

14.2 Homeostasis in plants

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS stomata • guard cell • abscisic acid
• transpiration • calcium ion

Objective

Build the skills to answer exam questions on **homeostasis in plants** – how **stomata** open and close, the role of **guard cells**, and **abscisic acid** (ABA) in water stress.

You must be able to:

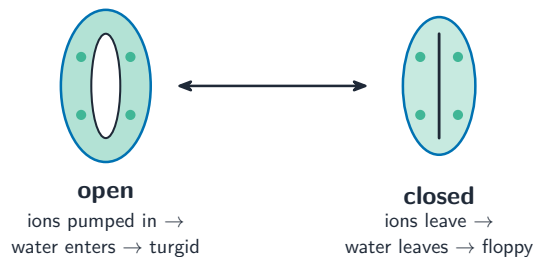
- explain why stomatal aperture balances CO₂ uptake against water loss
- describe how guard cells open and close stomata
- describe the role of ABA and calcium ions in closing stomata during water stress

1 Key knowledge and worked examples

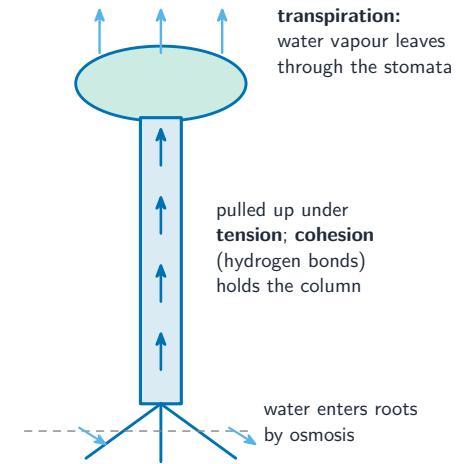
■ Why stomata open and close

A stoma must let in **carbon dioxide** for photosynthesis while limiting water loss by **transpiration**. So stomata usually open by day and close at night (a daily rhythm).

■ How guard cells work



Guard cells open the stoma when turgid (swollen with water); they close it when floppy



Guard cells control water loss through the stomata

- to **open**: guard cells pump in ions, lowering their **water potential**; water enters by **osmosis**; they swell, become turgid and bend apart, opening the pore.
- to **close**: ions leave, water follows out, the guard cells go floppy and the pore closes.

■ Water stress and ABA

When the plant is short of water, the hormone **abscisic acid** (ABA) is released. It makes the guard cells lose ions and water, so the stomata close and save water. **Calcium ions** act as a **second messenger** inside the guard cells.

2 Practice

2.1 State the **two** opposing needs that the opening of stomata must balance. [2]

2.2 Name the hormone that closes stomata when a plant is short of water. [1]

3 Exam-style questions

3.1 A stoma opens when its guard cells: [1]

- ☐ **A** lose ions and become floppy
B gain ions, so water enters by osmosis and they become turgid
C lose water by osmosis
D release abscisic acid

3.2 What is the role of calcium ions in the response to water stress? [1]

- ☐ **A** they are pumped out to open the stomata
B they act as a second messenger inside the guard cells
C they replace water in the guard cells
D they are absorbed for photosynthesis

3.3 Explain the mechanism by which guard cells open a stoma. [3]

3.4 (a) Explain why a plant closes its stomata when the soil becomes dry. [2]

(b) Suggest one disadvantage to the plant of keeping its stomata closed for a long time. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

- letting in carbon dioxide for photosynthesis; limiting water loss by transpiration

2.2

- abscisic acid (ABA)

3.1 B

- Gaining ions lowers the water potential, water enters by osmosis, and the turgid guard cells open the pore

3.2 B

- Calcium ions act as a second messenger inside the guard cells

3.3

- guard cells actively pump in ions, lowering their water potential; water enters by osmosis, so they become turgid; the unevenly thickened walls make them bend apart, opening the pore

3.4

(a)

- closing the stomata reduces water loss by transpiration, conserving the limited water

(b)

- less carbon dioxide can enter, so the rate of photosynthesis falls / less food is made