CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

1 Photosynthesis and the carbon cycle

Unit plan

Topic	Learning hours	Learning content	Resources
1.1 Photosynthesis	3-4	Introduction to photosynthesis	**Learner's Book:** Questions 1–4 Think like a scientist: Collecting the gas produced in photosynthesis Think like a scientist: Investigating how light intensity affects the rate of photosynthesis (extension material) Activity: Words beginning with photo- Activity: Photosynthesis and respiration **Workbook:** Exercise 1.1A, How light level affects photosynthesis Exercise 1.1B, The effect of different colours of light on the rate of photosynthesis Exercise 1.1C, Turning an idea into an hypothesis that can be tested **Teacher's Resource:** Worksheets 1.1A–C, The beginning of photosynthesis Template 1: Results table for *Think like a scientist: Investigating how light intensity affects the rate of photosynthesis* (extension material)
1.2 More about photosynthesis	3-4	Chloroplasts and chlorophyll; leaves; minerals required by plants.	**Learner's Book:** Questions 1–6 Activity: Which surface of a leaf has most stomata? Think like a scientist: Testing a leaf for starch Think like a scientist: Planning an investigation into the effect of fertilisers on plant growth **Workbook:** Exercise 1.2A, Duckweed experiment Exercise 1.2B, Testing a variegated leaf for starch Exercise 1.2C, Floating discs experiment **Teacher's Resource:** Template 2: Planning record for *Think like a scientist: Planning an investigation into the effect of fertilisers on plant growth*

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

Topic	Learning hours	Learning content	Resources
1.3 The carbon cycle	2.5-3	How carbon atoms move between organisms and the air	**Learner's Book:** Questions 1–4 Think like a scientist: How do plants and animals affect carbon dioxide concentration? Activity: Modelling the carbon cycle **Workbook:** Exercise 1.3, Completing a carbon cycle diagram **Teacher's Resource:** Worksheets 1.3A–C, Building a carbon cycle Template 3, Results chart for *Think like a scientist: How do plants and animals affect carbon dioxide concentration?*
1.4 Climate change	2.5-3	The effects of greenhouse gases and asteroid collisions on the Earth's climate	**Learner's Book:** Questions 1–6 Think like a scientist: How do rising temperatures affect sea level? Activity: The carbon cycle and climate change **Workbook:** Exercise 1.4, Interpreting graphs about climate change **Teacher's Resource:** Worksheet 1.4, Impacts of climate change
Cross-unit resources			**Learner's Book:** Check your Progress **Project:** What happened to the dinosaurs? **Teacher's Resource:** Language development worksheets 1.1 Completing sentences about the carbon cycle 1.2 Making predictions

BACKGROUND/PRIOR KNOWLEDGE

It is likely that learners will already know something about photosynthesis. Learners who have followed a science curriculum programme may have learnt at Primary level that plants get energy from light, and they will also know that plants are the producers in food chains, a concept that was addressed at Stages 7 and 8. They should know something about energy changes, which were covered in the Physics units in Stage 7.

Learners will also need to be confident with word equations. These are first dealt with in the chemistry topics in Stage 8, and learners are also likely to remember using the word equation for respiration in Stage 8.

The work on the carbon cycle requires an understanding of the concept of elements and compounds, which was covered in chemistry at Stage 7. Learners will revisit their earlier work on decomposers from Stage 7, and integrate this with their previous knowledge of respiration, as well as the new work on photosynthesis. They are likely to have met combustion reactions in their chemistry lessons, probably in Stage 8.

The climate change topic builds on earlier work on greenhouse gases in the chemistry topics in Stage 8. Learners are also likely to remember something about asteroids from Stage 8.

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

TEACHING SKILLS FOCUS

Assessment for learning

As teachers, we all want to know how our learners are progressing. The learners themselves also want to know this, as do their parents. We give learners tests to find out. You may also enter your learners for externally marked tests.

These assessments can be thought of as summative assessments. Their purpose is to find out what learners have learnt and how well they understand the material. Their results in summative assessments can be used to help them to move into further or higher education courses, or to employment.

However, this is not the only type of assessment that teachers use. Formative assessment – also known as assessment for learning – is a type of assessment that can be used almost all of the time. Its purpose is to find out what our learners can do, so that we can adjust our teaching and the tasks and support that we provide to the learners, to help them to move on and up from their current position. There is much evidence that using assessment for learning can have a significant impact on the standards that can be achieved by learners.

Good formative assessment is at the heart of successful teaching. However well we plan a lesson, and however well we teach a topic, we cannot know how successful we have been until we find out how well the learners have understood what we have taught. As every teacher knows, what we teach is not the same as what our learners learn. If we find that their understanding is not as good as we hoped, then we need to adjust the planned teaching, to take this into consideration. Perhaps we need to revisit the topic in the next lesson for the whole class, approaching it in a different way. Perhaps some learners need to be given a further challenge, while others need more support to help them to grasp the concepts we have been teaching.

How is assessment for learning done? There are several things that you can try to do.

- Find out where individual learners are now – what do they understand? What do they feel less confident about? A good teacher does this constantly – using questioning in class, listening to learners as they talk to each other during group work, watching them doing an experiment, as well as marking written work.
- Share learning intentions and success criteria with learners. Learners need to know what they are supposed to be able to do, and how to judge when they have done it well. Using self- and peer assessment can really help here, as it gives them clear targets to focus on.
- Give focused, specific and personal feedback to learners to make clear to them what is good about their work and what they can do to improve. Make sure that these targets are achievable, not so broad or ambitious that they are beyond the learner's capability. Develop your learners' confidence to make sure that everyone understands that they can improve.

In the Teacher's Resource for Units 2, 5 and 8, you will find more guidance on using self- and peer assessment. Units 3, 6 and 9 give advice on giving feedback to learners. In Unit 4, there are suggestions about how to set achievable targets for learners, while Unit 7 includes ideas on how to use reflection to help learners to think about how they learn and how they can improve. There is advice on using questioning in Units 2, 5 and 8 at Stage 8.

In this unit, you could try:

- watching and listening to learners as they work on *Think like a scientist: Investigating how light intensity affects the rate of photosynthesis*, to check how well everyone understands what they are doing, and what is happening
- using questioning when everyone has finished and is sitting down, to find out what they understand about what they have done
- using peer assessment to help learners to focus on how to design a good results chart
- using what you find to make adjustments to your teaching plans, if need be.

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

Topic 1.1 Photosynthesis

LEARNING PLAN

Learning Objectives	Learning intentions	Success criteria
9Bp.06 Know that photosynthesis occurs in chloroplasts and is the process by which plants make carbohydrates, using the energy from light. **9Bp.07** Know and use the summary word equation for photosynthesis (carbon dioxide + water glucose + oxygen, in the presence of light and chlorophyll). **9TWSa.01** Evaluate the strength of the evidence collected and how it supports, or refutes, the prediction. **9TWSa.02** Describe trends and patterns in results, identifying any anomalous results and suggesting why results are anomalous. **9TWSa.03** Make conclusions by interpreting results, explain the limitations of the conclusions and describe how the conclusions can be further investigated. **9TWSa.04** Evaluate experiments and investigations, including those done by others, and suggest improvements, explaining any proposed changes. **9TSWa.05** Present and interpret results, and predict results between the data points collected. **9TWSc.01** Sort, group and classify phenomena, objects, materials and organisms through testing, observation, using secondary information, and making and using keys. **9TWSc.02** Decide what equipment is required to carry out an investigation or experiment and use it appropriately.	• Learn what happens during photosynthesis, and be able to use and understand the word equation. • Collect the gas produced in photosynthesis, and test it. • Carry out a fair test experiment, to find out how light intensity affects the rate of photosynthesis.	• Be able to write the photosynthesis equation, and use it to name reactants and products. • Collect and test gas produced by a water plant. • Collect results in the light intensity experiment, draw a graph using these results, and write a conclusion

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

CONTINUED

Learning Objectives	Learning intentions	Success criteria
9TWSc.03 Decide when to increase the range of observations and measurements, and increase the extent of repetition, to give sufficiently reliable data.		
9TWSc.04 Take appropriately accurate and precise measurements, explaining why accuracy and precision are important.		
9TWSc.05 Carry out practical work safely, supported by risk assessments where appropriate.		
9TWSc.06 Make an informed decision whether to use evidence from first-hand experience or secondary sources.		
9TWSc.07 Collect, record and summarise sufficient observations and measurements, in an appropriate form.		
9TWSp.01 Suggest a testable hypothesis based on scientific understanding.		
9TWSp.02 Describe examples where scientists' unexpected results from enquiries have led to improved scientific understanding.		
9TWSp.03 Make predictions of likely outcomes for a scientific enquiry based on scientific knowledge and understanding.		
9TWSp.04 Plan a range of investigations of different types to obtain appropriate evidence when testing hypotheses.		
9TWSp.05 Make risk assessments for practical work to identify and control risks.		

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE
Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

LANGUAGE SUPPORT

Learners will use the following words:

photosynthesis: a series of chemical reactions that take place inside the chloroplasts of plants, in which carbon dioxide and water react together using light energy; the products are glucose (and other carbohydrates) and water

chlorophyll: a green pigment present in chloroplasts, which absorbs energy from light and helps to transfer it to the carbohydrates made in photosynthesis

light intensity: a measure of the quantity of light energy falling onto an object

Common misconceptions

Misconception	How to identify	How to overcome
Learners often say that photosynthesis is the way that plants respire.	Difficulties with this concept are likely to be brought out in *Activity: Photosynthesis and respiration*.	Throughout this unit, make sure that reference is made to respiration in plants.

Starter ideas

1 Getting started (10 minutes, including sharing ideas)

Resources: Two plants, or sets of plants; one that has grown in the light and one that has been in the dark. If these are not available then learners can look at the photographs in the Learner's Book.

Description: Ask learners to work with a partner to make a list of any differences they can see. Use their observations to discuss why plants need light.

2 Words beginning with photo- (5 minutes)

Description: Organise learners into teams. Ask them to follow the instructions for *Activity*: *Words beginning with photo-*.

Main teaching ideas

1 Collecting the gas produced in photosynthesis (10 minutes to set up; leave for one day; another 10 minutes to test the gas collected)

Learning intention: To observe photosynthesis in a water plant; to obtain first-hand evidence that plants release oxygen gas.

Resources: Per group: a large beaker; a glass funnel; blocks or modelling dough to hold the funnel off the bottom of the beaker; test tube; pond water (tap water can contain chemicals that harm the water plant); a water plant such as *Elodea* or *Cabomba* – these can be obtained from pet shops or aquarium shops (these plants should not be introduced to ponds or rivers unless they are native to the area).

Description: Learners can set up the apparatus as shown in the diagram in the Learner's Book.

› **Practical guidance:** Before the lesson, keep the water plants in the water that you will use for the experiment, in bright light, so that they are already photosynthesising. Choose short pieces of plant and cut diagonally across the stem – this makes it easier for the bubbles to emerge. When assembling the apparatus, place the pieces of plant upside down, so that the cut end is pointing upwards.

Raising the funnel above the bottom of the beaker enables good water circulation.

Learners can often be clumsy in placing the test-tube full of water over the funnel without the water spilling, and again when removing it at the end of the experiment. Practise this yourself first, then show the learners how to do it correctly.

› **Differentiation ideas:** All learners should be able to assemble the apparatus, but some may need support with removing the tube and testing the gas at the end.

Questions 1 and 2 are likely to be challenging for some learners, who will need support in thinking out possible answers for them.

Learners who need a challenge could be asked if they think that the gas that has collected is likely to be pure oxygen (it is not) and perhaps suggest what other gases might be present.

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

› **Assessment ideas:** You could assess learners on their ability to work safely, by watching them as they assemble the apparatus and test the gas.

2 Think like a scientist: Investigating how light intensity affects the rate of photosynthesis (40–45 minutes)

Learning intention: To increase confidence in handling apparatus, collecting and analysing results; to practise designing and completing their own results chart. Note: studying the intensity of light goes beyond Stage 9.

Resources: Per group:

- a piece of water plant, pre-treated as described in the previous activity
- a large test tube in which the piece of water plant easily fits
- a means of supporting the test tube – for example, a beaker (whatever is used must not prevent light from passing from the lamp to the tube)
- some pond water
- a lamp – make sure that this is safe, as it will be used close to water (though there is no need at all for any water to come into contact with the lamp, if learners obey safety instructions)
- a ruler to measure the distance between the test-tube and the lamp
- if necessary, a paperclip to weigh down the piece of plant in the tube of water
- a timer.

Description: Ask learners to follow the instructions in the Learner's Book. They should already be familiar with the idea of a water plant giving off bubbles, if they have done the previous activity.

Emphasise the importance of keeping all electrical components away from the water.

It is best to begin with the tube as close as possible to the lamp, as this will give the plant plenty of light so that photosynthesis should be reasonably rapid. If learners start with the lamp far away, nothing at all may happen.

Learners should make three bubble counts at each distance of the tube from the lamp, so that they can later calculate a mean number.

› **Differentiation ideas:** Some learners are likely to need help with setting up their apparatus and collecting results. They may also need help in designing their results chart. Template 1 is provided for this, which you could hand out to any individual or group that needs it.

Learners who need a challenge could be asked to look at the three readings they have made at each distance. Are the three readings the same? If they are not, what does that indicate? They may be able to see that this could mean that another variable might be affecting the number of bubbles, not only the light intensity (which does not change throughout the three readings) – what could this be, and what does it mean for their experiment? It is likely to be something internal to the plant, which we cannot see or measure.

› **Assessment ideas:** There are many skills that could be assessed here, but perhaps it is best to concentrate on the results charts that learners are asked to construct.

3 Activity: Photosynthesis and respiration (15 minutes)

Learning intention: To begin to appreciate the relationship between photosynthesis and respiration.

Description: Organise learners into pairs. Ask them to follow the instructions in the Learner's Book.

Similarities that they might suggest include:

- they are both chemical reactions
- they both have reactants and products
- we can write equations for both
- they both happen inside living cells
- they both involve energy changes
- they both involve carbon dioxide, water, glucose and oxygen.

Differences they might suggest include:

- respiration happens in all cells, but photosynthesis only in some plant cells
- aerobic respiration happens in mitochondria, but photosynthesis happens in chloroplasts
- photosynthesis needs sunlight, but respiration does not
- photosynthesis needs chlorophyll, but respiration does not
- photosynthesis needs an energy input, while respiration releases energy.

› **Differentiation ideas:** All learners can attempt this task. Differentiation will be by outcome, with some pairs providing few or very basic ideas, while others may show greater insight.

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

Plenary ideas

1 Sharing results charts (15 minutes)

Resources: Everyone's results charts from *Think like a scientist: Investigating how light intensity affects the rate of photosynthesis*.

Description: Put all the results charts onto the wall. Ask learners to bring a chair so that everyone sits in front of the display and can see the charts. Join the group (also sitting on a chair) and ask each group in turn to explain their chart to you all. Use questioning to check how well everyone understands what was happening during the experiment: that they know the photosynthesis equation; that they know how to construct a results chart, and so on. You can also ask the class to suggest one good point about each results chart that is discussed, and ideas about how each results chart could be improved

› **Assessment ideas:** As included in the Description above.

2 Mastermind (5 minutes)

Resources: A card for each learner, with a tick on one side and a cross on the other side.

Description: Choose a learner (or ask for a volunteer) to be Mastermind. You ask the Mastermind a question about photosynthesis based on the work done in this lesson. The Mastermind gives an answer – they can purposefully give a wrong answer if they like. The other members of the class hold up their cards to show whether the answer is correct or incorrect. You can then question the rest of the class to find the correct answer if necessary, or to find out why a learner has identified a correct answer as a wrong one.

Repeat with more questions to the same Mastermind.

› **Assessment ideas:** Use responses of the class to point out any misunderstandings.

Homework ideas

1 Workbook Exercises 1.1A–C

2 Worksheets 1.1A–C

Topic worksheets

- Worksheets 1.1A–C, The beginning of photosynthesis

Topic 1.2 More about photosynthesis

LEARNING PLAN

Learning Objectives	Learning intentions	Success criteria
9Bp.06 Know that photosynthesis occurs in chloroplasts and is the process by which plants make carbohydrates, using the energy from light. 9Bp.07 Know and use the summary word equation for photosynthesis (carbon dioxide + water glucose + oxygen, in the presence of light and chlorophyll). 9Bp.05 Know that plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein).	• Learn about the role of chlorophyll in photosynthesis. • Think about the relationship between structure and function in leaves. • Find out why plants need magnesium and nitrates. • Plan a fair test experiment about the effect of fertilisers on plant growth.	• Explain why chlorophyll is needed for photosynthesis, including explaining the results of testing a variegated leaf for starch. • Answer questions 1 and 2 following *Activity: Which surface of a leaf has most stomata?* • Produce a workable plan for *Think like a scientist: Planning an Investigation into the effect of fertilisers on plant growth.*

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

CONTINUED

Learning Objectives	Learning intentions	Success criteria
9TWSc.01 Sort, group and classify phenomena, objects, materials and organisms through testing, observation, using secondary information, and making and using keys. **9TWSc.02** Decide what equipment is required to carry out an investigation or experiment and use it appropriately. **9TWSc.03** Decide when to increase the range of observations and measurements, and increase the extent of repetition, to give sufficiently reliable data. **9TWSc.04** Take appropriately accurate and precise measurements, explaining why accuracy and precision are important. **9TWSc.05** Carry out practical work safely, supported by risk assessments where appropriate. **9TWSc.06** Make an informed decision whether to use evidence from first-hand experience or secondary sources. **9TWSc.07** Collect, record and summarise sufficient observations and measurements, in an appropriate form. **9TWSp.01** Suggest a testable hypothesis based on scientific understanding. **9TWSp.02** Describe examples where scientists' unexpected results from enquiries have led to improved scientific understanding. **9TWSp.03** Make predictions of likely outcomes for a scientific enquiry based on scientific knowledge and understanding.		

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-108-78522-8 — Cambridge Lower Secondary Science Teacher's Resource 9
with Digital Access 2nd Edition
Mary Jones , Diane Fellowes-Freeman , Michael Smyth
Excerpt
More Information

CONTINUED

Learning Objectives	Learning intentions	Success criteria
9TWSp.04 Plan a range of investigations of different types to obtain appropriate evidence when testing hypotheses. 9TWSp.05 Make risk assessments for practical work to identify and control risks.		

LANGUAGE SUPPORT

Learners will use the following words:

stomata (singular: stoma): a microscopic hole in the surface of a leaf (usually on the underside) through which gases diffuse into and out of the air spaces inside the leaf

fertiliser: a substance containing minerals required by plants, which can be added to soil

yield: the quantity of useful crop obtained at harvest

Common misconceptions

Misconception	How to identify	How to overcome
Learners often state that chlorophyll 'attracts' light, rather than absorbing energy from it.	Oral questioning about the role of chlorophyll, and question 4 in *Think like a scientist: Testing a leaf for starch.*	Constant use of the correct term yourself, and careful checking of learners' spoken and written statements.

Starter ideas

1 Getting started (10 minutes, including sharing ideas)

Resources: A complete plant with roots, stem, leaves and flowers.

If this is not available, learners can look at the diagram in the Learner's Book instead.

Description: Ask learners to work individually to answer the questions in the Learner's Book. Then ask for ideas from some of them, and discuss their answers.

2 What is happening? (5–10 minutes)

Description: Show the class a video clip of chloroplasts moving within mesophyll cells. Ask them: What are these structures? (They are cells.) What kind of cells are they? (Plant cells) What are the green objects? (Chloroplasts). Do you know what happens inside chloroplasts? Can you suggest why they are moving around inside the cells? (It is thought that they move to control the amount of light they receive.)

Main teaching ideas

1 Think like a scientist: Testing a leaf for starch (25 minutes)

Learning intention: To appreciate that plants produce starch and store it; to work safely and observe carefully.

Resources: Per group:

- access to a plant, preferably one with variegated leaves
- a burner and beaker to heat water
- a tripod and gauze (see diagram in the Learner's Book)

© in this web service Cambridge University Press www.cambridge.org