The Nitrogen Cycle

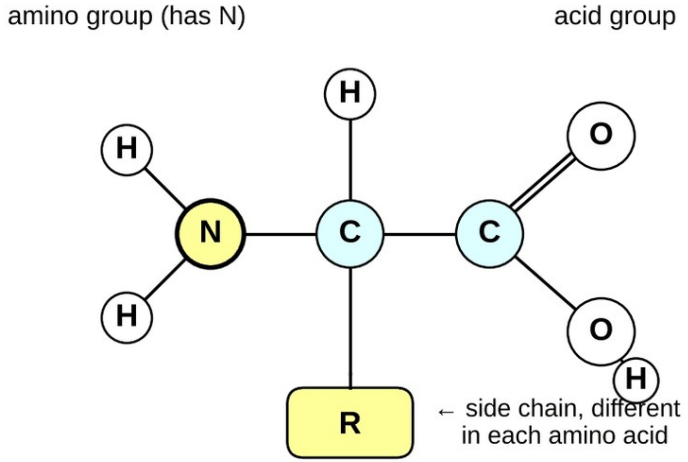
Essential Question

How does nitrogen from the air become part of living things?

The Nitrogen Cycle

Why Living Things Need Nitrogen

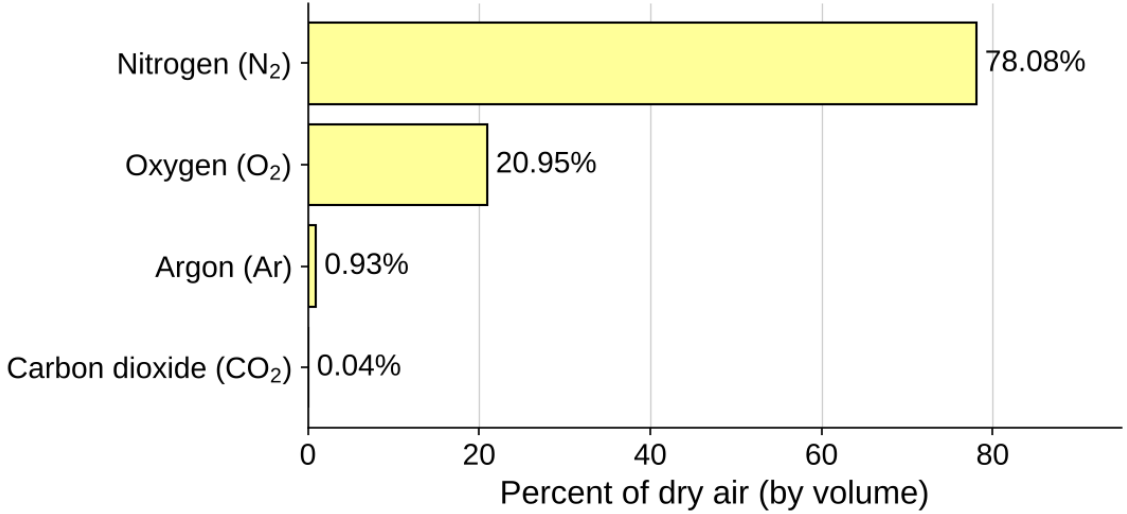
- Every amino acid contains nitrogen
- DNA, RNA, and ATP contain nitrogen
- Phosphorus is also needed for DNA and ATP



Nitrogen is in:
- every amino acid (proteins)
- DNA and RNA bases
- ATP

Nitrogen Gas Is Hard to Use

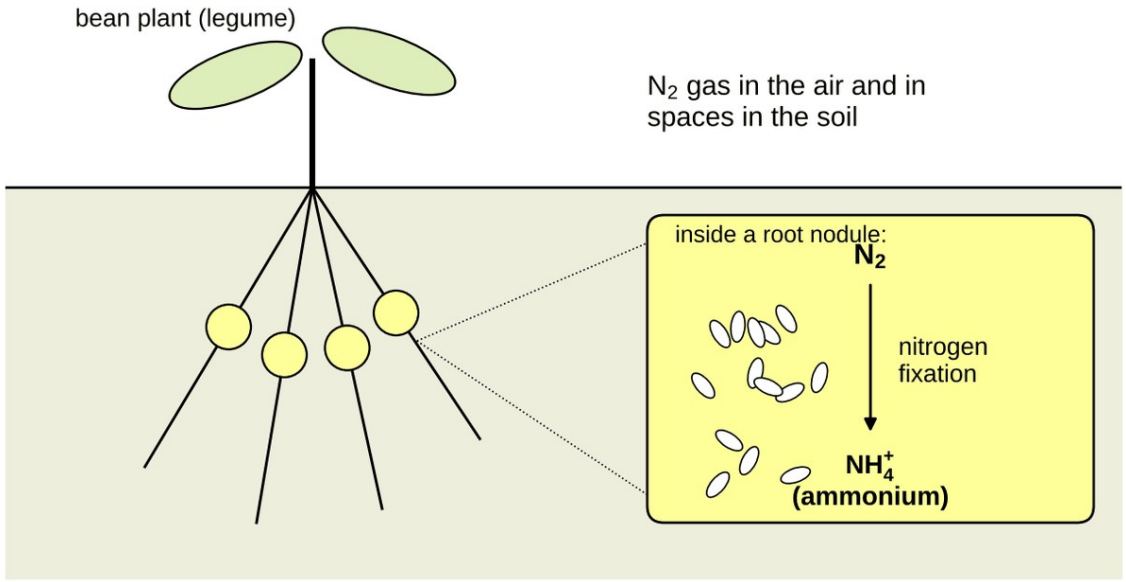
- Air is about 78% nitrogen gas (N_2)
- A strong triple bond holds N_2 together
- Plants and animals cannot break it



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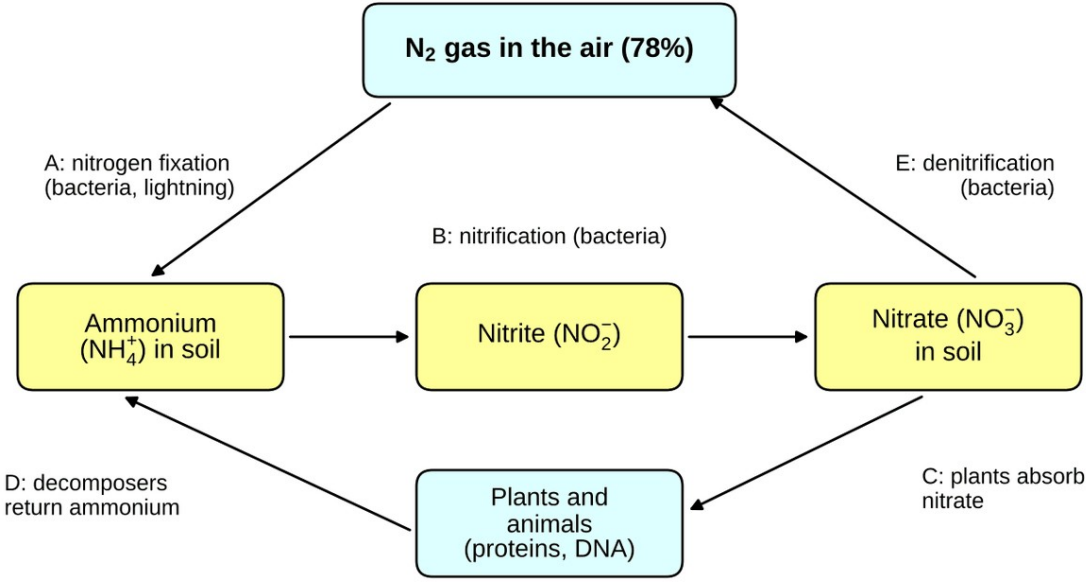
Nitrogen Fixation

- Bacteria convert N_2 into ammonium
- Some live in root nodules of legumes
- Lightning and factories also fix nitrogen



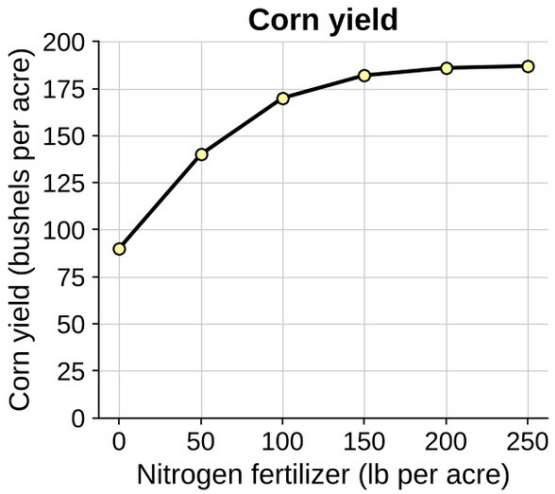
Bacteria Keep Nitrogen Cycling

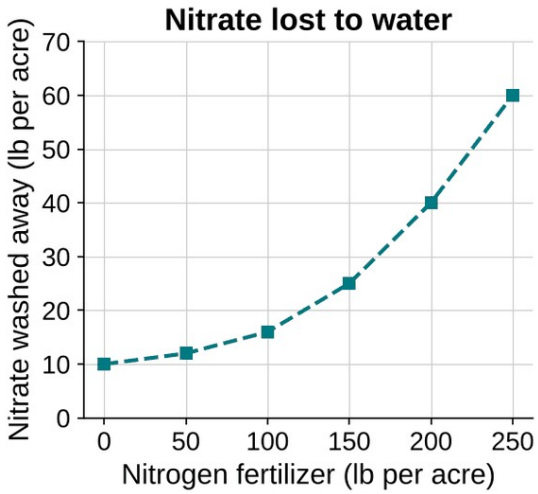
- Nitrification: ammonium → nitrite → nitrate
- Plants absorb nitrate and build proteins
- Decomposers return nitrogen as ammonium
- Denitrification returns N_2 to the air



Fertilizer and Water Pollution

- Farmers add nitrogen fertilizer to raise yields
- Extra nitrate washes into streams
- Algae bloom, die, and decompose
- Decomposers use up oxygen: dead zones

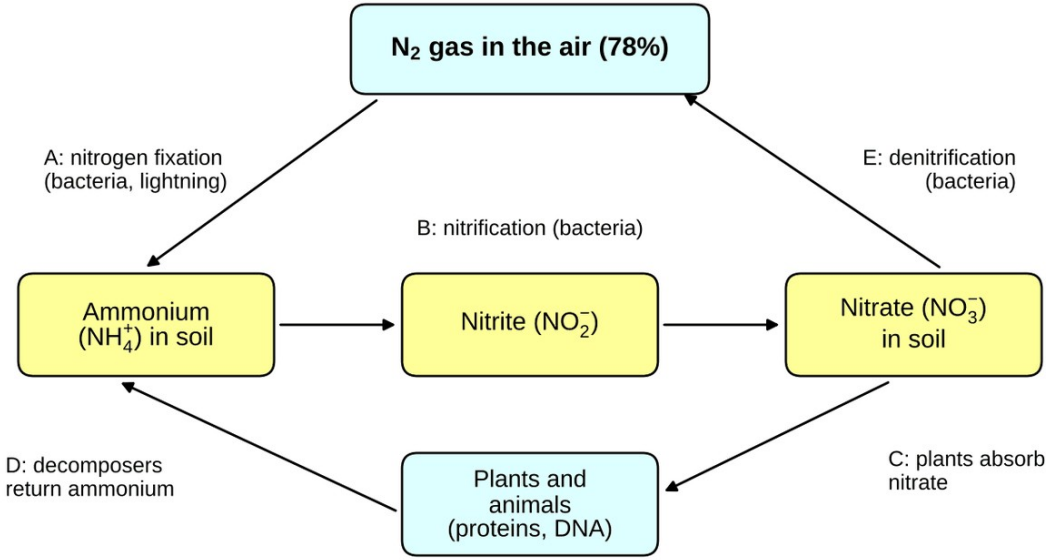




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Example: From the Air to Your Muscles

Trace a nitrogen atom from N_2 in the air into a protein in your muscle. Name each process and the organisms that carry it out.



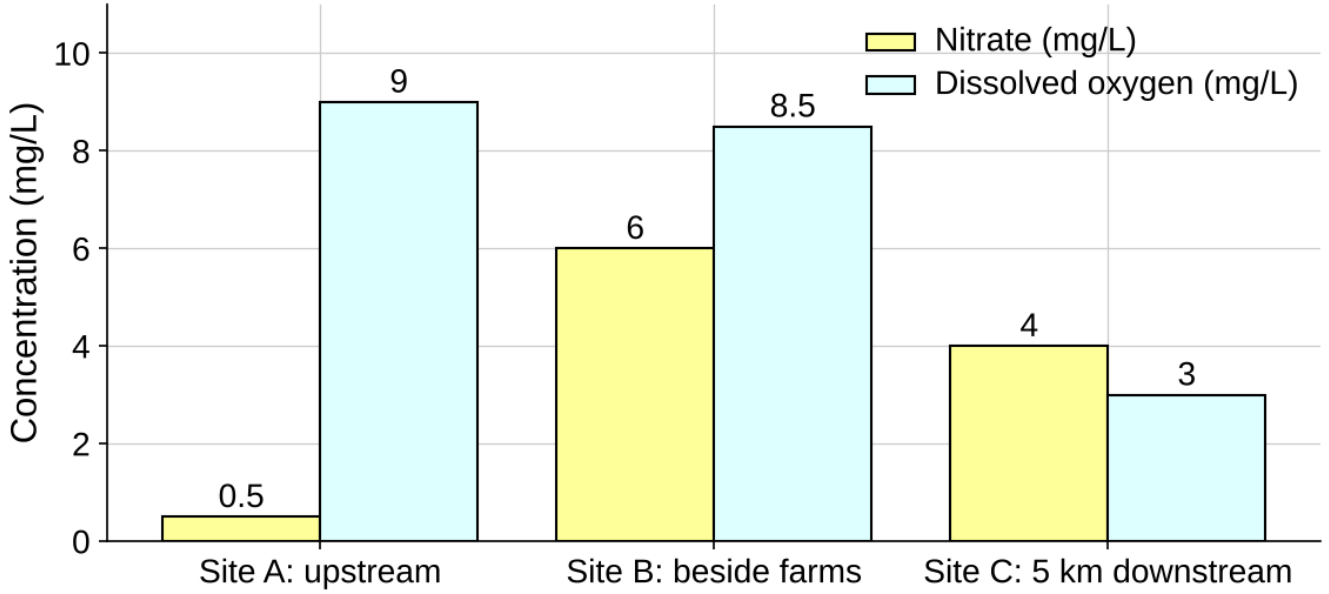
Example: How Much Fertilizer?

A farmer is choosing between 150 and 250 lb of nitrogen fertilizer per acre. Use the data to compare the extra corn with the extra nitrate lost. Which rate would you recommend? Support your claim.

Fertilizer (lb/acre)	Corn yield (bushels/acre)	Nitrate washed away (lb/acre)
0	90	10
50	140	12
100	170	16
150	182	25
200	186	40
250	187	60

Example: Oxygen Downstream from Farms

Students test a river at three sites. Site C has less nitrate than Site B, but much less dissolved oxygen. Explain this pattern.



The Nitrogen Cycle

Big Ideas

- Proteins, DNA, and ATP need nitrogen
- N_2 gas must be fixed before life can use it
- Bacteria fix, nitrify, decompose, and denitrify
- Extra fertilizer causes algal blooms and dead zones