

Nutrient cycles

Revision notes · How carbon is cycled by photosynthesis, respiration, feeding, decomposition and combustion, and how bacteria move nitrogen through the nitrogen cycle.

For Cambridge IGCSE Biology 0610 (and 0970, which has the same content). **Supplement** is Extended content, only examined on Papers 2 and 4.

Nutrient cycles Spec 19.3

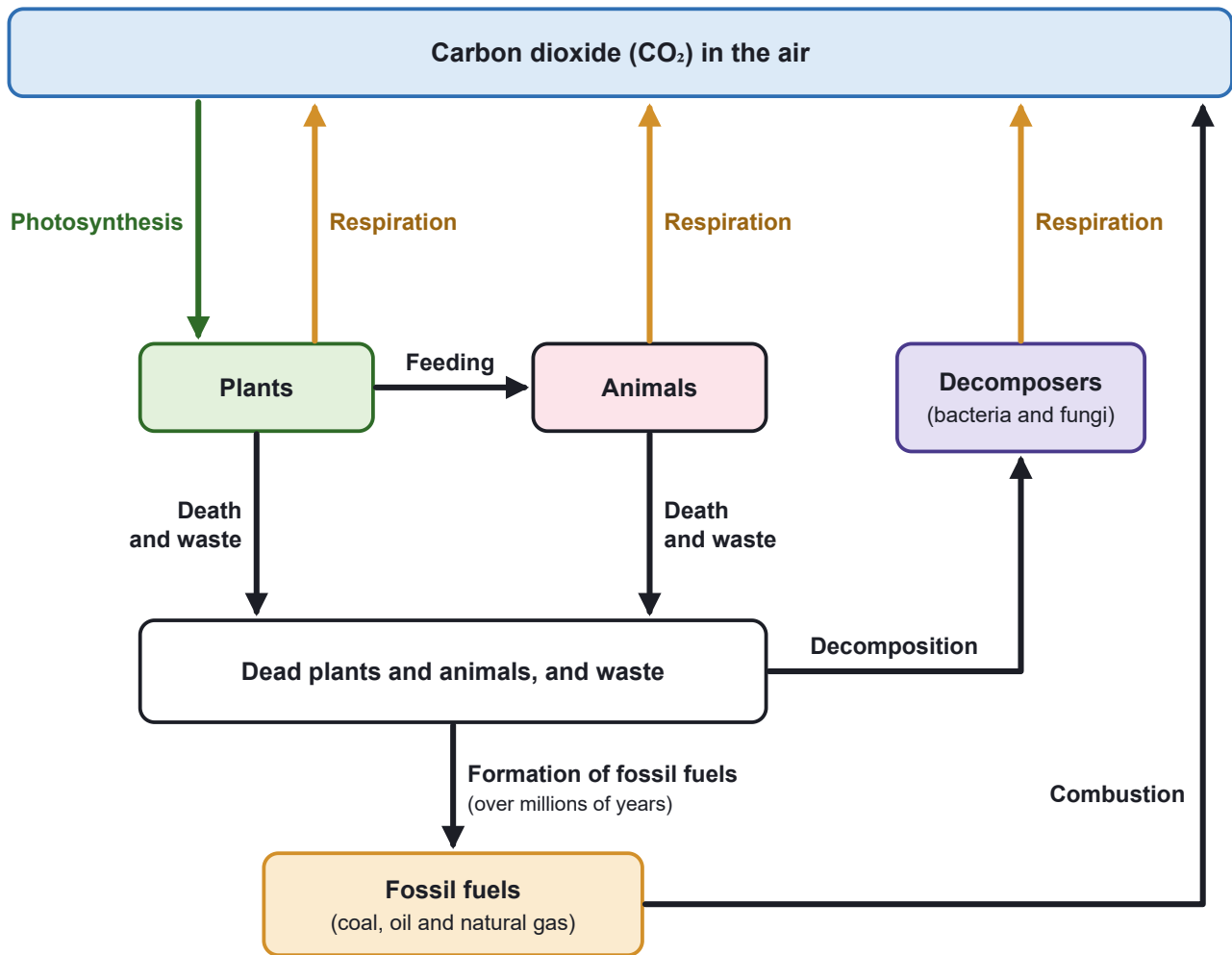
The carbon cycle Spec 19.3.1

All living things are made of carbon compounds, such as carbohydrates, proteins and fats. The carbon cycle moves carbon between the air, living organisms, dead material and fossil fuels. It makes sure carbon dioxide is available for plants to use in photosynthesis again.

1. Plants and algae take carbon dioxide from the air and use it in **photosynthesis** to make carbon compounds such as glucose, starch and proteins.
2. The carbon compounds pass along the food chain by feeding, when animals eat plants and other animals.
3. Plants, animals and decomposers all release carbon dioxide into the air by **respiration**.
4. When organisms die, and when they produce waste, **decomposers** (bacteria and fungi) break down the material. They release carbon dioxide into the air by respiration.
5. Over millions of years, some dead organisms are buried and do not decompose fully. They form **fossil fuels** (coal, oil and natural gas).
6. When fossil fuels, wood or other fuels are burned, **combustion** releases carbon dioxide into the air.

Processes in the carbon cycle

Process	Effect on carbon dioxide in the air
Photosynthesis	Removes carbon dioxide from the air
Respiration (plants, animals, decomposers)	Adds carbon dioxide to the air
Decomposition	Adds carbon dioxide to the air, because decomposers respire
Combustion	Adds carbon dioxide to the air
Feeding	Passes carbon compounds from one organism to the next; no change in the air
Formation of fossil fuels	Locks carbon away in coal, oil and gas



The carbon cycle. **Photosynthesis** removes carbon dioxide from the air; **respiration**, **decomposition** and **combustion** return it.

Exam tip: Name the process at every arrow. Photosynthesis takes carbon dioxide in. Respiration, decomposition and combustion put it back. Do not write 'breathing' for respiration.

The nitrogen cycle Spec 19.3.2, 19.3.3 Supplement

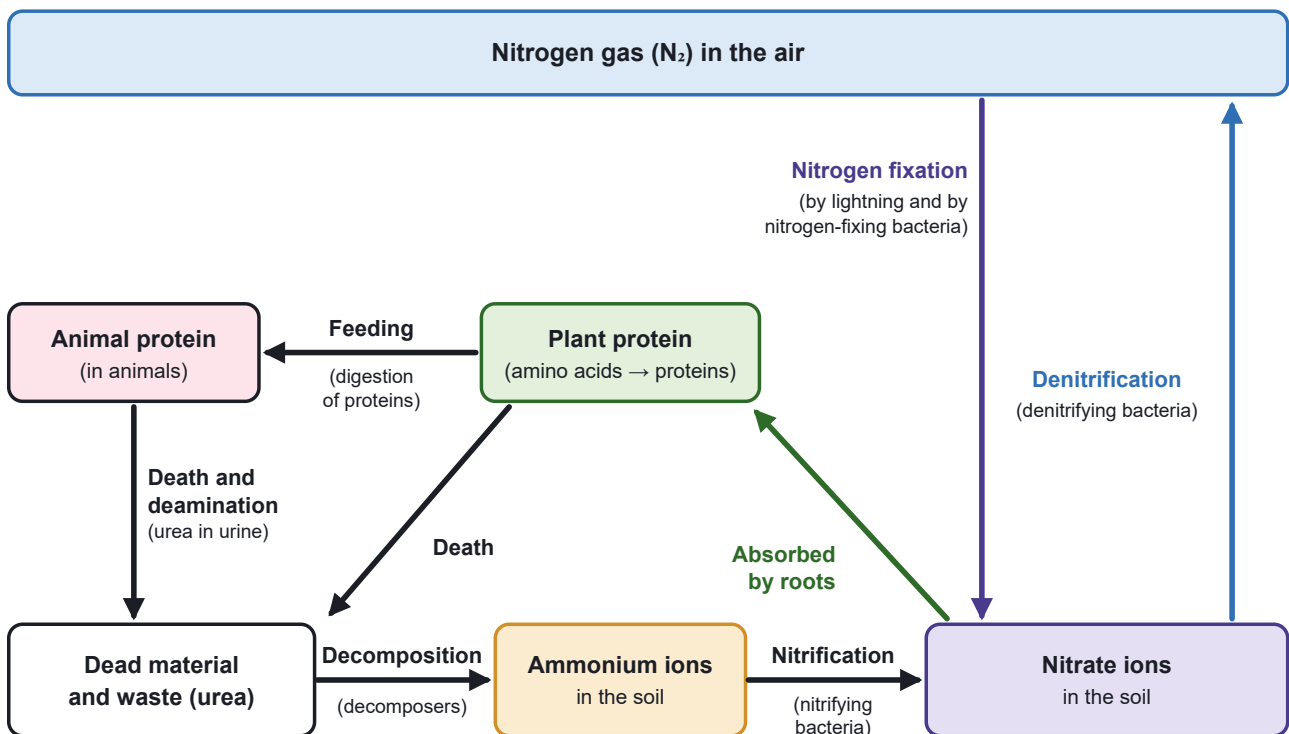
Plants need nitrogen to make amino acids and then proteins. Nitrogen gas makes up most of the air, but plants cannot use it. They absorb nitrate ions from the soil through their roots. The nitrogen cycle shows how nitrogen is moved between the air, the soil and living things.

1. Plants absorb nitrate ions from the soil. They combine them with carbohydrates to make amino acids, and then join the amino acids to make proteins.
2. Animals get proteins by feeding on plants or other animals. They digest the proteins to amino acids and use these to make their own proteins.
3. Excess amino acids cannot be stored. In the liver, **deamination** removes the nitrogen-containing part of the amino acids to form urea. Urea is excreted in urine.
4. Decomposers (bacteria and fungi) break down the proteins in dead plants and animals, and the urea in waste, to **ammonium ions** in the soil. This is decomposition.
5. Nitrifying bacteria change ammonium ions into nitrate ions. This is **nitrification**. Plants can absorb the nitrate ions again.
6. **Nitrogen fixation** changes nitrogen gas into nitrogen compounds that plants can use. It is done by nitrogen-fixing bacteria in the soil and in root nodules, and by lightning. The energy of lightning

makes nitrogen in the air combine with oxygen to form nitrogen oxides. These dissolve in rain and reach the soil as nitrates.

7. Denitrifying bacteria change nitrates in the soil back into nitrogen gas. This is **denitrification**. It lowers the amount of nitrate available to plants.

Roles of microorganisms in the nitrogen cycle		
Process	Role of microorganisms	Effect on nitrate in the soil
Decomposition	Decomposers break down proteins in dead material, and urea, to ammonium ions	Supplies ammonium ions for nitrification
Nitrification	Nitrifying bacteria change ammonium ions to nitrate ions	Increases nitrate
Nitrogen fixation	Nitrogen-fixing bacteria change nitrogen gas into nitrogen compounds	Increases the nitrogen compounds available to plants
Denitrification	Denitrifying bacteria change nitrates to nitrogen gas	Decreases nitrate



The nitrogen cycle. Microorganisms carry out **decomposition**, **nitrification**, **nitrogen fixation** and **denitrification**.

Common mistake: Nitrogen fixation turns nitrogen gas into nitrogen compounds. It is not the same as decomposition, which makes ammonium ions from dead material. You do not need the names of individual bacteria.

Exam tip: Link each step to a microorganism: decomposers (ammonium ions), nitrifying bacteria (nitrates), nitrogen-fixing bacteria (nitrogen compounds), denitrifying bacteria (nitrogen gas).

Quick check

1. Which process removes carbon dioxide from the air?
2. Name three processes that add carbon dioxide to the air.
3. How are fossil fuels formed?
4. **Supplement** What do nitrifying bacteria do?
5. **Supplement** Name two ways nitrogen gas is fixed.

Quick check answers

Nutrient cycles

1. Photosynthesis.
2. Respiration, decomposition and combustion.
3. From dead organisms that were buried and did not decompose fully, over millions of years.
4. They change ammonium ions into nitrate ions.
5. By lightning and by nitrogen-fixing bacteria.