Energy Changes

Sometimes energy is passed from one object to another. If you hit a tennis ball with a racquet, then some of the kinetic energy of the racquet is transferred to the ball. At other times, one form of energy changes into other forms of energy. For example, a television is powered by electrical energy, which is changed into light, sound and heat energy. A car travelling down the freeway uses the chemical energy in petrol to give it the kinetic energy to keep moving.

Energy transfer

Energy can be passed from one object to another. This is known as **energy transfer**. If you stand in front of a heater, then heat energy is transferred from the heater to you, warming you up. As Figure 5.2.1 shows, when you kick a ball, kinetic energy from your foot is transferred to the ball, causing the ball to move.

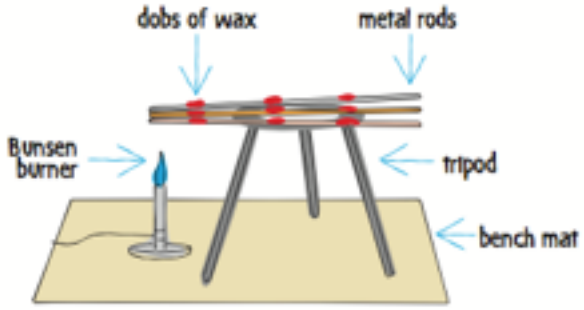
Figure 5.2.1 When a ball is kicked, kinetic energy is transferred from the person's foot to the ball.

Practical Number 5

INQUIRY science 4 fun

Heat transfer

How is heat energy transferred?



Collect this...

- three rods of different metals (e.g. iron, copper and steel)
- Bunsen burner, tripod and bench mat
- candle
- timer
- matches

Do this...

1 Place a tripod on a bench mat.

2 Lie the three metal rods on top of the tripod as shown.

2 Place the Bunsen burner just below the ends of the rods.

3 Light the candle and drip dobs of wax onto each rod as shown.

4 Heat the ends of the rods using the blue flame of the Bunsen burner. Time how long each dob of wax takes to melt.
Note: Do not touch the metal rods until they have cooled down.
If a dob of wax has not melted after 10 minutes, turn off the Bunsen burner.

5 From your observations, identify the rod that was best at transferring heat.

Record this...

Describe what happened.

Explain why you think this happened.

Energy transformation

Energy can be transferred from one object to another. Energy can also be changed, or transformed, from one type of energy into another type of energy. Whenever you watch TV, listen to music or play on a games console, you are relying on **energy transformation**. Computers, TVs and MP3 players convert electrical energy into sound, light and heat energy. Figure 5.2.2 shows some energy transformations using an **energy flow diagram**.

Figure 5.2.2 Energy transformations are shown using an arrow. Here are some energy transformations that occur when using a toaster, an MP3 player, a wind-up toy and a car.

Sometimes a number of different energy changes happen all at once. Imagine that you accidentally knock a glass off a table. The glass falls and smashes on the floor below. The glass initially has gravitational potential energy. When it is falling, this energy is changed into kinetic energy and some heat energy. When it hits the floor, some of the kinetic energy is transferred to the pieces of glass that break and fly off in all directions. Some kinetic energy is converted into sound and heat energy. Figure 5.2.3 describes these changes in a flow diagram.

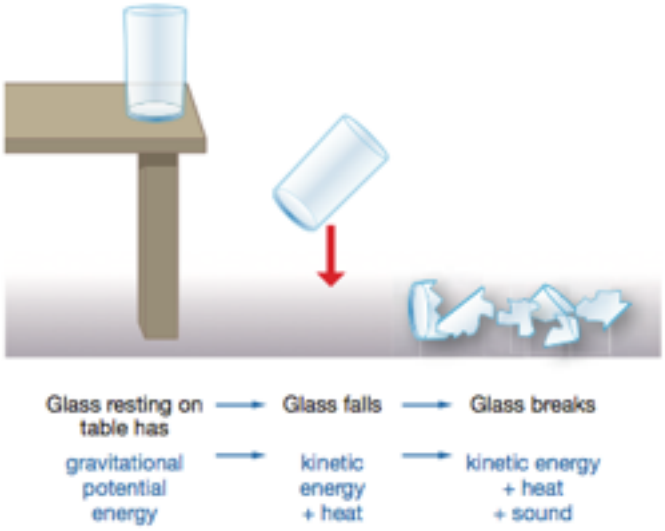


Figure 5.2.3 There are many energy changes happening when a glass falls off the table.

A solar cell converts light energy into electrical energy. This energy can then be converted into many different types of energy. Figure 5.2.4 shows an energy flow diagram for the energy changes involved in using a solar fan.

The law of conservation of energy

Sometimes it looks as though energy disappears. For example, when you kick a ball, the kinetic energy you give the ball seems to be lost when the ball stops moving. Actually, this kinetic energy has been converted into other forms of energy, such as heat and sound energy.

The **law of conservation of energy** states that energy can never be created or destroyed. It can only be converted from one form to another.

This means that:

- energy might be passed on or wasted, but it is never lost
- if one object wastes energy, then it is always gained by another object, usually as heat.

2 p188 5.2 5.3

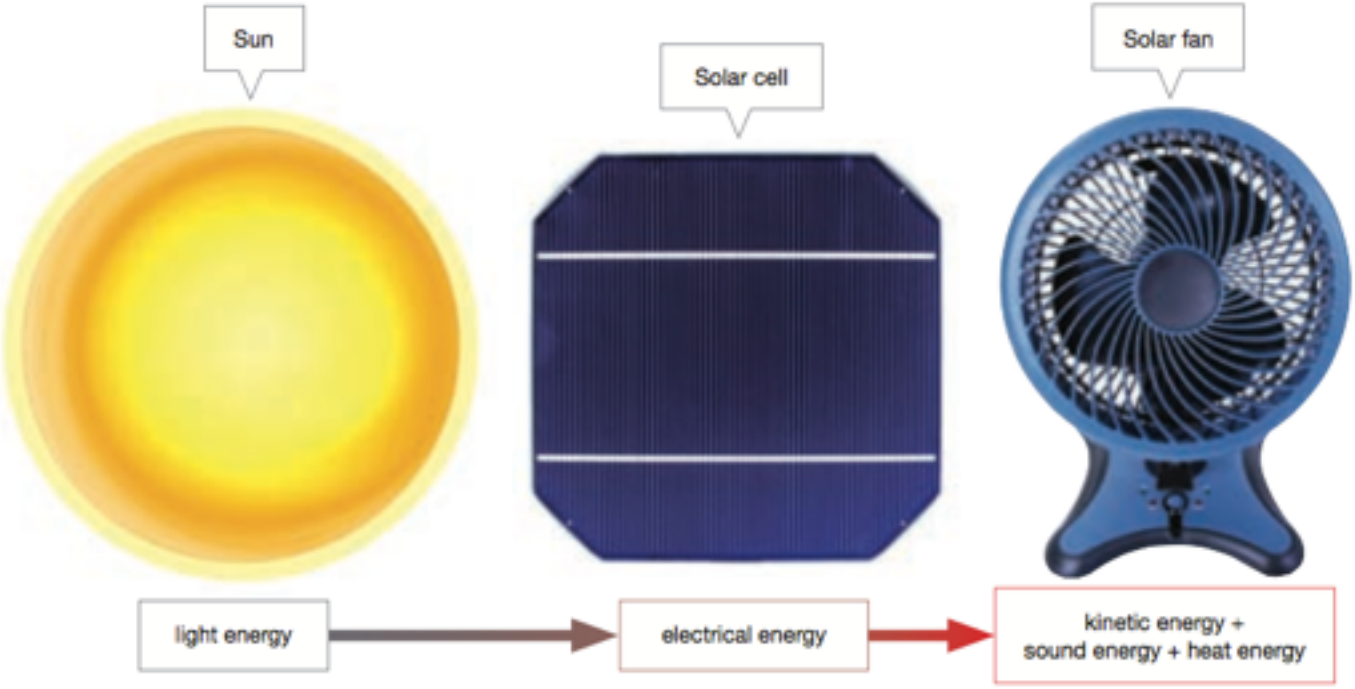
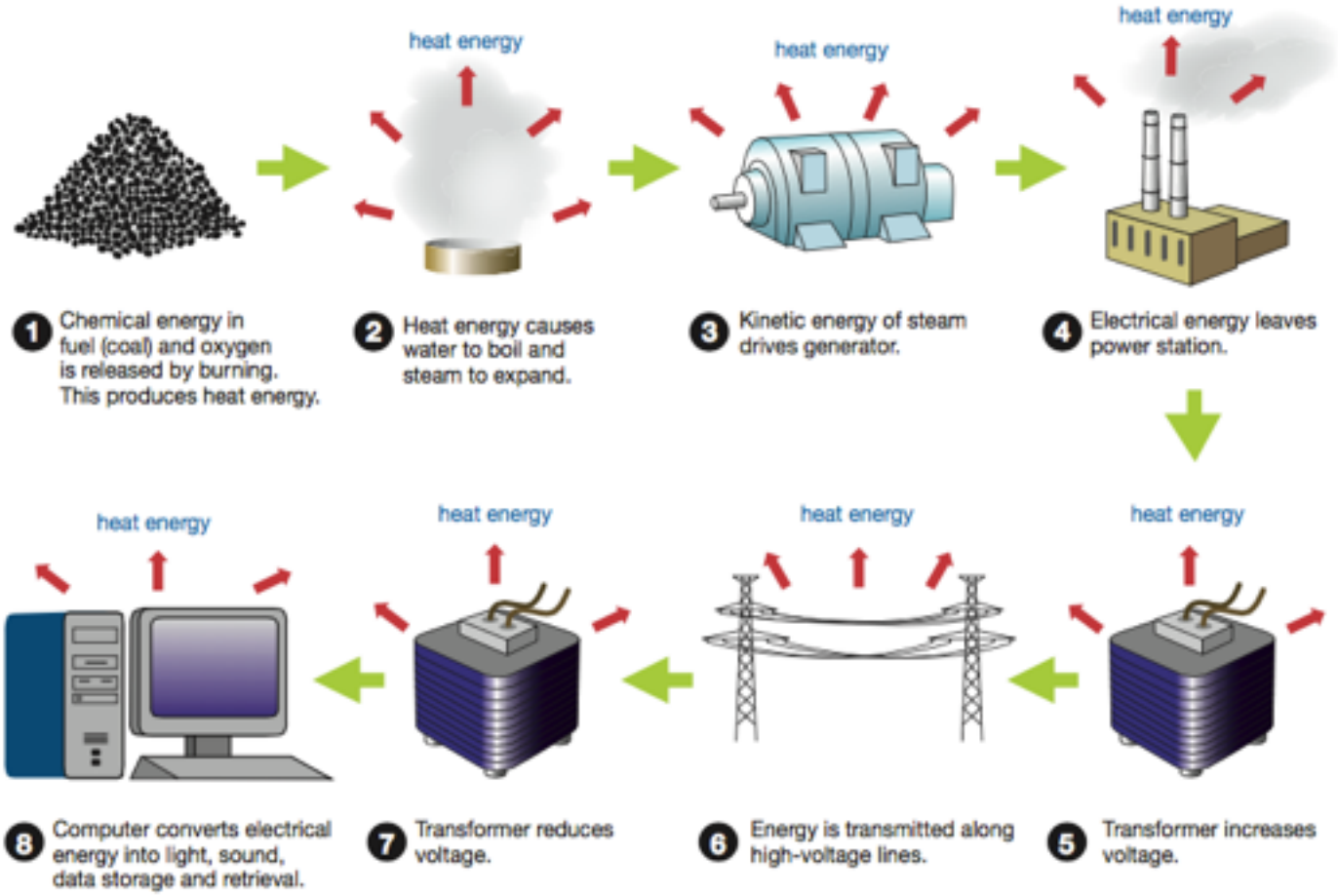


Figure 5.2.4 A solar cell converts light energy from the Sun directly into electrical energy. This electrical energy is converted into the kinetic energy of the blades, as well as sound and heat energy produced by the solar fan.

Renewable energy

Some energy sources are renewable. This means that they are unlimited in supply and can be used over and over again. Examples are solar energy, wind energy and hydroelectric energy. Most of the electrical energy that supplies Australian households comes from burning fossil fuels, such as coal, oil or natural gas. These fossil fuels were formed over millions of years and are known as non-renewable energy sources. Fossil fuels contain chemical potential energy, which is released when the fuel is burnt. Figure 5.2.7 on page 184 shows that only a small fraction of the original chemical potential energy of a fossil fuel is converted into the useful energy needed to operate devices in our homes. This happens because heat energy is lost at each step of generating and delivering the electricity.



You must answer ALL questions

Remembering

1 **Recall** two examples of energy transfer.

2 **Name** the type of energy that is produced by a solar cell.

4 Refer to the law of conservation of energy and **state** whether the following statements are true or false.

- a If energy is wasted, then it is lost altogether.
- b If energy is lost from one object, then it will be gained by another.
- c The total amount of energy in the universe is always changing.

5 **Name** the type of energy possessed by fossil fuels.

Understanding

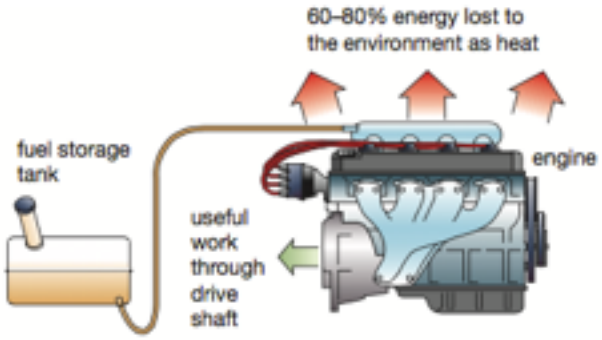
6 a Use an example to **explain** what is meant by the term *energy transformation*.

b **Describe** the energy transformation(s) that take place when you cook rice in a microwave oven.

7 a **State** the law of conservation of energy.

b **Explain** what this law means, using an example.

Applying



Efficiency:

petrol engine	25%
diesel engine	35%
jet turbine	30%
steam engine	40%

Figure 5.2.8

13 You ride a skateboard down the street.

- a **Identify** the source of energy input for this activity.
- b **Identify** the types of energy that are produced.

14 **Use** your knowledge of energy transformations to match the situations a–e below with the appropriate energy transformations i–v.

- a A girl toboggans down a slope.
- b You ride a bike.
- c A wind-up toy car travels across the floor.
- d A boy swims in a pool.
- e Wood burns in a fire.

i chemical energy → kinetic energy + sound energy + heat energy

ii gravitational potential energy → kinetic energy + sound energy + heat energy

iii chemical energy → heat energy + light energy + sound energy

iv elastic potential energy → kinetic energy + sound energy

v chemical energy → kinetic energy + sound energy + heat energy

Analysing

18 An apple that falls from the top of an apple tree hits the ground at a greater speed than an apple that falls from near the base of the tree. **Analyse** why this happens.

Creating

19 **Construct** a flow diagram to show the energy changes that happen when you:
- **a** ring a doorbell
- **b** light a match
- **c** fall over.

20 **Use** Figure 5.2.9 to **construct** a flow diagram to show the energy changes that occur when you vacuum the floor using electricity from a wind generator.

Inquiring

1 Materials differ in how well they transfer heat. If heat travels easily through a material it is called a good conductor of heat. If heat is not easily conducted through a material, it is called an insulator. Research which materials are good conductors of heat and which materials are insulators.
- **a** List three conductors and three insulators.
- **b** Discuss ways that materials can be used based on how well they transfer heat.

2 A scramjet is a new type of jet engine that is designed to operate at very high speeds. It has no moving parts, which is necessary to avoid losing energy due to friction at high speeds. Research the scramjet and outline four facts about it.

4 Does a ball bounce higher if it is warmer? Investigate, using a ball and a hair dryer.

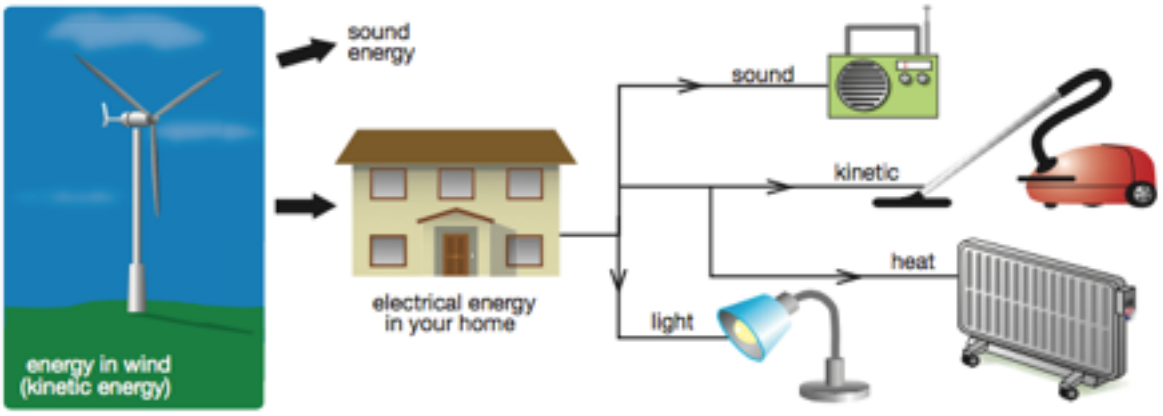


Figure 5.2.9

Practical Number 6

1 Investigating heat

Heat can be transferred in a number of different ways. If two substances are in contact, then the heat of one substance can be transferred to the second substance through a process called conduction. Some materials are better conductors than others.

Purpose

To compare how effectively different substances conduct heat.

Materials

- supply of hot water
- polystyrene cup
- metallic mug
- ceramic coffee mug
- thermometer or temperature probe and data logger

Procedure

1. Copy the results table below into your workbook.
2. Carefully pour 100 mL of hot water into each cup or mug. Make sure that the water poured into each is at the same temperature.
3. Place a temperature probe or thermometer into each cup or mug.
4. Record the starting temperature using the data logger or thermometer and take measurements for 10 minutes.

Results

Construct a line graph showing the temperature of the water in the cup and mugs over the 10 minutes.

Discussion

1. To be a fair scientific test, the three containers used in this experiment should be the same thickness and have the same diameter opening at the top. **Explain** why these factors are important.
2. Based on your results, **identify** the material that was the:
   a. best conductor of heat
   b. worst conductor of heat.
3. A pool blanket is used to trap heat within a swimming pool. **Propose** whether the blanket should be made from material that is a good or a poor conductor of heat.

Time (minutes)	Temperature of water in		
	Polystyrene cup (°C)	Metallic mug (°C)	Ceramic coffee mug (°C)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Practical Number 7

2 Energy changes

Purpose

To observe and identify different energy changes.

Materials

Part A

- alligator clips
- light globe
- 6 V battery

Part B

- steel wool
- bench mat
- alligator clips
- 6 V battery and switch

Part C

- tuning fork
- rubber stopper
- beaker of water

Part D

- 200 g mass
- modelling clay

Part E

- rubber band
- polystyrene ball

SAFETY

Wear safety glasses for these tasks.

In part B, do not leave the switch closed as the steel wool could catch fire.

In part E, do not flick polystyrene balls near people.

Procedure

Copy the results table into your workbook. As you complete each task, fill in your observations in this table.

Part A

1 Use two alligator clips to connect a light globe to a battery or power pack as shown in Figure 5.2.10.

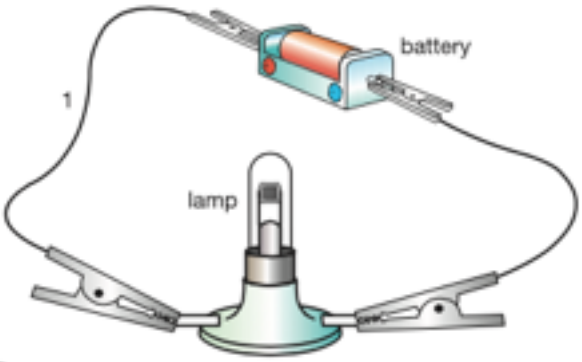


Figure 5.2.10

Part B

2 Place the strands of steel wool on a bench mat. Use alligator clips to connect these to a battery and a switch as shown in Figure 5.2.11. Close the switch for a few seconds and watch the steel wool.

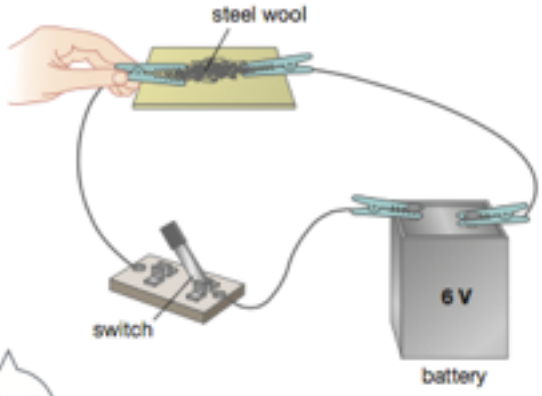


Figure 5.2.11

Part C

3 Strike a tuning fork on a rubber stopper. Put the ends of the tuning fork into a beaker of water.

Part D

4 Drop the 200 g mass onto a lump of modelling clay from a height of about 30 cm.

Part E

5 Place the polystyrene ball on the bench. See if you can make the ball roll along the bench using a stretched rubber band. Figure 5.2.12 shows the method.

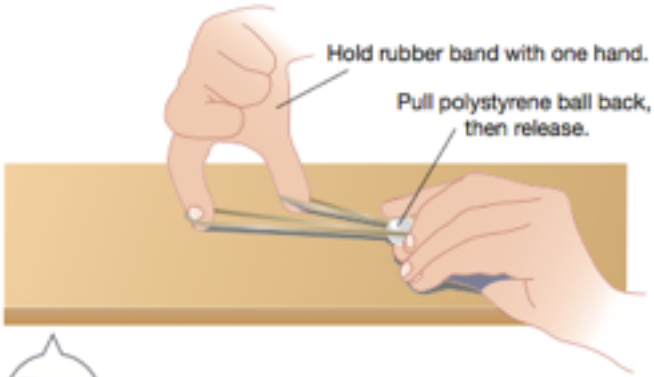


Figure 5.2.12

Results

1 Copy the table below into your workbook. Use it to record your observations.

2 Next to the observations recorded in your results, list the source of energy in each case, and any forms of energy produced.

Discussion

1 **Discuss** whether there were any situations in which energy was transferred but not transformed into a different form.

2 **Name** two devices that you have used today. **State** the energy changes that occurred in these devices.

Prac	Situation	Observations	Energy supplied	Energy produced
Part A	Connecting a light globe to a battery			
Part B	Connecting steel wool to a battery			
Part C	Striking a tuning fork and dipping its ends into water			
Part D	Dropping a 200 g mass onto a lump of modelling clay			
Part E	Propelling a polystyrene ball using a rubber band			