

The nitrogen cycle

1. Nitrogen fixation

nitrogen gas \longrightarrow nitrogen containing compounds

- The process by which nitrogen gas is converted into nitrogen containing compounds
- Carried out by:

Free living bacteria – Reduces gaseous nitrogen into ammonia (which they then use to manufacture amino acids). Nitrogen rich compounds are released when they die

Mutualistic nitrogen-fixing bacteria – The bacteria on the nodules require carbohydrates from the plant and in turn they provide the plant with amino acids

2. Ammonification

ammonium containing compounds $\xrightarrow{\text{saprobial bacteria}}$ ammonia

- Production of ammonia from ammonium containing compounds
- Saprobial bacteria feed on the materials releasing ammonia which converts to ammonium in the soil

3. Nitrification

ammonium ions \longrightarrow nitrites \longrightarrow nitrates

- Saprophytic bacteria in the soil convert ammonium ions into nitrite ions and then into nitrate ions.
- Oxygen is required!

4. Denitrification

nitrates \longrightarrow nitrogen gas

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- Denitrifying bacteria convert soil nitrates into gaseous nitrogen
- They can do this anaerobically.

FERTILISERS:

How fertilisers increase productivity

- Nitrogen is needed to make proteins and DNA
- Where there are more nitrates available, plants are likely to develop earlier, grow quicker and taller and cover a greater area with their leaves.
- This therefore increases the rate of photosynthesis and also increases productivity.

EFFECTS:

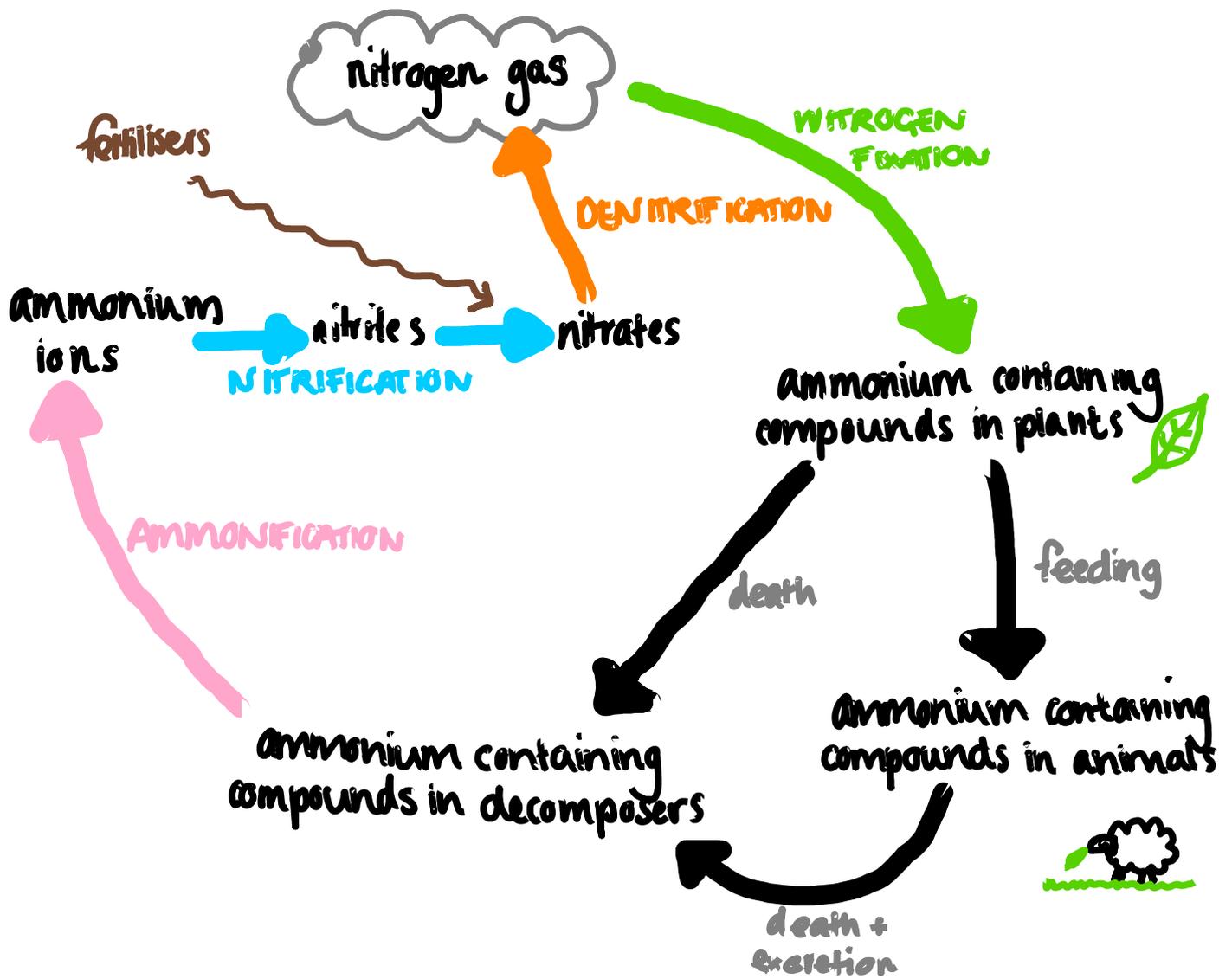
- ✗ **Reduced species diversity** – nitrogen favours the growth of rapidly growing species such as grasses, nettles and weeds. Some species grow quickly and out compete the others.
- ✗ **Leaching** – leads to pollution of watercourses
- ✗ **Eutrophication** – caused by leaching of fertilisers into watercourses

Leaching

- Rain water can dissolve soluble nitrates and carry them deeper into the soil beyond the reach of plant roots and into water courses that is used for human consumption.
- High levels of nitrates in water can cause inefficient transport of oxygen to the brain.

Eutrophication

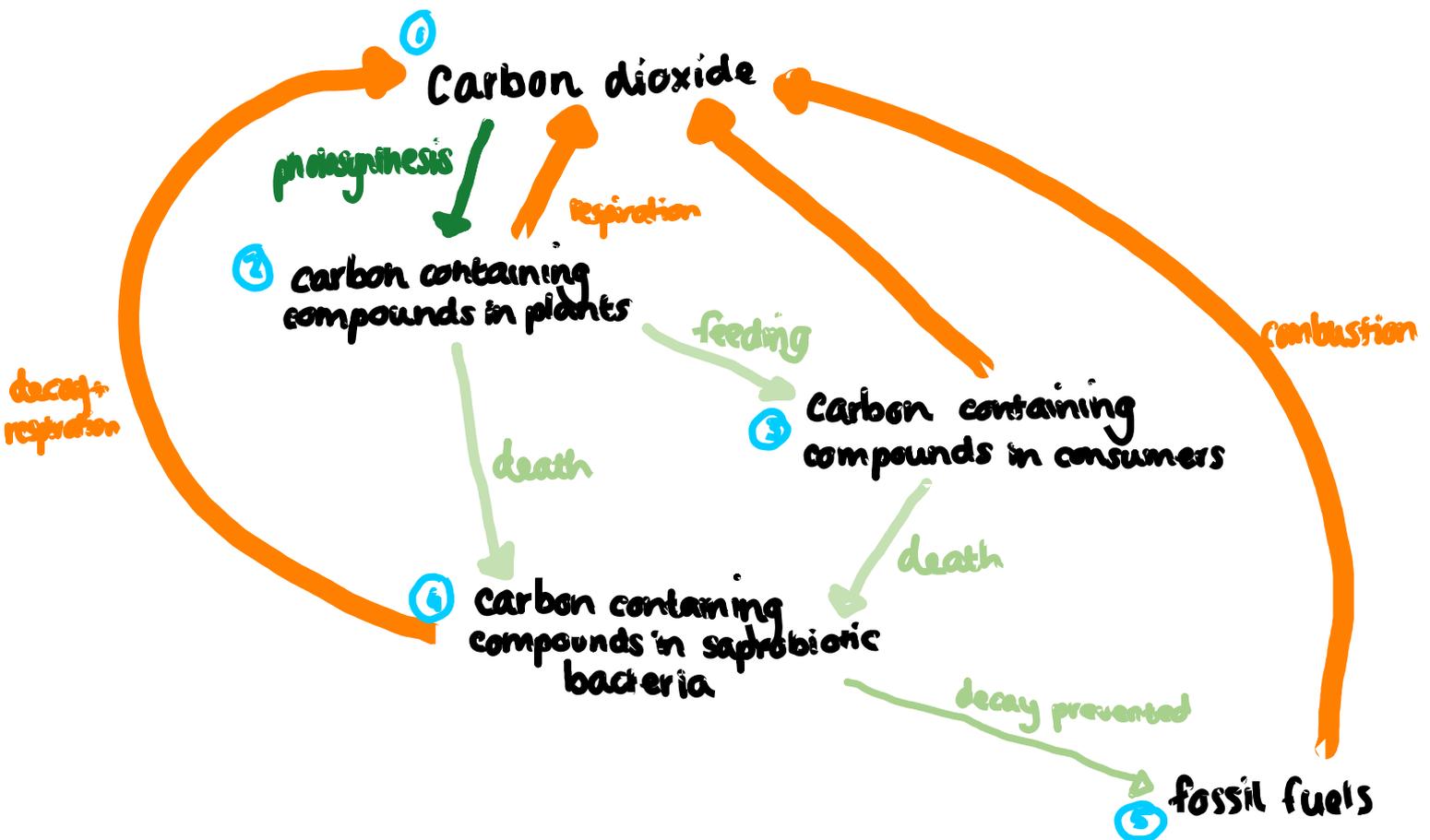
- Nitrate levels increase due to leaching, there is no longer a limiting factor, and so plants/algae both grow exponentially
- Algae grow and cover the upper layers of the water. This is called “algae bloom”.
- The algae on the top of the water absorbs sunlight, preventing it from reaching the bottom of the lake.
- Light becomes a limiting factor for plants/algae at the bottom of the lake and so they die
- Saprophytic algae can now grow exponentially feeding on the decaying plant matter
- More anaerobic saprophytic bacteria, more oxygen used up and more nitrates produced from decaying organisms.
- Oxygen is a limiting factor for aerobic organisms such as fish and so they eventually die.
- Without any aerobically respiring organisms, anaerobically respiring organisms no longer have to compete and so they begin to reproduce exponentially.
- Anaerobic organisms further breakdown other dead material thus producing more nitrates as well as some toxic wastes such as, hydrogen sulphide which makes the water putrid.



photosynthesis takes in carbon
respiration releases carbon

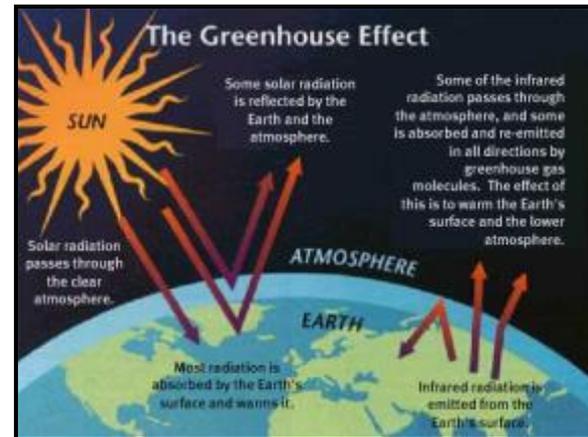
THE CARBON CYCLE

- Carbon is absorbed by plants during photosynthesis to become carbon compounds in plant tissue
- Consumers eat the plant and take the carbon
- Consumers die and their carbon is digested by saprobiotic bacteria
- Saprobiotic bacteria respire and release the carbon to the air
- (If there are no decomposers, it is turned to fossil fuels and is released by combustion)



GLOBAL WARMING

1. When solar radiation reaches the earth, some is reflected back into space, some is absorbed by the atmosphere and some reaches the earth.
2. The radiation that reaches the earth is absorbed, and reemitted back into space.
3. However, some of this radiation is absorbed by clouds and greenhouse gases that will reflect the radiation back to earth. This causes a heating effect known as the greenhouse effect



Consequences of global warming

- ✗ Affects the niches available in a community, leading to an alteration in the distribution of species
- ✗ Melting of polar ice caps and therefore increasing sea levels
- ✗ High temperature may lead to crop fail

Benefits

- ✓ Increased rate of photosynthesis, greater rain fall, possible twice a year harvest
- ✓ Allows crops to grow where it is now too cold
- ✓ Fill reservoirs