**5** A plant that is described as a mesophyte has evolved to grow in conditions that do not normally experience water stress (low availability of water).

**(a)** Fig. 5.1 is a diagram of a cross section through the leaf of a herbaceous dicotyledonous mesophyte.

Complete Fig. 5.1 by naming structure **A** and tissue layer **B**.

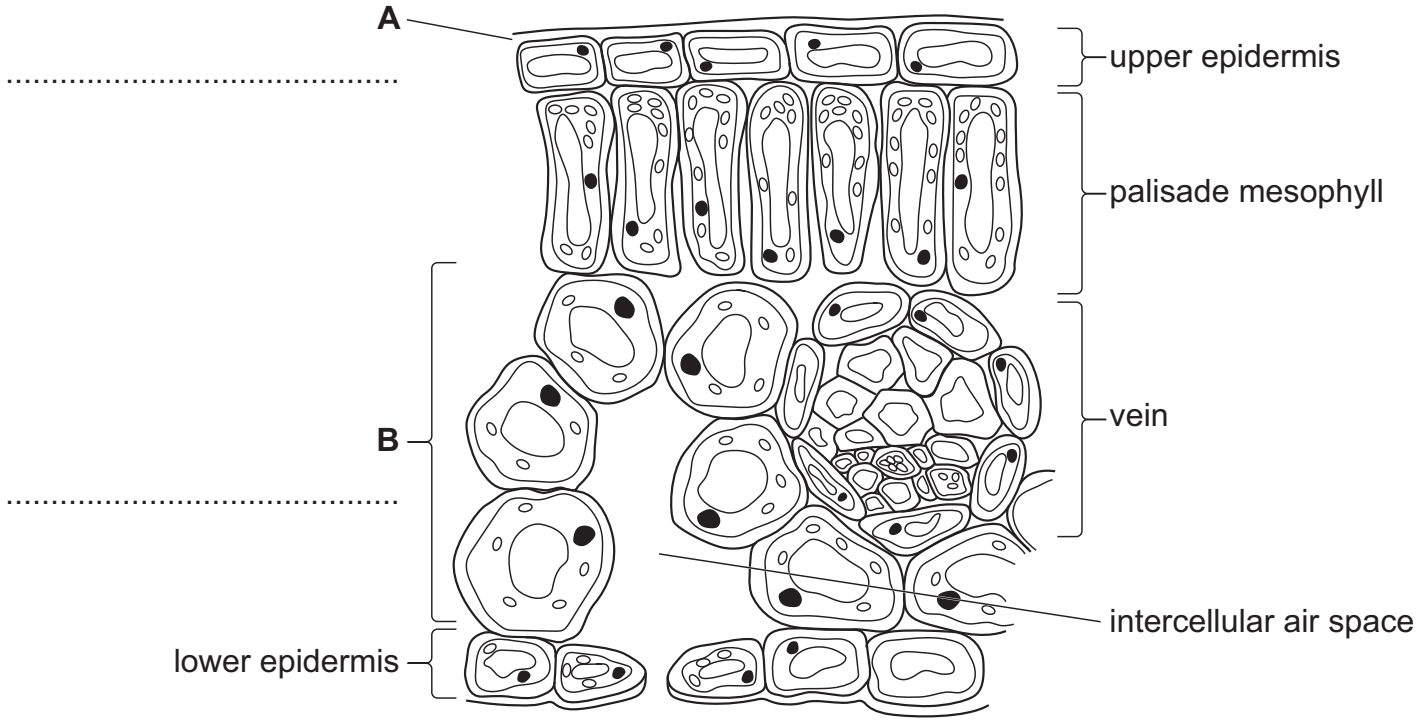


**Fig. 5.1**

[2]

**(b)** In **xerophytes**, some of the structural features shown in Fig. 5.1 are modified as adaptations for surviving conditions of water stress.

Complete **Table 5.1** to show how the structural feature listed may be modified in the leaf of a **xerophyte**.

Each feature should have a **different** example of a modification.

**Table 5.1**

| **structural feature in Fig. 5.1** | **one example of a xerophytic adaptation** |
|---|---|
| structure **A** | |
| upper epidermis | |
| lower epidermis | |

[3]



[Total: 5]

**8** **(a)** When the water supply to a plant is reduced, the concentration of abscisic acid (ABA) in the leaves increases.

ABA binds to receptors in the cell surface membranes of guard cells. This triggers a series of events in the cells, which results in stomatal closure.

Fig. 8.1 is a diagram of part of a guard cell showing some of the events that occur when ABA binds to its receptor.

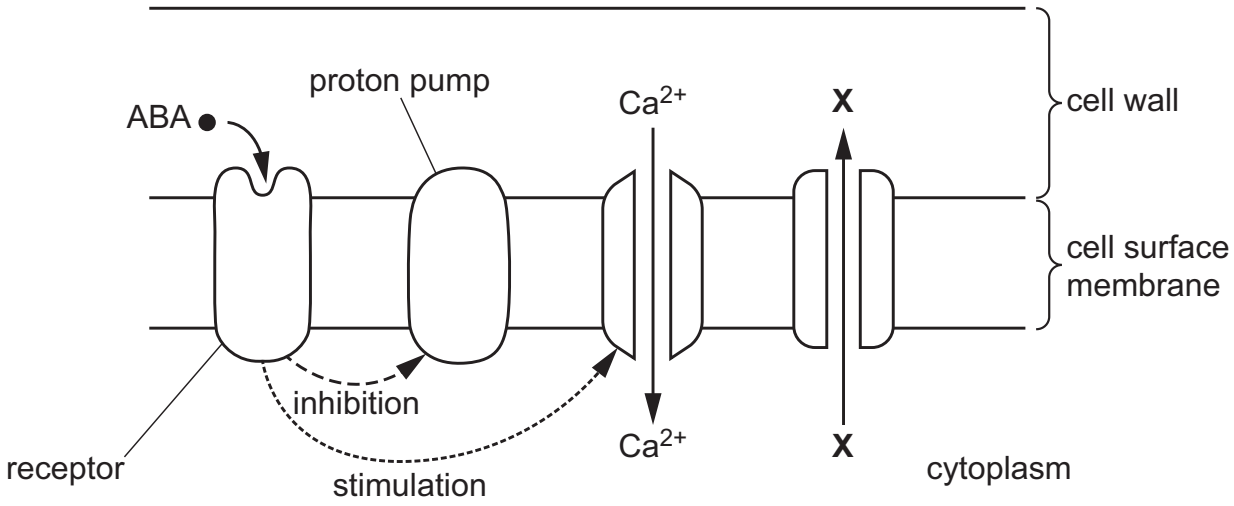


**Fig. 8.1**

Fig. 8.1 shows that calcium ions are involved in the events within a guard cell that result in stomatal closure.

Outline the role of calcium ions in the response of the guard cell to a reduced water supply **and** explain how this response results in stomatal closure.

Identify **X** in your answer.

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..... [4]

**(b)** Explain, using examples, why the homeostatic control involving the opening and closing of stomata is important for the efficient functioning of plants.

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..... [4]

[Total: 8]

**1** The plantain lily, *Hosta plantaginea,* as shown in Fig. 1.1, is a flowering plant found in Asia.


**Fig. 1.1**

The hydrostatic pressure increases inside guard cells when water enters the guard cells down a water potential gradient. This affects the width of the stomata.

Fig. 1.2 shows 1 open stoma from the plantain lily surrounded by 2 guard cells.

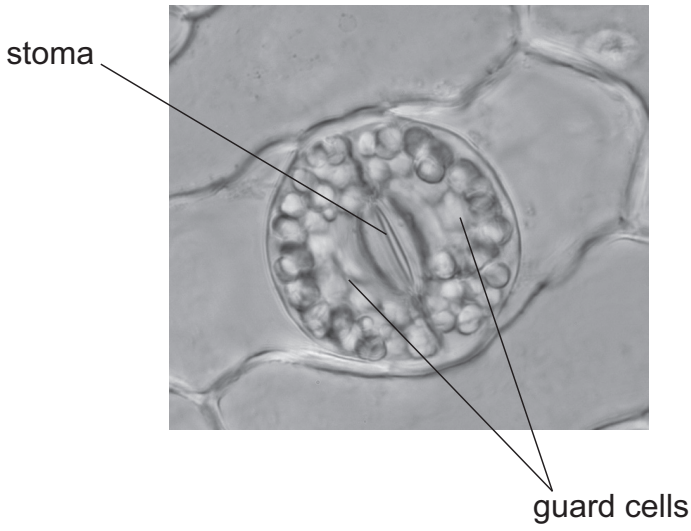


**Fig. 1.2**

A student investigated the effect of different sucrose solutions on the width of stomata in the leaves of plantain lily.

The student:

- prepared 5 microscope slides as shown in Table 1.1

**Table 1.1**

| microscope slide number | liquid added to microscope slide |
|---|---|
| 1 | large drop of distilled water |
| 2 | large drop of 2.5% sucrose solution |
| 3 | large drop of 5.0% sucrose solution |
| 4 | large drop of 10.0% sucrose solution |
| 5 | large drop of 20.0% sucrose solution |

- removed the lower epidermis from a leaf of plantain lily
- immersed 1 small piece of lower epidermis in the drop on microscope slide 1
- placed a cover slip over the piece of lower epidermis
- observed the stomata using a light microscope fitted with an eyepiece graticule
- repeated the steps for microscope slides 2, 3, 4 and 5.

**(a) (i)** State the independent and dependent variables in the investigation.

independent .....

.....

dependent .....

.....

[2]

**(ii)** The student prepared 20 $cm^3$ of 2.5%, 5.0% and 10.0% sucrose solutions from a 20.0% w/v stock solution.

Complete the description of the student's dilution method for the 2.5% and 5.0% sucrose solutions by writing the correct volumes in the following sentences.

The student mixed ..... $cm^3$ of 20.0% sucrose stock solution with ..... $cm^3$ of distilled water to produce a 2.5% sucrose solution.

The student mixed ..... $cm^3$ of 20.0% sucrose stock solution with ..... $cm^3$ of distilled water to produce a 5.0% sucrose solution.

[2]

**(iii)** The student observed stomata on the microscope slides using the high-power objective lens.

Outline a method the student could use to investigate the effect of the sucrose solutions in Table 1.1 on the width of stomata in the leaves of plantain lily.

Your method should be set out in a logical order and be detailed enough to allow another person to follow it.

Details of how to prepare the microscope slides should **not** be included.

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..... [5]

**(iv)** Predict the effect of increasing the sucrose concentration from 0.0% to 20.0% on the width of stomata in the leaves of plantain lily.

Explain your prediction.

prediction .....

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explanation .....

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[2]

**(b)** Another piece of lower epidermis from a leaf of plantain lily was immersed in a large drop of distilled water on a microscope slide.

Fig. 1.3 shows the lower epidermis viewed using the low-power objective lens.

The student determined the stomatal density on the lower epidermis using Fig. 1.3 only.

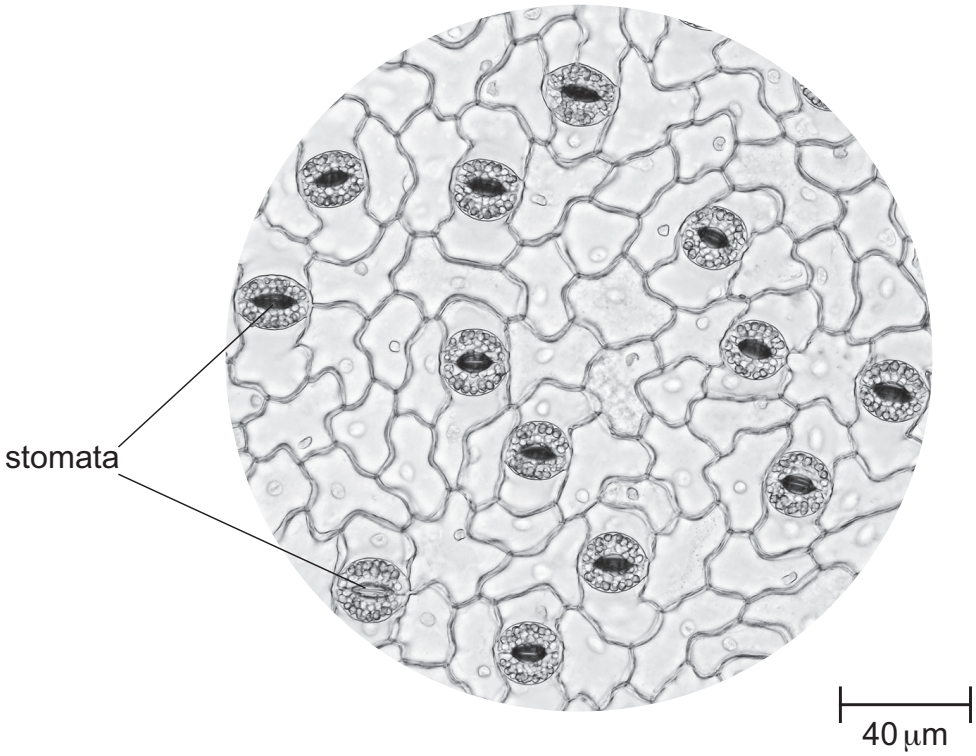


**Fig. 1.3**

**(i)** Use Fig. 1.3 to calculate the stomatal density on the lower epidermis.

Use the equation:

area = $\pi r^2$ and $\pi$ = 3.14

Give your answer to the nearest whole number and show your working.

stomatal density = ..... $mm^{-2}$

[4]

**(ii)** Suggest how this investigation could be improved to increase confidence in your answer in **(b)(i)**.

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[1]

**(iii)** A different plant species had a lower stomatal density than the value calculated for plantain lily in **(b)(i)**.

Suggest how the environmental conditions of the different plant species may vary from those of the plantain lily.

Explain your answer.

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..... [2]

[Total: 18]

**2** Scientists investigated the effect of abscisic acid (ABA) on reducing water loss in plants. The scientists predicted that ABA, as well as stimulating stomatal closure, also reduces water loss in plants in other ways.

The scientists used a mutant variety of thale cress, *Arabidopsis thaliana*, that has stomata that do **not** respond to ABA. When ABA is present, the stomata of the mutant variety remain open.

The scientists sprayed different concentrations of ABA on the leaves of the mutant variety and measured the transpiration rates of the plants.

The results are shown in Fig. 2.1.

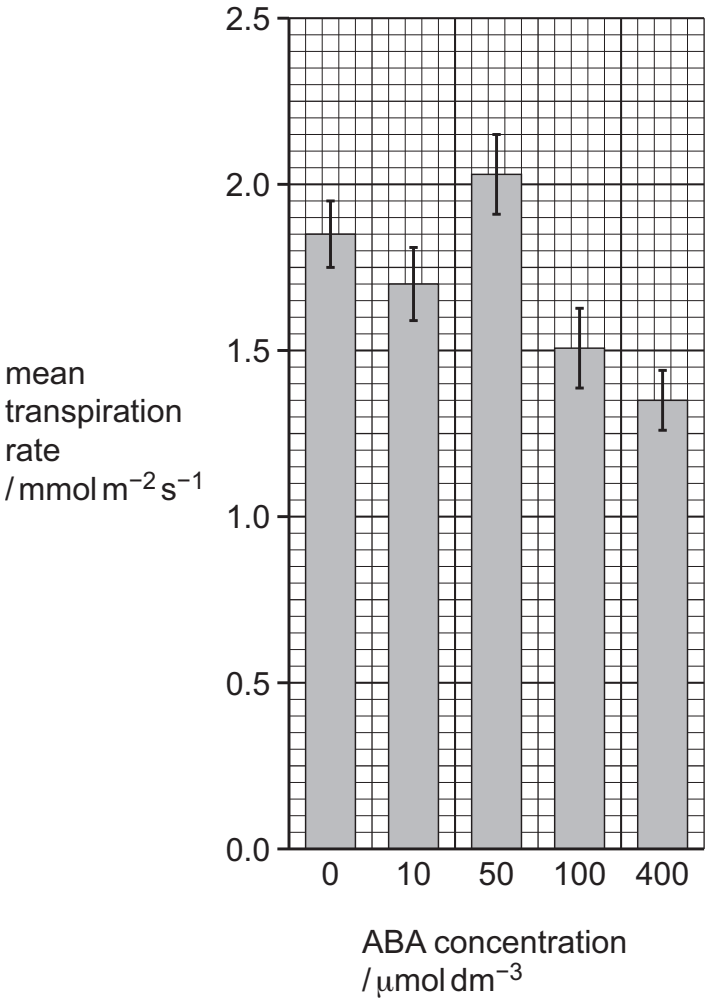


**Fig. 2.1**

**(a)** Calculate the percentage decrease in transpiration rate from 0 to 400 μmol dm$^{-3}$ of ABA for the mutant variety.

Show your working.

percentage decrease = .....

[2]

**(b)** With reference to Fig. 2.1, suggest conclusions that can be made about the effect of different concentrations of ABA on the transpiration rates of the mutant variety.

State the evidence that supports your conclusions.

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..... [2]

**(c)** The scientists used a mutant variety of thale cress that has stomata that do **not** respond to ABA.

The scientists concluded that ABA reduces water loss in thale cress by ways other than stomatal closure.

Suggest additional information that is required to increase the confidence in this conclusion.

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[Total: 7]