These notes explain the **why** behind every concept, not just the what. They include **analogies**, **real-life examples**, and explanations of **common mistakes**. Use these alongside your revision notes for full understanding.

Topic 9 Ecosystems — Understanding the Web of Life

Why Biodiversity Matters More Than You Might Think

Biodiversity is not just about pretty animals and interesting plants. Ecosystems provide services that human survival depends on — clean water, clean air, food production, climate regulation, flood protection, and medicine. More than 50% of currently prescribed medicines were originally derived from natural organisms. Many undiscovered medicines may exist in species not yet studied — and many of those species are going extinct before we find them.

■ **Real-life example:** The rosy periwinkle, a plant from Madagascar, yielded two drugs — vincristine and vinblastine — that have transformed childhood leukaemia survival rates from 10% to over 90%. If Madagascar's rainforests had been cleared before this plant was studied, these drugs might never have been discovered.

Eutrophication — A Cascade of Consequences

Eutrophication illustrates how human actions can trigger a chain of events that destroys an ecosystem. Fertilisers wash from farmland into rivers and lakes. Algae thrive on the extra nitrates and phosphates, forming a thick surface bloom. The bloom blocks sunlight to aquatic plants below. Plants die. Bacteria decompose the dead plants — and in doing so, use up the oxygen dissolved in the water. Fish and other aquatic organisms suffocate. The lake becomes an oxygen-depleted "dead zone".

■ ***Think of it like this:*** *Eutrophication is like covering a fish tank with a thick blanket — eventually everything inside it suffocates, not from the blanket directly, but from the chain of events it triggers.*

The Nitrogen Cycle — Why Bacteria Are Essential

Nitrogen makes up 78% of the atmosphere, but most organisms cannot use atmospheric nitrogen directly. The nitrogen cycle depends on specialised bacteria at every stage: nitrogen-fixing bacteria (in soil and root nodules of legumes) convert N■ to ammonia; nitrifying bacteria convert ammonia to nitrates; denitrifying bacteria return nitrates to N■. Without these bacteria, the cycle would stop and nitrogen in a usable form would be unavailable to plants.

■ **Why does this happen?** Legume plants (peas, beans, clover) have root nodules containing nitrogen-fixing bacteria (Rhizobium). The plant provides the bacteria with sugars; the bacteria provide the plant with fixed nitrogen. This mutualism is so valuable that farmers rotate crops, growing legumes every few years to naturally replenish soil nitrogen instead of using artificial fertilisers.

Ecosystem services	The benefits humans receive from functioning ecosystems — clean water, food, climate regulation
Eutrophication	Over-enrichment of water with nutrients — leads to algal bloom and oxygen depletion

Nitrogen cycle	The movement of nitrogen through atmosphere, soil, organisms and back — depends on specialist bacteria
Nitrogen fixation	Conversion of atmospheric N■ into ammonia/nitrates — by lightning or nitrogen-fixing bacteria
Denitrification	Conversion of nitrates back to N■ by denitrifying bacteria — completes the nitrogen cycle
Deforestation	Clearing of forests — destroys habitat, reduces biodiversity, releases stored CO■, causes soil erosion