

- 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

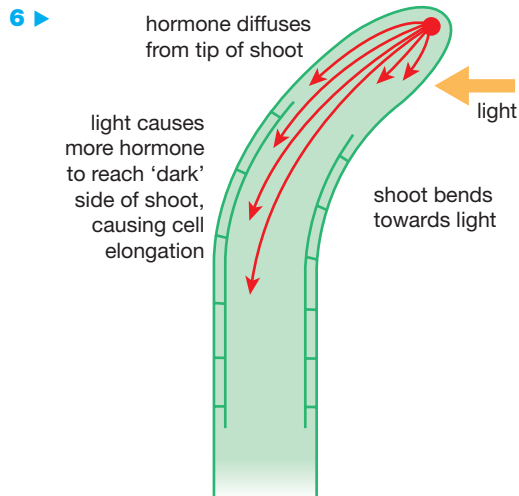
- b** Humid air around the leaf reduces the diffusion gradient between the air spaces in the leaf and the atmosphere around the leaf. Moving air removes the water vapour that might remain near the stomata and slow down diffusion.
- 10 ▶ a** Water forms a thin layer around the cells of the spongy mesophyll 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.

Coleoptiles with tips covered – no bending, since light does not reach the region behind the tip and auxin remains evenly distributed either side of the shoot (you could argue that bending may still occur if the covers are not long enough down the coleoptiles to prevent this). Untreated coleoptiles – bend towards the right, because auxin is produced by the tip and diffuses away from the light on the left, stimulating growth on that side.

- c** Each coleoptile is a different starting length. Therefore to make for a fair comparison between treatments we need to find the increase in length in comparison to the starting length. We can do this by calculating a percentage increase.

## CHAPTER 13

1 ► B      2 ► A      3 ► D      4 ► D

5 ► **a** Stigma.

- b** By the coloured petals, scent and nectar.  
**c** Pollen tube should be shown growing down through the rest of the style and entering the ovary.

6 ► **a** Independent: temperature

Dependent: height of seedlings and % of seeds that germinated

- b**  $(3.4 + 4.5 + 2.5 + 3.7 + 2.8 + 4.4 + 4.3 + 2.9 + 2.1 + 3.7) / 10 = 3.43$  cm  
**c** Higher temperatures (20 °C or 30 °C) are needed for germination to take place. At a low temperature (4 °C) few seeds germinated or grew. Growth of seedlings was greater at 30 °C than at 20 °C.  
**d** Temperature affects the activity of enzymes and the rate of metabolic reactions. It increases the kinetic energy of molecules, so that there are more collisions between enzyme and substrate molecules, resulting in an increase in successful reactions. Germination depends on metabolic reactions, so temperature affects germination.

**e** The light intensity is not controlled. Tube A is in the light, while B and C are in the dark. All three tubes should be in the light (or all three in the dark).

7 ► **a** This method of reproduction does not involve flowers / seeds / pollen and ovules, so is not sexual. It involves the tubers growing from body cells of the parent plant.

- b** The tubers grow from body cells of the parent plant by mitosis, which produces cells that are genetically identical.  
**c** Growth may be affected by the environment of the plants, e.g. different soil minerals or different light intensity.  
**d** Sexual reproduction produces offspring that show genetic variation, allowing them to survive if the environment changes.

8 ► **a** A = stigma, B = ovary, C = anther, D = filament.

- b** Any three of:
- lack of large petals (no need to attract insects)
  - lack of brightly coloured petals (no need to attract insects)

- exposed stamens (to catch the wind and blow pollen away)
- exposed stigma (to catch windborne pollen)
- stigma feathery (to catch pollen).

**c** The pollen grain produces a pollen tube, which grows down through the tissue of the style and into the ovary. The pollen tube enters an opening in an ovule. The tip of the pollen tube breaks down and the pollen grain nucleus moves out of the pollen tube into the ovule, where it fertilises the nucleus of the egg cell (ovum).

**d** Any four of:

- large petals
- brightly coloured petals
- stamens enclosed within flower
- stigma enclosed within flower
- stigma sticky
- nectaries present
- large, sticky pollen grains.

9 ► **a** Method A. Fruits are produced by flowers via sexual reproduction, which introduces genetic variation.

**b** Insect-pollinated. The flower has large, brightly coloured petals to attract insects.

10 ► **a** The banana plants reproduce asexually, so they are all genetically identical. Therefore all the plants are susceptible to the fungus, none is resistant to it.

**b** If the plants reproduced sexually, this would introduce genetic variation. Some of the plants might then have resistance to the fungus, and would be able to survive.

**c** Asexual reproduction is faster than sexual reproduction; so more banana plants can be produced more quickly. (Also, if the plants are resistant to a disease, they all will be, so won't be killed by it.)

## END OF UNIT 3 QUESTIONS

1 ► **a i** Any four points from:

As light intensity increases, the rate of photosynthesis increases (1). The rate of increase is faster at high CO<sub>2</sub> concentration than at low CO<sub>2</sub> concentration (1).

(At both CO<sub>2</sub> concentrations) the rate of photosynthesis reaches a plateau / maximum / levels off (1). At low CO<sub>2</sub> concentration this happens below light intensity X (1) whereas at high CO<sub>2</sub> concentration it happens at / above light intensity X (1).

The maximum rate of photosynthesis is higher at high CO<sub>2</sub> concentration than at low CO<sub>2</sub> concentration (1).

**ii** Up to X the limiting factor is light (1), because increasing light intensity increases the rate of photosynthesis (1). Beyond X the limiting factor is CO<sub>2</sub> (1), as increasing light intensity has no effect on the rate of photosynthesis (1) whereas increased CO<sub>2</sub> increases the rate (1).

**b i** Temperature, water availability.