Exercise walk-through

The Nitrogen Cycle ▪ 1.5

eXercise

You must be able to

- describe **nitrogen fixation** 固氮, nitrification, assimilation, and **denitrification** 反硝化
- explain why nitrogen must be “fixed” to be usable
- explain how fertilizer disturbs the cycle

Method — Why nitrogen must be fixed

The air is ~78% N_2, but most organisms **cannot use** N_2 directly. It must be **fixed** into usable forms (ammonia, nitrates), mostly by **bacteria**.

Method — The steps

- **Nitrogen fixation** — bacteria convert N_2 to ammonia.
- **Nitrification** — bacteria convert ammonia to nitrates.
- **Assimilation** — plants take up nitrates to build proteins/DNA.
- **Denitrification** — bacteria return nitrogen to the air as N_2.

Method — Human disturbance

Fertilizers add large amounts of reactive nitrogen. Runoff carries it to water, causing **eutrophication** (algal blooms).

Method — A worked link

Legume plants host nitrogen-fixing bacteria in their roots, enriching the soil naturally — which is why farmers rotate legumes into fields.

Practice 2.1 ▪ 1 mark

Why can't most organisms use atmospheric N_2 directly?

Solution 2.1

Method: Why nitrogen must be fixed

Worked steps

N_2 is very stable/unreactive, so most organisms cannot use it directly B1.

Practice 2.2 ▪ 1 mark

What converts N_2 into a usable form?

Solution 2.2

Method: Why nitrogen must be fixed

Worked steps

Nitrogen-fixing bacteria B1.

Practice 2.3 ▪ 1 mark

What does denitrification do?

Solution 2.3

Worked steps

Returns nitrogen to the air as N_2 B1.

Exam-style 3.1 ▪ 1 mark

Nitrogen fixation converts N_2 into

A nitrates directly usable by all animals

B ammonia (a usable form)

C carbon dioxide

D oxygen

Solution 3.1

Method: The steps

A nitrates directly usable by all animals

B ammonia (a usable form) ✓

C carbon dioxide

D oxygen

Worked steps

B — ammonia (a usable form).

Exam-style 3.2 ▪ 3 marks

A farmer applies nitrogen fertilizer to a field near a river.
(a) Explain how this can disturb the nitrogen cycle and harm the river.
(b) State one natural way to add nitrogen to soil.

Solution 3.2

Method: A worked link

Worked steps

(a) Excess reactive nitrogen runs off into the river; it fertilizes algae, causing an algal bloom (eutrophication); decomposition then depletes oxygen, harming aquatic life M1 M1 A1. (b) Planting legumes (nitrogen-fixing bacteria) B1.

Exam-style 3.3 ▪ 2 marks

Explain the role of bacteria in making nitrogen available to plants.

Solution 3.3

Worked steps

Nitrogen-fixing bacteria convert unusable N_2 into ammonia, and nitrifying bacteria convert it to nitrates that plants can absorb M1 A1.