

Part of leaf	Function	How the part is adapted for its function
palisade mesophyll layer	(main site of photosynthesis)	(cells contain many chloroplasts for photosynthesis)
spongy mesophyll layer	gas exchange surface: uptake of CO ₂ and release of O ₂ during photosynthesis, some photosynthesis	large surface area to volume ratio; air spaces between cells; many chloroplasts in cells for photosynthesis (but fewer than in palisade layer)
stomata	pores which exchange gases (CO ₂ , O ₂ and water vapour) with the atmosphere	pores formed between two guard cells; guard cells can change shape to open and close pores
xylem	transport of water and minerals	cells consist of dead, hollow vessels, allows transport through the lumen of each vessel; lignified walls for strength, preventing cells collapsing under suction pressure
phloem	transport of products of photosynthesis	sieve tubes with sieve plates forming continuous tubes to transport solutes; cells living, so can exercise control over movement

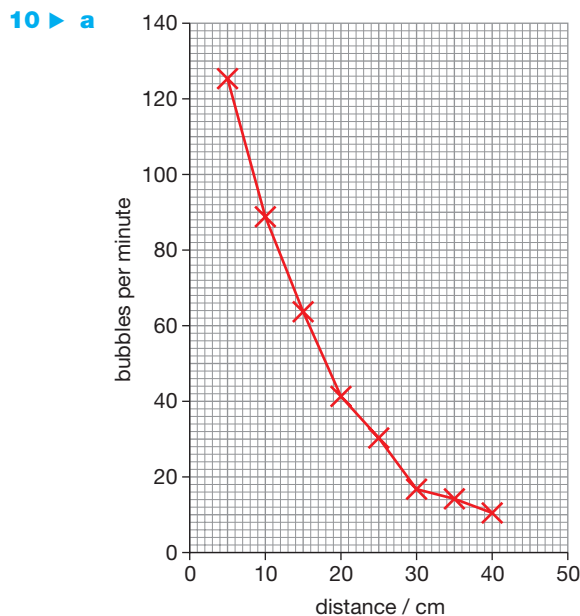
7 ▶ a At 0200 hours (night) the grass respire, producing CO₂, but there is no photosynthesis. At 1200 hours (midday) photosynthesis in the grass exceeds respiration, so CO₂ is used up.

b At 0400 hours: light intensity. At 1400 hours: the concentration of CO₂ in the air.

Substance	Use
glucose	oxidised in respiration to give energy
sucrose	main sugar transported in the phloem
starch	storage carbohydrate
cellulose	makes up plant cell walls
protein	growth and repair of cells
lipid	energy store in some plants, e.g. nuts, seeds. Part of all cell membranes.

9 ▶ a The aeration tube supplies oxygen to allow the roots to respire. The foil stops light entering the tube, preventing the growth of algae.

b Phosphate.



b About 52 bubbles per minute.

- c
- The gas is not pure oxygen, although it has a high oxygen content.
 - The bubbles may not be all the same size.
 - The water in the test tube may have increased in temperature as the lamp was brought nearer to the tube.

11 ▶ The account should include:

- Description of photosynthesis as a chemical reaction where CO₂ and water are combined using light energy trapped by chlorophyll, forming glucose and oxygen.
- Equation for the reaction.
- Leaf adaptations: details of palisade mesophyll, spongy mesophyll, stomata and epidermis, xylem and phloem (diagram needed).
- Photosynthesis supplies oxygen for respiration in animals and other organisms; it is needed at the start of food chains; how energy is harnessed by plants as the producers, and then passed to consumers (note: these topics are covered fully in Chapter 14).

CHAPTER 11

1 ▶ C 2 ▶ B 3 ▶ C 4 ▶ A

5 ▶ a Loss in mass = (8.2 – 8.0) g = 0.2 g.
Percentage change = $(-0.2/8.2) \times 100 = -2.4\%$.

b Osmosis. c Solution A.

d Solution C. e Solution B.

f It is permeable to small molecules such as water, but not permeable to large molecules such as sucrose.

6 ▶ a Long, thin extension of the cell has a large surface area for the absorption of water and minerals.

b Dead, lignified cells with hollow lumen, forming long tubes that carry water and minerals throughout the plant. The lignified walls are tough so that they don't collapse under pressure.

- c** 'Banana' shape with thicker cell wall on inside (around stoma) means that when the guard cells become turgid they change shape, bowing outwards, so opening the stoma for gas exchange.
- 7 ▶ a** If a ball of soil is not left around the roots (e.g. if they are pulled out roughly), it will damage the root hair cells on the roots. This will mean the plant will not be able to absorb water so easily, causing it to wilt.
- b** If a cutting has too many leaves, it will lose too much water through transpiration and may wilt or die before it can establish new root growth.
- c** When stomata are in sunken pits in the leaf, a region of humid air is trapped in the pit. This reduces evaporation through the stomata, conserving water in the plant.
- d** Phloem contains products of photosynthesis, such as sugars, which provide food for the greenflies.
- 8 ▶ a** A = epidermis, B = phloem, C = xylem.
- b** C. Xylem carries water up the stem. The dye is likely to be carried in this water.

9 ▶ a

Condition	Curve
1	(B)
2	A
3	D
4	C

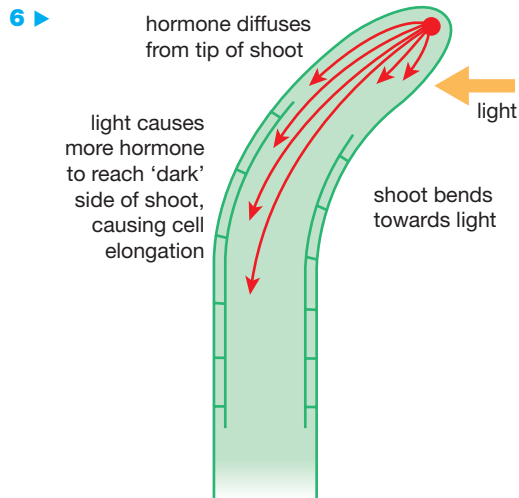
- b** Humid air around the leaf reduces the diffusion gradient between the air spaces in the leaf and the atmosphere around the leaf. Moving air removes the water vapour that might remain near the stomata and slow down diffusion.
- 10 ▶ a** Water forms a thin layer around the cells of the spongy mesophyll of the leaf, then evaporates from this layer and exits through the stomata. The water potential of the mesophyll cells falls, so more water passes from the xylem to the cells by osmosis. A gradient of water potential is set up, from the xylem to the cells.
- b** It would increase. A higher temperature would increase the rate of evaporation of water from the mesophyll.
- c** Many examples possible, for example:
- cacti have leaves reduced to spines
 - leaves rolled into a tube with most stomata facing the inside of the tube
 - sunken stomata in pits
 - hairy leaves to trap layer of moist air round stomata.
- 11 ▶ a** X = xylem, Y = phloem.
- b** Drawing should show a plant cell with root hair extension. Labels: cell wall, cytoplasm, vacuole, nucleus.
- c** Soil water contains few solutes, while there is a high concentration of solutes in the vacuole of the root hair cell. water therefore enters the cell by osmosis.
- 12 ▶** The description should include:
- uptake of water by osmosis from the soil through the root hairs

- the gradient of water potential across the root cortex, allowing water to move from cell to cell by osmosis
- passage of water into the xylem vessels in the root
- transport through the xylem to all parts of the plant
- evaporation of water vapour from the spongy mesophyll cells of the leaf, and loss through the stomata
- the water potential gradient in the mesophyll cells and water movement out of the xylem, the driving force for transpiration.

CHAPTER 12

1 ▶ B **2 ▶** B **3 ▶** D **4 ▶** A

- 5 ▶ a** **i** The direction of light and the direction of gravity.
ii The direction of gravity
- b** The stem grows towards the light, which allows more photosynthesis, and growth of the plant.



- 7 ▶ a** The coleoptile would not bend towards the light. The movement of auxin on the left (dark) side would be interrupted by the mica sheet.
- b** The coleoptile would grow (bend) towards the source of light. The greater amounts of auxin diffusing down the left side would be unaffected by the placement of the mica sheet. (It might even bend more than a control, with no sheet).
- c** The coleoptile would grow (bend) towards the source of light. The mica would not interrupt the movement of auxin away from the light.
- 8 ▶ a** Decapitated coleoptiles would produce the least increase in length, because the tip is the source of auxin, which normally stimulates growth. No tip means that there is no auxin, so there will be reduced growth. The tip with the greatest growth is more difficult to predict. The coleoptiles with the tips covered would probably produce the most growth, since auxin is still made by the tip, but none is moved to the left side of the shoot, so there will be no bending, just upward growth.
- b** Decapitated coleoptiles – no bending, since no auxin produced.