

1.5 The Nitrogen Cycle

Name: _____ Class: _____ Date: _____

Total: 10 marks**KEY WORDS** nitrogen fixation 固氮 • denitrification 反硝化 • nitrogen cycle 氮循环

Objective

Build the skills to answer exam questions on the **nitrogen cycle**.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Why nitrogen must be fixed

The air is ~78% N₂, but most organisms **cannot use** N₂ directly. It must be **fixed** into usable forms (ammonia, nitrates), mostly by **bacteria**.

■ The steps

- **Nitrogen fixation** — bacteria convert N₂ 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 N₂.

■ Human disturbance

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

■ A worked link

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

2 Practice

Now apply the methods above.

2.1 Why can't most organisms use atmospheric N_2 directly? [1]

2.2 What converts N_2 into a usable form? [1]

2.3 What does denitrification do? [1]

3 Exam-style questions

3.1 Nitrogen fixation converts N_2 into [1]

- **A** nitrates directly usable by all animals
 - **B** ammonia (a usable form)
 - **C** carbon dioxide
 - **D** oxygen
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3.2 A farmer applies nitrogen fertilizer to a field near a river.

(a) Explain how this can disturb the nitrogen cycle and harm the river. [3]

(b) State one natural way to add nitrogen to soil. [1]

3.3 Explain the role of bacteria in making nitrogen available to plants. [2]

Solutions

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

2.2 Nitrogen-fixing bacteria.

2.3 Returns nitrogen to the air as N_2 .

3.1 B — ammonia (a usable form).

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

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