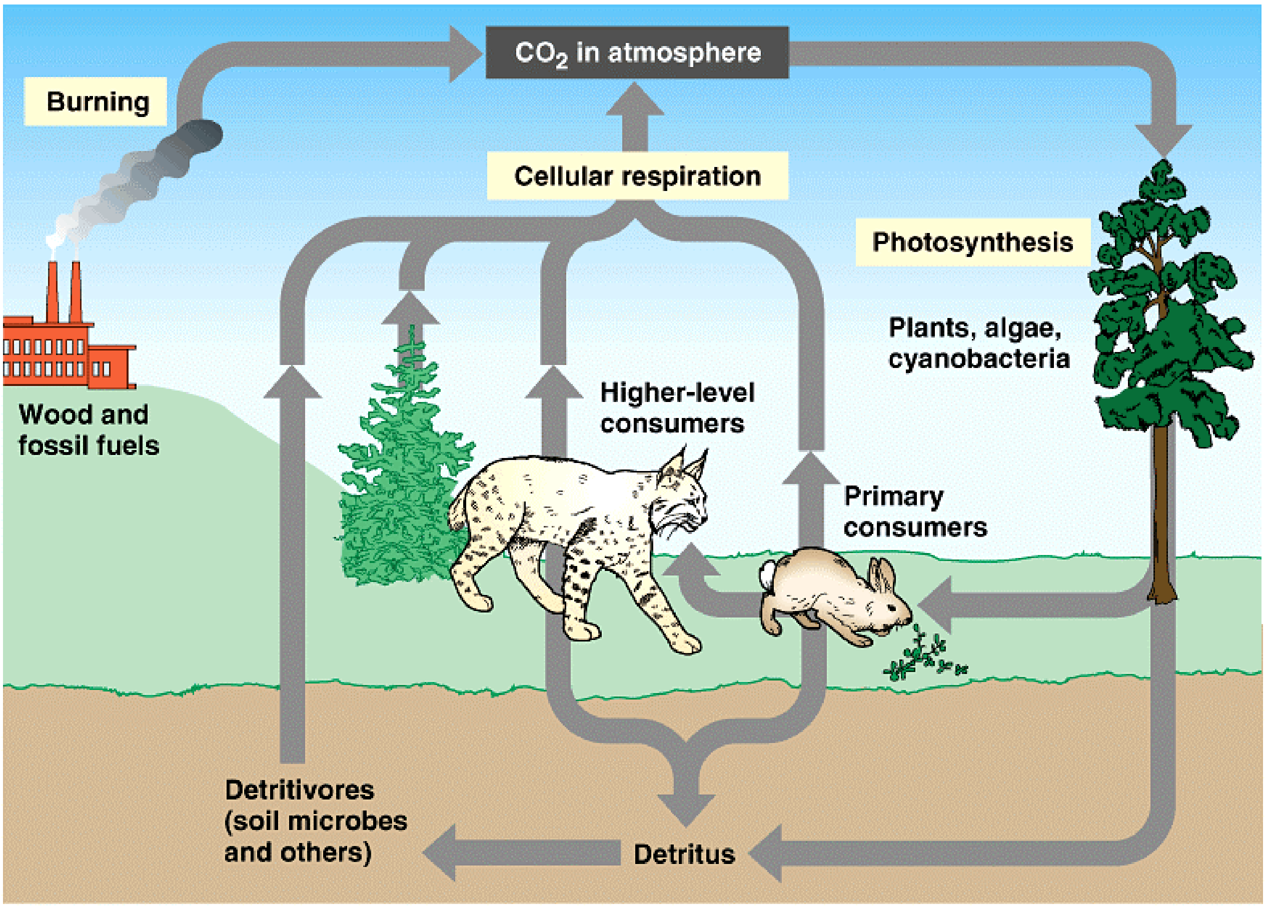
Chapter 6

There are a few essential elements that are passed through food chains, **other than** carbon and nitrogen, which make up most of this chapter. They are:

- **Iron (Fe).** Found in **cytochromes**, **haemoglobin**, enzymes (**catalase**) and for the **synthesis of chlorophyll**
- **Iodine (I).** Needed to make **thyroxin**, a vital hormone in animals
- **Molybdenum (Mb).** Needed by plants to make **nitrate reductase**, an enzyme essential for the synthesis of amino-acids (Nitrate → Ammonia → amino-acids).

The Carbon Cycle



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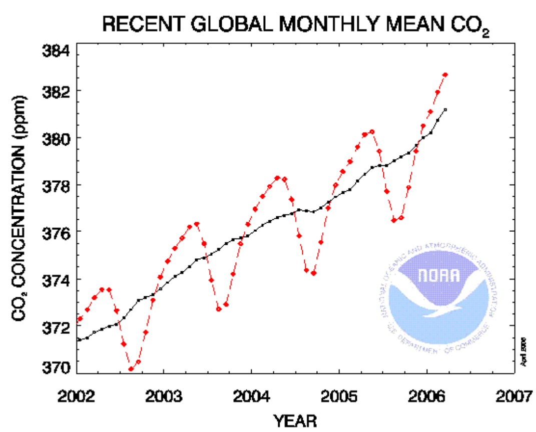
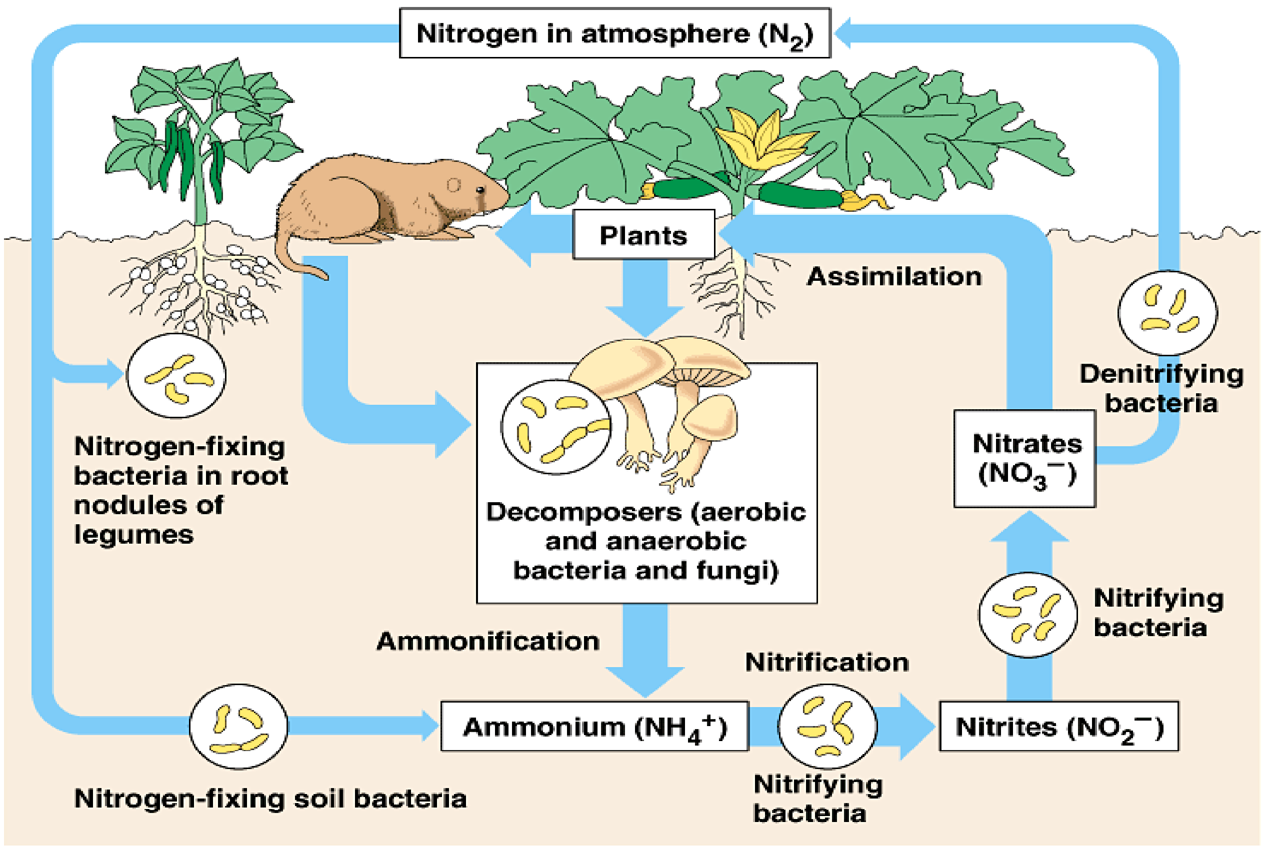
There is little to add to the above diagram. Note that 92% of global CO_2 production is from **respiration** (over which we have no control) and only 2% is produced by **all** forms of transport!



Atmospheric CO_2 levels are rising steadily (*see right*), but there is no way that humanity can stop this rise and even more uncertainty as to the consequences of this rise. **Plant growth will certainly increase**, as **lack of CO_2 is the limiting factor for photosynthesis throughout the world** (in summer, anyway).

Nitrogen Cycle



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Nitrogen forms part of both proteins and nucleic acids and is essential for life. **Heterotrophs** (animals and fungi) **can only assimilate amino-acids** (from proteins, which they digest). They therefore rely on **plants or bacteria to synthesise amino-acids** for them. Plants can only absorb nitrogen in the form of very soluble **nitrates**, which **do not** remain long in the soil, being either taken up by plants or washed away into rivers, causing **eutrophication**. Nitrates can be made from atmospheric nitrogen, but this is energy-intensive, whether via the **Haber process,** from the action of **lightning,** or by **nitrifying bacteria**. Nitrogen is removed from the active part of the cycle by anaerobic **denitrifying bacteria** – which only thrive in waterlogged soils (e.g. bogs). This is why carnivorous plants live there (no nitrates available to them in the soil).

Haber process

This uses high pressures, temperatures and a catalyst. The source of nitrogen in artificial fertilisers.

Lightning (note spelling!)

This forms twice as much nitrate as globally *via* the Haber process – particularly in the tropics.

Nitrifying bacteria

These can be free-living in the soil (as in rice paddy-fields) or in **mutualistic** arrangements in the **root nodules** of plants in the **Legume** family, such as peas, beans and clover. The process **needs ATP and the enzyme nitrogenase**, which only works in **anaerobic conditions**. Root nodules actually contain **haemoglobin to absorb the oxygen from the air** (the source of nitrogen gas). This is most important on **free-draining sandy soils, where the nitrates rapidly wash through**.

Deforestation

Tropical forests **rapidly recycle dead material**, but when the forest is cleared ('slash-and burn'), the nitrogen-containing compounds in the soil are either **burned or rapidly leach away** and, **after the first few years, crop yields fall** as the essential microbes have been lost in the run-off water.

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