Unit 11 · Monera

ANSWER KEY · FOR TEACHERS

Full marks 39

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. peptidoglycan
2. nucleoid
3. plasmids
4. pleomorphism
5. anoxygenic
6. chemosynthesis
7. heterocysts
8. hormogonia

K · 4

Each carries 0.5 mark.

2 Label the diagram

1. flagellum
2. capsule
3. pili
4. cell wall
5. plasmid (small loop of DNA)
6. nucleoid: DNA, no membrane

K · 3

Each carries 0.5 mark.

3 Multiple choice

i. **c.** cell membrane — K · 1

Bacteria have no mitochondria; their respiratory enzymes are on the inner surface of the **cell (plasma) membrane**. Chromatophores carry photosynthetic pigments. Some books give the mesosome, but mesosomes turned out to be artifacts of preparing cells for the electron microscope (see 3.1.2).

ii. **d.** Golgi bodies — K · 1

Golgi bodies are membrane-bound organelles, which no prokaryote has. Bacteria do have a cell wall, a nucleoid and (70S) ribosomes.

iii. **b.** streptococci — U · 1

Round cells (**cocci**) in a **chain** (Greek *streptos*, twisted, like a chain or necklace) are **streptococci**. Staphylococci are clusters like grapes; sarcina are cubical packets; streptobacilli are chains of **rods**.

iv. **b.** it is chemoautotrophic — U · 1

It makes its own food from carbon dioxide (**autotrophic**), with energy from a **chemical** reaction, not light: **chemoautotrophic**, like the nitrifying bacterium *Nitrosomonas*. Saprophytes and parasites are heterotrophs: they take ready-made food.

v. **b.** gram — A · 1

Gram (चना) is a legume (Fabaceae): its roots form **nodules** with *Rhizobium*, which fix nitrogen. Cotton, wheat and mustard don't form root nodules.

4 Very short answers

a. MARKING SCHEME — K · 1

✓ Leeuwenhoek, 1676.

b. MARKING SCHEME — K · 1

✓ Vibrio (comma-shaped).

c. MARKING SCHEME — U · 1

✓ Salt or sugar draws water out of bacteria, stopping growth.

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5 Short answers

a. MARKING SCHEME — U · 2

- ✓ DNA not combined with histones (and not in a nuclear membrane).
- ✓ Bacteria have naked circular DNA; eukaryotic DNA is wound round histones in a nucleus.

b. MARKING SCHEME — U · 2

- ✓ Bacteria use H_2S as the hydrogen donor; plants use water.
- ✓ Bacteria give off sulphur (no oxygen); plants give off oxygen.

c. MARKING SCHEME — A · 2

- ✓ Cold stops bacteria growing and their enzymes working; water frozen.
- ✓ A food kept the same way (freezing, sukuti, gundruk, pickles).

d. MARKING SCHEME — U · 3

- ✓ A first bacterial feature.
- ✓ A second bacterial feature.
- ✓ A third bacterial feature.

6 Numerical problems

ANSWER — A · 4

i. $4 \times 60 \div 20 =$ **12 generations**.

ii. $100 \times 2^{12} = 100 \times 4096 =$ **409,600** bacteria.

iii. 18 generations $\times$ 20 min = 360 min = **6 hours**.

iv. The **log (exponential) phase**. It stops because the **food runs out** and **toxic wastes** build up (stationary, then decline phase).

MARKING SCHEME

- ✓ 12 generations.
- ✓ 409,600 bacteria.
- ✓ 6 hours.
- ✓ Log phase; food runs out and wastes build up.

7 Long answers

a. ANSWER — U · 4

Lag phase: bacteria just put into a new medium are **active but not dividing**: they adjust and make the enzymes they need; the number stays nearly the same.
Log (exponential) phase: the cells **divide continuously** at their fastest rate, doubling each generation; a straight line on the log scale; antibiotics work best now.
Stationary phase: food runs short and toxic wastes build up; **new cells equal dying cells**, so there is no net increase.
Decline (death) phase: with food gone and wastes higher, **dying cells outnumber new cells** and the population falls.

MARKING SCHEME

- ✓ Lag: active, adjusting, not dividing.
- ✓ Log: continuous division, exponential increase.
- ✓ Stationary: new cells equal dying cells.
- ✓ Decline: dying cells exceed new cells, because food is used up and wastes accumulate.

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b. ANSWER A · 4

Grow legumes (gram, lentil, pea, soybean) in rotation with rice and wheat: *Rhizobium* in their **root nodules** fixes nitrogen from the air into ammonia; the plant gets nitrogen and the soil is left richer.
Grow *Azolla* on flooded rice fields: its leaves shelter the cyanobacterium *Anabaena*, whose **heterocysts** fix nitrogen; *Nostoc* and *Anabaena* also grow free on the water.
Make compost of crop waste and dung: **saprophytic bacteria** decompose it and return nitrogen and minerals; **nitrifying bacteria** (*Nitrosomonas*, *Nitrobacter*) turn the ammonia into nitrate that roots take up.

MARKING SCHEME

- ✓ Legumes in rotation: Rhizobium in nodules fixes nitrogen.
- ✓ Azolla with Anabaena (heterocysts) or free cyanobacteria in rice fields.
- ✓ Compost: saprophytes decompose waste and release nutrients.
- ✓ Nitrifying bacteria turn ammonia into nitrate.

8 Think

ANSWER HA · 3

Cyanobacteria were the first living things to **split water in photosynthesis**; about **2.4 billion years ago** the oxygen they gave off began to build up in the air, the **Great Oxidation Event**, which also made the ozone layer possible.
A **chloroplast** is a cyanobacterium that was swallowed by a larger cell over a billion years ago and stayed (the **endosymbiont theory**).
Evidence, any one: chloroplasts have their own **circular DNA without histones**, **70S ribosomes**, a **double membrane**, divide by **fission**, and use **thylakoids** with chlorophyll *a*, like a cyanobacterium.

MARKING SCHEME

- ✓ Cyanobacteria split water and made the air's first oxygen (Great Oxidation Event).
- ✓ Chloroplasts came from engulfed cyanobacteria (endosymbiosis).
- ✓ One piece of evidence (circular naked DNA, 70S ribosomes, double membrane, fission).

9 Activity: Observe the bacteria in curd

(not marked)

WHAT STUDENTS SHOULD FIND

Two kinds: **rods**, often in chains (*Lactobacillus*), and **round cells in chains** (*Streptococcus thermophilus*), many in every field. They feed on the milk's sugar, lactose, and turn it into **lactic acid**, which makes the curd sour and makes the milk proteins clump into a soft solid.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	11	14	11	3	**39**

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