

This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.

Nitrogen is essential for making proteins and DNA. Although nitrogen makes up 78% of the atmosphere, most organisms cannot use it directly.

★ **HT** Nitrogen fixation: nitrogen-fixing bacteria (in soil and in root nodules of legumes) convert  $N_2$  gas into ammonia/nitrates — making nitrogen available to plants.

★ **HT** Nitrification: nitrifying bacteria convert ammonia → nitrites → nitrates in the soil. Plants absorb nitrates through roots.

★ **HT** Assimilation: plants absorb nitrates from soil → use them to make amino acids and proteins. Animals eat plants → incorporate nitrogen into their proteins.

★ **HT** Ammonification (decomposition): decomposers (bacteria and fungi) break down dead organisms and excretion → release ammonia back into the soil.

★ **HT** Denitrification: denitrifying bacteria convert nitrates back into  $N_2$  gas — returns nitrogen to the atmosphere (completes the cycle).

★ **HT** Legumes (peas, beans, clover): have root nodules containing nitrogen-fixing bacteria (Rhizobium). Plant provides sugars; bacteria provide fixed nitrogen. Mutualism.

★ **HT** Fertilisers (artificial): supply nitrates to soil where natural nitrogen cycle is insufficient for crop yields.

### Key Terms

<b>Nitrogen fixation</b>	Conversion of atmospheric $N_2$ into ammonia or nitrates — by bacteria or lightning
<b>Nitrification</b>	Conversion of ammonia → nitrites → nitrates by nitrifying bacteria — makes nitrates available to plants
<b>Denitrification</b>	Conversion of nitrates → $N_2$ gas by denitrifying bacteria — returns N to atmosphere
<b>Ammonification</b>	Release of ammonia from dead organisms/excretion by decomposers
<b>Root nodule</b>	Swelling on legume roots containing nitrogen-fixing Rhizobium bacteria

■ **Exam Tip:** Four types of bacteria in the nitrogen cycle: nitrogen-FIXING, NITRIFYING, DENITRIFYING, and DECOMPOSERS (ammonification). Name all four correctly — each is worth a mark in a 4-mark question on the nitrogen cycle.