IGCSE BIOLOGY • EXERCISE SHEET

8.3 Transpiration

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

KEY WORDS transpiration 蒸腾作用 • humidity 湿度 • temperature 温度 • wind speed 风速 • stomata 气孔

Objective

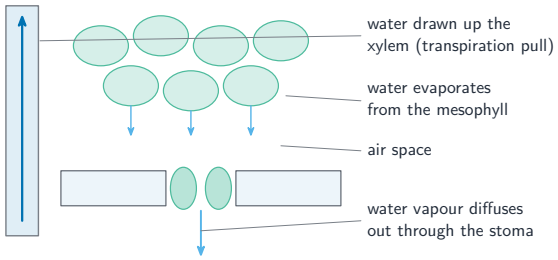
Build the skills to answer exam questions on **transpiration** 蒸腾作用 — what it is, the factors affecting its rate, and the **transpiration pull** 蒸腾拉力.

You must be able to:

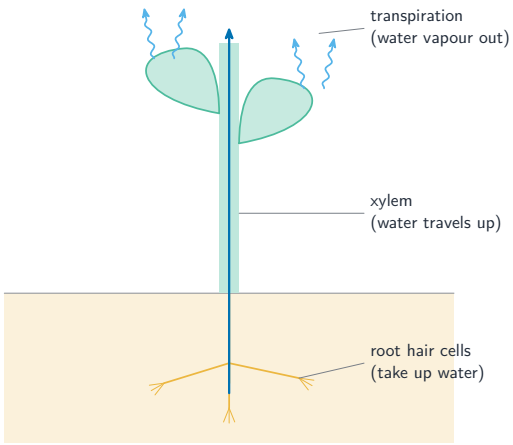
- describe transpiration (evaporation then diffusion out of the stomata)
- explain how temperature, wind and humidity affect the rate
- describe how the transpiration pull moves water up the xylem

1 Worked examples

Transpiration



Water evaporates from the wet mesophyll into the air spaces, then diffuses out of the stomata



Transpiration pulls water up the xylem pathway

- **faster when:** hotter (more evaporation), windier (vapour carried away), drier air.
- **transpiration pull:** water leaving the leaf pulls a column of water up the xylem.

2 Practice

2.1 Define transpiration. [1]

2.2 State the effect of higher wind speed on transpiration rate. [1]

3 Exam-style questions

3.1 Transpiration is fastest in conditions that are: [1]

- **A** cold, still and humid
- **B** hot, windy and dry
- **C** cold and dark
- **D** warm and very humid

3.2 Water vapour is lost from the leaves.

(a) Describe the two steps by which water leaves the leaf. [2]

(b) Explain why a higher temperature increases the rate of transpiration. [2]

3.3 Explain how the transpiration pull moves water up the xylem. [2]

3.4 A student measured the mass lost by a leafy shoot in four conditions, each for one hour.

Condition	Mass lost / g
A still air, 20 °C	1.2
B moving air (fan), 20 °C	2.8
C still air, 30 °C	2.1
D still air, 20 °C, in a plastic bag	0.3

(a) Explain the result for each of **B**, **C** and **D** compared with **A**. [6]

(b) State why measuring mass loss is a fair way to measure the rate of transpiration. [2]

(c) Describe how water moves from the soil, through the plant, to the air. [3]

(d) State **two** variables the student had to keep the same for the comparison to be fair. [2]

Solutions

2.1 the loss of water vapour from the leaves (of a plant).

2.2 it increases the rate.

3.1 B. Hot, windy and dry conditions give the fastest transpiration.

3.2 (a) water evaporates from the wet mesophyll cells into the air spaces; the water vapour diffuses out through the stomata.
(b) higher temperature makes water evaporate faster from the mesophyll, so more diffuses out.

3.3 as water leaves the leaf it pulls more water up behind it; the water molecules stick together and are drawn up the xylem as a column.

3.4 (a) **B** — moving air blows away the water vapour outside the stomata, keeping the concentration gradient steep so diffusion out is faster. **C** — higher temperature gives the water molecules more energy, so they evaporate from the mesophyll cells faster and diffuse faster. **D** — the bag traps water vapour, so the air just outside the leaf becomes very humid; the gradient is almost gone, so almost no water diffuses out.
(b) Almost all the mass a shoot loses is water leaving through the stomata; so the mass lost each hour is a good measure of how much water has been transpired.
(c) Water is absorbed from the soil by the root hair cells by **osmosis**; it travels up the stem in the **xylem** vessels; it evaporates from the mesophyll cell surfaces and diffuses out through the stomata as water vapour.
(d) The same shoot, or shoots with the same leaf area, so the surface losing water is the same; the same starting time and length of run, and the same light intensity, since light opens the stomata.