Unit 4 · Ecology

ANSWER KEY · FOR TEACHERS

Full marks 45.5

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. population
2. community
3. habitat
4. niche
5. detritus
6. keystone
7. detritivores
8. hydrophytes

K · 4

Each carries 0.5 mark.

2 Multiple choice

i. **b.** Ernst Haeckel — K · 1

Ernst Haeckel made the word in 1866, from the Greek *oikos* (home) and *logos* (study). Arthur Tansley gave us the word "ecosystem" in 1935.

ii. **b.** it decreases, because the rabbits increase — A · 1

With fewer foxes, fewer rabbits are eaten, so the rabbits increase. More rabbits eat more grass, so the grass then decreases. The effect on the grass comes through the rabbits, a step later.

iii. **c.** bacteria and fungi — U · 1

Bacteria and fungi break dead matter right down, outside their bodies, to simple substances. Earthworms and termites are detritivores, vultures and jackals scavengers; algae and mosses are producers.

iv. **c.** certain fungi — K · 1

Lignin is broken down almost only by certain fungi (white-rot fungi), whose hyphae grow into wood and release the enzymes that break it.

v. **b.** methane — U · 1

In waterlogged mud there is no oxygen, and microbes break down dead matter anaerobically, giving out methane (the main gas in biogas) and carbon dioxide.

vi. **c.** Koshi Tappu — K · 1

Koshi Tappu was listed on 17 December 1987. Rara and Gosaikunda were listed in 2007, and Phewa, as part of the Lake Cluster of Pokhara Valley, in 2016.

3 Match the columns

1. fragmentation → **c.** detritivores chew dead matter to pieces
2. leaching → **a.** water carries soluble substances down into the soil
3. catabolism → **d.** enzymes break large molecules into small ones
4. humification → **b.** resistant remains form a dark, crumbly substance
5. mineralization → **f.** inorganic salts are released for roots

K · 2.5

Each carries 0.5 mark.

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4 True or false

U · 3

i. ✗ **False**: Energy flows one way; materials cycle.
ii. ✓ **True**
iii. ✗ **False**: Vultures are scavengers; bacteria and fungi are the decomposers.
iv. ✓ **True**
v. ✗ **False**: It is slower and often incomplete.
vi. ✗ **False**: A lotus is rooted in the mud.

Each carries 0.5 mark.

5 Very short answers

a. MARKING SCHEME — K · 1

✓ Trophic cascade.

b. MARKING SCHEME — K · 1

✓ 2 February.

c. MARKING SCHEME — U · 1

✓ Diclofenac.

6 Short answers

a. MARKING SCHEME — U · 2

✓ In a web, an animal has several foods, so it can turn to another when one is scarce.
✓ In a chain each animal depends on one food, so if it goes, those above it starve.

b. MARKING SCHEME — U · 2

✓ Bacteria and fungi digest dead matter outside their bodies, right down to simple inorganic substances.
✓ Earthworms digest part of it inside their bodies, only breaking it to pieces: they are detritivores.

c. MARKING SCHEME — U · 2

✓ Kidneys clean blood by removing wastes.
✓ In a wetland silt settles, and plants and microbes take up nutrients and break down pollutants, so the water leaves cleaner.

d. MARKING SCHEME — U · 2

✓ Waterlogged ground has very little oxygen.
✓ Only anaerobic microbes can work, and they are slow and leave the breakdown incomplete.

e. MARKING SCHEME — K · 2

✓ Any two reasons.
✓ Any two threats.

7 Long answers

a. ANSWER

Decomposition is the breaking down of complex organic matter in dead plants, animals and their wastes into simpler substances, and finally into inorganic ones (carbon dioxide, water and minerals), mainly by bacteria and fungi. Its steps:

1. **Fragmentation:** detritivores such as earthworms, termites and millipedes break the dead matter into small pieces, giving more surface for microbes.
2. **Leaching:** water dissolves the soluble substances of the dead matter and carries them down into the soil.
3. **Catabolism:** bacteria and fungi release enzymes that break the large molecules (cellulose, starch, proteins, fats) into simple ones (sugars, amino acids, fatty acids), which they absorb.
4. **Humification:** the resistant remains form **humus**, a dark, crumbly, organic substance that holds water and minerals.

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5. **Mineralization:** humus is slowly broken down by microbes, releasing inorganic nutrients (ammonium, nitrates, phosphates, potassium) that plants take up again. U · 6

MARKING SCHEME

- ✓ Breaking down of organic matter into simpler and finally inorganic substances, mainly by bacteria and fungi.
- ✓ Fragmentation: detritivores break it into pieces.
- ✓ Leaching: water carries soluble substances into the soil.
- ✓ Catabolism: enzymes of bacteria and fungi break large molecules into simple ones.
- ✓ Humification: resistant remains form humus.
- ✓ Mineralization: humus slowly releases inorganic nutrients.

b. **ANSWER** A · 4

Take the chain **rice** → **grasshopper** → **frog** → **snake** → **hawk**, and suppose the frogs decrease (because they are caught or poisoned).

- **The frogs' eaters:** the snakes have less food, so fewer survive and breed, and the snakes decrease. With fewer snakes, the hawks have less food and decrease too.
- **The frogs' food:** fewer grasshoppers are eaten, so the grasshoppers increase. More grasshoppers eat more rice, so the rice crop decreases.

So a decrease in one population makes its eaters decrease and its food increase, and each change passes on to the next link. The ecosystem's balance is upset, and the farmer may lose his crop, though nobody touched the rice.

MARKING SCHEME

- ✓ A chain such as rice → grasshopper → frog → snake → hawk, with one population decreasing.
- ✓ Its eaters decrease, and then their eaters.
- ✓ Its food increases, and then the food of that decreases.
- ✓ The rule: a decrease makes eaters decrease and food increase, passing on along each link.

8 Working it out

ANSWER A · 4

- Moist soil: lost $25.0 - 17.5 = 7.5$ g; $7.5 \div 25.0 \times 100 = \mathbf{30\%}$.
- Dry ground: lost $25.0 - 23.0 = 2.0$ g; $2.0 \div 25.0 \times 100 = \mathbf{8\%}$.
- Compost heap: lost $25.0 - 11.5 = 13.5$ g; $13.5 \div 25.0 \times 100 = \mathbf{54\%}$.

The compost heap is warm (its microbes give out heat as they respire), moist and full of decomposers and detritivores, so the leaves decayed fastest. Moist soil has water and decomposers but is cooler. Dry, sunny ground has too little water for bacteria and fungi to work, so the leaves hardly changed. Most of the lost mass went into the air as carbon dioxide breathed out by the decomposers.

MARKING SCHEME

- ✓ Moist soil: $7.5 \div 25.0 \times 100 = 30\%$.
- ✓ Dry ground: $2.0 \div 25.0 \times 100 = 8\%$.
- ✓ Compost heap: $13.5 \div 25.0 \times 100 = 54\%$.
- ✓ The heap is warm, moist and full of decomposers; dry ground has too little water for them.

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9 Think

ANSWER HA · 3

No. Vultures are **scavengers**: animals that eat dead bodies and digest them inside their bodies. The true decomposers are bacteria and fungi, which break dead matter right down to simple inorganic substances. But vultures do an important job: they clear carcasses fast. When diclofenac killed most of South Asia's vultures, carcasses lay rotting for longer, spreading germs, and stray dogs ate them instead and multiplied, bringing more dog bites and rabies. One study estimated about half a million extra human deaths in India from 2000 to 2005. A decrease in one population affected many others, people among them.

MARKING SCHEME

- ✓ No: vultures are scavengers, and they digest inside their bodies; bacteria and fungi are the decomposers.
- ✓ Carcasses lay rotting for longer, spreading germs.
- ✓ Stray dogs ate them and multiplied, with more bites and rabies.

10 Activity: Observe an ecosystem

(not marked)

WHAT STUDENTS SHOULD FIND

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **The Ecosystem Pond** (exhibit): The guppies here are one population; with the plants and tiny algae they make a community, and with the water and light, an ecosystem.
- **Plant Terrarium** (exhibit): Living plants with non-living soil, air, water and light, all in one glass: an ecosystem small enough to see every part of.
- **Soil Layers** (exhibit): Find the humus layer at the top: fallen leaves and other dead matter, broken down by bacteria and fungi and given back to the soil.
- **The Paludarium** (exhibit): Water below and land above, like a riverbank: mosses grow on the rocks and wood, fed by moisture rising from the water.
- **Water Lily** (garden): Roots in the mud, leaves floating on the surface: a floating plant of a wetland, kept up by air-filled aerenchyma.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	13.5	20	9	3	**45.5**

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