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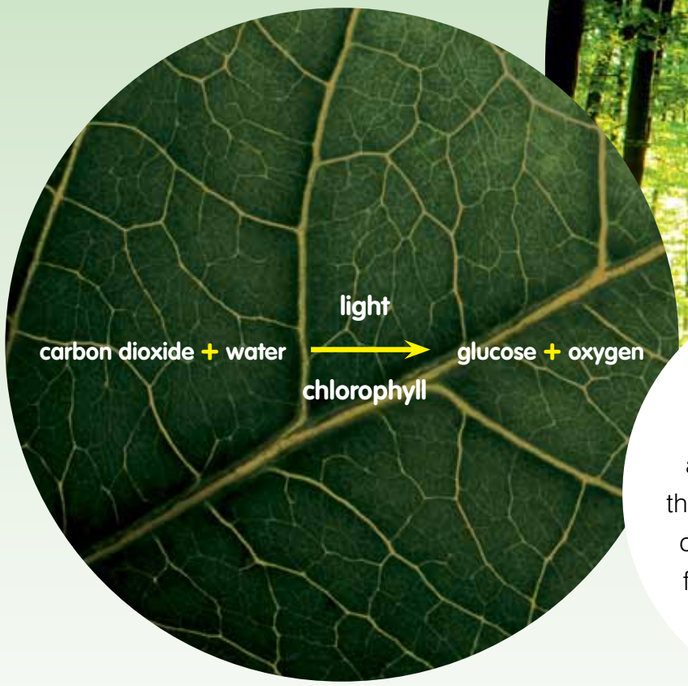
MODULE 8
PHOTOSYNTHESIS

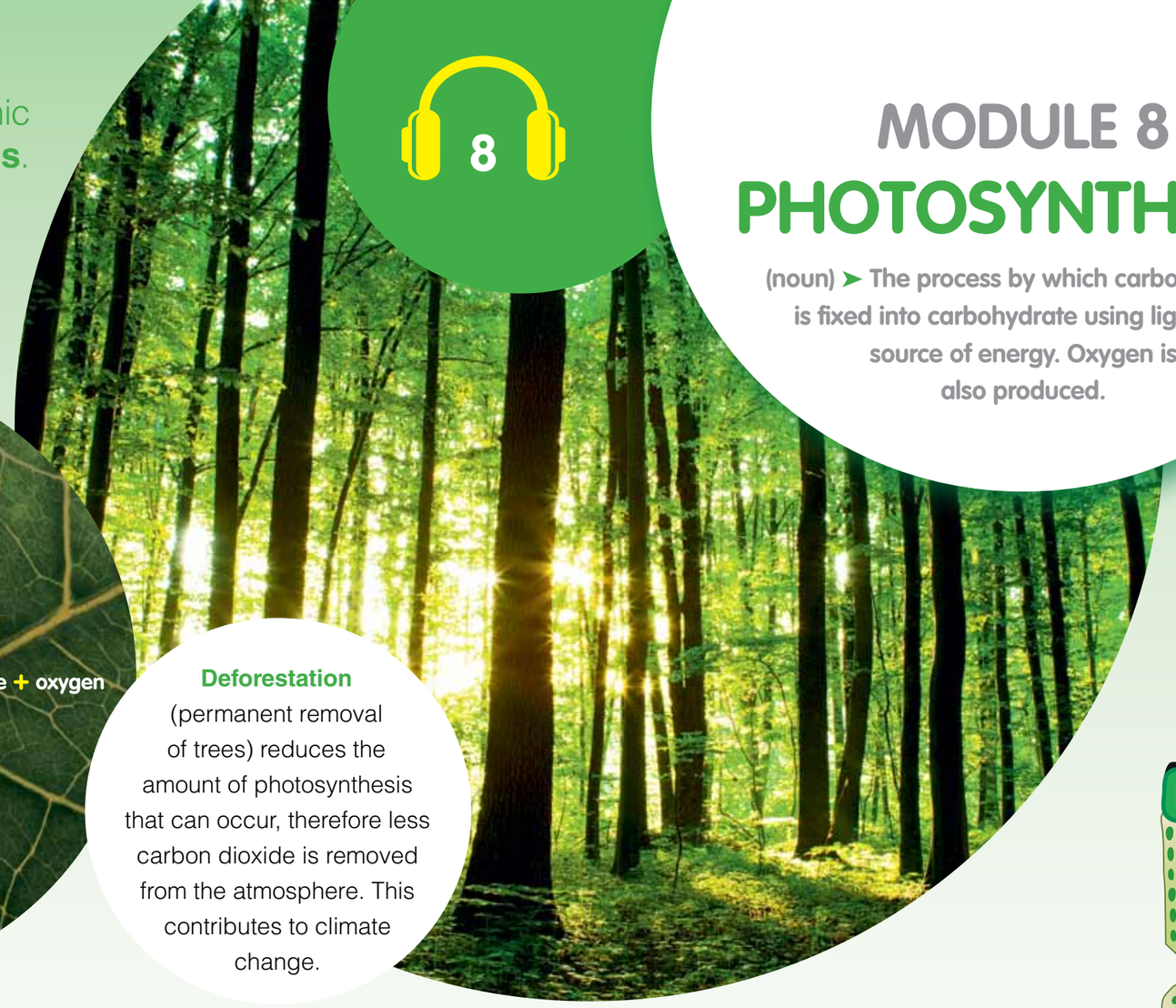
(noun) ➤ The process by which carbon dioxide is fixed into carbohydrate using light as a source of energy. Oxygen is also produced.

KEYWORDS

Chlorophyll (noun) ➤ Green chemical used in photosynthesis.
Leaf (noun) ➤ Main photosynthetic organ of a plant.

Plants and algae produce carbohydrates and other organic compounds by **photosynthesis**. **Carbon dioxide** and **water** are the reactants and the source of energy is **light**. **Oxygen** is also produced.





Deforestation (permanent removal of trees) reduces the amount of photosynthesis that can occur, therefore less carbon dioxide is removed from the atmosphere. This contributes to climate change.

Photosynthesis occurs in the chloroplasts within plant cells. The chemical **chlorophyll** (a pigment) is used in photosynthesis.

Nearly all life on Earth relies on the organic compounds that are produced by plants and algae in the process of photosynthesis. **Herbivores** (plant-eating animals) eat these products directly and utilise the energy they contain. **Carnivores** (meat-eating animals) are then able to feed on the herbivores and utilise the energy they contain.

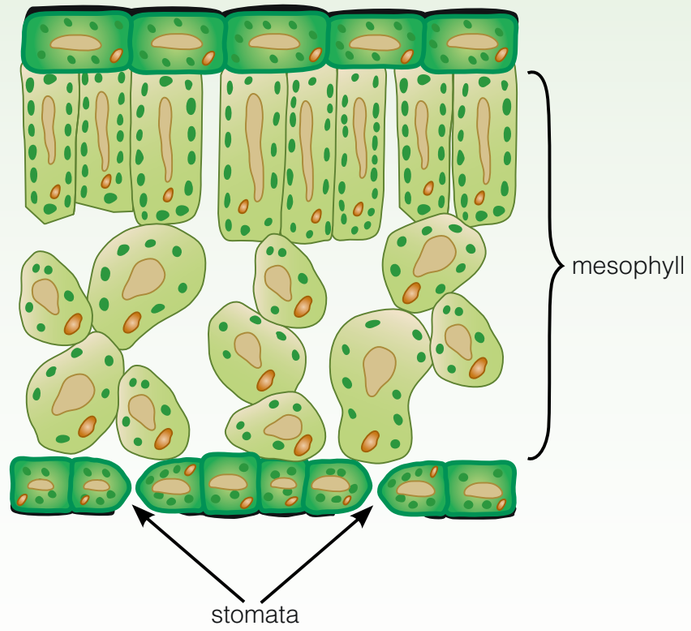
Over billions of years plants and algae have altered the Earth's atmosphere. They have increased the levels of oxygen in the atmosphere and decreased the levels of carbon dioxide.

Today, plants help maintain the concentrations of carbon dioxide and oxygen in the atmosphere.

Create a comic strip summarising the importance of photosynthesis to all living organisms, both in providing organic compounds and taking in carbon dioxide from the atmosphere.

The main photosynthetic organs in plants are **leaves**. They have a large surface area to absorb as much light as possible. Many plants have leaves which are also able to orientate (turn) themselves to the sun to ensure they absorb the most light possible.

Leaf Anatomy



- Small pores called **stomata** on the bottom of leaves allow carbon dioxide to enter the leaf for photosynthesis and for the oxygen produced to be released from the leaf.
- The majority of photosynthesis occurs in the **mesophyll** cells.
- **Xylem** provide the water for photosynthesis and **phloem** are used to transport the products of photosynthesis away from the leaf.

1. What gas is a reactant in photosynthesis?
2. What gas is a product of photosynthesis?
3. Where in the cell does photosynthesis occur?
4. What green chemical is required for photosynthesis?

KEYWORDS

Change of state ➤ When a substance changes from one state of matter to another, for example from a solid to a liquid by melting.

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MODULE 13
EXPANSION AND CONTRACTION

When a solid is heated it will expand and when it is cooled it will contract. This has lots of practical consequences, for example sections of railway tracks have to have gaps between them to allow the metal of the track to expand on hot days to prevent damage.

When solids are heated their particles gain energy and vibrate faster.

If a solid is heated to its melting point, its particles vibrate so much that they overcome the attractive forces between them. The particles then move relative to each other and the solid will become a liquid (the solid has melted).

If a liquid is heated the particles will again move more quickly.

If a liquid is heated to its boiling point, its particles move so quickly that they are able to overcome the weak attractive forces between the particles and move away from each other. The liquid then boils and becomes a gas.

Liquids also expand when heated. Thermometers use this principle to measure the temperature. The liquid in the thermometer (usually alcohol) expands when the temperature increases, rising up the thermometer. When the liquid cools it contracts and moves down the thermometer.

When matter cools the particles lose energy and move slower.

When a gas is cooled below its boiling point, the particles no longer have the energy to overcome the attractive forces. The gas becomes a liquid (it condenses).

When a liquid is cooled below its melting point, the particles no longer have enough energy to move around relative to each other. The liquid becomes a solid (it freezes).

Write out each of the stages of the flow charts from this module on small cards. Mix all the cards up and arrange them into the correct sequences to show:

- The heating of a solid to form a gas
- The cooling of a gas to form a solid

1. When a solid melts to form a liquid do the particles gain energy or lose energy?
2. How can a gas be converted into a liquid?
3. What happens to particles of matter when they are cooled?
4. When will a solid expand?
5. When will a liquid contract?

MATTER AND SPACE PHYSICS

PRACTICE QUESTIONS

1. a) What is the weight of an object with mass 67kg on Earth? (1)

Weight = mass × gravitational field strength (gravitational field strength = 10N/kg on Earth)

b) The same object would weigh more on Saturn. Which of the following statements is the best explanation for this? (1)

A. The gravitational field strength is lower on Saturn due to its rings.

B. The gravitational field strength is higher on Saturn as it is in a different galaxy.

C. The gravitational field strength on Saturn is lower as it is further from the Sun.

D. The gravitational field strength on Saturn is higher as it has a larger mass than the Earth.

c) Match the following features to their distance from the Earth. (2)

Uranus (a planet in our solar system)	7.8 light years
Wolf-359 (a star in our galaxy)	0.0003 light years
Large Magellanic Cloud (a galaxy outside the Milky Way)	163 000 light years

2. A sample of liquid water is heated until it boils and forms water vapour (a gas).

a) Complete the blanks in the following explanation. (3)

As the water is heated, the particles gain _____. This causes them to move _____. As the water boils, the particles move further away from each other. This means water vapour is less _____ than liquid water.

b) Why does solid ice float on liquid water? Explain your answer in terms of particles. (2)

3. a) The average maximum temperature in December in England is 9.9°C, whilst the average maximum temperature in July is 20.9°C. Explain this difference in terms of the Earth's tilt. (2)

b) On average it is much warmer in Australia in December than it is in the U.K. Why is this? (3)

c) The Sun is a star. There are billions of other stars in our galaxy. Explain why the Earth's seasons are not affected by these other stars. (2)