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Weekend worksheet

It's all about Science!

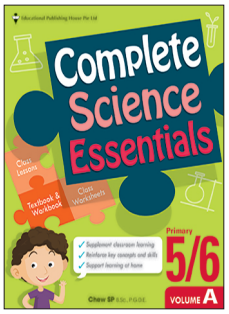
Primary 5 Science

Changes of state of water and the water cycle

Chapter Overview	Suggested duration
3.1 Introduction to water 3.2a The three states of water	45 min
3.2b Effect of heat on the state of water	1 h
Review 1	15 min
3.2c Finding the state of a substance	1 h
Review 2	15 min
3.2d Reading temperature-time graphs	1 h
Review 3	15 min
3.3a Evaporation 3.3b Evaporation and boiling of water 3.3c Water vapour and steam	1 h 30 min
Review 4	15 min
3.4a Condensation 3.4b Evaporation/Boiling and condensation	1 h 30 min
Review 5	15 min
3.5 Water cycle	30 min
Review 6	15 min
3.6 Water pollution	45 min
3.7 Concept map	45 min
Chapter Review	1 h 15 min

Essential but not in textbooks

Publisher: EPH



COMPLETE SCIENCE ESSENTIALS
Primary 5

Scan the QR code for the Answer Sheet.

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3.1 Introduction to water

- All living things need water to survive.
- All living things can only live for three days without water.
- About 70% of our body is water.
- Blood is mainly water.
- 70% of our Earth is covered in water, but only 1% is fresh water suitable for drinking.
- Pure water is colourless and odourless.

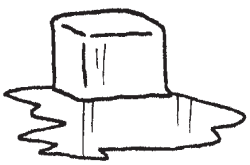
3.2a The three states of water

- Water can exist in three states — solid, liquid and gas.
- Depending on its **temperature,** the state of water changes.

Water		
State	Temperature	Examples
Solid	0°C and below	Ice, snow
Liquid	0°C–100°C	Water, clouds, mist
Gas	100°C and above 0°C–100°C	Steam Water vapour

3.2b Effect of heat on the state of water

- **Heat gain** or **heat loss** can change the state of water.

Heat gain			
Process	Change of state	Temperature	
Melting 	Solid to liquid	Takes place at 0°C	Temperature **remains constant at 0˚C** during the process of melting until all the ice has melted.

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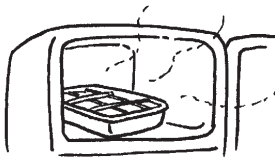
Heat gain			
Process	**Change of state**	**Temperature**	
Boiling 	Liquid to gas	Takes place at 100°C	Temperature **remains constant at 100°C** during the process of boiling until all the liquid has boiled off.
***Evaporation**	Liquid to gas	Takes place at any temperature for the liquid	

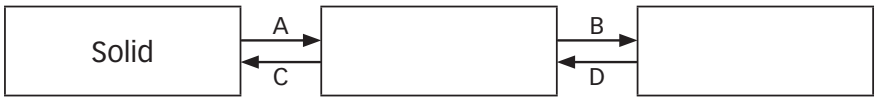
* New concept to be covered later in the chapter

Heat Loss			
Process	**Change of state**	**Temperature**	
Freezing 	Liquid to solid	Takes place at 0°C	Temperature **remains constant at 0°C** during the process of freezing until all the water has frozen.
***Condensation**	Gas to liquid	No fixed temperature	

* New concept to be covered later in the chapter

Review 1

1. The flowchart below represents the changes of states of water.



(a) Fill in the words in the boxes.

(b) What processes do A, B, C and D represent?

A : _____

B : _____

C : _____

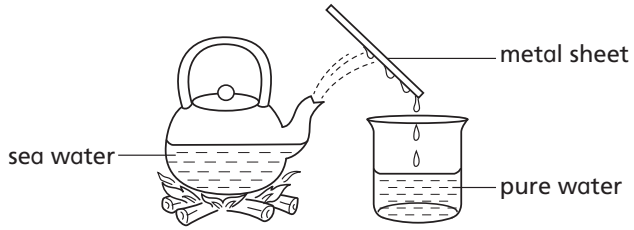
D : _____

2. Which of the following processes involve a heat gain by water?

A Boiling
B Melting
C Evaporation
D Condensation

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

3. The diagram below shows a way of getting drinking water from seawater.



What is the process that is happening at the metal sheet?

(1) Melting
(2) Freezing
(3) Evaporation
(4) Condensation ( )

3.2c Finding the state of a substance

- The state of a substance changes according to its **temperature.**

Temperature	State of a substance
Temperatures **below its melting point**	Solid
Temperatures **above its melting point but below its boiling point**	Liquid
Temperatures **above its boiling point**	Gas

- The table below shows some examples.

Substance	Melting point	Boiling point	State of substance at 40°C	Explanation
W	0°C	100°C	Liquid	• 40°C is above its melting point. Hence, W has already melted. • It has not boiled yet because 40°C is below its boiling point. Hence, it is a liquid.
E	55°C	197°C	Solid	• 40°C is below its melting point. Hence, E has not melted and it is still a solid.
G	–10°C	38°C	Gas	• 40°C is above its boiling point. Hence, G has already boiled and it is a gas.

Review 2

1. A substance has a melting point of 25°C and a boiling point of 125°C
   What is the state of the substance at

   (a) 100°C : _____

   (b) 180°C : _____

   (c) 10°C : _____

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2. The table below shows the melting point and boiling point of three substances X, Y and Z.

Substance	Melting point / °C	Boiling point / °C
X	2	107
Y	12	57
Z	200	350

Which of the following statements is correct? Put a tick (✓)

(a) X and Y are liquids at 25°C. ☐

(b) Z is a solid at 25°C. ☐

(c) At 200°C, all three substances are at the same state. ☐

3. The table below shows the melting point and boiling point of three substances P, Q and R.

Substance	Melting point / °C	Boiling point / °C
P	35	70
Q	17	85
R	4	99

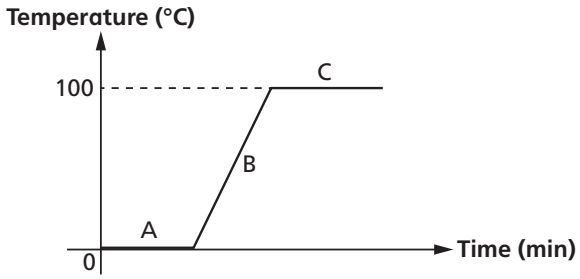
(a) At 200°C, all three substances will be at the _____ state.

(b) At 21°C, substance P will be at the _____ state.

(c) At _____, substance R will be a solid.

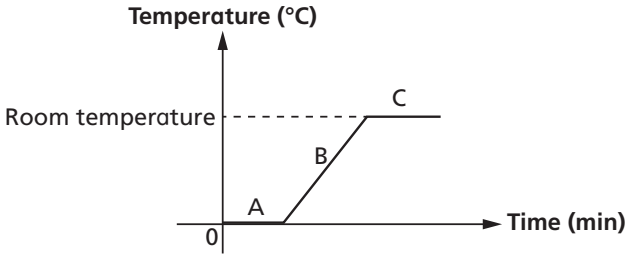
3.2d Reading temperature–time graphs

- The change in temperature of a substance over a period of time can be recorded in a temperature-time graph.
- During the process of **melting, freezing and boiling,** temperature remains **constant.** Therefore, these processes are shown as straight horizontal lines on the graph.
- Example 1: The graph below shows the temperature changes when ice is taken out of the freezer and heated until boiling temperature.



  - At A: Melting at 0°C
  - At B: Water is being heated until it reaches boiling point 100°C at C
  - At C: Boiling
  - Although temperature remains constant at A and C, heat is gained to change the state of water, and not to raise the temperature.

- Example 2: The graph below shows the temperature changes when ice is taken out of the freezer and left on the table until room temperature.



  - At A: Melting at 0°C
  - At B: Gaining heat from the surroundings
  - At C: Water reaches room temperature and remains constant.
    Recall in P4 Heat: Temperature of water will remain constant at room temperature.

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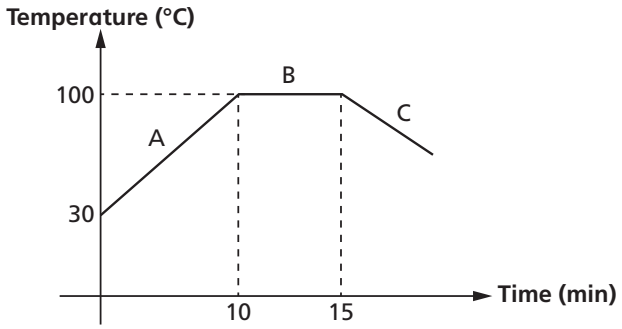
Review 3

1. A kettle containing water is placed over a stove. The graph below shows the temperature-time graph of the water.



Refer to the graph above and answer the following questions.

(a) How long did the water boil for?

_____

(b) What is happening to the water at A?

_____

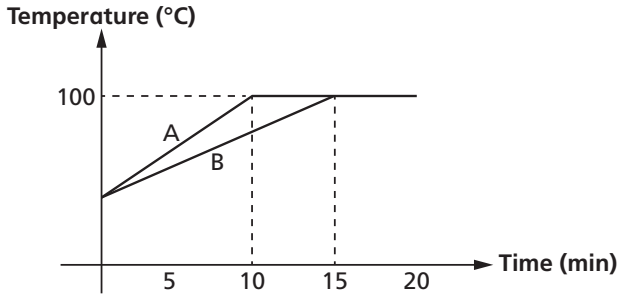
_____

(c) Suggest what had caused the temperature to drop at C?

_____

_____

2. The same amount of water was placed in two containers A and B of different materials. The containers of water were heated over a stove. The changes in temperature were monitored for 20 minutes as shown in the graph below.



(a) Referring to the graph above, which container of water boiled faster?

_____

(b) Suggest and explain how the container in (a) could result in water boiling faster as compared to the other container.

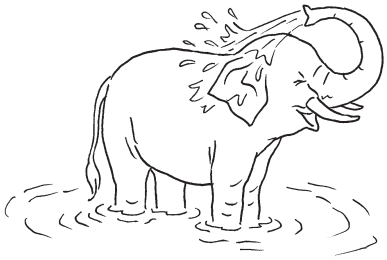
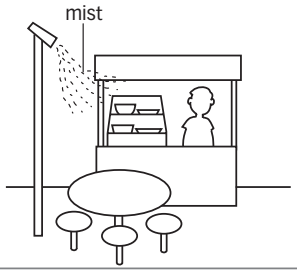
_____

_____

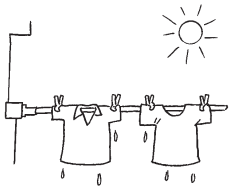
3.3a Evaporation

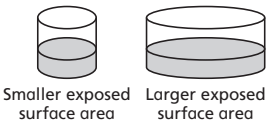
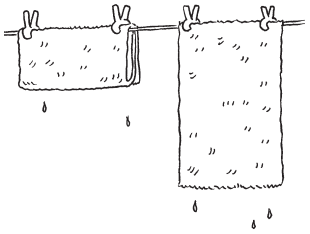
- Evaporation is a process where **water gains heat** and changes into **water vapour.**
- Evaporation occurs on liquid surface.
- The following are everyday examples of evaporation of water
  - Puddle of water on the floor dries up
  - Wet floor dries up
  - Wet hair dries up
  - Wet clothes dry up
- Where did all the water go?
  - The **water gained heat from the surroundings** and **evaporated into water vapour.**

- There is **no fixed temperature** for evaporation to take place. It can take place at any temperature for the liquid.
- Evaporation causes cooling effect.

Other examples of evaporation	
• Example 1: An elephant sprays water at itself to cool down. – The **water gains heat from the elephant's body** to evaporate into water vapour. – As a result, its **body loses heat,** making it feel cool. 	• Example 2: Mist(liquid) is being sprayed into the surroundings. – The mist **gains heat from the hotter surroundings** to evaporate into water vapour. – As a result, the **surroundings lose heat** and cool down. 

- There are a few conditions that will affect the rate of evaporation.

Conditions affecting rate of evaporation	Explanation	Examples
Temperature of surroundings	– The **higher** the temperature of surroundings, the **faster** the rate of evaporation. – Water is able to **gain more heat** and **evaporate faster.**	– Example 1: Wet clothes dry faster under the Sun than indoors.  – Example 2: Wet hair dries faster with a hair dryer blowing hot air at it. 

Conditions affecting rate of evaporation	Explanation	Examples
Exposed surface area	The **larger** the exposed surface area, the **faster** the rate of evaporation. – **More water** is able to gain heat and evaporate.  Smaller exposed surface area Larger exposed surface area	Example: Towel dries faster when not folded.  Smaller exposed surface area (Towel dries slower) Larger exposed surface area (Towel dries faster)
Presence of wind	The **stronger** the wind, the **faster** the rate of evaporation. – Wind blows away the water vapour, allowing more space for more water vapour to form.	Example: Wet floor dries faster when a fan is blowing at it.

3.3b Evaporation and boiling of water

Similarities between evaporation and boiling of water
Both processes involve a **change of state from liquid to gas.**

Evaporation of water	Differences	Boiling of water
Sun or surroundings	Heat source	Constant heat source (example: fire)
At any temperature for the liquid	Temperature at which it takes place	At 100°C
Water vapour	What is formed	Steam
Occurs at the surface of the liquid	Where it takes place	Occurs throughout the whole liquid

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3.3c Water vapour and steam

Similarities between water vapour and steam
Both are gaseous state of water.

Water vapour	Differences	Steam
At temperatures between 0–100°C	Temperature at which it exists	At temperatures 100°C and above
Formed as a result of evaporation	How it is formed	Formed as a result of boiling

Review 4

1. Which of the following describes the changes when water becomes water vapour?
   - A Heat is lost by the water.
   - B Heat is gained by the water.
   - C The process is called evaporation.
   - D It takes place at temperatures between the melting point and boiling point of water.

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

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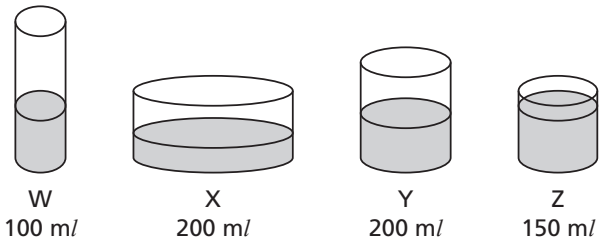
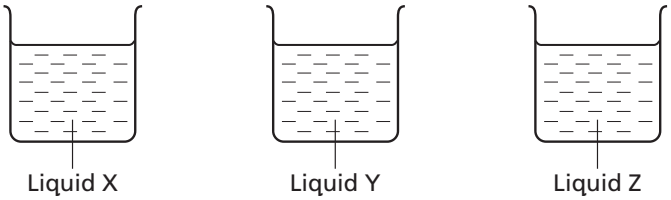
2. Peter wanted to find out if the exposed surface area of water in a container affects the rate of evaporation. Containers W, X, Y and Z are made of the same material but filled with different amounts of water shown below.



Which two containers should he use?
(1) W and X
(2) W and Z
(3) X and Y
(4) Y and Z ( )

3. Margaret carries out an experiment by filling three beakers with an equal volume of liquid X, Y and Z as shown in the diagram. She places the beakers side by side in the open where it is sunny and windy.



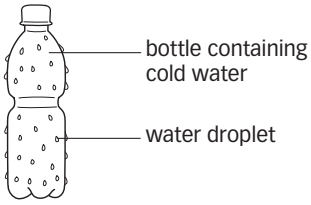
After a few hours, she records the volume of liquid remaining in each of the three beakers.

The aim of the experiment is to find out _____.
(1) if liquid evaporates when there is wind
(2) if different liquids evaporate at different rates
(3) if liquid evaporates faster at a higher temperature
(4) if the rate of evaporation depends on the temperature ( )

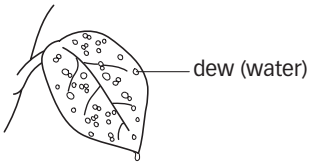
4. Which of the following is an example of evaporation?
(1) Ironing a damp shirt
(2) Water turning into steam
(3) Leaving a piece of ice on a plate
(4) Water being placed in a refrigerator ( )

3.4a Condensation

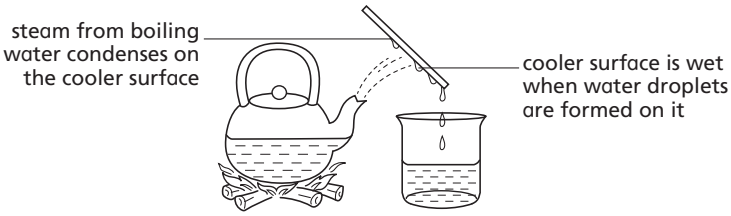
- Condensation is a process where **water vapour/steam loses heat** and **changes into water droplets.**
- The following are everyday examples of condensation
  - Example 1: **Warmer water vapour** from the surroundings condenses on the **cooler surface of the bottle of cold water.** The outside surface of the bottle becomes wet.



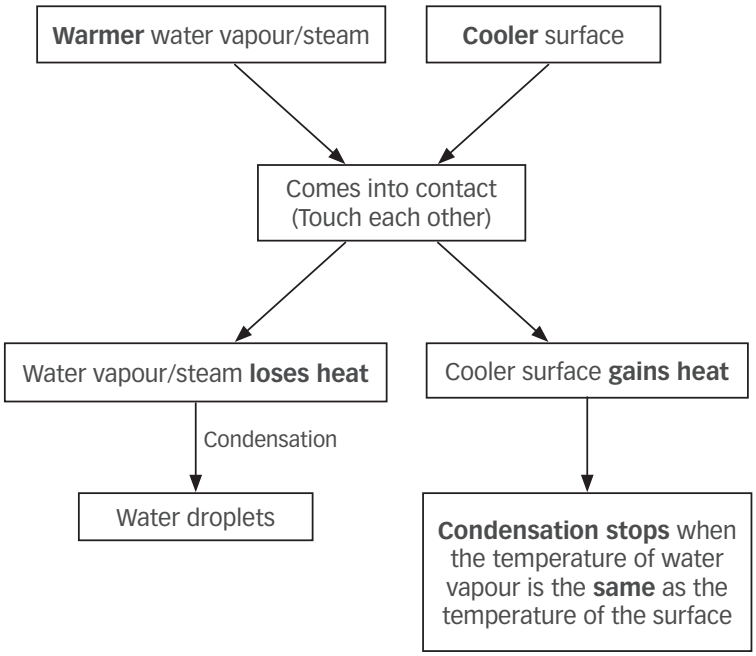
  - Example 2: **Warmer water vapour** from the surroundings condenses on the **cooler surface of the leaves.** Dew (water) is formed.



  - Example 3: Steam from boiling water condenses on a cooler surface. The cooler surface becomes wet as water droplets are formed.



- The following is a summary of the process of condensation
  - The **warmer water vapour/steam** comes into contact with the **cooler surface.**
  - The water vapour/steam then loses heat and condenses into water droplets.
  - **Temperature difference** between the water vapour/steam and surface must be stated clearly. Hence, the use of the words **"warmer" and "cooler".**

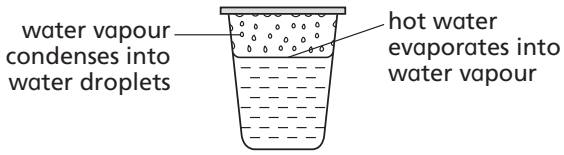


- The two factors for condensation to take place are the **warmer water vapour/steam** and **cooler surface.**

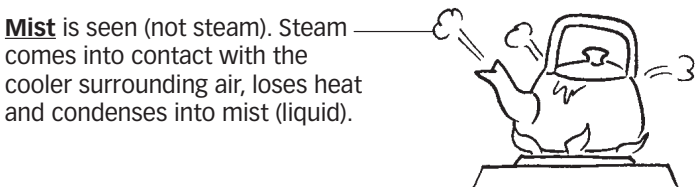
Factors for condensation to take place	What happens to the factor	Examples of factor
Warmer water vapour/steam	Loses heat	Water vapour present in surrounding air Steam
Cooler surface	Gains heat	Metal tray Plastic tray Mirror Surrounding air Glass panels / Windows

3.4b Evaporation/Boiling and condensation

- Evaporation and condensation often take place one after another.
  - Example: In a cup of **hot** water



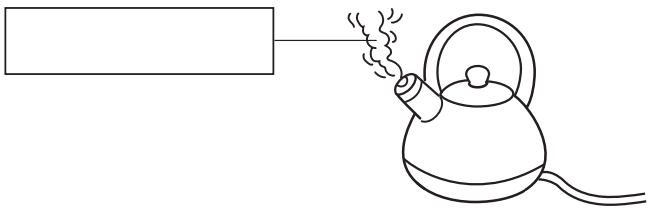
- Similarly, boiling and condensation often take place one after another.
  - Example: Boiling water in a kettle



Review 5

1. The following diagram shows an example of condensation.

   Fill in the blank with a suitable word.



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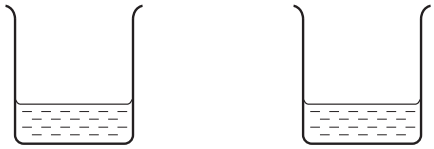
2. In which of the following situations will condensation take place?

   A Breathing onto a mirror
   B Leaving a glass of water on the table
   C Leaving a cold can of soft drink on the table
   D A person wearing spectacles alighting from an air-conditioned bus

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

3. The two beakers shown below contain the same amount of water. The waters are at different temperatures.



Cold water
Beaker A

Hot water
Beaker B

   (a) Draw the water droplets that would be formed on the two beakers.

   (b) State the source of the water droplets.

   Beaker A: _____

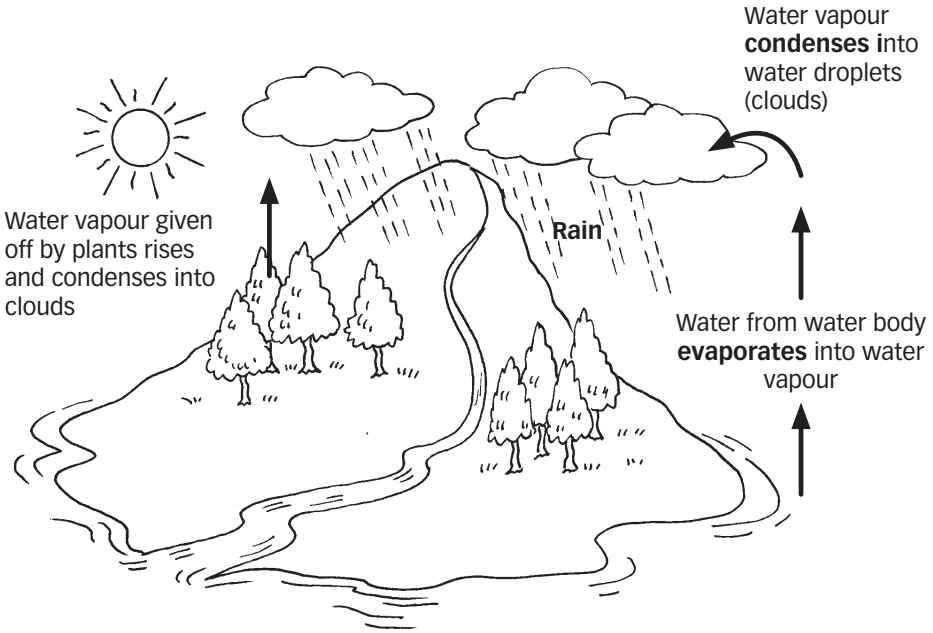
   Beaker B: _____

3.5 Water cycle

Energy	• Heat energy from the Sun
Importance	• To ensure that all living things have a **continuous supply of water**
Process	• Water from water bodies (seas, rivers, lakes) evaporates into water vapour • Plants also give off water vapour (through stomata)*
	• Water vapour first rises before coming into contact with cooler surrounding air • Water vapour then loses heat and condenses into water droplets • Many water droplets form clouds (liquid)
Results in	• Formation of rain
	• Water coming back to Earth after evaporating (water is recycled)

* Learn about how plants lose water in Chapter 5.

Water cycle



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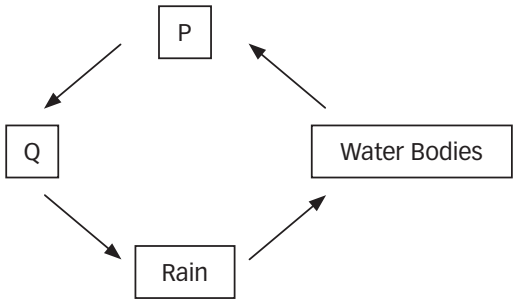
Review 6

1. The process below shows the water cycle.



What do P and Q represent?

P: _____

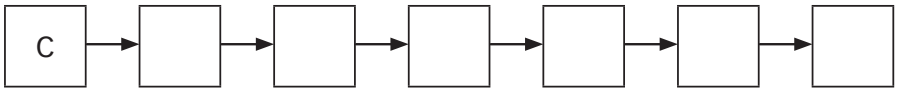
Q: _____

2. Fill in the correct state of water for each example.

Examples of water	State of water
Clouds	
Steam	
Mist	
Snow	

3. The sentences below describe the water cycle. Arrange the sentences in the correct order.

   A Clouds fall as rain
   B Warmer water vapour rises up
   C Heat from the Sun warms the water
   D Water droplets gather to form clouds
   E Loses heat and condenses into water droplets
   F Water gains heat and evaporates into water vapour
   G Comes into contact with the cooler surrounding air



3.6 Water pollution

- Water pollution results from the presence of unwanted or harmful substances in the water.
- Man's activities have polluted water sources (seas, oceans, rivers, reservoirs).

Man's activities	Unwanted / harmful substance
Littering	Rubbish
Dumping of chemical waste from factories	Chemical waste
Sewage release from toilets	Sewage
Oil spills from oil tankers and ships	Oil
Farming	Fertilisers and pesticides
Deforestation	Harmful substances from soil erosion

- Man depend on water sources for
  - water to survive (reservoirs)
  - travel (seas and oceans)

- Animals and plants depend on water sources for
  - water to survive
  - their habitats (aquatic organisms)
  - food (birds feed on crabs, fishes and small organisms in the water)
- Polluted water has a negative impact on man and other living things.

Unwanted / harmful substance from Man's activities	Negative impact
Rubbish (e.g. plastic bags) from littering	• Smelly and dirty water that is undrinkable • Water that spreads diseases • Chokes and kills marine animals
Chemical waste	• Causes water to be undrinkable • Poisons aquatic life
Sewage	• Smelly and dirty water that is undrinkable • Water that spreads diseases • Poisons aquatic life
Oil from oil spills	• Oil coats the feathers on sea birds when they dive into the water to search for food. – This causes them to become heavy, unable to fly and drown in the water. • Oil blocks sunlight from entering the water. – Submerged plants receive less sunlight to photosynthesise and produce less dissolved oxygen for the aquatic animals. – Aquatic animals die due to lack of oxygen.
Fertilisers and pesticides	• Increased amount of fertilisers in the water causes the rapid growth of algae. – Algae cover the surface of water and block sunlight from entering the water. – Submerged plants receive less sunlight to photosynthesise and produce less dissolved oxygen for the aquatic animals. – Aquatic animals die due to lack of oxygen. • Poisons aquatic life

3.7 Concept map

Use the given words to complete the following concept map.

evaporation surroundings	melting temperature	freezing cooler surface	condensation boiling	ice loss	steam wind	surface area 100