

14.2 Homeostasis in plants

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS stomata 气孔 • guard cell 保卫细胞 • abscisic acid 脱落酸
• transpiration 蒸腾作用 • calcium ion 钙离子

Objective

Build the skills to answer exam questions on **homeostasis in plants** — how **stomata** 气孔 open and close, the role of **guard cells** 保卫细胞, and **abscisic acid** 脱落酸 (ABA) in water stress.

You must be able to:

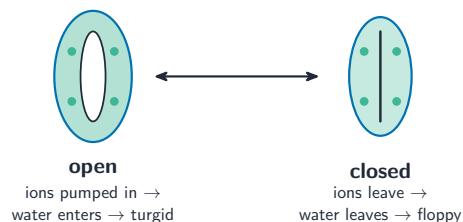
- explain why stomatal aperture balances CO_2 uptake against water loss
- describe how guard cells open and close stomata
- describe the role of ABA and calcium ions in closing stomata during water stress

1 Worked examples

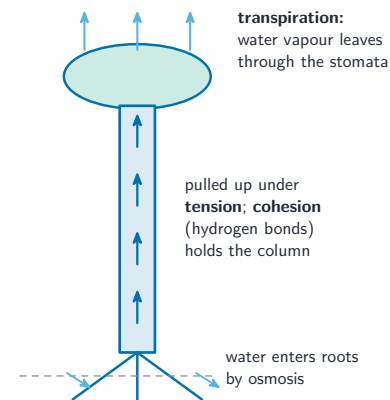
■ Why stomata open and close

A stoma must let in **carbon dioxide** 二氧化碳 for photosynthesis while limiting water loss by **transpiration** 蒸腾作用. 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** 水势; water enters by **osmosis** 渗透; 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** 钙离子 act as a **second messenger** 第二信使 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 | B |
| C | D |
- 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 | B |
| C | D |
- 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]
