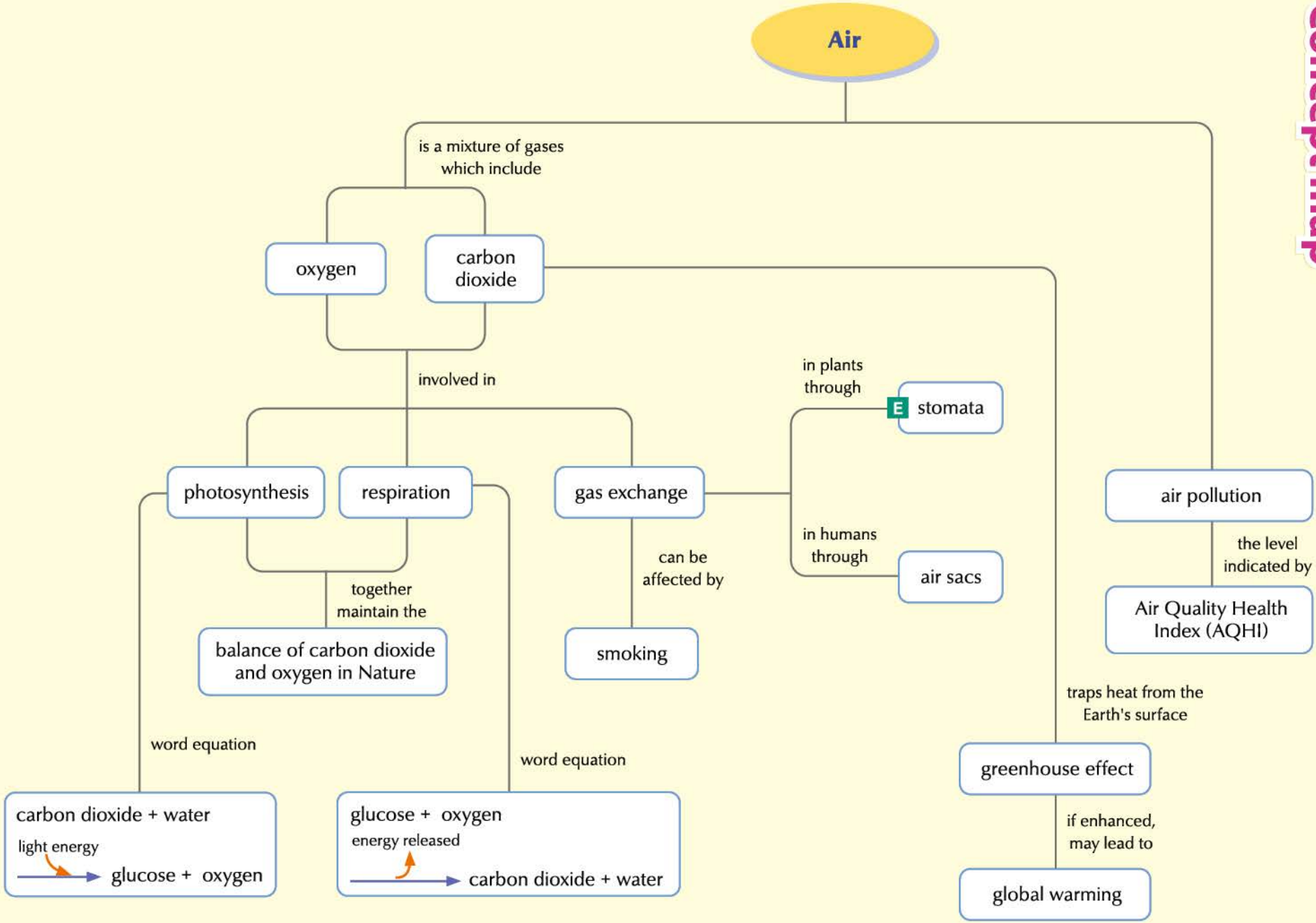
Concept map


Air
is a mixture of gases which include
oxygen
carbon dioxide
involved in
photosynthesis
respiration
gas exchange
in plants through
E stomata
in humans through
air sacs
can be affected by
smoking
together maintain the
balance of carbon dioxide and oxygen in Nature
word equation
carbon dioxide + water
light energy
glucose + oxygen
word equation
glucose + oxygen
energy released
carbon dioxide + water
air pollution
the level indicated by
Air Quality Health Index (AQHI)
traps heat from the Earth's surface
greenhouse effect
if enhanced, may lead to
global warming

Unit summary

7.1 Air

1. Air is a mixture of nitrogen (78%), oxygen (21%), carbon dioxide (0.03%), noble gases (0.9%), water vapour and other gases (0.07%).

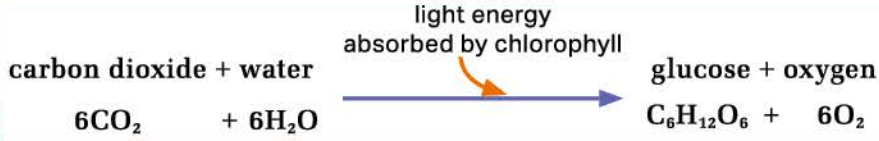
2.

	Oxygen	Carbon dioxide	Water and water vapour
Tests	• It relights a glowing splint. • It causes a burning splint to burn more brightly.	• It turns hydrogencarbonate indicator from red to yellow. • It turns limewater from colourless to milky.	• Both turn dry cobalt chloride paper from blue to pink.

7.2 Photosynthesis

3. Plants make their own food by photosynthesis. Photosynthesis can be summarized by the word equation and chemical equation below:

E



4. The following are the significance of photosynthesis:
   - providing food for living things
   - maintaining the balance of oxygen and carbon dioxide in Nature

E 5. A food chain shows the feeding relationship and the flow of energy among living things. In a food chain, plants are producers and animals are consumers.

7.3 Respiration

6. Respiration can be summarized by the word equation and chemical equation below:

E

7. A comparison of photosynthesis and respiration is given below:

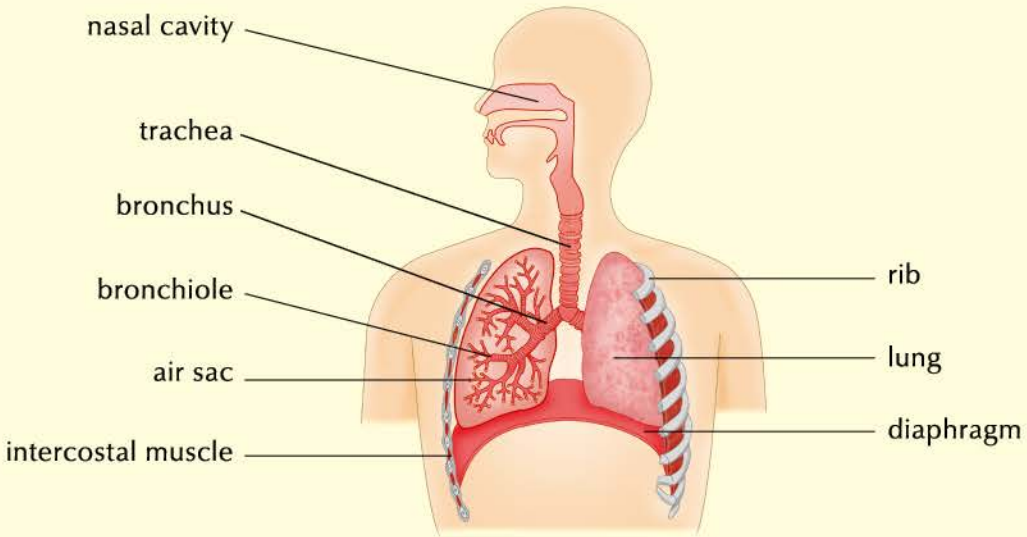
	Photosynthesis	Respiration
Raw materials	Carbon dioxide and water	Food (glucose) and oxygen
Products	Food (glucose) and oxygen	Carbon dioxide and water
Where it takes place	Takes place only in plants	Takes place in both plants and animals
When it takes place	Takes place under the presence of light	Takes place all the time
Energy	Energy is stored in food	Energy is released from food

7.4 Gas exchange in plants and animals

8. The net gas exchange in plants depends on the relative rates of photosynthesis and respiration.
   - In the daytime, there is a net uptake of carbon dioxide and a net release of oxygen.
   - At night, there is a net uptake of oxygen and a net release of carbon dioxide.

E 9. Gas exchange in plants is carried out through the stomata on the leaf epidermis.

10. Main parts of the human breathing system are shown below:



E 11. Gas exchange at the air sacs:
   - oxygen passes from the air sacs into the blood
   - carbon dioxide passes from the blood into the air sacs

12. Cigarette smoke contains harmful substances such as tar, nicotine and carbon monoxide. These increase risks of respiratory diseases, heart diseases and lung cancer.

7.5 Balance of carbon dioxide and oxygen in Nature

13. Photosynthesis and respiration are two important processes to maintain the balance of carbon dioxide and oxygen in Nature.

14. The increasing amount of carbon dioxide in the atmosphere enhances the greenhouse effect and leads to global warming.

15. Global warming will result in the melting of ice at polar regions and climate change.

7.6 Air quality

16. Carbon monoxide, sulphur dioxide, nitrogen oxides and suspended particulates are common air pollutants. They can cause headaches, irritation to the breathing system and respiratory diseases (e.g. bronchitis and asthma), and even death.

17. The AQHI provides information about air quality. The higher the index, the poorer the air quality.

Key terms

e-Dictionary di07

7.1

atmosphere (大氣層) p.3

burning splint (燃燒中的木條) p.5

cobalt chloride paper (氯化鈷試紙) p.7

glowing splint (有餘燼的木條) p.5

hydrogencarbonate indicator (碳酸氫鹽指示劑) p.6

limewater (石灰水) p.6

7.2

E chemical equation (化學方程式) p.11

chlorophyll (葉綠素) p.10

E consumer (消費者) p.24

control set-up (對照裝置) p.13

destarch (脱澱粉) p.17

E food chain (食物鏈) p.24

glucose (葡萄糖) p.10

photosynthesis (光合作用) p.10

E producer (生產者) p.24

starch (澱粉) p.10

word equation (文字方程式) p.11

7.3

respiration (呼吸作用) p.28

7.4

air sac (氣囊) p.44

breathing system (呼吸系統) p.44

E cilia (纖毛) p.50

E ciliated cell (纖毛細胞) p.50

gas exchange (氣體交換) p.32

E guard cell (保衛細胞) p.35

lung (肺) p.44

E mucus-secreting cell (黏液分泌細胞) p.50

E stoma (氣孔) p.35

tar (焦油) p.49

7.5

climate change (氣候變化) p.56

global warming (全球增温) p.55

greenhouse effect (温室效應) p.55

greenhouse gas (温室氣體) p.55

7.6

Air Quality Health Index (AQHI) (空氣質素健康指數) p.62

nitrogen oxides (氮氧化物) p.60

sulphur dioxide (二氧化硫) p.60

suspended particulate (懸浮粒子) p.60

Unit exercise

A. True or false (1 mark each)

Write 'T' for a true statement and 'F' for a false statement.

1. Starch is the food produced in photosynthesis and it can be used by the plant immediately. ☐
2. When we breathe, gas exchange takes place at the nasal cavity. ☐
E 3. The tar in cigarette smoke causes the cilia along the airway to stick together, and also increases mucus production. ☐
4. Carbon dioxide is a greenhouse gas. ☐
5. Planting more trees can help slow down global warming. ☐

B. Multiple-choice (1 mark each)

Choose the correct answer for each question.

1. In an experiment, two burning candles were covered by two bell jars, *X* and *Y*. A potted green plant was also placed in jar *X*. Both set-ups were placed under the Sun.

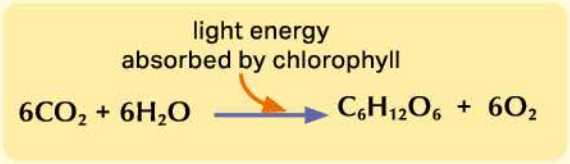
Which of the following statements is correct?

A. The candle in jar *X* will go out first.
B. The candle in jar *Y* will go out first.
C. Both candles will go out at the same time.
D. Both candles will not go out within 30 minutes from the start of the experiment. ☐

2. Which of the following is the ultimate source of energy for all food chains?

A. Producers
B. Consumers
C. The Sun
D. Humans ☐

E 3. The chemical equation below summarizes the process of photosynthesis.



Which of following statements about the process are correct?

(1) The total mass of the substances involved is a constant.
(2) The total numbers of molecules on the two sides of the equation are the same.
(3) Energy is conserved in the process. It only changes from one form to another.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3) ☐

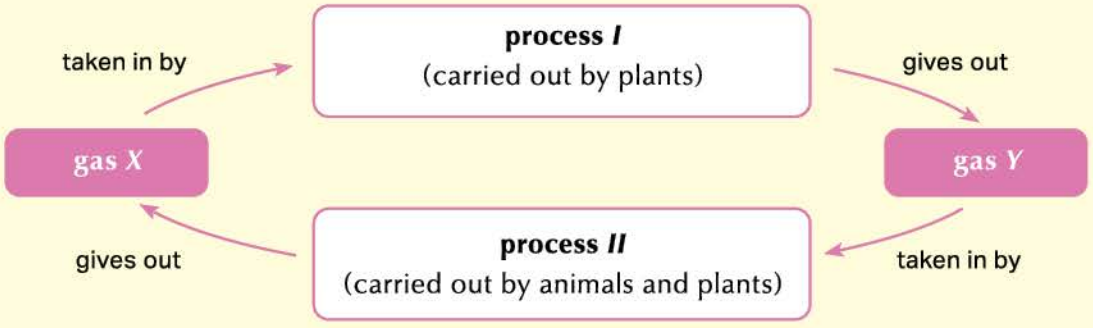
4. Which equation summarizes the process of respiration?

A. water + carbon dioxide + energy → sugar + oxygen
B. oxygen + sugar → carbon dioxide + water + energy
C. carbon dioxide + oxygen + water → sugar + energy
D. sugar + carbon dioxide + energy → oxygen + water ☐

(TIMSS 2011)

C. Questions (12 marks)

1. Two processes are important in maintaining the balance of two gases in Nature.



(a) Name process *I*, process *II*, gas *X* and gas *Y*. (4 marks)

process I: _____ *process II:* _____

gas X: _____ *gas Y:* _____

(b) Through the two processes, the two gases remain almost at constant levels in Nature. Write their percentages in air. (2 marks)

Percentage of gas X in air: _____% *Percentage of gas Y in air:* _____%

(c) Many human activities are disrupting the balance of the two gases in Nature. Suggest ONE such human activity. (1 mark)

_____

2. The photo shows a LED filament bulb. It is newly invented by PolyU students. It is more energy-efficient than traditional LED lamp. It also reduces the emission of carbon dioxide.

	LED filament bulb	Traditional LED lamp
Electricity cost	$33 per year	$47 per year
Carbon dioxide emission	22 kg per year	31 kg per year

(a) Fill in the blank below. (1 mark)

When compared with traditional LED lamp, the LED filament bulb can reduce carbon dioxide emission by _____%.

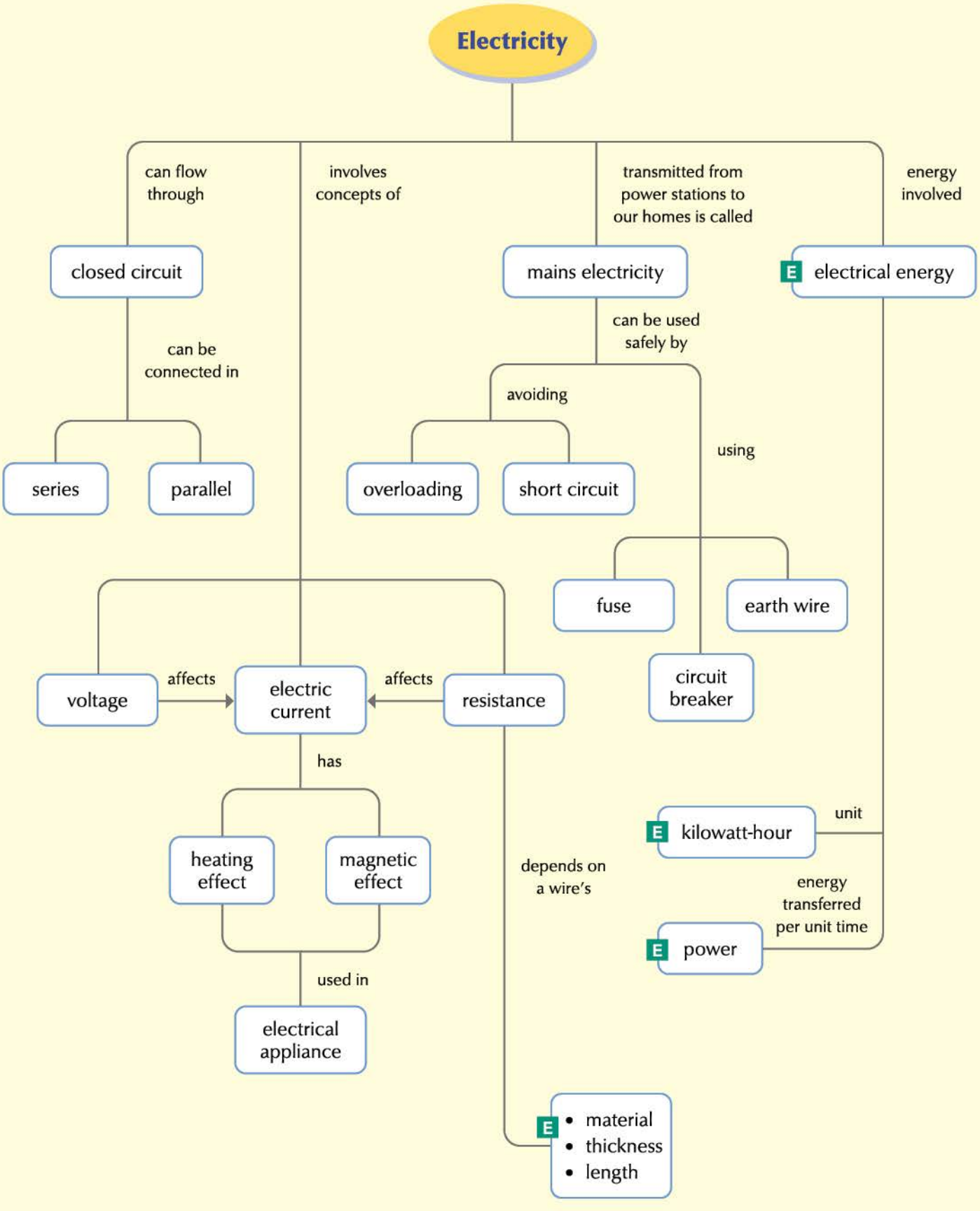
(b) This LED filament bulb is more environmentally friendly. Briefly explain why reducing carbon dioxide emission helps reduce the harmful effects to the environment. (4 marks)

Carbon dioxide is a (i)_____ . *The increasing amount of carbon dioxide in the atmosphere enhances the* (ii)_____ *and more heat is trapped in the atmosphere. This results in* (iii)_____ , *which has many possible harmful effects on the environment, such as the melting of ice at polar regions and* (iv)_____ .

Hence, reducing carbon dioxide emission helps reduce the harmful effects to the environment.

Score: /21

Concept map


Electricity
can flow through
involves concepts of
transmitted from power stations to our homes is called
energy involved
closed circuit
mains electricity
E electrical energy
can be connected in
can be used safely by
avoiding
using
series
parallel
overloading
short circuit
fuse
earth wire
voltage
affects
electric current
affects
resistance
circuit breaker
has
E kilowatt-hour
unit
heating effect
magnetic effect
depends on a wire's
energy transferred per unit time
E power
used in
electrical appliance
E
material
thickness
length

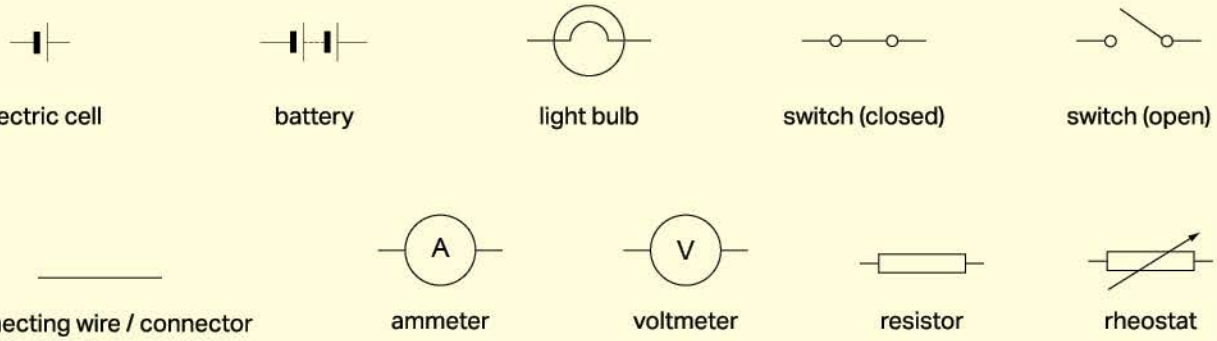
Unit summary

8.1 Introducing electricity and simple circuits

1. A closed circuit with a source of electrical energy is required for electricity to flow.
2. Materials that allow electricity to flow through them are called electrical conductors.
3. Materials that do not allow electricity to flow through them are called electrical insulators.
4. A switch is used to open or close a circuit.

8.2 Circuit diagrams

5. Circuit symbols are used to represent circuit components.



electric cell | battery | light bulb | switch (closed) | switch (open)

connecting wire / connector | ammeter | voltmeter | resistor | rheostat

6. A circuit diagram is drawn to represent an actual circuit.

8.3 Electric current

7. An electric current in metal is a flow of free electrons.
8. In a closed circuit with an electric cell, the free electrons flow towards the positive pole of the cell.
9. Electric current can be measured using an ammeter.
10. Electric current is measured in amperes (A).
11. When an electric current flows through a conductor, some electrical energy is converted into thermal energy. This is called the heating effect of electric current.
12. A current-carrying wire can affect the direction of the needle of a compass. This shows the magnetic effect of electric current.
13. A current-carrying coil acts like a magnet. It is called an electromagnet.

8.4 Voltage

14. The voltage of an electric cell is a measure of the amount of energy supplied to the free electrons by the cell.
15. Voltage can be measured using a voltmeter.
16. Voltage is measured in volts (V).
17. The higher the voltage, the larger the current.

8.5 Resistance

18. Resistance measures the opposition of a material to the flow of electric current. It is measured in ohms (Ω).
19. When resistance increases, the electric current in a circuit decreases.

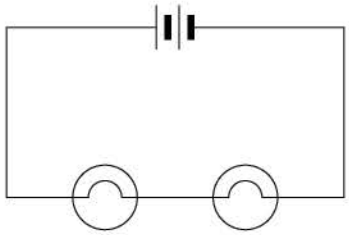
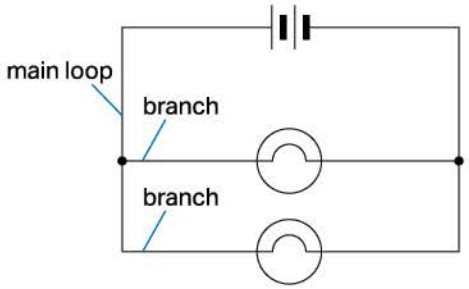
E 20. The thinner a wire, the higher its resistance. The longer a wire, the higher its resistance.

21. A resistor is a circuit component with a fixed resistance.

E 22. A rheostat is a circuit component whose resistance can be changed.

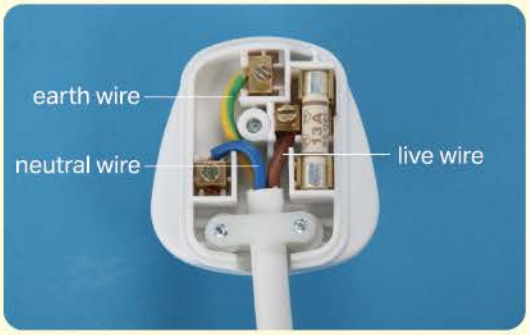
8.6 Series circuits and parallel circuits

23.

Series circuit	Parallel circuit
Two light bulbs connected in series 	Two light bulbs connected in parallel 
• If a gap appears in the circuit, there is no current flow in the circuit.	• If a gap appears in a branch of the circuit, there is still current flow in the other branch.
• The current is the same at every point in the circuit.	• A larger current flows in the branch with lower resistance. • The current in the main loop is equal to the sum of the currents in the branches.
• The voltage is not the same across different circuit components.	• The voltage is the same across every branch. • The voltage across each branch is equal to the voltage across the electric cells.

8.7 Our household electricity

24. Electrical energy is converted into thermal energy for use in the heating elements in electrical appliances. The moving parts of electrical appliances are driven by electric motors, which make use of the magnetic effect of electric current to work.
25. The mains voltage in Hong Kong is 220 V.
26. The pins of a three-pin plug are connected to the live wire, neutral wire and earth wire.
27. Domestic circuits are parallel circuits so that the electrical appliances can operate independently.



8.8 Electrical safety with household electricity

28. Connecting too many electrical appliances to a mains socket causes overloading.
29. In a short circuit, the current is very large and the circuit is very hot.
30. A fuse will blow and break a circuit if the current is above its fuse rating. A circuit breaker will turn off by itself and break a circuit if the current is above its rating.
31. The earth wire is used to protect us from getting an electric shock.

E 8.9 Power, energy and the cost of electricity

32. Power is the amount of energy transferred to an electrical appliance per second. It is measured in watts (W) or kilowatts (kW).
33. The relationship between power, energy and time can be shown using the formula below.

$$\text{power (W)} = \frac{\text{energy (J)}}{\text{time (s)}} \quad \text{or} \quad \text{energy (J)} = \text{power (W)} \times \text{time (s)}$$

34. Electrical energy can be measured using a joulemeter or a kilowatt-hour meter. Electrical energy can be measured in kilowatt-hours (kW h). It can be calculated using the formula below.

$$\text{electrical energy (kW h)} = \text{power (kW)} \times \text{time (h)}$$

35. For the household electricity, 1 unit of electricity means 1 kilowatt-hour of electrical energy used.
36. The efficiency of an electrical appliance is the ratio of the useful power output to the power input of the appliance.

$$\text{efficiency} = \frac{\text{useful power output}}{\text{power input}} \times 100\%$$

Key terms

e-Dictionary di08

8.1

8.2

8.3

8.4

8.5

8.6

8.7

8.8

E 8.9

Skills level-up

Necessary factors for photosynthesis (p.22)

Understanding control set-ups

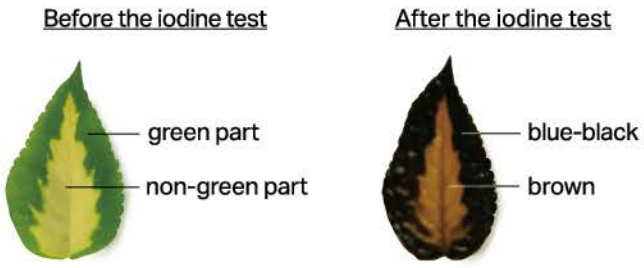
When doing experiments, you may need to prepare a control set-up. It is similar to the experimental set-up, except that it does not contain the substance (or condition) under investigation. By comparing the results of the experimental set-up and that of the control, we can conclude that the result is due to the presence of the substance (or condition) under investigation.

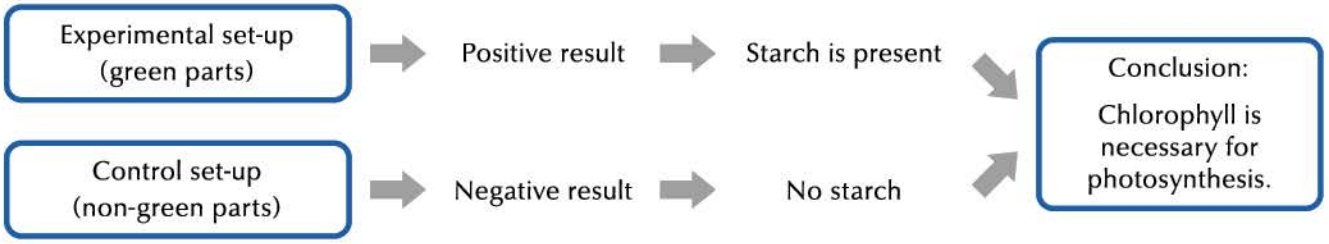
Example

Investigating the factors necessary for photosynthesis

To find out the need of chlorophyll for photosynthesis, a variegated leaf is used. The green parts contain chlorophyll and the non-green parts contain little or no chlorophyll.

The non-green parts serve as the control set-up, whereas the green parts are the experimental set-up. The results of the iodine test are shown on the right.





Question:

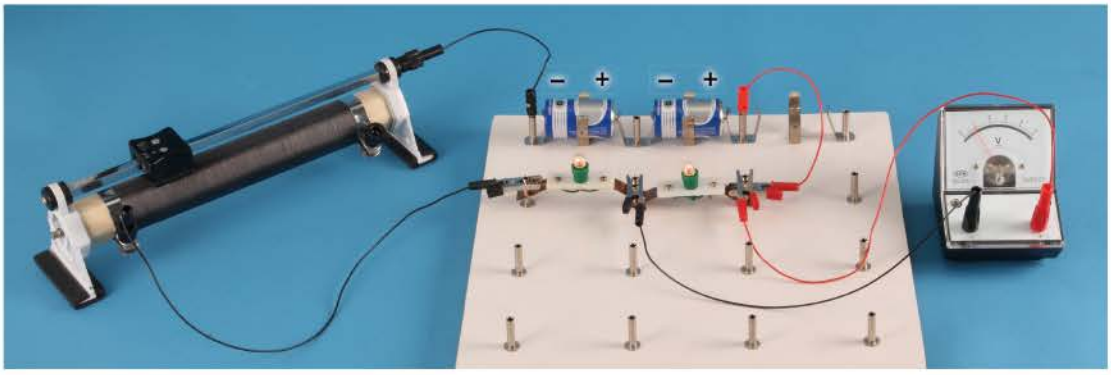
What are the experimental set-up and control set-up in each fair test related to the necessary factors for photosynthesis? Complete the table below.

Factor	Experimental set-up	Control set-up
Chlorophyll	green parts of the variegated leaf which contain chlorophyll	non-green parts of the variegated leaf which contain little or no chlorophyll
Carbon dioxide		
Light		

Activity 8.1 (p.86)

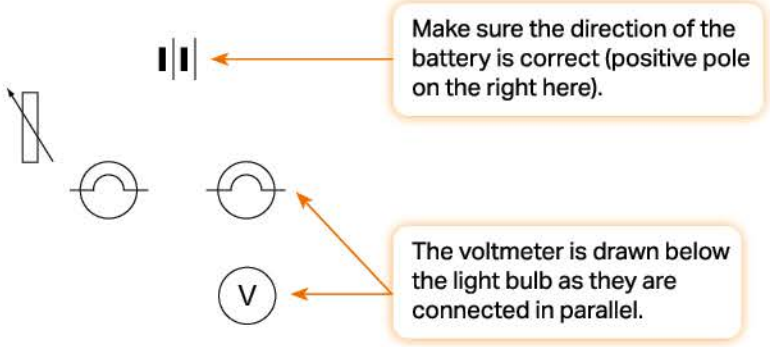
Drawing circuit diagrams

We can use a circuit diagram to represent an actual circuit. Let us take the following circuit as an example to learn how to draw a circuit diagram in four steps.



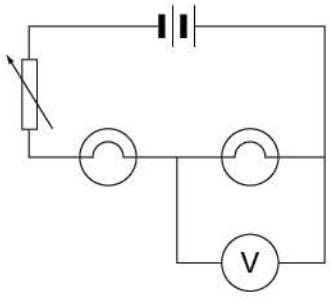
Step 1: Draw the circuit symbol of each component in the circuit

- You can find the circuit symbols of the circuit components on the next page.
- Use a ruler to draw the straight lines.



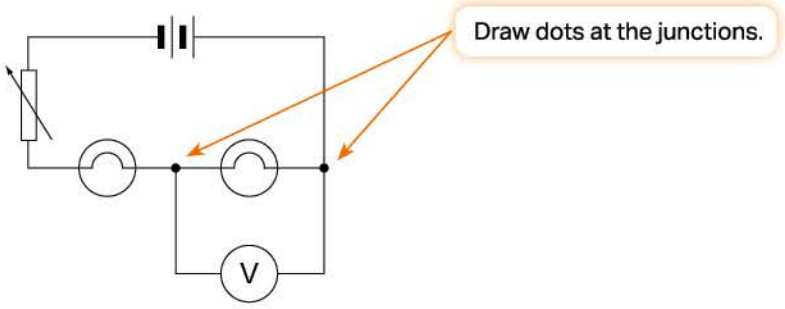
Step 2: Draw straight lines to represent the connecting wires

- Use a ruler to draw the straight lines.
- The straight lines should be either vertical or horizontal.
- Keep in mind that the circuit diagram is drawn with right-angled corners.



Cont'd

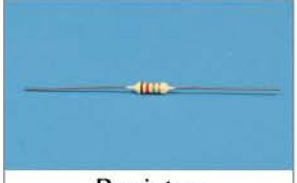
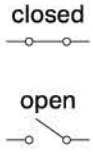
Step 3: Draw a dot at each junction



Step 4: Check the circuit diagram

- Check your circuit diagram to see if the circuit components are connected in the correct order.

For your reference, the circuit symbols of some commonly used circuit components are shown below.

Circuit component	Circuit symbol	Circuit component	Circuit symbol	Circuit component	Circuit symbol
 Electric cell		 Light bulb		 Resistor	
 Battery		 Ammeter		 Rheostat	
 Switch		 Voltmeter		 Fuse	

Skills level-up

Experiment 8.9 (p.105)
Experiment 8.11 (p.109)
Experiment 8.12 (p.113)

Plotting graphs

Line graphs are useful for presenting experimental results. They show trends and patterns in data. This helps us understand the relationship between variables in investigations. In the following, you will learn how to plot the line graph.

Example

A certain amount of water is heated with a heater. The changes in its temperature with time are recorded in the table below.

Time (min)	0	1	2	3	4	5	6
Temperature (°C)	25	30	35	40	45	50	55

Plot a line graph to present the above experimental results.

✓ *Use a sharp HB pencil to plot graphs.*

✗ *Do not use a ball pen.*

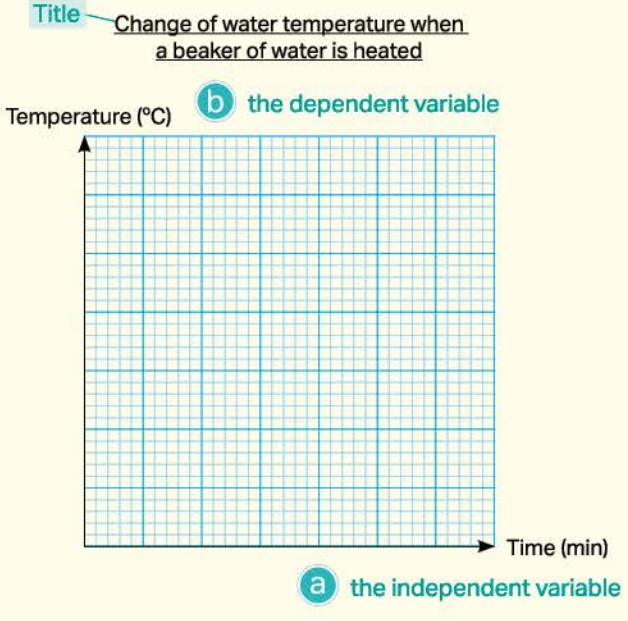
Step

1. Choose the variables on the horizontal axis and vertical axis. Label the axes. Also, write down the units of the variables.

(a) The independent variable is usually placed in the horizontal axis.

(b) The dependent variable is usually placed in the vertical axis.

Then, give the graph a title.



Cont'd

Skills level-up

Experiment 8.9 (p.105)
Experiment 8.11 (p.109)
Experiment 8.12 (p.113)

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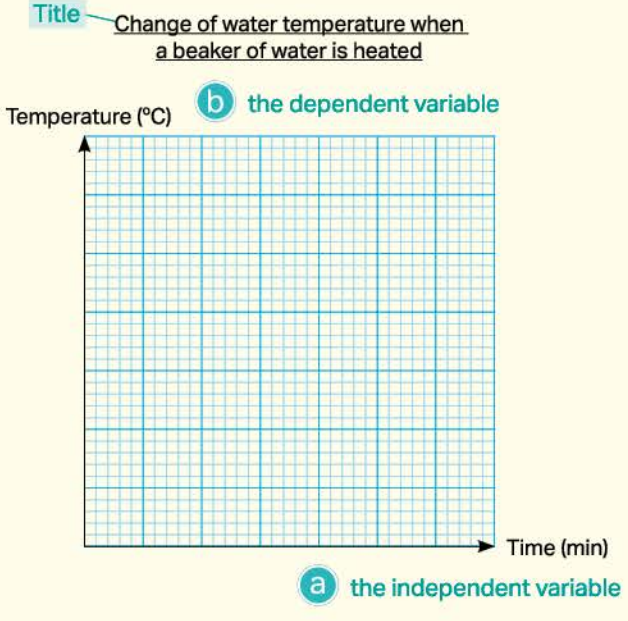

Cont'd