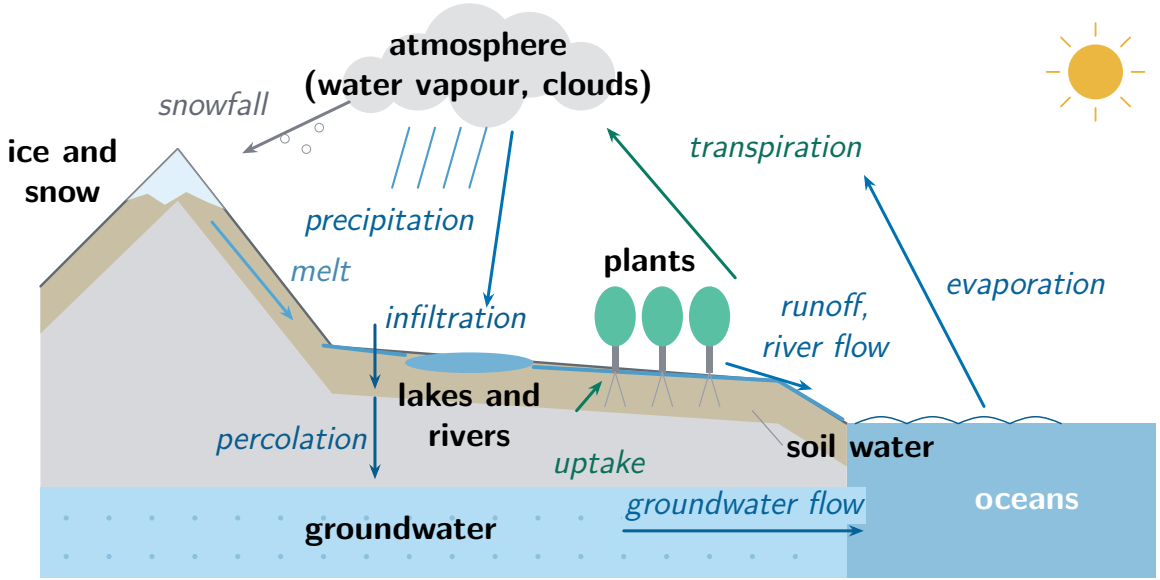
Exercise walk-through

4.4
Water pollution

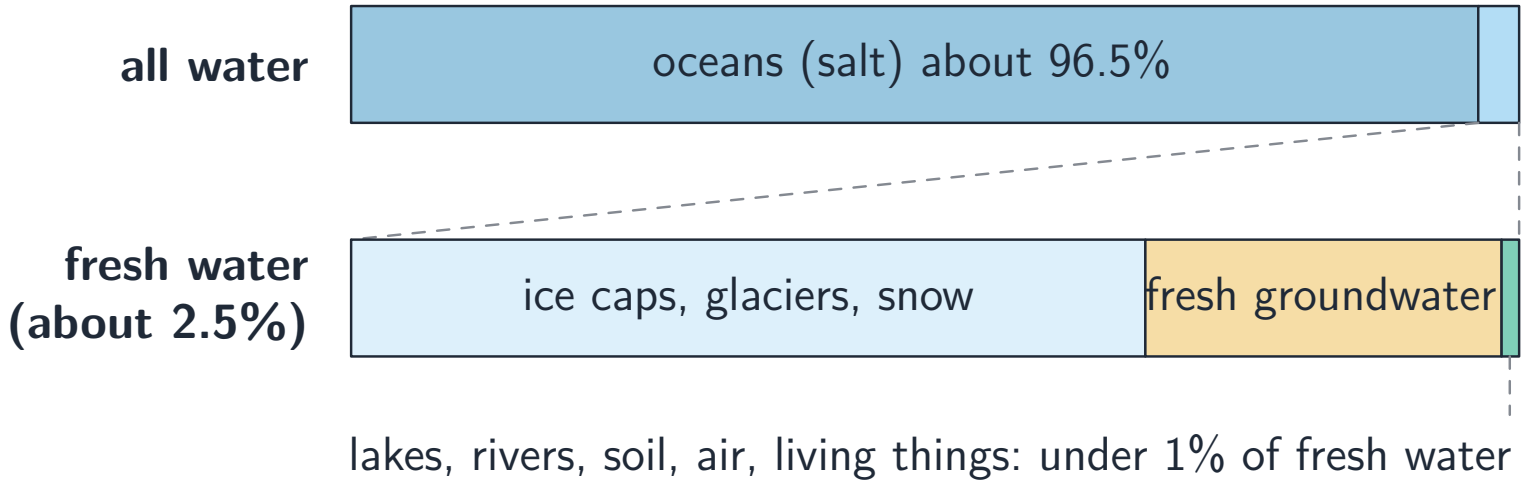
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The hydrological cycle



Selected storages and flows: solar energy and gravity drive different processes.

Where the Earth's water is



Lakes and rivers are under 1% of fresh water

AHL: Footprints and two stress indicators

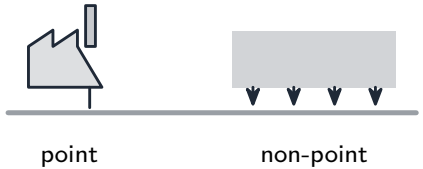
1. **Assigned shirt footprint.** 0.25 kg $\times$ 10000 L/kg $=$ 2500 L/item. **Virtual water** is attributed to trade, not just liquid in products.
2. **Falkenmark availability.** 120 km^3/year $\div$ 80 million people $=$ 1500 m^3 per person per year: stress.
3. **SDG-style stress.** Withdrawals 30, resources 100, environmental requirement 40 million m^3/year: $100\times30/(100-40)=50\%$.

Decision

Freshwater-change planetary boundaries instead concern streamflow and root-zone soil-moisture departures.

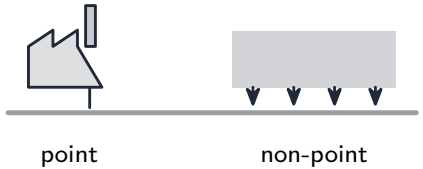
Exercise 2.1

2.1 Distinguish between point-source and non-point-source pollution, with **one** example of each. [2]



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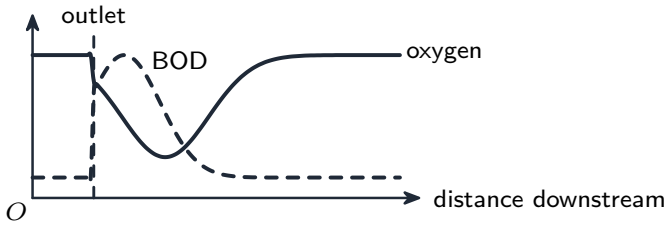


2.1

point: from one identifiable place, e.g. a factory outlet pipe; non-point: from many spread-out places, e.g. fertilizer runoff from farmland

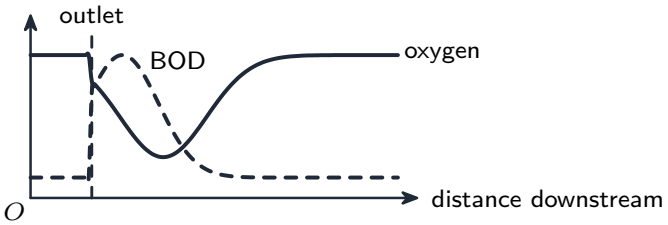
Exercise 2.2

2.2 The graph shows dissolved oxygen and BOD downstream of a sewage outlet. Explain the changes in oxygen. [3]



Exercise 2.2

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2.2

below the outlet, organic matter is decomposed by bacteria, so BOD is high; bacteria use up oxygen, so dissolved oxygen falls; further downstream the organic matter is used up and oxygen dissolves from the air, so oxygen recovers

Exercise 2.3

2.3 Students find many stonefly larvae upstream of a farm and only bloodworms downstream. Explain what this shows, and **one** advantage of indicator species over a single chemical test. [3]



stonefly



bloodworm

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stonefly



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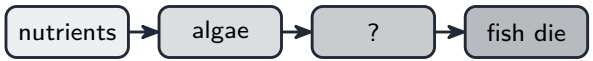
2.3

stoneflies need clean, oxygen-rich water, so upstream water is clean; bloodworms tolerate low oxygen, so downstream water is polluted, probably with organic matter or nutrients from the farm; indicator species show conditions over a long period, while a chemical test shows only one moment

Exercise 3.1 (a)

3.1 Fertilizer runs off farmland into a lake.

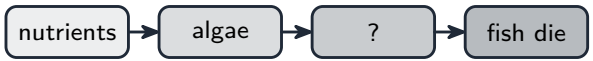
(a) Outline the process of eutrophication. [3]



Exercise 3.1 (a)

3.1 Fertilizer runs off farmland into a lake.

(a) Outline the process of eutrophication. [3]



(a) nitrate and phosphate cause rapid growth of algae; algae block light, so plants die; dead matter is decomposed by bacteria; bacteria use up oxygen, so fish and other animals die

Exercise 3.1 (b)

3.1 Fertilizer runs off farmland into a lake.

(b) Explain why eutrophication is an example of positive feedback. [1]

Exercise 3.1 (b)

3.1 Fertilizer runs off farmland into a lake.

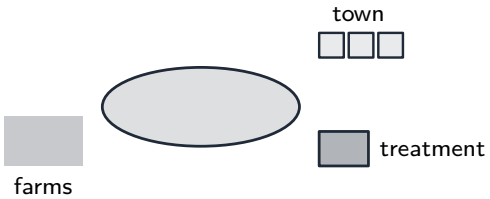
(b) Explain why eutrophication is an example of positive feedback. [1]

(b) the dead animals add more organic matter, so decomposition and oxygen loss increase further

Exercise 3.2

3.2 A lake suffers from eutrophication caused by farm runoff and town sewage.

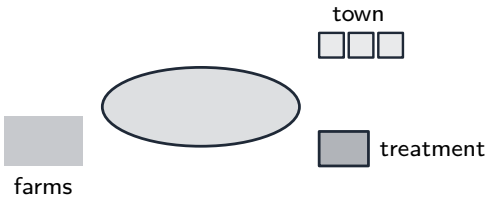
Evaluate strategies at **three** levels to manage the problem. [5]



Exercise 3.2

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Evaluate strategies at **three** levels to manage the problem. [5]



3.2

award up to [5]: change the activity: use less fertilizer, apply it at the right time, phosphate-free detergents: cheapest in the long term but needs farmer cooperation; control the release: buffer strips and sewage treatment that removes nutrients: effective but costly to build; clean-up: dredge nutrient-rich sediment, aerate water, remove algae: fast effect but expensive and only treats the symptoms; conclusion: prevention at the source is most sustainable, with clean-up for quick relief

Exercise 3.3 (a)

3.3 Plastics now occur in all oceans.

(a) Explain **two** ways plastics harm marine organisms. [2]



Exercise 3.3 (a)

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(a) Explain **two** ways plastics harm marine organisms. [2]



(a) animals become entangled, or swallow plastic and starve; microplastics enter food chains and carry toxic chemicals

Exercise 3.3 (b)

3.3 Plastics now occur in all oceans.

(b) Discuss whether a ban on single-use plastic bags is an effective way to reduce ocean plastic. [2]

Exercise 3.3 (b)

3.3 Plastics now occur in all oceans.

(b) Discuss whether a ban on single-use plastic bags is an effective way to reduce ocean plastic. [2]

(b) bans can sharply cut bag use and are easy to understand; but bags are only a small part of ocean plastic, much of which comes from fishing gear and poor waste collection, so other measures are needed