POLLUTION

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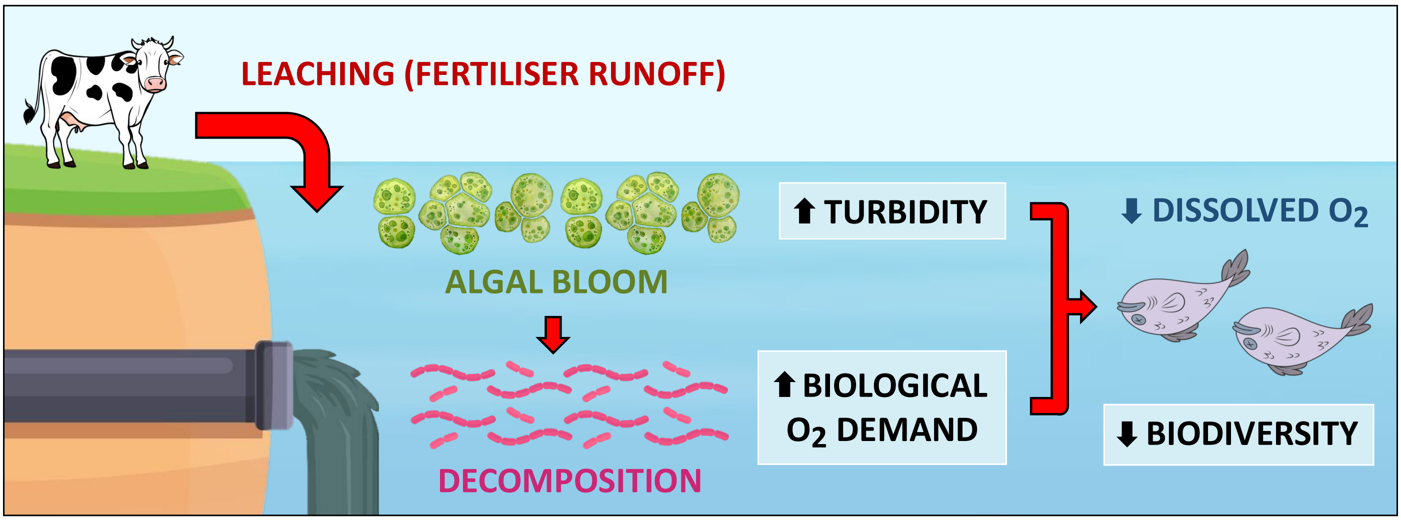
POLLUTION

Pollutants are substances that are released into an environment and have a damaging effect. They can be naturally forming but are predominantly anthropogenic (man-made). Pollutants can have a severe impact on human and environmental health and so require regulation. The consequences of unregulated pollution may include eutrophication, biomagnification, plastic persistence and increased carbon dioxide emissions.

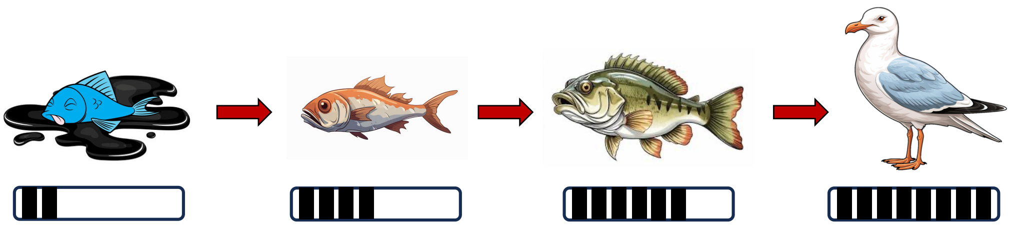
EUTROPHICATION

Eutrophication describes the enrichment of ecosystems with chemical nutrients (nitrate, phosphate, etc.). The nutrients can be introduced into waterways via **leaching** from soil by rainfall or may be released as part of sewage. Eutrophication is common around farms where the use of artificial fertilisers is prevalent. The increase in nutrient supply within aquatic and marine ecosystems will result in several ecological impacts. A rapid growth in algal populations will occur (algal bloom) as a result of an increased availability of nutrients. As the algae die, there will be a subsequent spike in the numbers of saprotrophic microbes (decomposers). The high rate of decomposition will result in increased **biochemical oxygen demand** (BOD) by saprotrophs. The saprotrophs will consume the available quantities of dissolved oxygen, leading to deoxygenation of the water supply. Eutrophication also increases the turbidity of the water, which will reduce oxygen production by photosynthetic seaweeds. This will stress the survival of marine organisms, causing reduced biodiversity. Eutrophication of waterways increases water treatment costs and impacts commercial fishing. The impacts of eutrophication can be minimised by controlling the discharge or treatment of sewage, reducing reliance on chemical fertilisers and planting field buffers near bodies of water to help catch runoff and absorb the nutrients before they pollute the waterways. Government policies and ecological monitoring are necessary.



BIOMAGNIFICATION

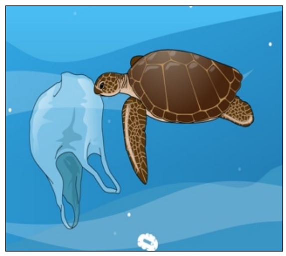
Biomagnification is the process in which chemical substances become more concentrated at each trophic level. Biomagnification occurs because organisms at higher trophic levels must consume more biomass to meet energy requirements. Energy transformations are only ~10% efficient, so the higher order consumers must eat more food to meet energy demands. If the chemical is persistent, the higher order consumers will experience increased contamination from the substance. A chemical that accumulates via biomagnification is **DDT** (**d**ichloro-**d**iphenyl-**t**richloroethane). This chemical is a pesticide that is sprayed on crops and washed into waterways at low concentrations. As is fat soluble, it is retained in the tissues of aquatic algae instead of being excreted. At each subsequent trophic level, the concentration of DDT stored in the body increases due to increased food intake. Very high levels of DDT were discovered in birds that preyed on fish, and was found to interfere with eggshell formation. Another example of a toxin that demonstrates biomagnification is **mercury**. Mercury is a heavy metal that can be released into the environment through activities such as coal-fired power generation and gold mining. The mercury is then converted by microorganisms into highly toxic methyl-mercury, which accumulates within consumers such as fish (along with humans who eat fish).

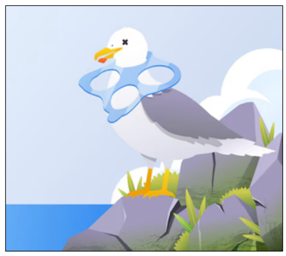


Biomagnification can lead to death if high levels of a toxin accumulates

PLASTIC POLLUTION

Plastics are a type of synthetic polymer found in certain types of clothes, bottles, bags, wrappings and containers. Most plastics are not biodegradable and persist in the environment for many centuries. Large plastic debris (> 1 mm = visible) is defined as *macroplastic*, while smaller debris (< 1 mm) is defined as *microplastic*. Macroplastic debris can be degraded and broken down into microplastic debris by UV radiation and the action of waves. The plastic debris will leach chemicals into water and will also absorb contaminants (**persistent organic pollutants**) that can become toxic via biomagnification. Microplastics will absorb more persistent organic pollutants due to their smaller size (as have more available surface area). Both types of plastic debris will be ingested by marine animals that mistake the debris for food. Sea turtles commonly mistake plastic bags for jellyfish, while an albatross can ingest the plastics when it skims the ocean surface with their beak.





COMBUSTION

Carbon compounds may undergo combustion reactions and produce carbon dioxide (CO_2) as a by-product. Humans are using the combustion of **fossil fuels** to produce energy for various uses (electricity, etc.). Fossil fuels form as a consequence of the incomplete decomposition of biomass under either low oxygen or acidic conditions. When the biomass is compressed under sediment, heat and pressure forces out any impurities and removes any moisture. Peat and coal are formed from the fossilisation of terrestrial organisms, while oil and natural gas are formed from the fossilisation of marine organisms. The combustion of fossil fuels is substantially increasing the concentration of carbon dioxide within the atmosphere. This anthropomorphic pollution is leading to ecological disturbances such as adverse weather conditions and global warming. The concentration of atmospheric carbon dioxide is now higher than it has been in the last ~16 million years.