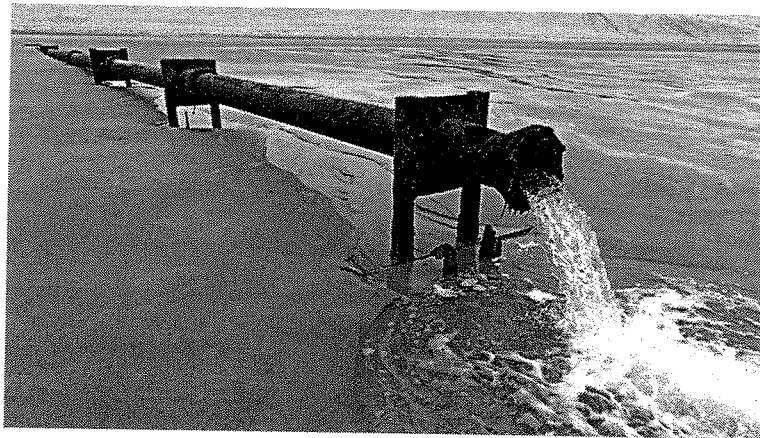Name: _____

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IB ESS

4.4 Water Pollution

Significant ideas:

Water pollution, both groundwater and surface water, is a major global problem the effects of which influence human and other biological systems.

Types of Water Pollution

1. Define water pollution.

   The contamination of bodies of water by pollutants either directly
   or indirectly.

2. Give **three** examples of *natural* pollution sources.

   Volcano eruptions

   algal blooms

   invasive species eg Cane toads

3. Outline what is meant by the term *anthropogenic pollutant*.

   Created by human activities

4. Pollutants may be organic or inorganic. Give three examples of each and state their possible effects.

Pollutant Type	Example	Effect
Organic	Pathogens	Disease
	Human + Animal waste	Smell
	Biological detergents	Eutrophication
Inorganic	Heavy toxic metals	Bioaccumulation
	Phosphates	Eutrophication
	Noise	Disrupts marine life

5. List **three** sources of freshwater pollution and **three** sources of marine pollution.

Freshwater pollution	Marine Pollution
Agricultural run-off	Rivers
Sewage	Pipelines
Industrial discharge	The atmosphere
Solid domestic waste	Human activities at sea
	Oil spills
	Aquaculture farms

Measuring Water Pollution

1. Describe what is meant by the term *Biochemical Oxygen Demand (BOD)*.

a measure of the amount of dissolved oxygen required to break down the organic material in a given volume of water through aerobic biological activity by micro-organisms

2. Describe what is meant by the term *biotic index*.

A biotic index indirectly measures pollution by assaying the impact on species within the community according to their tolerance, diversity and relative abundance

3. a) Outline how *indicator species* **can be used to assess pollution levels in water.**
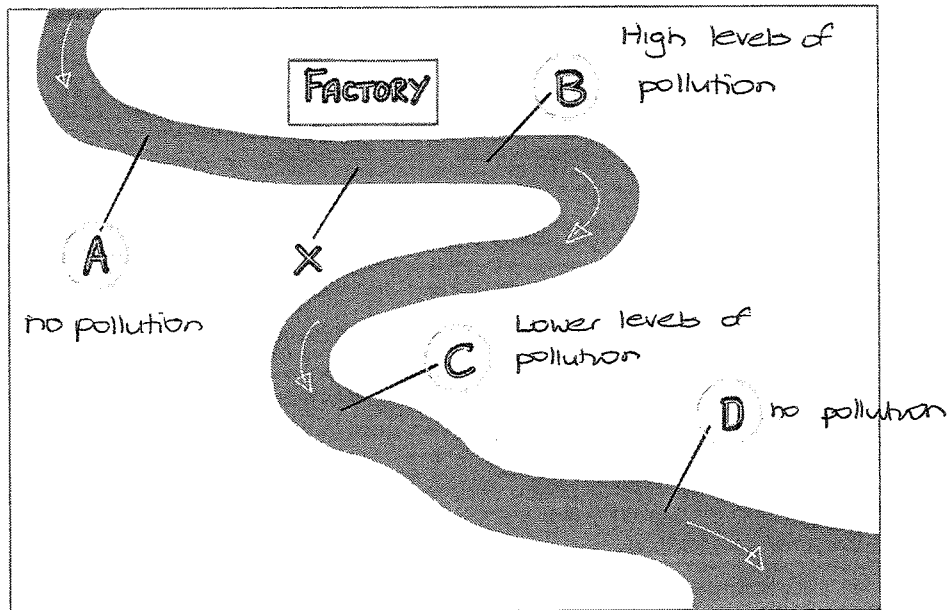
Certain species have different levels of tolerance to environmental conditions and change. The presence or absence and health of these indicator species can be used to suggest conditions in the environment.

eg certain lichen species indicate low levels of sulphur dioxide in the air
Red alga inhabits saline rock pools and is absent from brackish ponds

b) The diagram below represents a river. There is a point-source of **organic** pollution from a factory at point X. Using examples of organisms, and the phrase "pollution (in)tolerant organism", **compare** and **explain** the distribution of freshwater invertebrates you may expect to find at each site A, B, C and D.

A - at this site there will be no organic pollutant and the invertebrates found here will be pollution intolerant species such as mayfly nymph, stonefly nymph, caddisfly larva and shrimp. Biological oxygen demand (BOD) is low.

B - here the organic pollutant levels are highest and the invertebrates found will be sludge worms, rat-tailed maggots + bloodworm pollution tolerant species.
BOD is high as bacteria and fungi break down organic matter.

C - pollutant levels are decreasing as they become more dispersed. Here you would find bloodworms, caddisfly larva, freshwater shrimp and water louse.
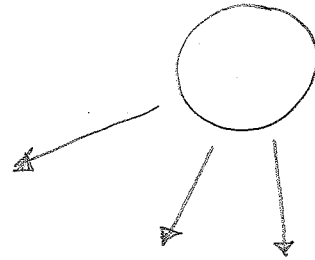The BOD is lower than point B but still higher than A.

D - At this point the organic pollutant is mostly broken down. so you would see the presence of pollution intolerant invertebrates as in A. BOD would be back to normal as organic pollution is broken down.
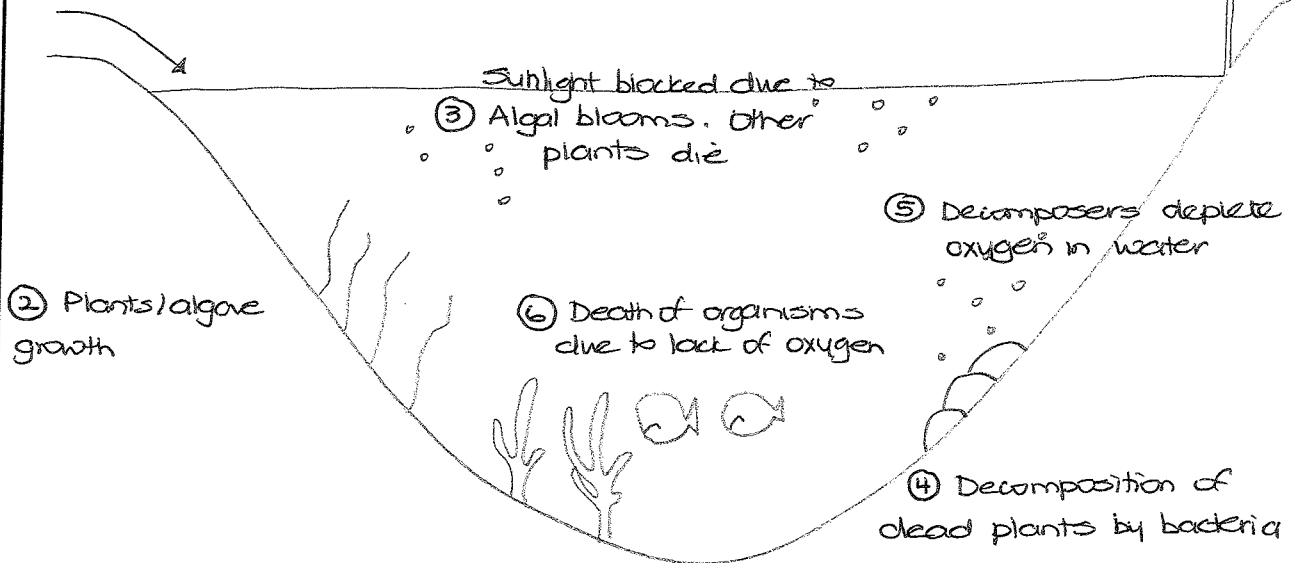
Eutrophication

With the help of a diagram, describe the process of eutrophication. Include each of the following

- Addition of fertilisers ①
- Plant/algae growth ②
- Sunlight blocked ③
- Decomposition ④
- Oxygen depletion ⑤
- Death of organisms ⑥

① Addition of fertilizer: excessive nutrients from fertilizer are flushed into water by rainwater

Sunlight blocked due to
③ Algal blooms. Other plants die

⑤ Decomposers deplete oxygen in water

② Plants/algae growth

⑥ Death of organisms due to lack of oxygen

④ Decomposition of dead plants by bacteria

Eutrophication is the natural or artificial enrichment of a body of water, particularly with respect to nitrates and phosphates, that results in the depletion of oxygen levels in the water. Can be accelerated by human activities that add detergents, sewage or agricultural fertilisers to water.
1. Nutrient load up: excessive nutrients from fertilizers are flushed from the land into rivers or lakes by rainwater
2. Plants flourish: these pollutants cause aquatic plant growth of algae, duckweed and other plants.
3. Algae blooms, oxygen is depleted: this prevents sunlight from reaching

Other plants. The plants die and oxygen in the water is depleted due to the lack of photosynthesis.

4. Decomposition further deplete oxygen: dead plants are broken down by decomposers, using up even more oxygen in the water.

5. Death of the ecosystem: oxygen levels reach a point where no life is possible. Fish and other organisms die.

A number of changes may occur as a result of eutrophication

- Turbidity increases and reduces the amount of light reaching submerged plants.
- Rate of deposition of sediment increases. This decreases the speed of water and decreases the lifespan of lakes.
- NPP is usually higher compared with unpolluted water as seen by blooms
- Dissolved oxygen decreases as decomposition increases.
- Diversity of primary producers changes and finally decreases: the dominant species change. Initially the number of primary producers increases and may become more diverse. As eutrophication proceeds, early algal blooms give way to cyanobacteria.
- Fish communities become dominated by surface-dwelling coarse fish such as pike and perch. Other species migrate from the area if they can.

Impacts on society
- Financial - loss of fertilizers from fields may reduce crop productivity and therefore farm yield and profit
    - cost of treating nitrate-enriched water is expensive
- Health - nitrate-enriched water is associated with higher rates of stomach cancer and blue-baby syndrome (insufficient oxygen in pregnant women's blood)
- Dead zones can occur in oceans and freshwater