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Photocopy Master Sheets

Years 7-8

ENERGY

Disk filename = “01.Energy”

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Topics Available

Year 7-8 General Science

Disk Filename	Topic Name
01.Energy	Energy
02.Forces	Forces
03.Matter	Solids, Liquids & Gases
04.Mixtures	Separating Mixtures
05.Elements	Elements & Compounds
06.Cells	Living Cells
07.Life	Living Things
08.LifeSystems	Plant & Animal Systems
09.Astronomy	Astronomy
10.Earth	The Earth
11.Ecosystems	Ecosystems

Year 9-10 General Science

Disk Filename	Topic Name
12.Waves	Wave Energy (inc. Light)
13.Motion	Forces & Motion
14.Electricity	Electricity
15.Atoms	Atoms & Elements
16.Reactions	Compounds & Reactions
17.DNA	Cell Division & DNA
18.Evolution	Evolution of Life
19.Health	Health & Reproduction
20.Universe	The Universe
21.EarthScience	Earth Science
22.Resources	Resources & Technology

Year 11-12 Science Courses

Biology

Preliminary Core
Local Ecosystem
Patterns in Nature
Life on Earth
Evolution Aust. Biota
HSC Core
Maintain. a Balance
Blueprint of Life
Search for Better Health
Options
Communication
Genetics:Code Broken?

Chemistry

Preliminary Core
Chemical Earth
Metals
Water
Energy
HSC Core
Production of Materials
Acidic Environment
Chem.Monit.&Mngment
Options
Shipwrecks, Corrosion...
Industrial Chemistry

Earth & Envir. Science

Preliminary Core
Planet Earth...
Local Environment
Water Issues
Dynamic Earth
HSC Core
Tectonic Impacts
Environs thru Time
Caring for the Country
Option
Introduced Species

Physics

Preliminary Core
World Communicates
Electrical Energy...
Moving About
Cosmic Engine
HSC Core
Space
Motors & Generators
Ideas to Implementation
Options
Quanta to Quarks
Astrophysics

All Topics Available as PHOTOCOPY MASTERS and/or KCiC

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KCiC = Key Concepts in Colour
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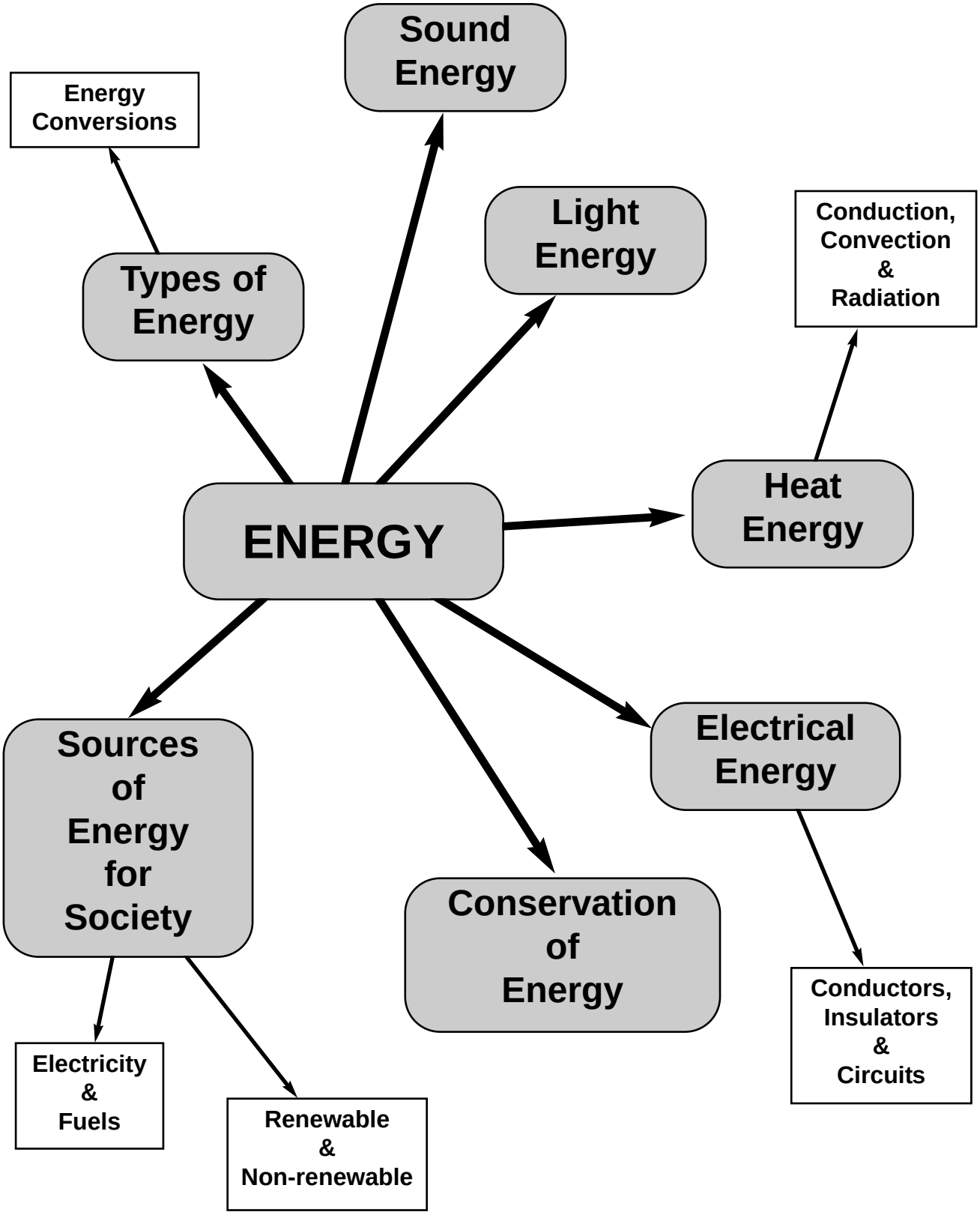
"Mind-Map" Outline of Topic

This topic belongs to the branch of Science called "Physics".
Physics is the study of the physical world of forces, motion & energy.



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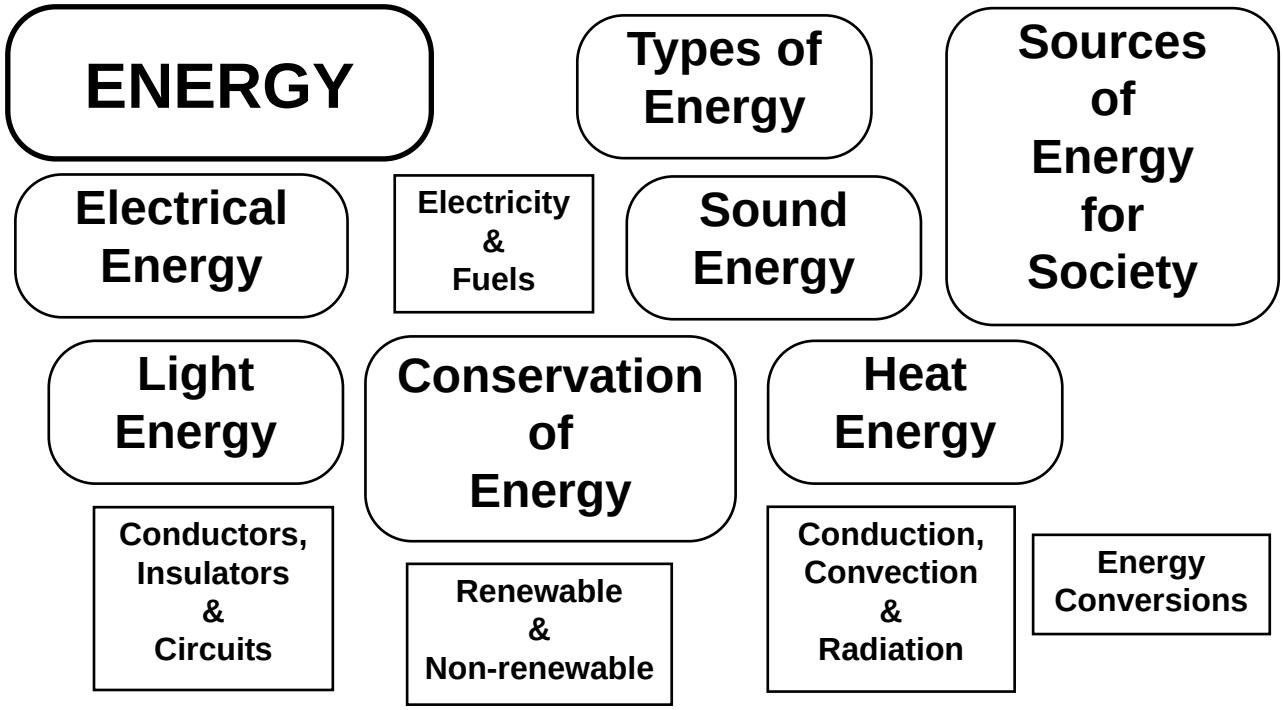
Make your own "Mind-Map" TITLE PAGE.
Cut out the boxes. Sort them into an appropriate lay-out on a page of your workbook, then glue them down. Add connecting arrows and colour in.



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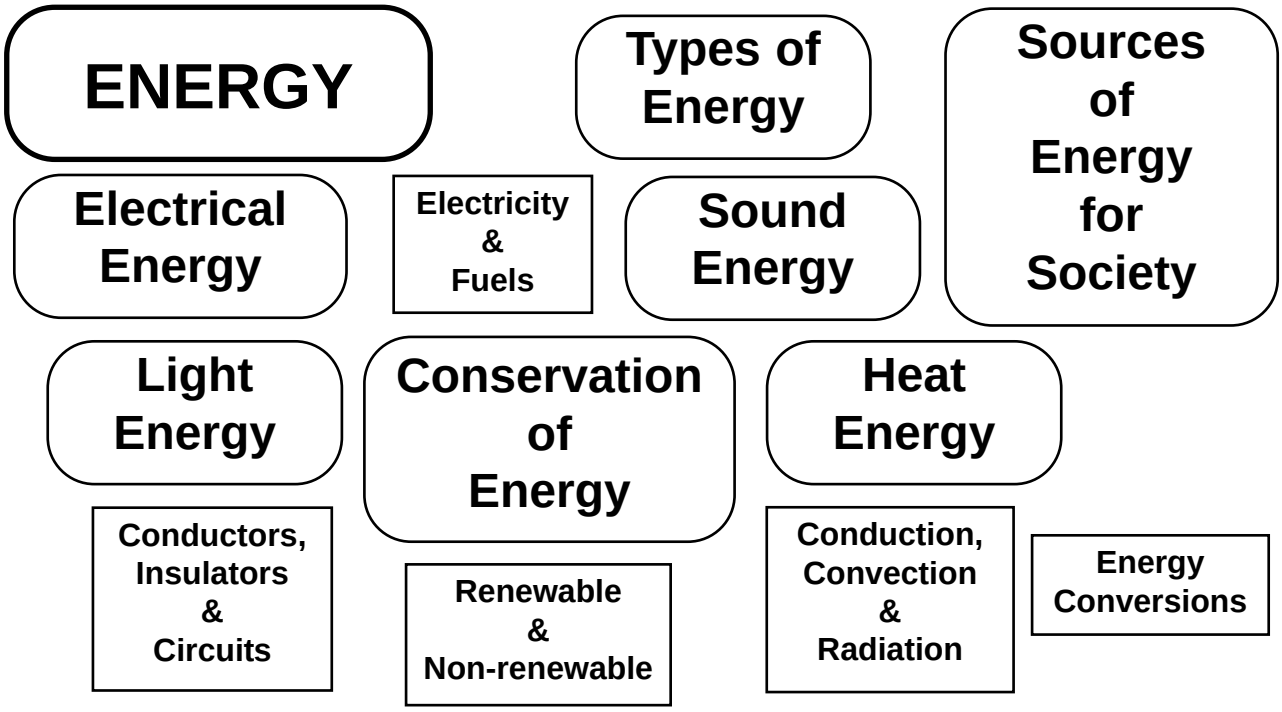

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What is Energy?

Energy is what causes things to change.

There are many different types of energy. Here are just a few:

Type of Energy	Changes Caused by this Energy
Heat	Change in temperature. e.g. a stove causes food to get hot.
Light	Nerve changes in your eye which allow you to see things, or chemical changes in the film in a camera.
Sound	Vibrations in your ear which allow you to hear.
Electrical Energy	Can cause a light bulb to glow and produce light, or a stove element to get hot and produce heat.
Radio Waves	Can cause electrical vibrations in an antenna. This allows reception of mobile phone, radio & TV programs.

Two types of energy need special attention: (learn these especially!)

Kinetic Energy (KE)

KE is the energy of a moving object. It causes the object to change its position by moving. If the moving object hits something, the KE can cause other changes, such as the damage done when moving cars collide.

Potential Energy (PE)

PE is energy stored in things, and not always obvious or apparent. There are 3 types:

Gravitational PE is energy stored in an object in a high position. The energy is not apparent until the object falls down due to gravity. As it falls, it converts into KE.

Chemical PE is energy stored in chemicals. The energy is not apparent until a chemical change occurs which releases the energy. Chemical PE is stored in chemicals like candle wax (can burn to release heat and light) or in a battery (can make electricity) or in petrol (can make a car move with KE).

Elastic PE is energy stored in objects which have been stretched, compressed or twisted out of shape. When released, the elastic PE is released, often causing something to move with KE.
e.g. When released, a stretched bow makes the arrow fly.

Why Learn about Energy?
Energy is the basic stuff of the universe. It powers all living things, all machines, the weather, the Sun... everything!

Energy Conversions

When energy causes a change, it always results in the energy converting into a new form. Examples:

Stove: electrical energy $\xrightarrow{\text{converts to}}$ heat

Car: Chemical PE in petrol $\xrightarrow{\text{converts to}}$ KE of moving car

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WORKSHEET 1

Fill in the blank spaces

Student Name.....

Energy is what causes (a).....

The energy which causes temperature to change is b).....

c)..... energy can cause a light bulb to glow.

You can hear because d)..... energy causes e)..... in your ear.

Radio and TV programs are received as the energy of f)..... waves.

Two very important forms of energy are abbreviated as KE and PE. KE stands for (g)..... and is the energy of a h)..... thing.

PE stands for i)..... This is energy j)..... in things. There are 3 types of PE:

(k)..... PE is energy stored in things which are stretched or (l)..... or twisted.

Gravitational PE is energy stored in things which are (m).....

(n)..... PE is energy stored in (o)..... such as (p)..... or (q).....

Whenever some energy causes a (r)....., the energy (s)..... into a different (t).....

WORKSHEET 2

Answer in the spaces provided

Student Name.....

1. What type of energy is <u>possessed by</u>:

a) petrol? .....

b) a car battery? .....

c) a rock, balanced on a high cliff?
.....

d) a bow & arrow, stretched & ready to fire?
.....

e) an arrow, once fired from the bow?
.....

2. What type(s) of energy is <u>produced by</u>:

a) a bunsen burner? ..... & .....

b) a musical instrument?.....

c) firing a gun?..... & .....

d) a TV set? ..... & .....

e) a car battery?.....

3. Describe the <u>energy conversion</u> in each case. The first one is done for you.

a) bunsen burner.

Chem P.E. ⟶ heat + light

b) electric lawn mower

c) a petrol lawn mower

d) battery powered flashlight (2 changes)

..... ⟶ ..... ⟶ .....

e) electrical toaster

f) hand-cranked alarm siren

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WORKSHEET 3

In each case <u>identify</u> the starting energy and the energy produced, and write an energy summary. (First one is done for you)

Student Name.....

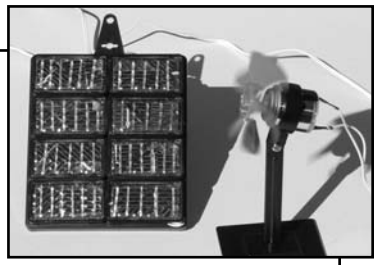
1. Light Bulb

Starting Energy =
<u>electrical</u>

Energy produced =
<u>light (and heat)</u>

<u>Summary</u>
electrical → light + heat

2. Solar Cell Fan



Starting Energy =

.....

Energy produced by the cell =

.....

Energy produced by the fan =

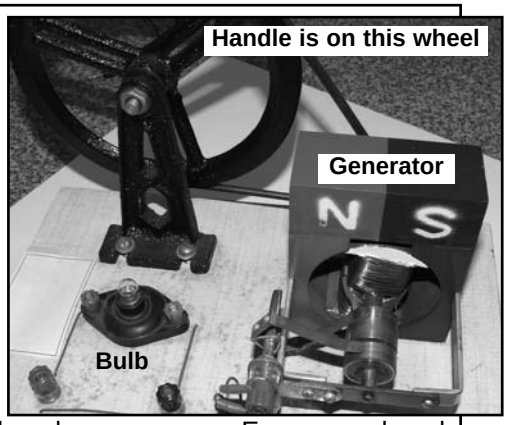
.....

When the cell is placed in strong light the little fan spins around. It is connected to the "solar cell" by electric wires.

<u>Summary</u>

..... → ..... → .....

3. Model Generator



When you crank the handle the bulb glows.

Starting Energy

.....

Energy produced by the generator

.....

Energy produced by the bulb

.....

<u>Summary</u>

..... → ..... → .....

4. Wind Generator

Starting Energy

.....

Energy produced

.....

This generates electricity when <u>moving</u> air (wind) blows across the blades

<u>Summary</u>

..... → .....

5. Slingshot

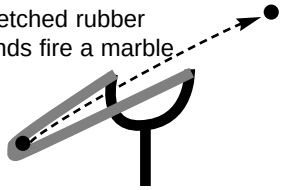
Starting Energy

.....

Energy produced

.....

Stretched rubber bands fire a marble



<u>Summary</u>

..... → .....

6. Power Tools

Starting Energy

.....

Energy produced

.....

<u>Summary</u>

..... → .....

7. Rocket

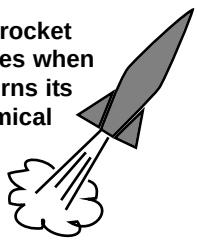
Starting Energy

.....

Energy produced

.....

The rocket moves when it burns its chemical fuel



<u>Summary</u>

..... → .....

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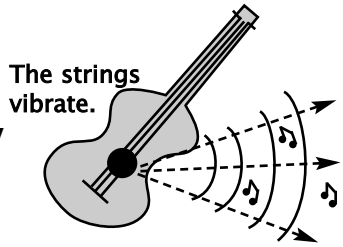
Sound Energy

When you hear a sound, you are detecting the energy of vibrations travelling through the air. These are sound waves.



In air, sound waves travel at about 330 metres per second (m/s). This means they can travel 1 km in 3 seconds.

The air doesn't really go anywhere as the vibrations pass through it. The air simply vibrates back-and-forth.

The air is called the "medium" for the sound waves... the substance it travels through.

Sound can travel through many different mediums, but cannot travel through "nothingness"... a vacuum. It must have a substance to vibrate and carry the sound waves.

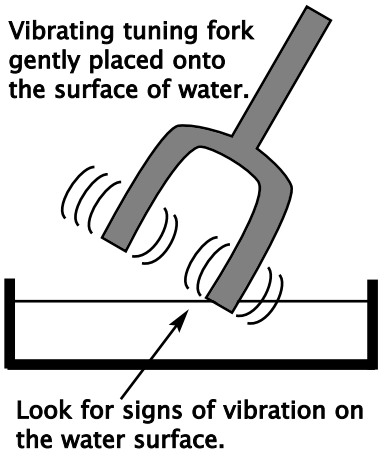
Sound travels at different speeds in different mediums.
In water, it travels at about 1,500 m/s (1.5 km in 1 second) and can carry for hundreds of kilometres. The "singing" of whales can be heard by other whales 500 km away!

In a metal, sound travels at about 5,000 m/s. (That's 5 km in 1 second!)

Sound is a Vibration

1. Look closely at a plucked guitar string. You can see it is vibrating as it makes a sound.

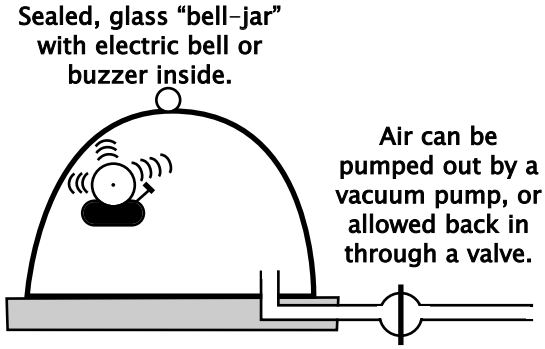
2. You might do this in class.



3. Gently touch the front of the speaker of a radio or music system. You can feel the vibrations as sounds are produced.

Sound Needs a Medium

Your teacher might demonstrate this in class.



When the bell-jar is filled with air, you can clearly hear the bell ringing.

When most of the air is pumped out, you can barely hear it, but you can see that it is still ringing.

Sound cannot travel in a vacuum. It must have a medium.

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Light Energy

Light is a form of energy which travels as waves. Unlike sound, light waves do NOT need a medium to travel through... in fact they travel best through a vacuum.

When you see light from the Sun, Moon or the stars it has travelled to your eyes through the empty vacuum of outer space.

Light can also travel through some substances, such as air, water and glass. These substances which allow light to pass through, are "transparent". Substances that block light (such as metal or concrete) are said to be "opaque".

Light waves travel at the amazing speed of 300,000 kilometres per second. That's the equivalent of going around the Earth 6 times in one second!

Thunder and Lightning

When you see a flash of lightning, you are detecting light waves which travel so fast ("speed of light" = 300,000 km/sec) that it is virtually instantaneous.

The lightning also creates sound energy ..."thunder". Being sound waves, the thunder travels much slower. So, you hear the thunder after you see the lightning, even though they are created together.

If you count the seconds between seeing the lightning and hearing the thunder, you can calculate how far away it is.

Every 3 seconds = 1 km away.

Light's "Family" of Waves

Light is a very special type of energy because we can detect it with our eyes.

There are also many other types of energy which are waves of the same type as light waves, but we cannot see them.

Gamma Rays - dangerous nuclear radiations.
X-Rays - penetrating waves used for medical investigation.
Ultra-violet (U.V.) - rays from the Sun which cause tanning, sunburn and skin cancers.
Light - which our eyes can detect.
Infra-Red (I.R.) - waves which carry heat energy.
Microwaves - used in communications and in microwave ovens.
Radio waves - used for radio and TV broadcasts.

All these are waves of the same type, and can travel through space at the "speed of light".

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Worksheet 4
Sound Energy
Fill in the Blank Spaces

Sound energy travels as a)..... through the air. The air b)..... (does/does not) travel anywhere as the wave passes, but it c)..... back-and-forth.

In air, sound travels at about d)..... metres per sec., but much e)..... (faster/slower) in water or in a metal.

Sound cannot travel through a f)..... Sound must have a substance, or g)"....." to travel through.

On the Moon there is no h)..... so astronauts cannot simply speak to each other. They must communicate by i)....., because these waves can travel through empty space.

Student Name.....

Which item in the list fits each definition?

Definition	matches with...
1. nothingness	.....
2. speed of sound in air	.....
3. medium	.....
4. vibration carrying energy	.....
5. What you hear through a vacuum	.....
6. solid which carries sound waves very fast	.....

List Items (Some will NOT be used)
silence, air, 330m/s, wave, metal, vacuum, 500m/s, substance which carries a wave, water, whales

Worksheet 5
Light Energy
Fill in the Blank Spaces

Light energy travels as a).....
Light does not need a b)..... to travel through and can move through a c)..... such as when it travels from the d)..... to Earth.

Light can also travel through some substances such as air, e)..... or ..... These substances, which light can travel through are said to be f)"....."

In vacuum, light travels at a speed of g)..... km per sec.

You always hear the thunder after you see the h)..... because the light travels i)..... (faster/slower) than the sound.

Student Name.....

Which item in the list fits each definition?

Definition	matches with...
1. nuclear radiations	.....
2. used for TV	.....
3. causes sunburn	.....
4. carries heat energy	.....
5. detected by eyes	.....
6. used in special ovens	.....
7. used to photograph your guts and bones	.....

List Items (Some will NOT be used)
light, X-rays, sound, I.R., microwaves, U.V., radio, gamma rays, laser beams

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Heat Energy

We cannot see or hear heat energy, but we can <u>feel</u> it because of receptors in our skin.

Heat energy is responsible for the measurement we call "temperature".

Heat energy can "flow" (or transfer) from a hotter zone to a cooler zone in three ways:

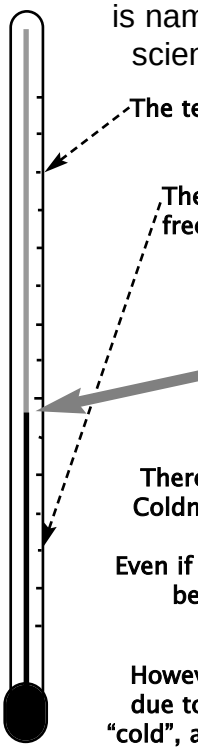
<u>Conduction</u> **is the main way that heat energy moves through <u>solids</u>. Some solid substances allow heat energy to flow through quickly. These are said to be "<u>good conductors</u>" of heat. (example: metals) Other substances are poor conductors because heat flows slowly. If very poor conductors, they are called "<u>insulators</u>". (examples: wool, foam plastics)**

<u>Convection</u> **is the main way that heat energy moves through <u>liquids</u> and <u>gases.</u> Hot fluid rises and flows in a "<u>convection current</u>".**

<u>Radiation</u> **is the only way that heat energy can move through empty space, such as when the heat of the Sun reaches the Earth. Heat radiation is carried by <u>Infra-Red waves</u> (I.R.), which travel at the speed of light. I.R. waves can also travel through air, and many other transparent substances.**

The Celsius Temperature Scale

is named after the Swedish scientist who invented it.



The temperature at which water boils is defined as 100ºC.

The temperature at which water freezes to ice is defined as 0ºC.

1ºC is simply $^{1}/_{100}$ of the scale in between.

37ºC is normal body temperature for humans.

There is no such thing as "cold". Coldness is a <u>lack</u> of heat energy.

Even if something has a temperature below zero, it still contains some heat energy.

However, if we feel uncomfortable due to lack of heat, we say we are "cold", and wear insulating clothing to trap our body heat.

Insulating Animals

Most **<u>mammals</u>** and **<u>birds</u>** keep their bodies at a constant temperature close to 40ºC, but many are quite comfortable in freezing conditions. How come?

Its all about **<u>insulation</u>** to slow down heat loss.

This bear stays warm because of its insulating fur coat.

Fur doesn't insulate when wet, so this sealion needs a layer of blubber (fat) under its skin.

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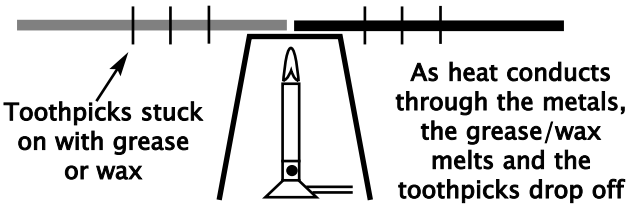
Investigating Conduction

An experiment you may have done, or seen demonstrated:

Two (or more) different-metal rods, held by clamps, heated at one end by a bunsen.



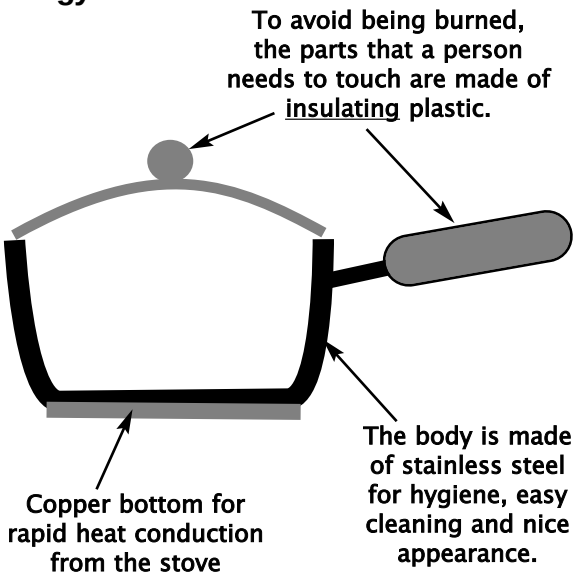
This allows you to compare the rate of heat conduction through different metals.

If a copper rod was used, you probably found its toothpicks fell off first.

All metals are good heat conductors, but copper is really excellent.

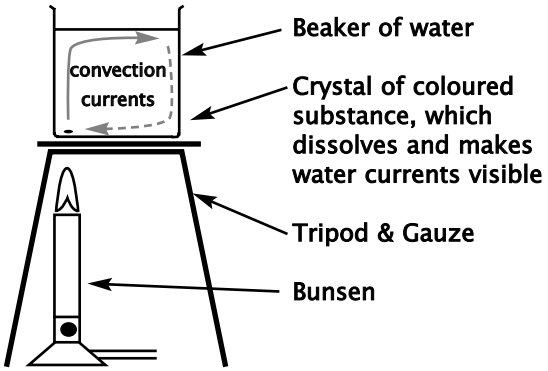
Heat Conduction in the Kitchen

Look at the features of a typical saucepan, and relate them to the conduction of Heat Energy.



Investigating Convection

You may have done an experiment similar to this:

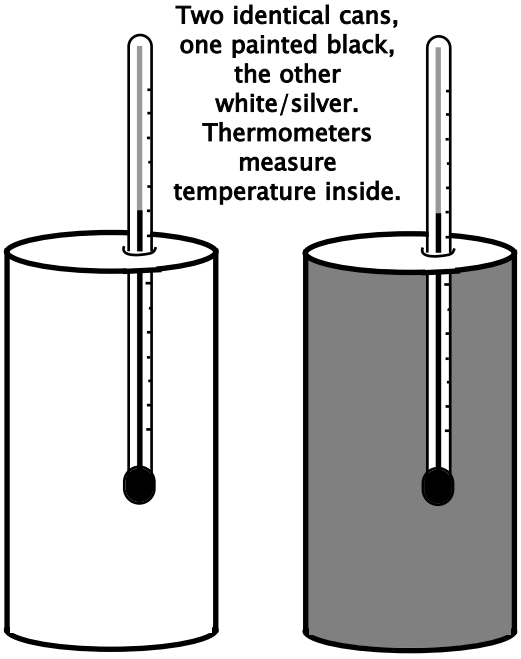


The coloured chemical makes any movement of the water visible.

The hotter water (directly above the bunsen) flows upwards, then spreads across the top, then sinks down the sides to complete a circuit.

This is a convection current, which moves heat quickly through gases (e.g. the atmosphere) and liquids (e.g. oceans)

Investigating Radiation



If placed in sunshine (or radiation from an electric radiator) you will find:

- **the black can heats up faster because it absorbs heat radiation.**
- **the white/silver can heats more slowly because it reflects radiation.**

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Worksheet 6
Skills Exercise Heat Radiation

Student Name.....

Two metals cans were fitted with thermometers to measure the temperature inside them. The cans were identical, except that one was painted black, the other painted white.

They were placed at equal distances from an electrical radiator... not yet switched on.

At "time zero", their temperatures were measured, then measured again every minute, for 10 minutes.

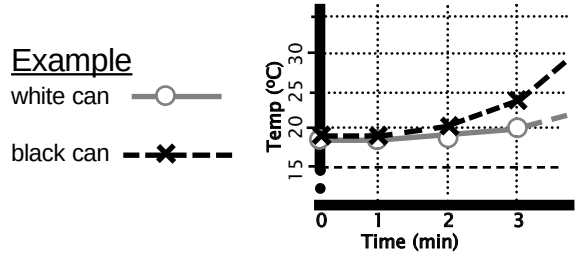
At time=1 min. the radiator was switched on.

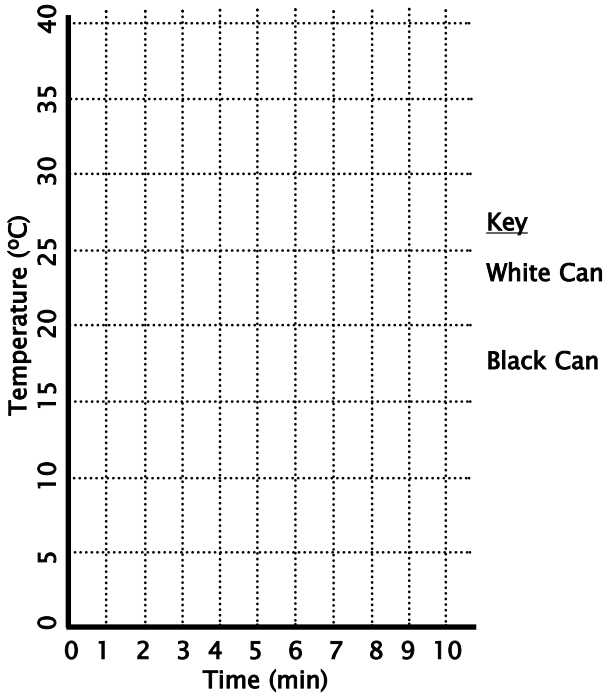
At time=6 min. the radiator was switched off.

This table shows the temperature recordings for each can.

Time (min)	White Can (°C)	Black Can (°C)
0	18	18
1	18	18
2	19	20
3	20	24
4	22	29
5	23	33
6	25	37
7	25	32
8	24	28
9	23	26
10	22	24

Graph the data on the grid.
Plot each data point, then connect with a line.
Use a different colour or style for each can.





Questions
(Some may require class discussion)

1. What is a suitable title for this graph? (Write it across the top of the grid)
Also indicate clearly which graph is the data for each of the cans. (Complete the "Key")

2. Complete the conclusions which can be drawn from the graphs.
a) "During heating, the black can's temperature increased ..... than the white can's."

b) During cooling, the black can's temperature decreased ..... than the white can's."

3. The two "variables" of this set of data are

..... and .....

4. a) Which variable can be called the "manipulated variable"? .....
b) Which is the "dependent variable"?
.....
Explain:

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Worksheet 7 (2 pages)

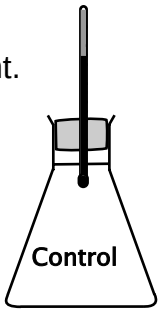
Student Name.....

Skills Exercise Heat Conduction

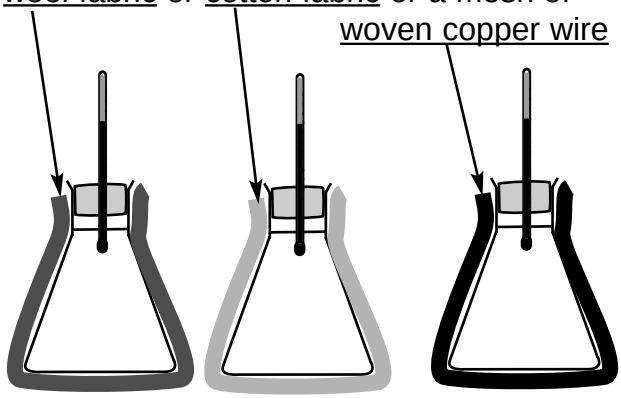
Four students wanted to investigate the insulating properties of various materials, such as wool and cotton and a metal mesh.They organized 4 laboratory flasks, each filled with the same amount of hot water all at the same temperature, and each with a thermometer.

One flask was left uncovered, as a "**control**" on the experiment.

The "control" is used to compare other results. In this case, the control flask has no insulation. Its temperature change will be used to judge the effects of insulation on the "test" flasks.



The "test" flasks were wrapped with a single layer of either
wool fabric or cotton fabric or a mesh of woven copper wire



To share the workload, each student recorded the temperature of one of the flasks every minute for 10 minutes, as the flasks cooled down.

Here are their individual recordings of the temperatures:

Copper covered Flask started at 82°C
after 1min is 75, 1 min later 68, cooling fast! at 3 min 62, next 57, then 52, at 6 min = 48, next 44. 8 min forgot to measure.
9 min 39, last one 35

Flask with cotton
start 82 C 1min 79
2min = 75 3min 71
5 min64 6min = 61
FORGOT 4 min !!!
7 = 58, 8=56, 9= 54, 10=52

Control Flask. start temp=82° C
after 1 min=76, 2 min it's now 70.
3mins = 66 after 4 = ~~65~~ 61,
5 min 57 6 = 53, 7 = 49 degrees C,
after 8 mins its 46, 9 = 43 degrees
final temp at 10 min = 41 C

Wool Flask

time	temp
0	82
1	81
2	79
3	76
4	74
5	~~73~~ 72
6	70
7	68
8	67
9	65
10	63

Your first task is to organize these results in a simpler, clearer, more scientific way... for measurements like these that always means a data table.

Questions

1. **What are the "variables" of this experiment? ..... & .....**
2. **Which is the "manipulated variable"? .....**
3. **Which is the "dependent variable"? .....**
4. **To place ALL the measurements above into a single data table, how many columns will be needed? .....**
5. **How many graphs will you plot on the grid? .....**

Now Turn Over and DO IT !!

Worksheet 7 (continued)

Student Name.....

A Rule to Remember

Always place the "manipulated variable" in the left column of a data table, and plot it on the horizontal axis of a graph.

Use this blank table to re-organize the data collected by the 4 students.

- **Write a heading for each column, including the units (in brackets) which apply to each column.**
- **Carefully fill in the body of the table with the numbers (only) from the student records.**
- **If there is a measurement missing, write a dash (-). Do NOT leave blank. Do NOT write zero.**

Temperature Changes in Cooling Flasks

Heading (units)	Heading (units)	Heading (units)	Heading (units)	Heading (units)

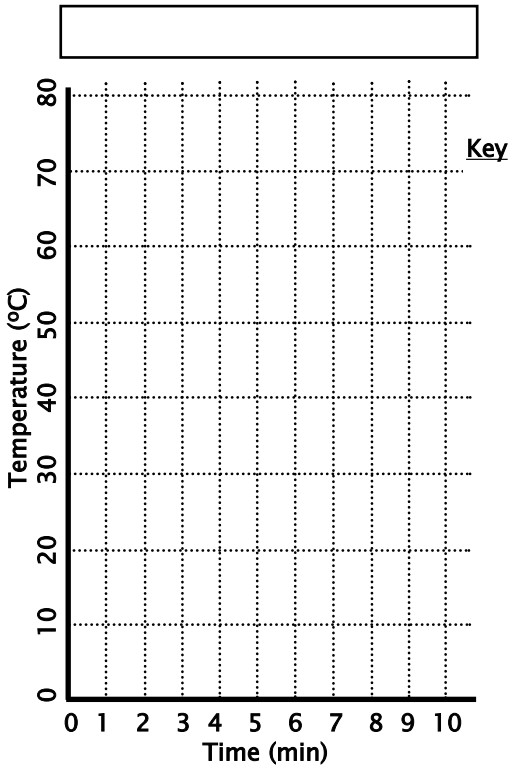
Write only numbers in the body of the table no words, no units

Now plot data points to line-graph the experimental measurements.

There will be 4 graphs on the one grid.

Use different style or colours for each, and be sure to complete a "Key" to identify each one.

Add a suitable Title at the top.



Questions (continued)

In each case, explain your answer by referring to the graph.

6. Which substance, wool, cotton or copper is the best insulator of heat?

7. Would you describe cotton as a heat conductor or insulator?

8. Suggest an explanation for the results obtained with the copper mesh covering.

Electrical Energy

The most useful form of energy for our society is electricity. It is so useful because:

- **electricity can be produced in one place (power station) and moved instantly to wherever the energy is needed.**
- **electricity can be easily converted into many other forms of energy, as needed. E.g. it is easily converted to heat, light, etc.**

What is Electricity?

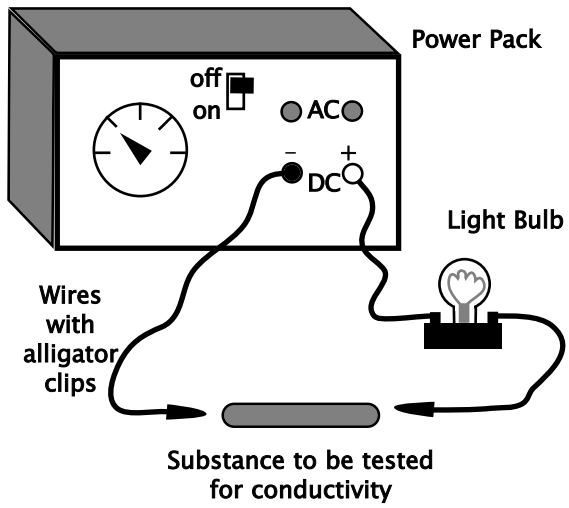
Electricity is a flow of tiny particles called electrons.
Electrons can flow through some substances (electrical conductors), but not through other things (electrical insulators).

Electrical Conductors
Metals, (Copper is especially good) graphite, salty water.

Electrical Insulators
Plastics, cotton, wood, air, pure water.

Notice that generally (but there are a few exceptions) the things that are good heat conductors are also good electrical conductors, and heat insulators are also electrical insulators.

Conductor or Insulator?



This equipment set-up is suitable to test the electrical conductivity of a variety of objects or substances.

The alligator clips are attached to the test object, then the power is turned on.

If the bulb lights up, it means that electricity is flowing through the entire circuit. Therefore, the test object is a conductor.

If the bulb does not light, then electricity is not getting through. Therefore, the test object is not a conductor... it is an insulator.

keep it simple science

Electrical Circuits, Voltage & Current

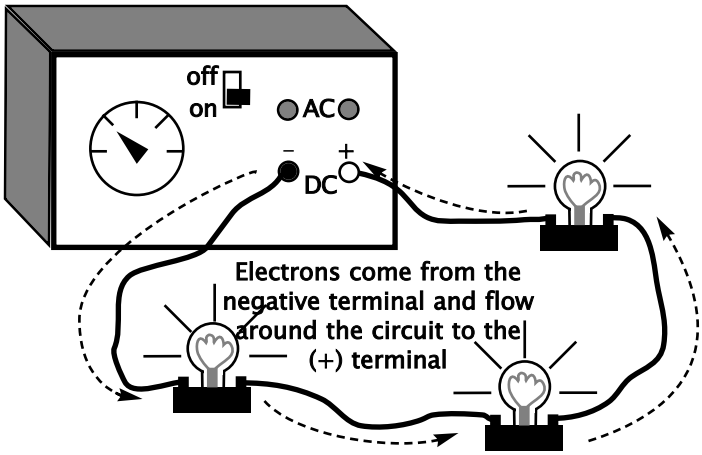
Electricity is a flow of tiny particles called electrons. They can flow through a wire (or other conductor) by rapidly "jumping" from atom to atom. However, they cannot jump onto the atoms of an insulating material. This why an insulator can block electricity and stop it getting through.

Each electron carries some negative electric charge.

For electricity to flow at all, there must be a complete circuit (i.e. an unbroken chain of conductors) from the negative (-) terminal to the positive (+) terminal.

It turns out that there are two kinds of electric charge, with opposite properties.

We could have called them "black" & "white", or "left" & "right", but they ended up as "positive" & "negative".



If there is any break in the circuit (e.g. a wire not connected properly) the electrons cannot get through and the whole circuit stops working.

Voltage Makes the Electrons Flow

The amount of electrical energy carried by each electron is determined by the voltage of the power source. The higher the voltage, the bigger the "push" given to each electron. Unit of measurement is the "volt" (V).

Small electrical batteries provide 1.5V, (safe to handle) and your school power pack can give up to 12V (fairly safe). Mains electricity is 240V (deadly dangerous) and power distribution lines may be 100,000V or more. (don't go there!)

Electrical Current

Electrical current is a measure of how many electrons are flowing.
Current is measured in units called "amperes" (abbreviated to "amps")(A).
1 A of current involves the flow of many billions of electrons per second.

Energy Conversion in an Electrical Circuit

Since voltage determines how much energy each electron has, and current measures how many electrons flow, then the total energy of a circuit depends on both voltage and current.

The energy produced (per second) by a circuit is called "Power", and is measured in "watts" (W). If you look at the labels on electrical devices it will tell you their power rating in watts or kilowatts (kW).

keep it simple science

Worksheet 8

Energy Transfers in Electric Circuits

Each electrical circuit described on this page converts electrical energy into some other form(s) of energy.

For each:

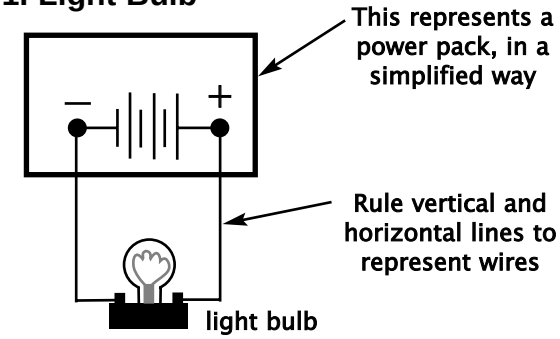
a) sketch what the circuit looks like.

b) state the energy conversion occurring.

<u>The first one has been done as an example.</u>

It may be possible for you to build each circuit yourself, or to see it demonstrated.
Your teacher might instruct you to sketch the circuits in a different way.

1. Light Bulb



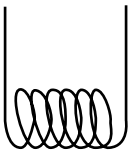
<u>Energy Conversion</u>

Electricity → Light + Heat

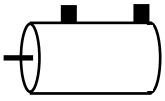
You do the rest.

Use simple diagrams such as these to represent the different devices.

Electric bell or buzzer



heating coil
(or jug element)



Electric Motor
(possibly driving a fan)

Student Name.....

2. Heating Water in a Beaker

<u>Energy Conversion</u>

3. Electric Motor

<u>Energy Conversion</u>

4. Electric Bell or Buzzer

<u>Energy Conversion</u>

Conservation of Energy

The word "conservation" simply means to keep things the same.

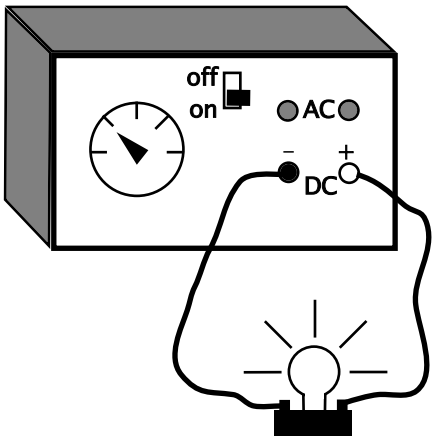
When applied to energy it refers to the fact that, whenever a change occurs and energy is transformed into another type, the total amount of energy after the change is exactly the same amount as there was before the change.

This is often written in this way:

"Energy cannot be created, nor destroyed. When energy is transformed, the total energy before is equal to the total energy after the change."

This is called the "LAW OF CONSERVATION OF ENERGY"

For example:



In this simple circuit, electricity is being converted into light and heat energy.

If you measure the amount of electrical energy being used, and the amount of light and heat energy being produced, the total is the same.

Amount of Electrical Energy used = Amount of Light & Heat Energy Produced

So, you cannot get energy from nothing... it cannot be created. You always get energy from something that has energy in it, often stored as Potential Energy (PE).

When you use energy, it doesn't just "disappear" and cease to exist... it transforms into other types of energy, but it is never destroyed.

Energy Sources

Think about where we get all the energy for our society.

Most Australian electricity is produced from the burning of coal.
Most of our cars, trucks, buses, etc are powered by petrol, or diesel fuel.

These are all "Fossil Fuels".
They are fossilised remains of living things which lived millions of years ago. They contain Chemical PE stored by those ancient creatures. Originally the energy came from the Sun.

Once used, this energy cannot be replaced... it is "non-renewable".

Efficient Energy Use

When we use energy it is converted into different types of energy.

However, not all of it converts into the type of energy we might want.

For example, when we burn petrol to power a car, what we really want is for the energy to convert to KE to make the car move. (Plus a little electricity for the lights, radio, etc)

In reality, only about 10% of the total energy originally in the petrol ends up as KE.

90% is "wasted" as (mainly) heat energy, which spreads out into the surroundings and is no longer useful.

A car is only about 10% efficient in energy!

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Worksheet 9
Electrical Energy

Fill in the blank spaces

Student Name.....

Electricity is the most a)..... type of energy for society because it can be produced on a large scale in a b)..... ..... and moved instantly to where energy is needed. It can also be easily c)..... into other forms of energy such as d)..... or .....

Substances which allow electricity to flow through them easily are called e)..... Examples are f)..... Substances which electricity cannot flow through are called g)..... and include h)..... and .....

Electricity is the flow of tiny particles called i)..... which carry j)..... electric charge.

For electricity to flow, there must be a complete k)..... of conductors from the l)..... terminal to the m)..... terminal of the power source, such as a n).....

The amount of energy carried by each electron is determined by the o)"....." of the circuit, measured in p).....

The number of electrons flowing is measured by the electric q)"....." measured in r).....

The total energy produced (per second) by a circuit is called the s)"....." and depends on both t)..... and .....

Different electrical devices convert electricity into other energy forms. A light bulb produces u)..... energy, a motor produces v)..... energy and a jug element produces w).....

Worksheet 10
Conservation of Energy

Fill in the blank spaces

Student Name.....

"Conservation" means to keep things a).....

Conservation of energy refers to the fact that whenever energy is used, it b)..... into a new type, but the amount of energy is c).....

For example, the amount of d)..... energy used by a stove to cook food is exactly e)..... ..... as the amount of f)..... energy produced by the elements.

This principle is called "The Law of g)....."

In Australia, most of our electricity is generated by burning h)..... and our vehicles are powered by i)..... or ..... fuel.

All these are j)"....." because they are the fossilized remains of k)..... things which lived l)..... of years ago.

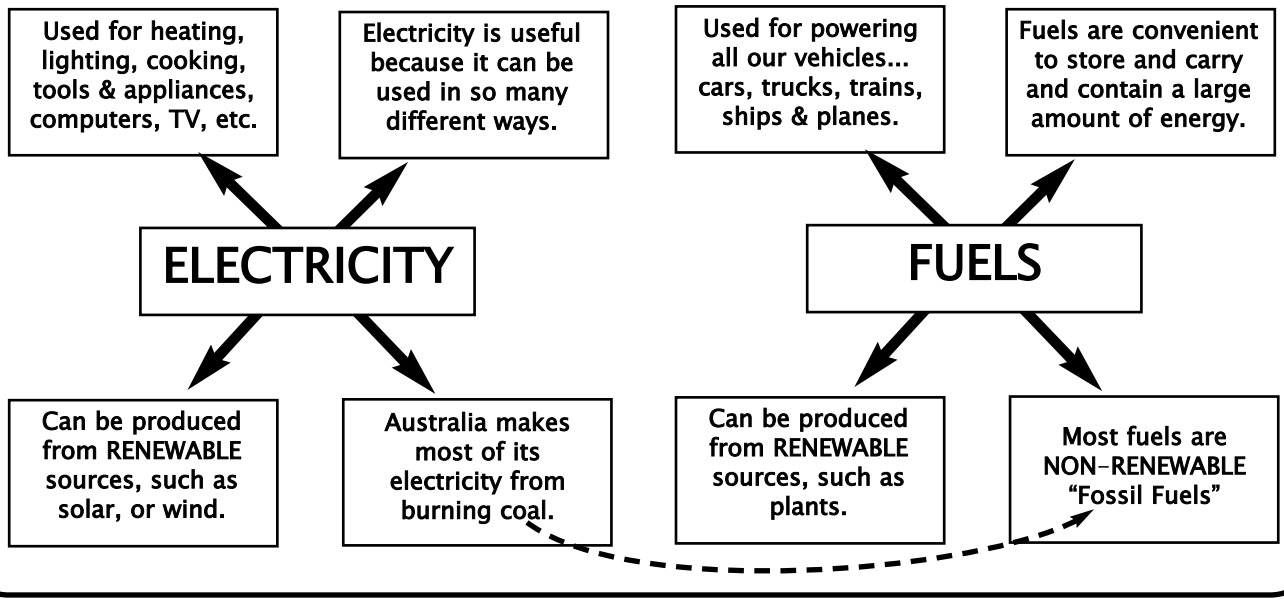
The energy in a fossil fuel is m)..... PE, and is released when the fuel is n)..... The energy came originally from the Sun, and was stored by living things in chemicals of their bodies.

However, once it is used, it is impossible to replace, so it said to be o)"..... - ....."

keep it simple science

Sources of Energy for Society

We need a lot of energy for our homes, schools, businesses, factories, transport, etc.



Renewable and Non-Renewable

A renewable resource is something we need which can be replaced.

Water is an important resource we need. It is renewable because the natural weather cycles bring rain to re-fill rivers and dams.

Wool and cotton are resources we use for clothing, carpets, furnishings, etc. These are renewable because we can grow the plants and animals they come from.

A non-renewable resource is something we need, or use, which cannot be replaced.

Petroleum is used to make fuels such as petrol, diesel and to make many "petro-chemicals" such as plastics.

Petroleum is non-renewable, because it took millions of years to form. Once it is used, it cannot be replaced in any reasonable time.

Fossil Fuels

Coal

Millions of years ago, many parts of the world were covered in great forests of fern trees growing in swamps. When leaves and trunks fell, they did not rot away, but "composted" into peat-like deposits.

Layer after layer were buried by more and more deposits. Later, the material was buried under sediments of sand and mud and compressed and changed into coal.

Coal is fossilised plant matter, and still contains the chemical PE that the plants stored when alive. This energy is released as heat when coal is burned.

Petroleum (Petra = rock, oleum = oil)

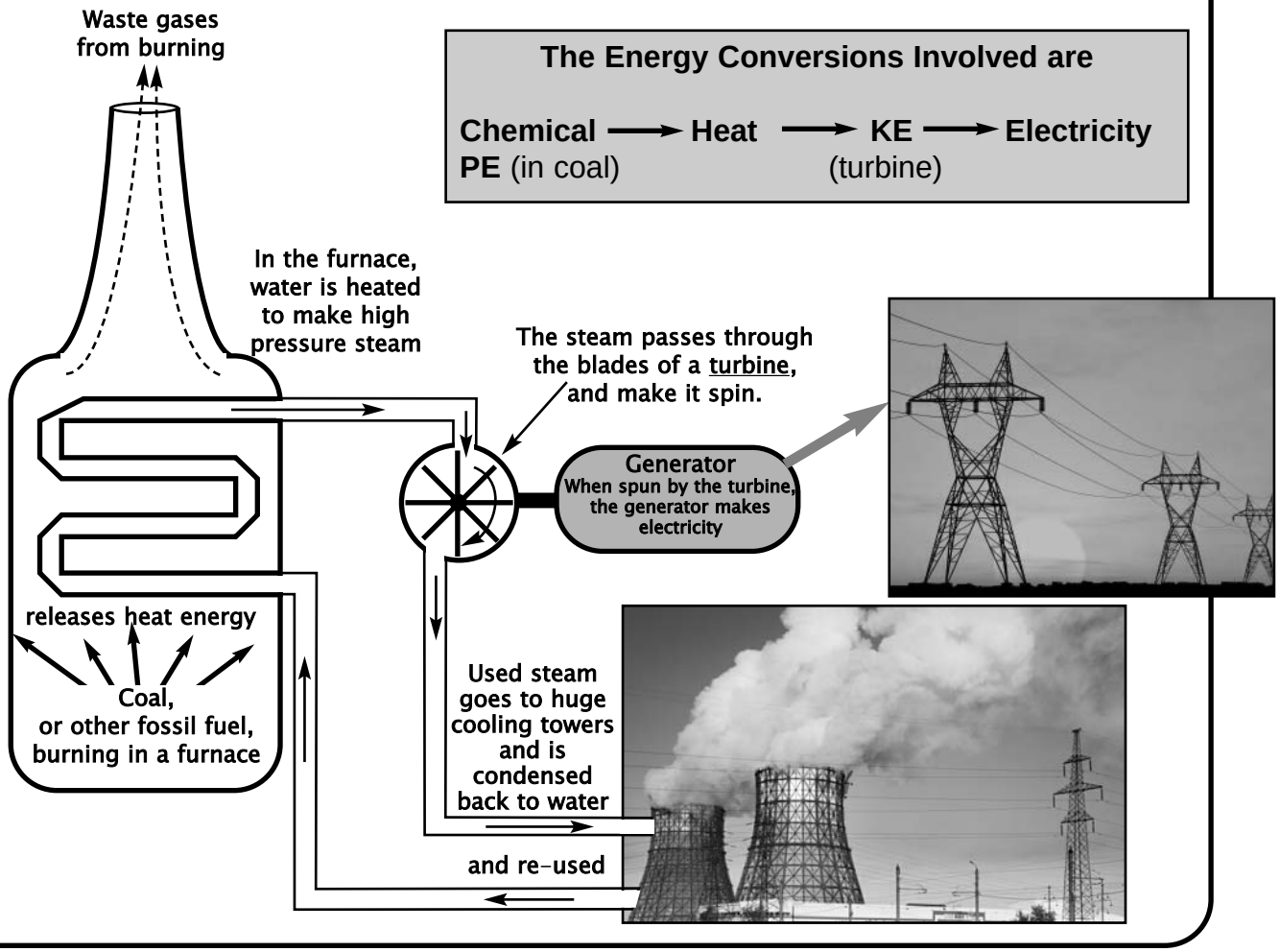
Petroleum is the fossilised remains of tiny sea creatures which died and settled into the mud of ancient shallow seas. Buried in sediments, their remains have been chemically changed, but still contain some chemical PE stored in the cells of the ancient creatures.

Petroleum can be refined to make fuels like petrol, diesel and L.P.G.

keep it simple science

How We Make Electricity from Fossil Fuels

In Australia, we mostly burn coal. Petroleum gas, or other petroleum fuels, could be used.



Problems With Burning Fossil Fuels

1. Non-Renewable

All fossil fuels are non-renewable resources and must eventually run out. Coal will last a few hundred years, but petroleum may run out within your lifetime.

2. Pollution

Burning coal can produce sulfur dioxide gas which is acidic. It can lead to "Acid Rain" which destroys forests and kills plant & animal communities in lakes & streams.

Burning petroleum fuels in vehicle engines produces waste gases which cause "smog". This damages people's lungs and results in many health problems.

3. Global Warming

Burning fossil fuels produces huge amounts of the gas carbon dioxide (CO_2).

Check your family's latest electricity bill: it will tell you how many tonnes of CO_2 have been released to make your electricity.

CO_2 in the air is known to "trap" heat which would normally escape into space. Increased CO_2 levels can cause a "Greenhouse Effect" which is now believed to be causing the whole world to warm up.

This "Global Warming" will cause climate change so that weather patterns will be disrupted and many natural environments may be destroyed in the next century.

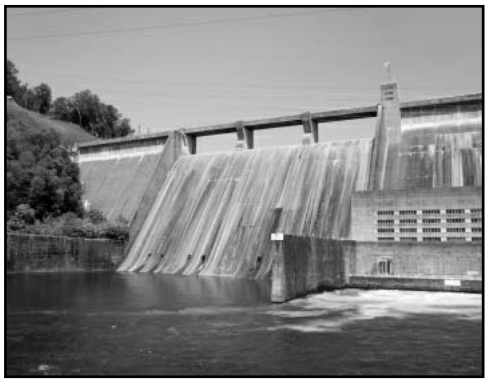
keep it simple science

Electricity from Renewable Resources

1. Hydro-Electricity ("hydro" = water)

Water from rain or melted snow can be stored in a dam.

It can then flow down through pipes to spin turbines, which drive generators to make electricity.



Australia makes about 30% of electricity this way, most of it in Tasmania and in the Snowy Mountains Scheme.

Unfortunately, there are not any more suitable places in Australia to make much more hydroelectricity. Areas with mountains and high rainfall, (or snowfall) are needed.

2. Wind Power

The power of wind can spin a turbine to make electricity. More and more are being built world-wide, but only a tiny fraction of electricity is being made this way.

3. Solar Power

Using solar cells, light energy from the Sun can make electricity to power a single home. So far, it is not practical or economical to make electricity on a large scale (i.e. a power station) this way.

Experiments are under way to use mirrors to concentrate heat radiation from the Sun. This is used to make high pressure steam to spin the turbines of a large power station.

The problem is to store energy for night-time electricity supply, since a solar power station can only work in the daytime.

Fuels from Renewable Resources

1. Ethanol

Ethanol is a liquid fuel which can be made from sugar or starch from plants. It is already being added to petrol to make the petrol last longer.

This is only a "stop-gap" solution. The process of making ethanol needs fertilisers & electricity which currently rely heavily on fossil fuel use.

It would be impossible to totally replace petrol with ethanol from sugar or starch anyway. To make enough ethanol to replace petrol world-wide, over 75% of all farmland would be needed. Many places struggle to feed all the people now, so growing ethanol crops would mean mass starvation.

2. Bio-Diesel

Most trucks, buses & trains use diesel fuel made from petroleum. Many vegetable oils can be chemically treated so that they can replace diesel.

The problem is the same as for ethanol... how to grow plant crops for fuel without using farmland needed for food production. Research is going on to get bio-diesel from plants that grow in deserts or in the oceans.

3. Hydrogen

One possible fuel for the future would be hydrogen gas, which can be made from water, but requires a lot of electricity to make, and different engines to use it.

If we had cheap solar electricity, we could make enough hydrogen to fuel our vehicles.

Worksheet 11
Energy for Society

Fill in the blank spaces

Student Name.....

Most of the energy we need comes from either a)..... or from the chemical PE in various b)..... such as petrol.

Australia makes most of its electricity from burning c)....., and most of our fuels are made from d).....

A "renewable resource" is something we use which can be e)..... For example, f)..... is a renewable resource because it can be replaced by g) ....

A h)".....-..... resource cannot be replaced. Fossil fuels are all i)..... resources.

Coal is the fossilized remains of j)..... k)..... is the fossil remains of tiny sea creatures.

To make electricity from coal, it is burned in a l)....., releasing m)..... energy. This is used to turn water into high-pressure n)..... This causes a o)..... to spin, which in turn drives a p)....., which makes electricity.

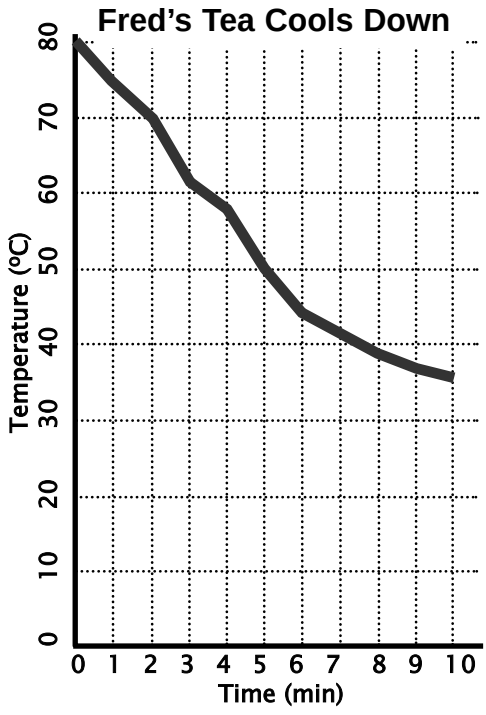
The main problems with using fossil fuels are:
• the fuels are q)..... and must eventually run out.
• burning them releases gases which can cause r)..... problems.
• s) "..... Warming" caused by the release of t)..... gas, which causes a u) "..... Effect" by trapping extra heat in the air.

Some renewable ways to make electricity include the use of v)..... as well as w)..... power or x)..... energy. Some possible renewable fuels include y)..... and .....

Worksheet 12
Skills Exercise

Student Name.....

Fred made a hot cup of tea and placed a thermometer in it (as you do!). He recorded the temperature of the tea every minute and graphed the data.
On the right is his graph.



a) What was the starting temperature of the tea?

.....

b) After how many minutes was the temperature of the tea 50ºC?

.....

c) Fred made his tea in an ordinary china cup.
Draw on the graph grid the graph you might expect if he had used an insulated cup. Label it "insulated".

d) Draw on the grid the graph you might expect if he had used a metal cup. Label it "metal cup".

keep it simple science

How Scientific Development Affects Everyday Life

Science is not just a "subject at school".
Science is a process which allows us to get a better understanding of everything.
As scientists learn more, new technologies are invented to make life easier, more efficient, interesting and convenient.

For example, scientific developments in the field of Electrical Energy is one area which has had a huge impact on everyone's everyday life.

ELECTRICITY
provides energy to power:

- Clean, safe heat & light
- Tools and labour-saving appliances
- Entertainment from TV, DVDs, electronic games
- Machinery in factories which make things
- Telephones & Internet for business, finance and communication

Scientific knowledge about electricity was gradually discovered over about 100 years from about 1780 to 1880.

Next, followed a period during which new technologies and inventions took advantage of the new knowledge.

LIGHT BULB
TELEPHONE
RADIO & TV
POWER TOOLS
FRIDGE, WASHER

Then, from about 1950, new understandings, and new inventions led to transistors and then "silicon chips", and all modern electronic gadgets.

COMPUTERS *MOBILE PHONES* *INTERNET*

Think about how all these things have changed the everyday life of people!

Choices About Scientific Developments

Our society needs to make choices about the technologies we use and come to rely on. For example, we know that burning of fossil fuels cannot last forever, and causes environmental damage, but we now rely on electricity and must have it.

Some people think that Nuclear Energy could supply a lot of our electricity with no emission of "Greenhouse Gases". This is done in many other countries.

Others point out the danger of nuclear accidents (such as Chernobyl 1986... research if necessary) and other problems.

Who is right? Who chooses?
People vote to elect a government who will make these decisions on our behalf. It is vital that we, the citizens, know the scientific facts so that we can vote sensibly.

Current Research

So, what's being done?

One idea being developed is called "carbon capture & storage" (CCS). The idea is to collect the CO_2 gas emitted from a coal-burning power station and pump it deep underground (about 2km down) into porous rock layers where it will remain trapped for thousands of years, or even longer.

A test station started operations in Victoria in 2008. Scientists will use it to study the methods of liquifying and pumping the CO_2 underground, and whether the gas will stay down there safely. Australia is a world leader in this research.

However, the technology to actually collect the CO_2 from a power station (typically 300-500 tonnes per day) has not been tested.

We have a long way to go to solve the energy problems.

Topic Test - Energy

Answer all questions in the spaces provided

Student Name.....

Score /30

1. (5 marks)

Match each description to an item from the list. To answer, write the letter (A,B,C, etc) of the list item beside the description.

Description matches with	**List Item**
i) Energy of a moving object.	.....
ii) Carries heat energy at the speed of light.	.....
iii) Sound cannot travel through this.	.....
iv) Opposite of conductor.	.....
v) Electricity is a flow of these tiny particles.	.....

List Items (not all will be used)

A. gamma rays	**B. electrons**
C. vacuum	**D. opaque**
E. convection	**F. kinetic**
G. infra red	**H. insulator**

2. (3 marks)

Give a brief explanation of each of the following.

a) There is always complete silence on the Moon. Why?

b) Your always hear the thunder after you see the lightning. Why?

c) A metal spoon in a hot cup of tea soon feels hot, but a wooden spoon does not. Why?

3. (3 marks)

List 3 types of waves (other than light) which can travel through a vacuum at the "speed of light".

.....

.....

.....

4. (3 marks)

Give a brief explanation of each of the following.

a) The base of a saucepan is made of metal, but the handle is plastic. Why?

b) On a sunny day, a black-painted car becomes very hot inside, while a white-painted car stays cooler. Why?

c) When cooking peas in a saucepan, the peas are seen to move up to the top, then across, then go down again... repeating a circular pattern of movements. Why?

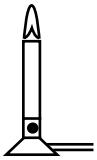
5. (5 marks)
Describe the main energy conversion in each situation or device.

a) electric fan

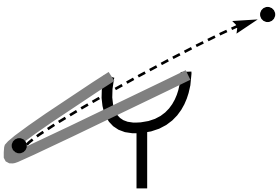
..... → .....

b) electric light

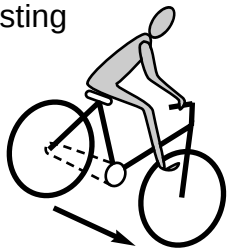
c) bunsen burner



d) slingshot



e) bicycle gaining speed, coasting down a hill.



6. (2 marks)
a) In any situation involving energy change, how does the <u>total energy used</u> **compare to** the <u>total energy produced</u>, ?

b) The principle or idea involved is known as the

"Law of .....

....."

7. (5 marks)
Fill in the blank spaces.
Electricity is a flow of particles called a).....

Each one carries some b)..... electric charge.

The amount of energy carried by each one is determined by the c)..... of the circuit.

The d)..... is a measure of the number of particles flowing.

For electricity to flow in a circuit, there must be an unbroken chain of e)..... from beginning to end.

8. (4 marks)
Briefly explain the <u>difference</u> between a "**renewable**" resource and a "**non-renewable**" resource.
In your answer, give an <u>example</u> of each.

Answer Section

Worksheet 1

a) things to change. b) heat
c) Electrical d) sound
e) vibrations f) radio
g) Kinetic Energy h) moving
i) Potential Energy j) stored
k) Elastic l) compressed
m) in a high position n) Chemical
o) chemicals p) petrol
q) anything which can burn
r) change s) converted
t) type or form

Worksheet 2

1.
a) Chemical PE b) Chemical PE
c) Gravitational PE d) Elastic PE
e) Kinetic energy
2.
a) heat & light b) sound
c) kinetic & sound (also heat and light)
d) light & sound e) electricity
3.
a) Chem PE → heat + light
b) electricity → KE
c) Chem PE → KE
d) Chem PE → electricity → light
e) electricity → heat (+ light)
f) KE → sound

Worksheet 3

1. Electricity → light + heat
2. Light → electricity → KE
3. KE → electricity → light
4. KE → electricity
5. Elastic PE → KE
6. Electricity → KE
7. Chem PE → KE (+ heat, light, sound)

Worksheet 4

a) waves b) does not
c) vibrates d) 330
e) faster f) vacuum
g) medium h) air
i) radio

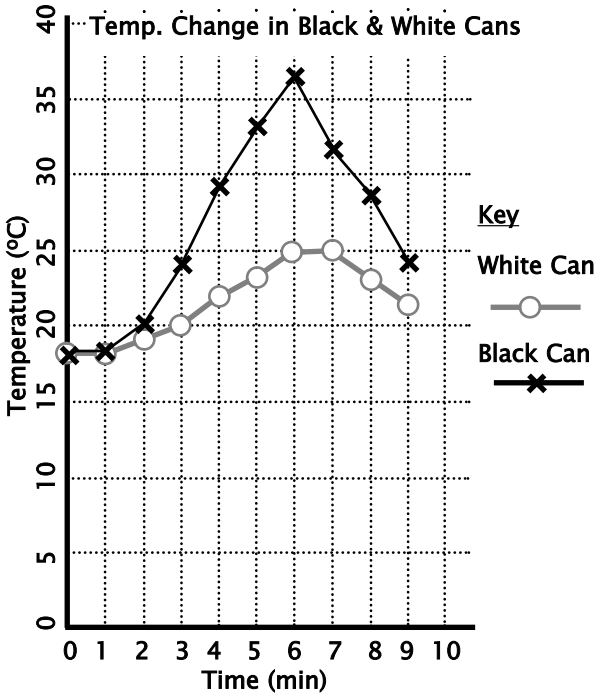
1. vacuum 2. 330 m/s
3. substance which carries a wave
4. wave 5. silence
6. metal

Worksheet 5

a) wave b) medium
c) vacuum d) Sun
e) water or glass f) transparent
g) 300,000 h) lightning
i) faster

1. gamma rays 2. radio
3. UV 4. IR
5. light 6. microwaves
7. X-rays

Worksheet 6



Questions
1. "Temp. Change in Black & White Cans"
2. a) black can's temp. increased faster (or more than) the white can
b) black can's temp. decreased faster (or more than) the white can
3. Temperature and Time
4. a) Time b) Temp.
Explanation: the experimenter decides on which time to take the measurements, so the time is being manipulated. The Temperature depends on the time readings are taken.

NOTICE ANY ERRORS?

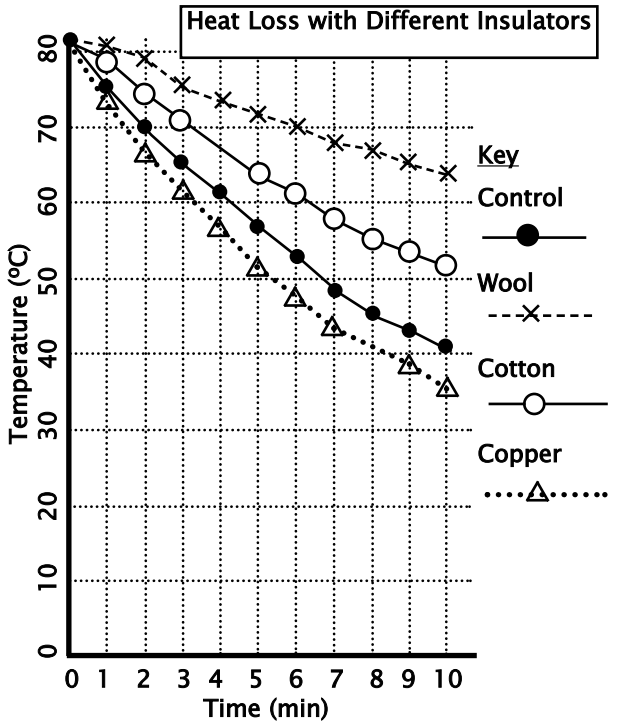
Our material is carefully proof-read but we're only human

If you notice any errors, please let us know

Worksheet 7

1. Time and Temperature **2. Time**
3. Temperature **4. 5 columns**
5. 4 graphs

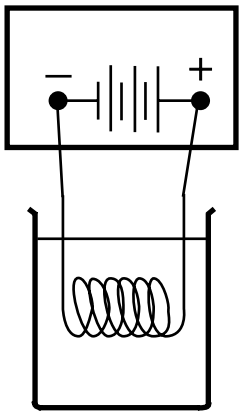
Time (min)	Temp Control Flask (ºC)	Temp Wool Flask (ºC)	Temp Cotton Flask (ºC)	Temp Copper Flask (ºC)
0	82	82	82	82
1	76	81	79	75
2	70	79	75	68
3	66	76	71	62
4	61	74	--	57
5	57	72	64	52
6	53	70	61	48
7	49	68	58	44
8	46	67	56	--
9	43	65	54	39
10	41	63	52	35



6. Wool. The graph for wool shows that its temp. dropped slowest, or least. Therefore, it must be insulating better than any others.
7. Insulator. Its graph shows that its temp. dropped slower than the control, so it must be holding heat in better than a bare flask.
8. Graph for copper shows its temp. dropped faster than the control which was not insulated at all. It must be a <u>good heat conductor</u> and losing heat faster than an uncovered flask.

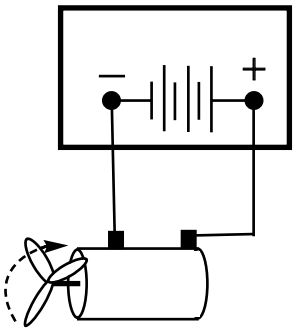
Worksheet 8

1.



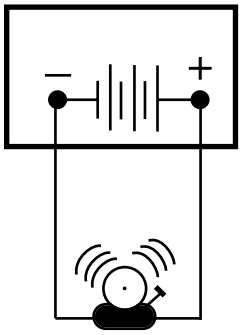
Electricity → heat

2.



Electricity → KE

3.



Electricity → Sound
(Observant students may notice that it's really
Electricity → KE → Sound)

Worksheet 9

a) useful
b) power station
c) converted
d) heat or light
e) conductors
f) metals
g) insulators
h) plastic, air, wood, etc
i) electrons
j) negative
k) circuit
l) negative
m) positive
n) battery / power pack
o) voltage
p) volts
q) current
r) amps
s) power
t) voltage & current
u) light
v) kinetic
w) heat

Worksheet 10

a) the same
b) converts
c) the same
d) electrical
e) the same
f) heat (& light)
g) Conservation of Energy
h) coal
i) petrol or diesel
j) Fossil Fuels
k) living
l) millions
m) chemical
n) burned
o) non-renewable

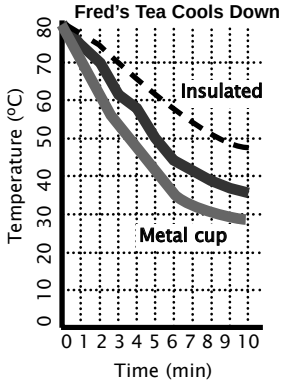
Worksheet 11

a) electricity
b) fuels
c) coal
d) petroleum
e) replaced
f) cotton
g) growng the plants it comes from
h) non-renewable
i) non-renewable
j) plants / trees
k) Petroleum
l) furnace
m) heat
n) steam
o) turbine
p) generator
q) non-renewable
r) pollution
s) Global
t) carbon dioxide
u) Greenhouse
v) hydro-electricity
w) wind
x) solar
y) bio-diesel & hydrogen

Worksheet 12

a) 80ºC
b) 5 min
c) & d) on graph

Sketched graphs should start at same point as original, and follow a similar trend, one above, and one below the original.



Topic Test

1.
i) F ii) G iii) C iv) H v) B

2.
a) There is no air to act as a medium to carry sound waves.
b) Sound waves travel much slower than light, so sounds arrive later than things you see.
c) Metal is a good heat conductor, while wood is a poor conductor, or insulator.

3.
Any 3 of gamma, X-ray, UV, IR, microwaves, radio

4.
a) Metal base allows heat to conduct rapidly into the food. Plastic handle is an insulator and prevents people being burnt by hot saucepan.
b) White/light colours reflect heat radiation and so they stay cooler. Dark/black colours absorb heat radiation (IR) and so heat up faster.
c) They are flowing along in the convection currents in the water.

5.
a) electricity → KE
b) electricity → light (+ heat)
c) Chem PE → heat (+ light)
d) Elastic PE → KE
e) Gravitational PE → KE

6.
a) total energy before the change is equal to (the same as) total energy after the change.
b) ...Conservation of Energy

7.
a) electrons
b) negative
c) voltage
d) current
e) conductors

8.
A renewable resource is one that can be easily replaced. eg wool can be replaced by farming sheep.

A non-renewable resource cannot be replaced in any reasonable time. eg petroleum, which takes millions of years to form.

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