Cambridge checkpoint

SECOND EDITION

Lower Secondary Science

REVISION GUIDE

FOR THE SECONDARY 1 TEST

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Boost
HODDER EDUCATION

Contents

Chapter 1 Water and life

CHAPTER INFORMATION

This chapter will help you to revise your learning about how water is important to plants, how water is transported in plants, and about the human renal system. By the end of this chapter you should be able to:

- describe the pathway of water and mineral salts from the roots to the leaves in flowering plants
- explain how water is absorbed in root hair cells
- describe how water is transported through plants in xylem vessels
- describe how water that evaporates from the leaves is replaced by water from the xylem vessels in a process called transpiration
- explain how water absorbed from the soil through osmosis contains mineral salts that are used by plants
- describe the structure of the human excretory (renal) system and how the kidneys remove urea from the blood
- describe how plants use magnesium and nitrates.

REVISION APPROACH: PLANTS KEY WORD CONCEPT MAP

You are going to begin this chapter by using a revision strategy called a concept map. Concept maps are useful for helping you to remember ideas and make connections between those ideas. They enable you to see what you know and make links across a topic.

By creating a concept map, you will be able to see the bigger picture of how to link ideas about minerals and how plants take in water. Concept maps also help you to 'dig deeper' into your memory, because putting one thing on the concept map can lead to your memory linking to another idea.

You are going to begin by making key word cards to use when you create your concept map.

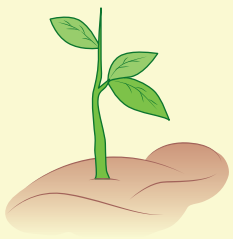
Activity 1: Key word cards

a) Look at the list of words below. Which words do you already know? Highlight these words.

chlorophyll	nitrate	protein	vacuole
leaf	osmosis	root	vascular bundle
magnesium	photosynthesis	stem	xylem
mineral salt	plant	transpiration	xylem vessel

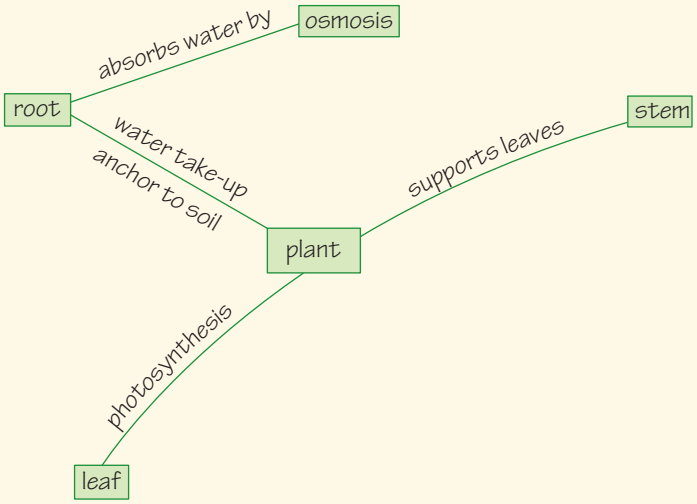
b) Make key word cards for all the words you highlighted. Write each word on the front of a piece of card and add any images that help you remember what the word means.

c) On the back of each card, write as much information as you can linked to the word. This could include a definition, facts or examples. Do not worry if you do not know all the words yet; you can make cards later for the new words you learn. You will repeat this activity at the end of this chapter when you know more words.

Front of card	Back of card
Stem 	**Stem** • supports leaves • supports flowers and fruit • keeps plant upright • transports water to rest of plant • transports minerals to rest of plant • we eat stems, e.g. celery, sugar cane, rhubarb.

Activity 2: Plants concept map

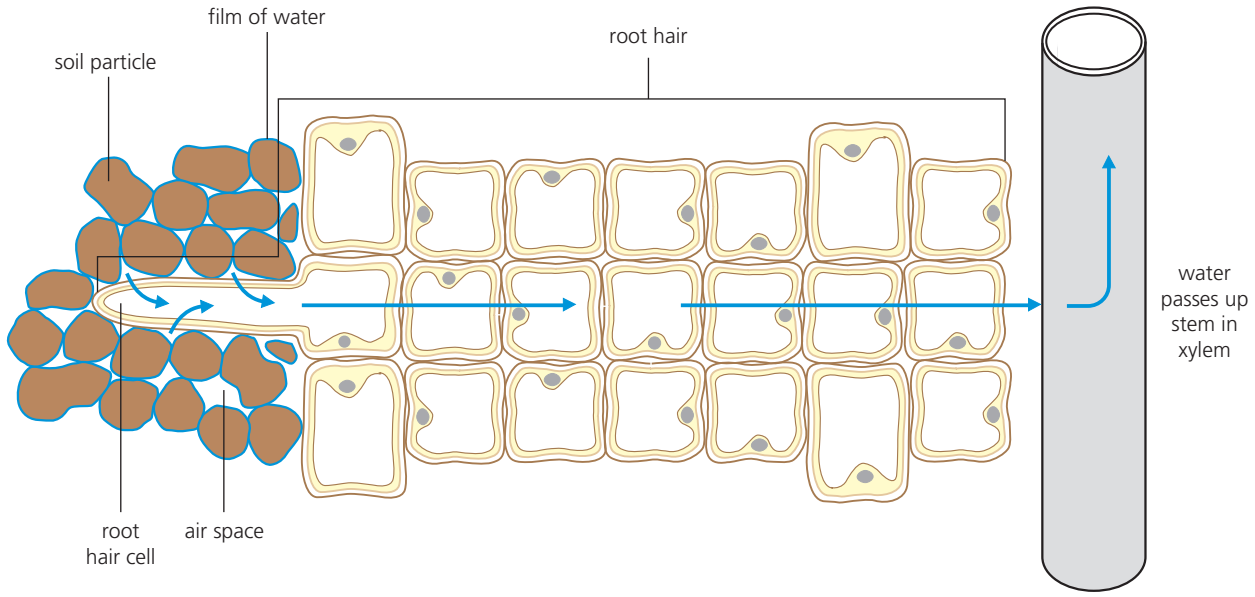
a) Using the key word cards you made in Activity 1, sort the cards you know into groups; for example, everything to do with leaves.
b) Lay out the key word cards you have made on a large sheet of plain paper.
c) Now draw lines to join as many of the cards as you can on the sheet, and on the connecting lines write the reason why you have linked the cards. The more lines you draw, the more links there are that show your knowledge and understanding. The picture below shows a concept map that has just been started.
d) When you have finished, take a photograph of your concept map. Then collect up your word cards and keep them safe. You will need them again at the end of this chapter.



REMEMBER: MOVEMENT OF WATER THROUGH A FLOWERING PLANT

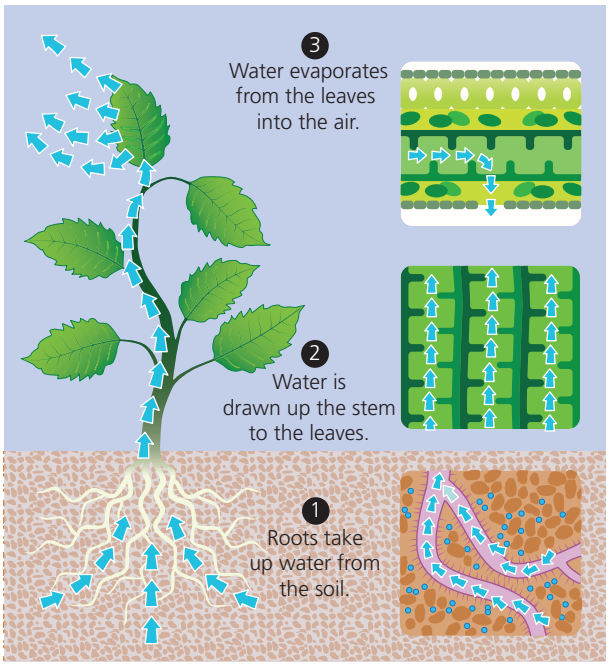
In flowering plants, water and dissolved minerals from the soil enter the plant through the roots. Roots have root hairs; these give the root system a greater surface area, allowing the plant to take up more water. The root hairs are numerous, long and thin, which allows them to get between soil particles to reach water.

Water enters the roots by a process called osmosis. Osmosis is the movement of water molecules across a partially permeable membrane, from an area of higher water concentration to an area of lower water concentration. In plants, the cell membrane allows water and minerals to pass through and so allows water to be transported around the plant.



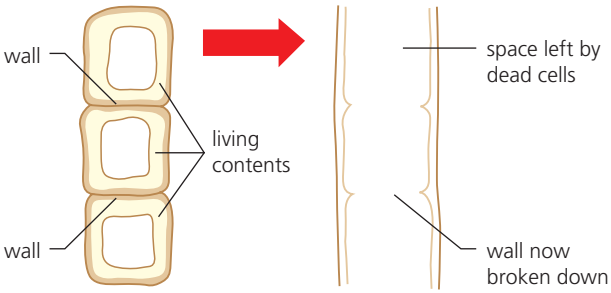
Plants need minerals for healthy growth. Minerals dissolved in the water are taken up by the roots and absorbed by the plant. Two important minerals that plants need are nitrogen and magnesium. These help to make chlorophyll. Without nitrogen, plants cannot make chlorophyll and the leaves turn yellow. The plant then shows poor growth.

The movement of water through a flowering plant is controlled by the process of transpiration. Transpiration is the loss of water through evaporation, mostly from the lower side of the leaves. The movement of water from the roots, through the stem to the leaves is called the transpiration stream. Follow this movement of water in the diagram below.



As a plant transpires and water evaporates from the lower side of the leaves, the cells in the lower layer of the leaf become short of water. These cells then take in water from the xylem to replace the water that has been lost by evaporation. As the xylem loses water to the leaves, water is then drawn in by the plant using the roots.

Water and minerals therefore pass from the root hairs through the xylem and into the leaves and all other parts of the plant. In flowering plants, most of the cells that make up the xylem are called vessels. These vessels do not have ends to their walls, so the xylem forms a continuous, hollow tube that water and minerals can flow through.



Activity 3: Movement of water through celery

Look at the photograph below.

a) Describe what the leaves show about the movement of water through the celery.

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b) Describe what the cross-section through the celery stem shows.

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c) Explain how the cross-section through the celery stem helps to show the movement of water through a flowering plant.

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Activity 4: Removing leaves

Learners placed two celery plants with a similar number of leaves in one container of blue water and one container of red water, as shown in the picture in Activity 3. The volume of the blue water and red water was the same. They then took all the leaves off the celery in the red water, and left all the leaves on the celery in the blue water.

Predict how taking the leaves off the celery in the red water would affect the rate at which water was transported in that celery stem.

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Activity 5: Annotated diagram

Draw and label a diagram to show how water is transported in a plant.

TAKE A BREAK

Now take a short break from revising. Go and drink one or two glasses of water before you begin the next section.

Scientists have researched the effect of learners drinking water when they take exams. Learners who drank water regularly did about 5 per cent better than those who did not. Staying hydrated can help your memory and concentration.

Activity 6: Revisit your concept map

a) Use the concept map word cards that you made at the start of this chapter in Activity 1.
b) Highlight any words from the list in Activity 1 that you now know but did not at the beginning, and make new cards for those words.
c) Group the cards on the plain paper to create a new concept map using all the cards.
d) Draw lines to join as many of the cards as you can, making sure that you write what connects the cards on each line.
e) Compare this concept map to the one you made at the start of the unit. How many new connections can you now make?
f) Give your concept map to a partner and ask them to pick two words that you have connected. You must then explain to them how you have connected these words.
g) Take a photo of your concept map. Stick the corner of each card down so that you can still read the information on the back. Use your map for revision to help you remember the connections you have made.

REMEMBER: THE HUMAN RENAL SYSTEM

Taking a break to drink water is a good place to start this section of revision, because it is about the human renal system. Anything using the word 'renal' has something to do with the kidneys. The kidneys filter your blood, removing waste and excess water.

It is important that the body keeps its water levels steady. We take in water through food and drink, and lose water through the skin by sweating and when we breathe out (exhale). We also lose water when we urinate (go to the toilet). In this section, we will focus on the role of the kidneys in keeping the level of water in our body constant.

Humans have two kidneys, one on either side of the back above the waistline. The kidneys are about the size of an adult fist.

Activity 7: Five key facts

Choose five facts from the Remember section on the human renal system that you think a learner should know.

1 .....
2 .....
3 .....
4 .....
5 .....

REMEMBER: HOW THE KIDNEYS WORK

The kidneys have two important functions:

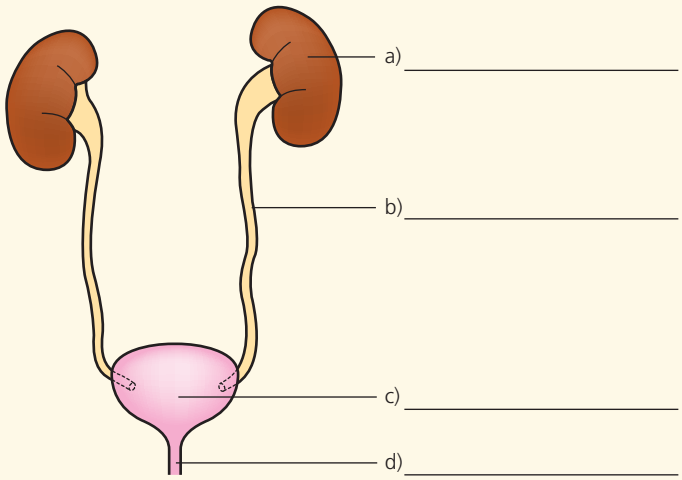
- to control the amount of water in the body
- to remove waste (urea) from the body.

The body breaks down food for energy and to repair itself. Any waste from this process enters the blood. The main function of the kidneys is to remove this waste from the blood and return the cleaned blood back to the body. The blood enters each kidney through the renal arteries, which are two large blood vessels. Each renal artery then branches into smaller and smaller blood vessels and finally into tubes called nephrons, which act as tiny filters. Each kidney contains about 1 million of these microscopic nephrons. Blood passes through the nephrons and is filtered to remove a substance called urea, which is a toxin that the body needs to get rid of. After the blood is cleaned, it flows out of the kidneys through the renal veins.

The waste from the blood, together with any excess water, is known as urine. The urine flows from the kidneys to the bladder through the ureters. The ureter is a tube from each kidney to the bladder, so there is a ureter on each side of the bladder. The urine is stored in the bladder and then passes from the body through a tube called the urethra when you go to the toilet.

Activity 8: Label the diagram

Use the information from the Remember section to label the diagram below.



Activity 9: Parts of the kidney

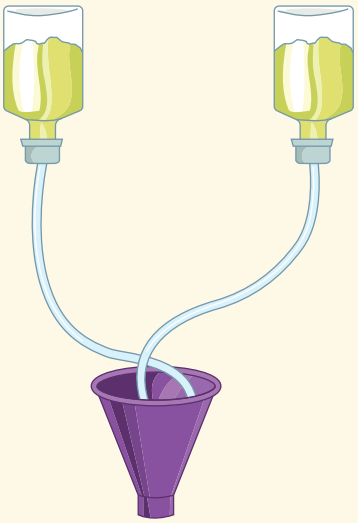
Read the Remember section on how the kidneys work to help you complete this activity. Draw lines to match each scientific term related to the renal system to the correct definition.

nephron	Carries blood from your heart to your kidneys
ureter	A filter that removes urine
renal vein	Carries cleaned blood back to the heart
renal artery	A tube from each kidney that carries urine to the bladder

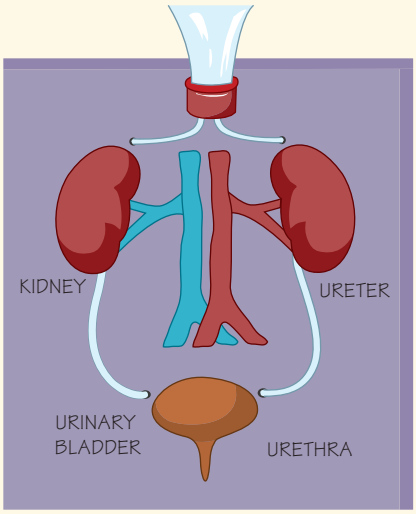
Activity 10: Working models

Learners were challenged to make a working model of the renal system, which would show how the system filters blood to remove urea and create urine. Below are three pictures of different models made by learners. Look carefully at each model and reflect on how the learners have represented the different parts of the system. Then answer the questions below.

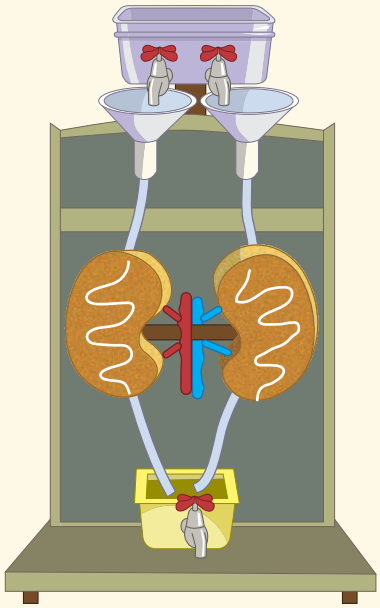
Remember that a model represents something; it is not the real thing, so it may have limitations and not work exactly as a real renal system would.



A



B



C

List the different parts of the renal system shown in each model in the following table, and say how each part is represented in the model. One has already been started for you.

Model	Part of the renal system	How it is represented in the model
A	Kidneys Bladder	Plastic bottles with filter paper Filter funnel
B		
C		

Activity 11: PMIs

What are the PMIs (**P**ositives, **M**inuses and **I**nteresting features) for each model shown in Activity 10? Complete the table to show your ideas. The first one has been done for you.

Model	Positives	Minuses	Interesting features
A	Shows the main parts of the system (kidneys, ureters and bladder)	Less detail than the other models	The way filter paper has been used to show a filtering system
B			
C			

Activity 12: Best model

Which model do you think will best help learners to understand the renal system? Explain why, using your knowledge of the renal system.

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TIPS FOR SUCCESS

Go back over the work you have done in this chapter to remind yourself of all the information you have covered. When you are ready, complete this short test.

As you work through it, you can help yourself by:

- reading each question carefully – check you understand the question
- looking for key words to use in your answer
- answering the question in your mind first, before you write it down
- making sure you use correct scientific vocabulary in your answers
- using a piece of spare paper to draft any extended answers first, then when you are happy with it you can write your answer in this book
- checking your answers to make sure that you do not want to make any changes.

Revision test

1 Which of the following words is part of the renal system? Circle the correct answer. [1 mark]

nephron root hair transpiration vascular bundle xylem

2 Which of the following could be shown by monitoring the colour of urine? Circle the correct answer. [1 mark]

A How much oxygen is in the blood
B Whether someone is hydrated
C Whether someone has a healthy diet

3 Complete the following table by ticking the correct column to show whether each statement is true or false. [5 marks]

Statement	True	False
Roots absorb water and dissolved minerals.		
Transpiration is when a plant takes in water from the air.		
Root hairs have a large surface area for absorption of water.		
Most of the water lost by plants evaporates from the stem.		
Xylem transports water and dissolved minerals from the roots to the rest of the plant.		

4 Write definitions for each of the following: [3 marks]

a) Xylem .....

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b) Nephron .....

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c) Urea .....

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5 Describe the difference in the functions of the renal arteries and the renal veins. [2 marks]

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6 The title of this chapter is 'Water and life'. Suggest why both flowering plants and human kidneys are included together in this chapter. [3 marks]

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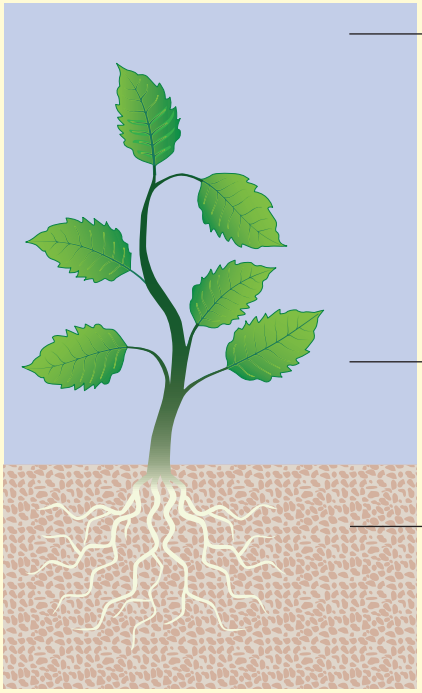
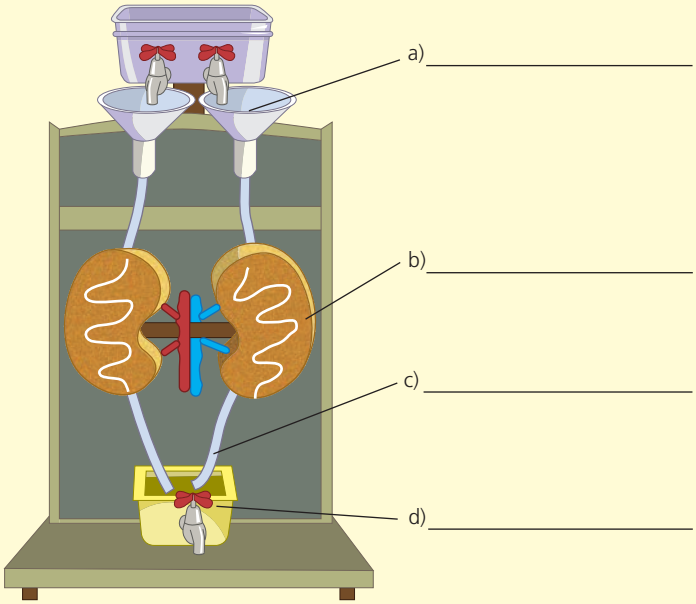
7 **a)** Draw arrows on the diagram to show the transpiration stream in the plant. [1 mark]



b) Add labels to the diagram to describe the processes in the transpiration stream shown at points 1, 2 and 3. [3 marks]

8 Label the parts of the renal system represented in this model. [4 marks]



Chapter 2 Photosynthesis

CHAPTER INFORMATION

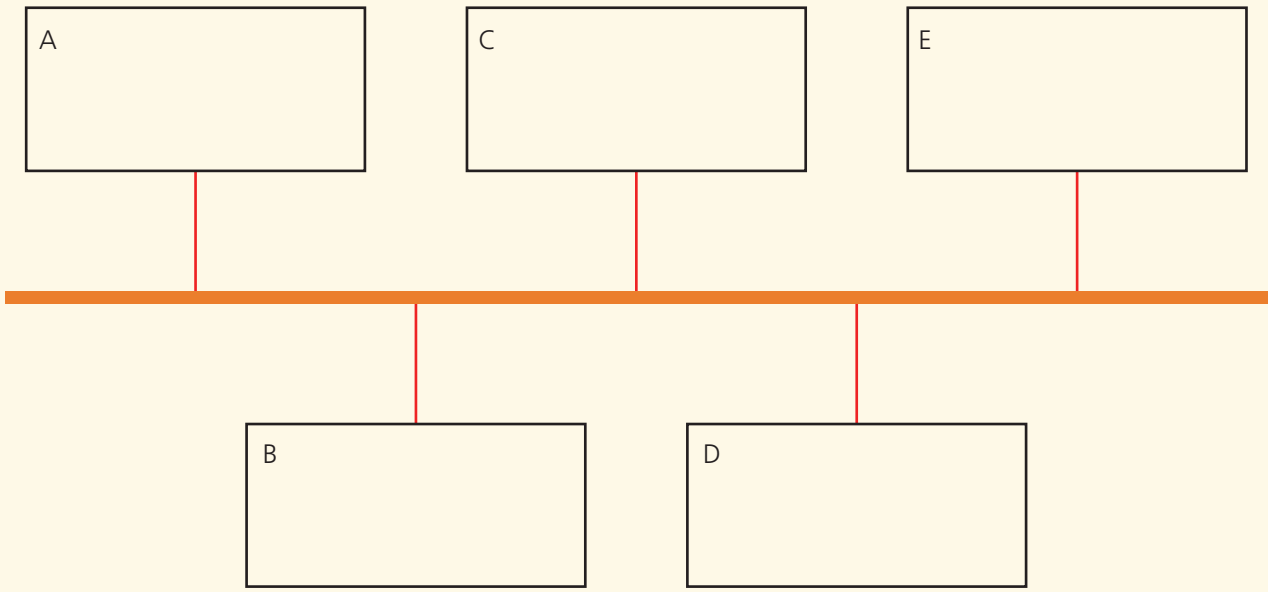
This chapter will help you to revise the process of photosynthesis and how knowledge about photosynthesis is used to grow more and better-quality food. By the end of this chapter you should be able to:

- describe the process of photosynthesis as the process by which plants make carbohydrates using energy from sunlight
- state that photosynthesis occurs in chloroplasts
- use knowledge of the work of past scientists to explain different aspects of photosynthesis
- use the word equation for photosynthesis
- describe how people are using scientific knowledge about photosynthesis to grow more and better-quality food.

REMEMBER: SCIENTISTS AND OUR UNDERSTANDING OF PLANTS

Over the last 450 years, scientists have gradually built upon each other's work in order to understand how plants grow. Joannes Baptista van Helmont (1580–1644) carried out an experiment where he watered a willow tree and measured its mass, which led him to believe that plants need only water to grow. We now know that this was incorrect, but it led to further work by other scientists who wanted to check his idea. Stephen Hales (1677–1761) thought that 'a portion of air' helped a plant to survive. Jan Ingenhousz (1730–1799) built on the knowledge of van Helmont and Hales to show that the 'portion of air' that green plants take up is carbon dioxide when they are in the sunlight. Later, Joseph Priestly (1733–1804) placed a mint plant in a jar of this gas and let sunlight shine on it. He found that the gas appeared to change into another one that allowed things to burn in it. Later, Priestley met the French chemist Antoine Lavoisier (1743–1794) and told him about his discovery. Lavoisier named the gas oxygen.

Activity 1: Timeline



Above is a timeline with five empty boxes. Use the Remember section to help you put each scientist in the correct place on the timeline, to show when they made their contributions.

Activity 2: Matching scientists to ideas

Draw a line to match each scientist with the scientific idea they developed.

Joseph Priestley	Water is a basic requirement for life.
Antoine Lavoisier	The gas produced by plants is named oxygen.
Jan Ingenhousz	A gas produced by plants allows things to burn in it.
Stephen Hales	Air helps plants to survive.
Joannes Baptista van Helmont	Plants take up carbon dioxide.

Activity 3: Using information

a) What did Joannes Baptista van Helmont investigate? How is his contribution to science important to our knowledge of plants today?

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b) How did Stephen Hales' work contribute to scientists' understanding of plant growth?

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c) How did Jan Ingenhousz's work add to knowledge about plant growth?

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d) Joseph Priestley and Antoine Lavoisier met and shared their scientific findings. What did they discuss and what gas did Lavoisier name?

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e) Why are plants and photosynthesis crucial to life on Earth? Explain your answer.

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REMEMBER: TESTING FOR STARCH

Scientists use a range of tests when working with plants. One is called the starch test, which is used to look for the presence of starch to find out if photosynthesis has occurred.

Plants use energy from the Sun to change water and carbon dioxide into a sugar called glucose. This can be expressed in the word equation:

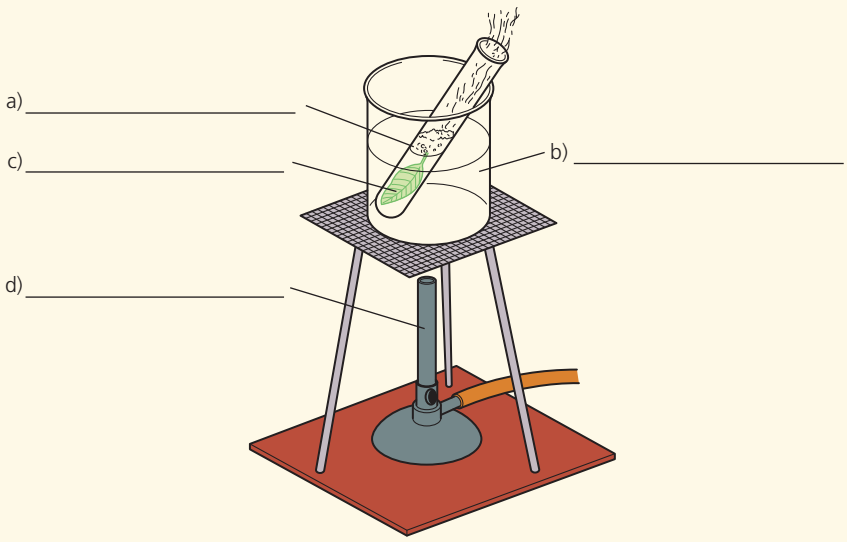
carbon dioxide + water → glucose + oxygen

Glucose is a simple sugar that is used by plants for energy and to make other substances, like cellulose and starch, which are used to form the plant's structure. Starch is made up of glucose units linked together; plants make and store starch and then break it down into glucose when they need energy.

So, photosynthesis needs sunlight, carbon dioxide and water to produce glucose.

Activity 4: Starch test

a) Stage 9 learners were planning to test a leaf for starch. In this diagram, they are preparing the leaf for the starch test. Complete the diagram by adding the labels.



b) What effect does ethanol have on the leaf?

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c) Which substance in a leaf captures light for energy? .....

d) What colour will the leaf turn if it contains starch? .....

e) Which sugar do plants make when they photosynthesise?.....

f) What happens in the chloroplasts in a leaf?

.....

REVISION APPROACH: MODEL ANSWER

A model answer is an 'ideal' response to a question. Looking at different answers to questions and thinking about how they can be improved is one way of helping you to revise and remember your science. Thinking about the strengths and weaknesses of an answer helps you assess how good the answer is, and rewriting it to improve the answer can help you later when you have to write an answer yourself.

Activity 5: Criteria for model answer

Write a set of four criteria that a teacher could use to mark an answer to this question:

Describe how to carry out a starch test.

1 .....

2 .....

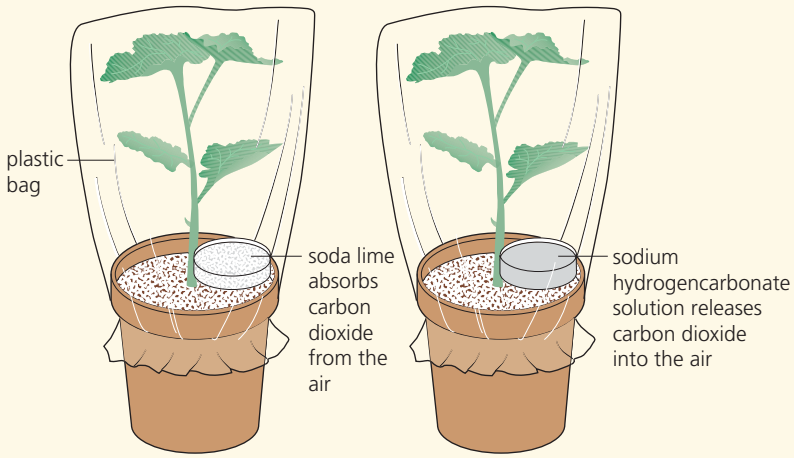
3 .....

4 .....

Activity 6: The role of carbon dioxide in photosynthesis

Learners were testing Jan Ingenhousz's hypothesis that green plants take up carbon dioxide from the air when they are put in sunlight. They investigated the effect of carbon dioxide on starch production in leaves.

Two de-starched plants were placed in individual transparent plastic bags. One was enclosed with a dish of soda lime, and the other with a dish of sodium hydrogencarbonate solution. The two plastic bags were sealed and both plants were left in a sunny place for a few hours.



a) Why did the learners use de-starched plants?

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b) List three things that the learners should control to make sure their test is fair.

1 .....

2 .....

3 .....

c) Why did the learners place both plants in a sunny place instead of a dark cupboard?

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d) What will the learners need to do to find out the effect of carbon dioxide on each plant?

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e) Predict the outcome of this investigation and explain the reasons for your prediction.

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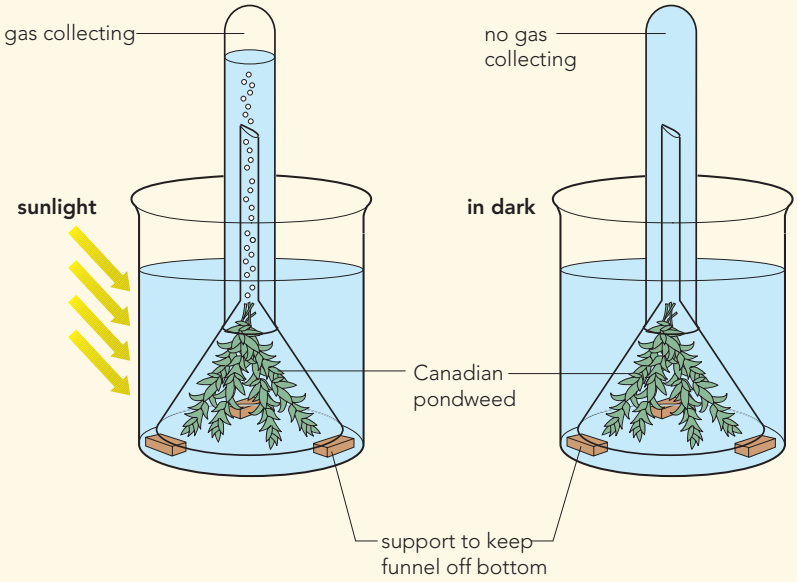
Activity 7: Dual coding

Dual coding uses images alongside words to help you remember complex ideas; for example, remembering equations such as the one for photosynthesis.

Look at this part of the photosynthesis equation. Underneath the words, add some drawings to help you or someone else to remember this equation.

carbon dioxide + water → carbohydrate + oxygen

Activity 8: Investigating oxygen production



Plant A Plant B

a) In the investigation shown above, learners put Plant A in sunlight and Plant B in darkness. What were they trying to prove?

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b) What process is taking place in Plant A that is not taking place in Plant B? Why?

.....

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c) What could you do to prove that the gas produced by Plant A is oxygen?

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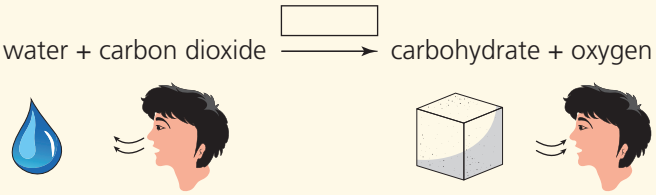
d) Using the outcomes of the investigation the learners carried out, complete the missing section of the photosynthesis equation below. You will notice that the equation is dual coded; it has words and pictures, as an example of how to memorise equations.



TAKE A BREAK

When you sit in the same position for a long time, your body can become tense. To relieve some of this tension, take a break from revising and stand up and stretch. This will also help to improve your energy levels and keep you calm. Try bending your neck gently from side to side, stretching out your arms above your head, or standing up and touching your toes without bending your knees.

REMEMBER: MAXIMISING PLANT GROWTH

Knowledge of plant growth, in particular photosynthesis, can be used to create conditions that maximise plant growth. For example, to help farmers grow more and better-quality food, some crops are grown indoors, such as tomatoes, cucumbers and sweet peppers. Farmers also use special lights, which means they do not have to rely on natural sunlight. Using artificial lighting allows plants to photosynthesise 24 hours a day, and also through the winter months when natural sunlight levels are low.

The global population has risen, so more food is needed, and climate change has led to unpredictable weather and growing conditions. Growing plants indoors under artificial lights means that food can be grown all year round and in urban spaces, not just open farmland. This means that people can get more food that is locally grown in a shorter amount of time, and also reduces the distance food travels, which helps to reduce pollution caused by transporting food.

Activity 9: Evaluating a learner's answer

Learners were asked to answer the following question:

Why do commercial plant growers use artificial light throughout the day and at night?

Using the Remember section and your own knowledge about photosynthesis, highlight one strength and one weakness of the model answer below. For the weakness, rewrite the sentence to improve it, so that it would get more marks in a test.

The learner's answer

Commercial plant growers use artificial light so that plants photosynthesise for 24 hours a day. Because plants can photosynthesise 24 hours a day, they can produce more glucose, which is for energy and to make cellulose and starch.

a) Strength .....

.....

b) Weakness .....

.....

c) Rewrite the answer to improve it.

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Activity 10: Marking learners' answers

Below is the mark scheme for the question: *Why do commercial plant growers use waste carbon dioxide from local factories*?

Use the mark scheme to mark each of the following answers out of five. Explain the reason for the marks you have given each answer.

Includes	Mark
Plants need carbon dioxide	1
Equation for photosynthesis	1
Begins answer using the first part of the question	1
Explanation of the role of carbon dioxide in photosynthesis	1
Done so that plants can photosynthesise more and more food is grown	1

Answer A:

They use carbon dioxide because it is needed in photosynthesis.

Mark and reasoning .....

.....

Answer B:

Some commercial growers use waste carbon dioxide from local factories because carbon dioxide is needed when plants photosynthesise.

Mark and reasoning .....

.....

Answer C:

Some commercial growers use waste carbon dioxide from local factories because carbon dioxide is used by plants, along with light and water, to photosynthesise and create oxygen and glucose. The word equation for this is: carbon dioxide + water + energy from light → glucose + oxygen. This increases food production, grows food more cheaply and uses up waste products.

Mark and reasoning .....

.....

Activity 11: Create a test question

Here is an answer from a test paper. Create the question that fits this answer:

Pipes for carrying CO_2 are placed near the leaves because it is the leaves that take in carbon dioxide in the process of photosynthesis.

Question .....

.....

Activity 12: Variegated leaves

This is a photograph of a geranium plant. The leaves are variegated, which means that they are different colours, not just green.

Answer the following question, using the mark scheme in the table below to help you achieve all four marks.

How do you think variegated leaves affect the process of photosynthesis? [4 marks]

Includes	Mark
Use of scientific vocabulary	1
Link made between chlorophyll and colours in variegated leaves	1
Equation for photosynthesis	1
Link made between chlorophyll and photosynthesis	1

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.....

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Activity 13: Testing for starch

Plant A: Non-variegated geranium

Plant B: Variegated geranium

Learners tested the leaves from two geranium plants, A and B, for starch.

Predict what their results should show. Explain the reasons for your predictions.

Plant A .....

.....

Plant B .....

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TIPS FOR SUCCESS

Go back over the work you have done in this chapter to remind yourself of all the information you have covered. When you are ready, complete this short test.

As you work through it, you can help yourself by:

- reading each question carefully – check you understand the question
- looking for key words to use in your answer
- answering the question in your mind first, before you write it down
- making sure you use correct scientific vocabulary in your answers
- using a piece of spare paper to draft any extended answers first, then when you are happy with it you can write your answer in this book
- checking your answers to make sure that you do not want to make any changes.

Revision test

1 Which part of a plant does **not** carry out photosynthesis? Circle the correct answer. [1 mark]

A Stem **B** Roots **C** Leaves

2 Which of these is a product of photosynthesis? Circle the correct answer. [1 mark]

A Water **B** Minerals

C Carbon dioxide **D** Glucose

3 Write the word equation for photosynthesis. Use these words to help you:

carbohydrate carbon dioxide oxygen sunlight water [1 mark]

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4 Use the correct word equation to explain, using sentences, the process of photosynthesis. [2 marks]

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5 Name two factors in the environment that affect the rate of photosynthesis in a plant. [2 marks]

1 .....

2 .....

6 Describe four stages in testing a leaf for starch and explain each stage. Finally, describe the result of a starch test. [5 marks]

1 .....

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2 .....

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3 .....

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4 .....

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Result: .....

7 If a variegated geranium is kept indoors in low light, the non-green areas of the leaf start to turn green. Explain why this is an advantage for the plant. [2 marks]

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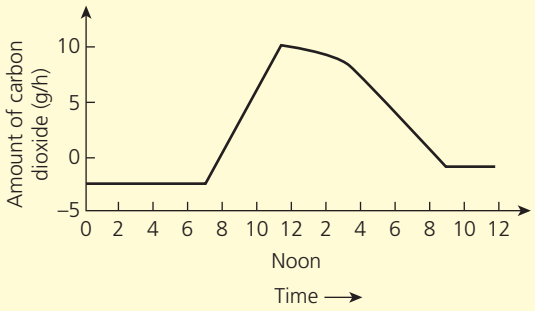
8 Look at the graph.



a) Suggest a title for this graph. [1 mark]

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b) At what time of the day is photosynthesis at its peak? Suggest why. [2 marks]

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c) Why does the rate of photosynthesis slow down during the afternoon? Explain your answer. [2 marks]

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d) How much carbon dioxide is absorbed at 2 p.m.? [1 mark]

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e) If carbon dioxide is being absorbed by the plant, what gas is being produced? [1 mark]

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Lower Secondary Science

SECOND EDITION

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ISBN 978-1-3983-6421-9

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