do you think you rely on electricity for your modern way of living? Think about what you have done so far today since you woke up until sitting down to start your science lessons for the day. Do you have any idea how much electricity you used? The electric meter box outside your home records how much electricity you use. It may look similar to Figure 1 or Figure 2 below. Figure 1 shows a traditional meter. The dial on the left shows how many lots of 10000 kWh have been used, and in this meter

2 x 10000 kWh have been. The other dials, going from left to right, show the following electricity use: (2 x 1000)(8 x 100) (5 x 10) and 5.5 × 1. Adding all the dial readings together gives a total use of 22855.5 kWh.

Figure 2 shows a digital meter with a reading of 605 kWh.

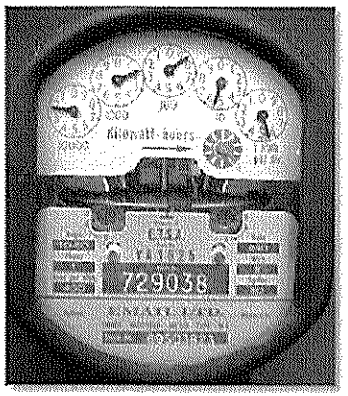


Figure 1: Traditional meter

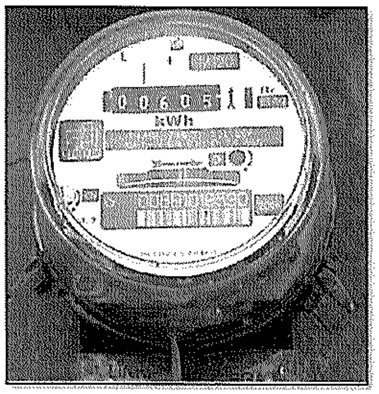


Figure 2: Digital Meter

Activity 1: Electrical count

1. Make a list of the things you have used to today that use electricity either connected to a power point (mains supply) or operating from a battery.

____

____

2. To see how much mains supply electricity you used, I would like you to go outside to the electrical meter box for your home.

   a) Look at the reading on your meter and record the kilowatt-hour (kWh) reading.

      Reading 1: ______________ kWh

   b) Go to the meter at the same time tomorrow and record the kWh reading.

      Reading 2: ______________ kWh

   c) Calculate how much electricity your home used from mains supply for the day (24 hours).

      Reading 2 – Reading 1 = ______________ kWh

   d) Take readings for three more days at the same time, and record these observations in the table in the Send-in exercises for Lesson 1.

EXERCISE

Complete the Send-in exercises for Lesson 1 , <u>Question 1 Only</u>

Paying for electricity

When you pay for electricity you are charged for the amount of electrical energy you have used in different appliances. You receive a bill every three months and are charged for the number of kilowatt-hours you use. Different electrical appliances use different amounts of energy.

The rate at which the energy is used is called power and this is measured as joules of energy per second (watts, W).

One kilowatt is 1000 watts so a kilowatt-hour is 1000 watts used for 1 hour.

The higher the wattage of an appliance, the more energy it uses and the more it costs you to run. A 1000 watt heater uses electricity twice as fast as a 500 watt heater so is more expensive to run for an hour.

When a 1000 watt heater is on for an hour, 1 kilowatt-hour (kWh) will be added to your electricity bill.

Use this information to decide if the heater in Figure 3 or the heater in Figure 4 will cost you more to use for an hour.

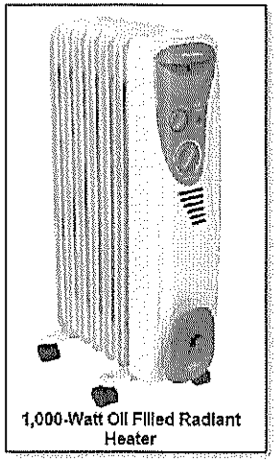


Figure 3

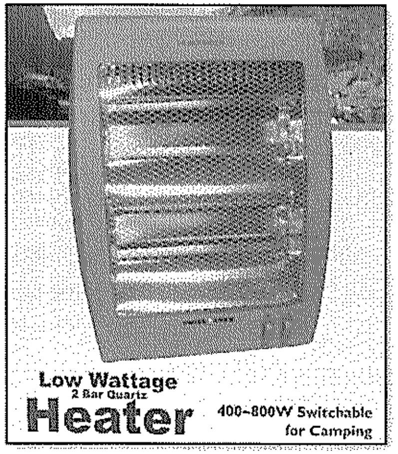


Figure 4

The heater in Figure 3 uses 1000 watts (W) when it is on and the heater in Figure 4 will use a maximum of 800 watts (W) so Figure 3 heater is the most expensive to use.

The table below shows how much power is used by some common household appliances.

Table 1: Power rating in watts of appliances

Appliance in home	Power rating (watts)
light bulb	60
TV	200
laptop computer	20-50
refrigerator	400-500
electric kettle	2000
toaster	1000
small heater	1000
hair dryer	1500
stove hotplate	2000
dishwasher	2500
hot water system	3000
iron	1000

Activity 2: Analysing power ratings

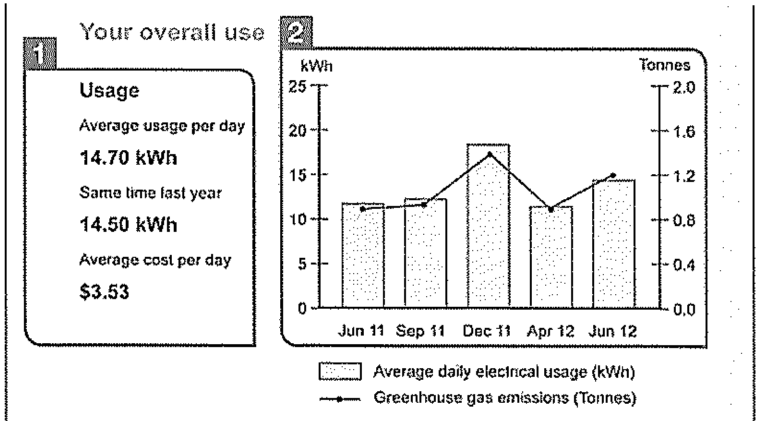
1. Which household appliance uses the most watts? ________________

2. Which household appliance is the most expensive to use? __________

3. If the dishwasher was working for an hour how many kilowatt-hours would you be charged? ____________________

Check your responses by going to the suggested answers section

The price charged for electricity from the electricity grid (mains supply) depends on how much you use and when you use it. Electricity used late at night is the cheapest because there is less demand at this time. This electricity is called **Off Peak**. The peak electricity use time is during the hours when people are going to work and working. Figure 5 shows part of a home electricity bill.



Supply address 111 Faux Way TWEEDVALE SA 0000

NMI 12345678910 3

Supply Period 9 Mar to 7 Jun

Reading Type Actual read on 7 Jun

4 Tariff description 5 Domestic light and power 6

	Meter no.	Days billed	Previous reading	Current reading	Usage kWh
Peak	1039011	91	01945	02554	609
Off Peak	1039011	91	02436	03165	729

Figure 5: Peak price is 25c per kWh and the Off Peak price is

Activity 3: Analysing electricity bill extract

1. Look at Section 4 of the bill. Explain what is meant by Peak and Off Peak.

   Peak: ____________________

   Off Peak: ____________________

2. Look at Section 1 of the bill. What was the average electricity use per day for this home during the three month billing period.

   ____

3. Look at Section 2 of the bill. Why do you think more kWh were used in December compared to April.

   ____

Check your response by going to the suggested answers section

Have a look at Section 2 of the bill again. Notice that on the left hand side of the graph the vertical axis shows the kWh of electricity used. On the right hand side of the graph the vertical axis is labelled Tonnes. This scale shows the amount of greenhouse gases (such as carbon dioxide) emitted into the atmosphere when producing the electricity used by this home.

At present over 80% of electricity in Australia is produced by coal and gas burning power stations that emit a lot of greenhouse gases such as carbon dioxide. Section 2 of the power bill tries to make people aware of their carbon footprint (carbon dioxide released due to their activities).

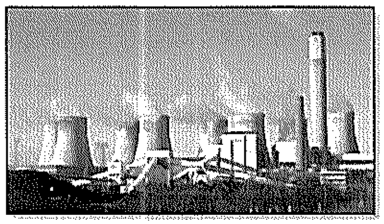


Figure 6: Coal burning power station

International agreements require countries of the United Nations to reduce their greenhouse gas emissions. One way Australia can reduce its greenhouse gas emissions is to reduce the electricity used that is produced by coal and gas burning.

Think about ways that you could reduce your use of electricity from the electricity grid each day. Reducing your use of this electricity will reduce greenhouse gas emissions.

To finish this lesson, reflect on the main points and read the summary below.

Summary of Lesson 1

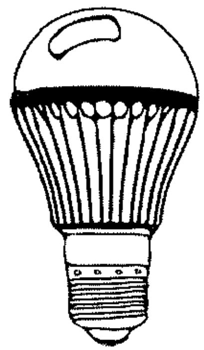
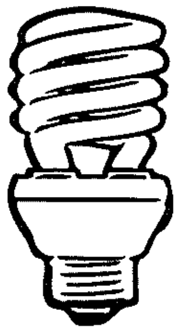
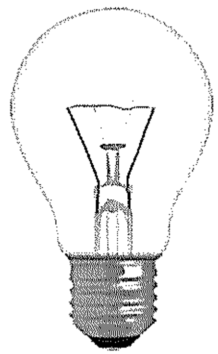
- The rate of use of electricity is called power and is measured in watts (W).
- 1 watt (W) = 1 joule of electrical energy used in 1 second
- 1 kilowatt (kW) = 1000 watts
- 1 kilowatt-hour (kWh) = 1000 watts used in 1 hour
- Home use of electricity is measured in kilowatt-hours (kWh) by electricity meters. Electricity companies use the meter readings to charge homes for the kWh of electricity used every three months.
- Different home appliances use different amounts of electricity so have different power ratings (watts).
- Off Peak electricity is electricity supplied when demand is small.
- Greenhouse gases are emitted by the production of most of Australia's electricity.

EXERCISE

Complete the remaining Send-in exercises for Lesson 1

Light Bulb Comparison Worksheet

Purpose: Let's explore energy use and energy efficiency by comparing the electricity consumption of different light bulbs.

THE FACTS:			
Acronym	LED	CFL	
Definition	Light-Emitting Diode	Compact Fluorescent Lamp	Incandescent
Picture			
Energy used	9 watts = 0.009 kWh	23 watts = 0.023 kWh	60 watts = 0.06 kWh
Lifespan of bulb	25,000 hours	12,000 hours	1,000 hours
Average use per day	5 hours		
Estimated light bulbs per house	20 light bulbs		
Price of electricity in NS	$0.15/kWh		

Light Bulb Comparison Calculations

1. a) How much energy is consumed by 20 incandescent light bulbs used for five hours per day for a year?

________W ÷ 1000 W/kWh = ________ kWh

________kWh x 5h/day = ________kWh/day

________kWh/day x 365 days = __________kWh/yr

________kWh/yr x 20 incandescent bulbs per house = ________kWh/yr per house

b) What is the annual cost?

________kWh/yr per house x $0.15/kWh = $________/yr

2. a) How much energy is consumed by 20 CFL light bulbs used for five hours per day for a year?

________W ÷ 1000 W/kWh = ________ kWh

________kWh x 5h/day = ________kWh/day

________kWh/day x 365 days/yr = __________kWh/yr

________kWh/yr x 20 incandescent bulbs per house = ________kWh/yr per house

b) **What is the annual cost?**

________kWh/yr per house x $0.15/kWh = $________/yr

3. **a) How much energy is consumed by 20 LED light bulbs used for five hours per day for a year?**

________W ÷ 1000 W/kWh = _______ kWh

________kWh x 5h/day = _______kWh/day

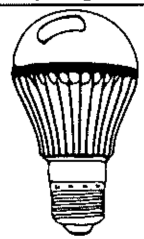
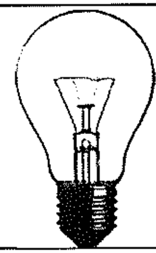
________kWh/day x 365 days/yr = _________kWh/yr

________kWh/yr x 20 incandescent bulbs per house = _______kWh/yr per house

b) What is the annual cost?

_______kWh/yr per house x $0.15/kWh = $_______/yr

CONCLUSION:

	Light-Emitting Diode (LED) light bulb	Compact Fluorescent Light (CFL) light bulb	Incandescent light bulb
			
Annual energy cost (5hrs/day)			

Light Bulb Comparison Discussion

1. Which type of light bulb has the **highest** electricity cost for a year?

____

2. Which type of light bulb has the **lowest** electricity cost for a year?

____

3. How much money would you **save** in electricity costs in a year if you switched all 20 incandescent light bulbs to LEDs? How much would you save if you switched 40 bulbs?

____

4. How much money would you **save** in electricity costs for a year if you switched all 20 CFL light bulbs to LEDs? How much would you save if you switched 40 bulbs?

____

5. How much money would you **save** in electricity costs for a year if you used 20 incandescent bulbs for half the amount of time, so 2.5 hours per day rather than 5 hours per day?

____

6. Which strategy would you **save** more in electricity costs for a year, by reducing your light bulb use by half the amount of time as in Question 5 or by switching from incandescent to LED light bulbs as in Question 3?

____

Renewable or Nonrenewable?

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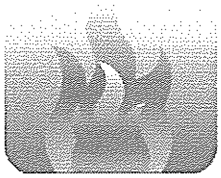
Draw a circle around the renewable energy sources and a square around the nonrenewable energy sources.

INTERMEDIATE STUDENTS

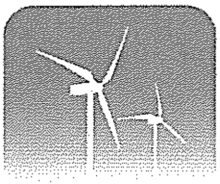
Coal

Oil/Petroleum

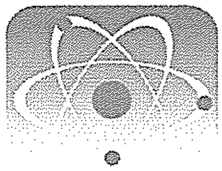
Solar



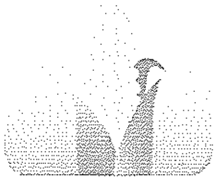
Natural Gas



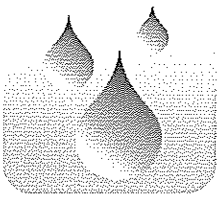
Wind Power



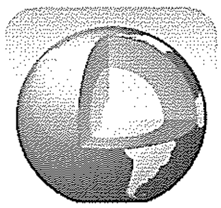
Nuclear



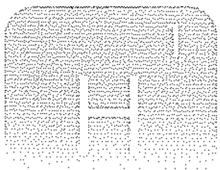
Biomass



Hydroelectric Power



Geothermal



Hydrogen

H4

energy4me

Energy Internet Scavenger Hunt

Use your computer to search for the answers to these questions.

INTERMEDIATE STUDENTS

1) **What are fossil fuels?**
http://glossary.eea.europa.eu/EEAGlossary

2) **What are renewable energy sources?**
http://glossary.eea.europa.eu/EEAGlossary

3) **What percent of the world's electricity is supplied by hydro power?**
www.worldcoal.org/assets_cm/files/PDF/fact_card07.pdf

4) **What types of gases make up natural gas?**
www.naturalgas.org/overview/background.asp

5) **What materials are used on solar panels to allow them to produce electricity?**
www.managenergy.net/kidscorner/en/u11/u11.html

6) **What is nuclear energy?**
http://scienceclub.nei.org/scienceclub/nuclearworld.html

7) **Who is considered the entrepreneur of the oil industry?**
www.eia.doe.gov/kids/history/people/pioneers.html

8) **Do electronics use energy when they're off?**
www.energy4me.org/use/home.htm

9) **By what percentage is the use of wind power growing worldwide each year?**
www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10501

10) **How did oil and natural gas form?**
http://worldalmanacforkids.com/WAKI-Chapter.aspx?chapter_id=4#Energy_and_its_Sources
(In the chapter articles, click petroleum.)