Unit 5 · Fungi and Lichens

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. mycelium → **g.** the network of hyphae that makes the body of a fungus
2. columella → **c.** the sterile, dome-shaped top of the sporangiophore inside a Mucor sporangium
3. oidia → **a.** short cells of a Mucor hypha in a sugary liquid, which bud like yeast
4. pseudomycelium → **i.** a temporary chain of yeast cells that stay joined after budding
5. annulus → **j.** the ring on a mushroom's stipe, left by the torn velum
6. mycorrhiza → **e.** fungal hyphae living on or in plant roots, helping both
7. mycobiont → **f.** the fungal partner of a lichen
8. fruticose → **d.** a shrubby or hanging lichen, attached only at its base

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. cell wall
2. nucleus
3. glycogen
4. bud scar
5. vacuole
6. lipid droplet

K · 3

Each carries 0.5 mark.

3 Multiple choice

i. **b.** basidiomycetes — K · 1

The **basidium** is club-shaped, so the basidiomycetes are the club fungi. Ascomycetes are the sac fungi; phycomycetes the algal fungi; deuteromycetes the imperfect fungi.

ii. **c.** glycogen — K · 1

Fungi store **glycogen** (and some oil), like animals; plants store starch. This is one of the reasons fungi are no longer classed as plants.

iii. **b.** secondary, dikaryotic mycelium — U · 1

The **secondary** mycelium forms when two monokaryotic primary mycelia fuse; its cells are **dikaryotic** (two nuclei). It lives long and makes the fruiting bodies.

iv. **a.** haplobiontic, as in *Schizosaccharomyces octosporus* — U · 1

In the **haplobiontic** cycle the zygote turns directly into an ascus and undergoes meiosis, so it is the only diploid cell; every other cell is haploid. In the diplobiontic cycle the four ascospores are the only haploid cells; in *S. cerevisiae* both phases bud for many generations.

v. **b.** *Rhizopus stolonifer*, the black bread mold — A · 1

Stolons and **rhizoids**, with sporangiophores in clusters, mark *Rhizopus*. *Mucor* has no stolons or rhizoids, and its sporangiophores rise one by one.

4 Very short answers

a. MARKING SCHEME — K · 1

✓ Penicillium.

b. MARKING SCHEME — K · 1

✓ Erik Acharius.

c. MARKING SCHEME — U · 1

✓ Cold slows the molds' enzymes and growth.

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5 Short answers

a. MARKING SCHEME — U · 2

- ✓ The sexual stage is the perfect stage; Deuteromycetes have only the asexual (conidia) stage known.
- ✓ When a sexual stage is found, the fungus moves to its class (usually Ascomycetes).

b. MARKING SCHEME — U · 2

- ✓ Two correct reasons.
- ✓ Two more correct reasons.

c. MARKING SCHEME — A · 2

- ✓ No: the death cap passes all these tests and is deadly.
- ✓ Eat only farmed mushrooms or ones an expert has identified.

d. MARKING SCHEME — U · 3

- ✓ Crustose, described, with an example.
- ✓ Foliose, described, with an example.
- ✓ Fruticose, described, with an example.

6 Long answers

a. ANSWER — U · 4

It happens in unfavorable conditions, by **conjugation** between **+ and − strains** (most species are heterothallic).

Hyphae of the two strains put out club-shaped **progametangia** towards each other. Their tips meet, and a septum cuts each into a basal **suspensor** and a terminal **gametangium**.

The wall between the gametangia dissolves and their multinucleate contents fuse into a **zygote**, whose nuclei fuse in + and − pairs. It grows a thick, warty, dark wall: the **zygospore**, which rests, sometimes for months.

On germination one diploid nucleus divides by **meiosis**; one of the four haploid nuclei survives and divides many times. The protoplast grows out as a **promycelium** whose tip forms a **germ sporangium** of haploid **germ spores**, each growing into a new mycelium.

MARKING SCHEME

- ✓ + and − strains; progametangia; suspensors and gametangia.
- ✓ Gametangia fuse into a zygote; nuclei fuse in pairs.
- ✓ A thick-walled resting zygospore.
- ✓ Meiosis on germination; promycelium; germ sporangium with germ spores.

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b. ANSWER A · 4

Why lichens are sensitive:

a. They have no roots and no waxy cuticle: they absorb water and dissolved substances, including pollutants, straight from rain, mist and air over their whole surface.
b. They have no way of excreting what they absorb, so pollutants build up in them.
c. They grow slowly and live for many years, and keep absorbing all year round, so they show the long-term average air, not one day's.
d. Their alga's chlorophyll is damaged by **sulphur dioxide**, which also makes their surface acidic.

How to use them:

a. Choose sites along a line from the industrial area out into the countryside, and at each site examine the same kind of tree (the same bark) at the same height.
b. At each site, record which lichens grow and how much of the bark they cover, for example with a transparent grid of squares held on the trunk.
c. Compare the sites: near the polluting source, lichens are few or absent (a "lichen desert"), or only crustose kinds survive; farther away foliose kinds appear; in clean air shrubby fruticose kinds such as *Usnea* grow. The kinds of lichen present form a scale of air quality.
d. Lichens can also be collected and analyzed for the sulphur and metals they have absorbed.

Changes over time: repeating the survey every few years shows trends. If lichens disappear, or the sensitive kinds give way to tolerant crusts, the air is getting worse; if fruticose and foliose lichens come back, the air is improving, as happened in many European cities after sulphur dioxide was cut from the 1970s onwards.

MARKING SCHEME

✓ Why sensitive: absorb over the whole surface, can't excrete, slow-growing and long-lived (any two).
✓ Sites from the industrial area to the countryside, on the same kind of tree, recording the lichens.
✓ Near the source few or only crustose; farther foliose; in clean air fruticose.
✓ Repeated surveys show whether the air is getting better or worse.

7 Think

ANSWER HA · 3

A **lichen** is two organisms from different kingdoms (a fungus and an alga or cyanobacterium), and the kingdoms classify single kinds of organisms, so a partnership fits none of them.
The **oomycetes** were put with the fungi because they look and live like them, but their **walls are cellulose**, their cells are mostly diploid and their **DNA** puts them with the brown algae: grouping by looks can mislead, and DNA now shows true relationships.
Today a lichen is named and classified by its **fungus**, placed among the Fungi (mostly Ascomycetes).

MARKING SCHEME

✓ A lichen is two organisms from different kingdoms: a partnership fits no single kingdom.
✓ Oomycetes: cellulose walls and DNA show grouping by looks can mislead.
✓ A lichen is classified by its fungal partner.

8 Activity: Observe the growth of a mold on bread

(not marked)

WHAT STUDENTS SHOULD FIND

After 3–6 days a white, cottony fur of hyphae spreads over the bread, then fine upright threads each tipped with a tiny round head, white at first, then gray or black: sporangiophores with sporangia. Tufts of root-like threads under clusters of stalks, joined by arching runners, mean *Rhizopus*; stalks rising one by one, with no rhizoids or stolons, mean *Mucor*.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	11	14	7	3	**35**

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