Unit 14 · Ecological Adaptation

ANSWER KEY · FOR TEACHERS

Full marks 35

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. hydrophytes
2. xerophytes
3. mesophytes
4. aerenchyma
5. root pocket
6. sunken
7. ephemerals
8. succulents

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. free- floating Pistia
2. rooted, with floating leaves lotus
3. rooted submerged Hydrilla
4. rooted emergent reed

K · 2

Each carries 0.5 mark.

3 Multiple choice

i. **c.** drought escapers — K · 1

Ephemerals are called **drought escapers** or **drought evaders**: they escape the drought by not being alive (except as seeds) when it comes.

ii. **c.** *Solanum xanthocarpum* — K · 1

Solanum xanthocarpum (kantakari) is the ephemeral. *Aloe* is a succulent, *Acacia nilotica* a true xerophyte, and *Begonia* a plant of moist, shady places.

iii. **b.** only the upper surface is in contact with the air — U · 1

Stomata exchange gases with the **air**, and only the upper surface of a floating leaf faces the air; on the lower side, lying on the water, they would be flooded and useless.

iv. **b.** the still, moist air trapped in the pit above them slows the escape of water vapor — U · 1

Water vapor leaves a stoma by diffusing into drier air. In a pit (a crypt), often lined with hairs, the air stays **still and humid**, so the difference in humidity is small and the vapor escapes slowly.

v. **b.** rooted with floating leaves — A · 1

Rooted in the mud, with leaves floating on the surface: **rooted with floating leaves**, like the water lily.

4 Very short answers

a. MARKING SCHEME — K · 1

✓ Morphological, physiological and behavioral.

b. MARKING SCHEME — K · 1

✓ Ceratophyllum or Utricularia.

c. MARKING SCHEME — U · 1

✓ So the roots can draw water from dry soil by osmosis.

d. MARKING SCHEME — U · 1

✓ It lives in moist shade and wilts in dry air: a mesophyte.

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5 Short answers

a. MARKING SCHEME U · 2

- ✓ Hydrophytes: water supports the plant and is everywhere.
- ✓ Xerophytes: they carry water far and must not collapse when they lose water.

b. MARKING SCHEME U · 2

- ✓ Stomata open at night; CO_2 stored as an acid, used in the day.
- ✓ Stomata closed in the heat of the day, so little water is lost.

c. MARKING SCHEME A · 2

- ✓ Aerenchyma: tissue with large air spaces.
- ✓ It gives buoyancy and stores and carries oxygen and carbon dioxide.

d. MARKING SCHEME U · 3

- ✓ A first way.
- ✓ A second way.
- ✓ A third way.

6 Long answers

a. ANSWER U · 4

Anatomical adaptations:

a. **Aerenchyma** (tissue with large air spaces) is well developed in stems, leaf stalks and leaves: it stores gases, carries oxygen to roots in the airless mud, and gives buoyancy.
b. **Mechanical tissue** and **vascular tissue** (especially xylem) are poorly developed, since water supports the plant and is everywhere.
c. The **cuticle** is absent or thin in submerged parts, so water and gases pass in easily.
d. **Stomata** are absent in submerged leaves, and only on the upper surface of floating leaves.
e. The epidermis of submerged parts has chloroplasts and absorbs water, minerals and gases.

Physiological adaptations:

a. A **low compensation point**: they photosynthesize enough in dim light under water.
b. A **low osmotic concentration** of the cell sap.
c. Nutrients are absorbed, and gases exchanged with the water, through the whole surface (epidermis).
d. **Transpiration** is absent in submerged plants, but very fast in floating and emergent ones.

MARKING SCHEME

- ✓ Aerenchyma: stores gases, carries oxygen to roots, buoyancy.
- ✓ Mechanical and vascular tissue poorly developed; cuticle absent or thin.
- ✓ Stomata absent in submerged leaves, upper surface only in floating ones.
- ✓ Physiological: low compensation point, low osmotic concentration, absorption through the whole surface (any two).

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b. ANSWER A · 4

	Hydrophyte (e.g. *Hydrilla*, *Eichhornia*)	Xerophyte (e.g. *Opuntia*, *Nerium*)
Roots	absent or few and short, no root hairs; root pockets in free-floating plants	long and deep, or wide-spreading; many root hairs
Leaves	thin, divided or ribbon-like (submerged), or broad and flat (floating)	small, scaly, spiny, rolled or absent
Cuticle and stomata	cuticle absent or thin; stomata absent (submerged) or on the upper surface (floating)	thick, waxy cuticle; sunken stomata, few, mostly on the lower surface
Cell sap	low osmotic concentration	high osmotic concentration

MARKING SCHEME

- ✓ Roots compared.
- ✓ Leaves compared.
- ✓ Cuticle and stomata compared.
- ✓ Cell sap compared, with an example of each plant.

7 Think

ANSWER HA · 3

Upper Mustang lies in the **rain shadow** of the Himalaya: the wet monsoon air drops its rain on the southern slopes, so very little reaches it, and it is almost a desert.

Plants that survive there must **get, store and save** water, so natural selection has favored xerophytic features.

Any two on a shrub: **deep or wide-spreading roots**; **small, hard or spiny leaves**; a **thick, waxy cuticle**; **sunken stomata**; high osmotic concentration of the sap.

MARKING SCHEME

- ✓ Rain shadow: little rain reaches it.
- ✓ Only plants that get, store and save water survive.
- ✓ Two expected xerophytic features.

8 Activity: Leaves from wet and dry places

(not marked)

WHAT STUDENTS SHOULD FIND

The water plant's leaf or leaf stalk is soft and spongy, with large air spaces visible in the cut (aerenchyma); the dry-place leaf is thick, tough and glossy, with a waxy surface on which water beads, and *Aloe* or *Agave* shows clear, jelly-like water-storing tissue. The water plant's leaf wilts much faster in the sun: it has little cuticle and no way of saving water, while the xerophyte's thick cuticle and few, sunken stomata hold the water in.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	10	15	7	3	**35**

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