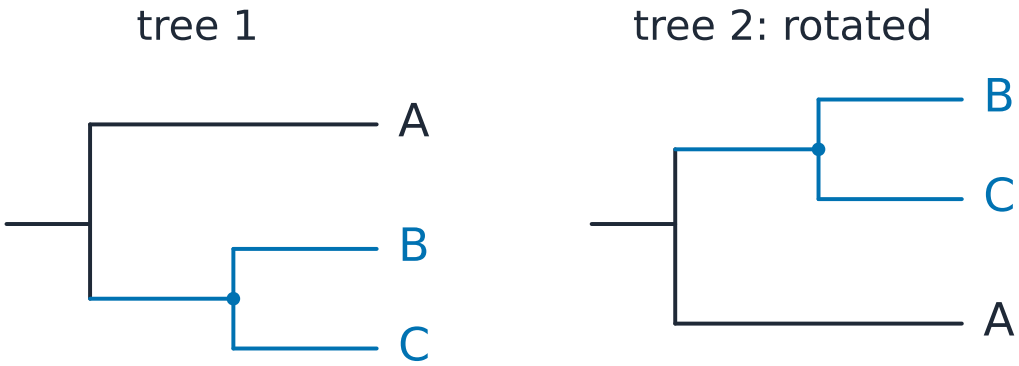
Exercise walk-through

2.3 Biogeochemical cycles

International Baccalaureate · IB Diploma · Environmental Systems and Societies · HL

AHL: Classify by ancestry



same ancestry: B and C share
a more recent ancestor
invented taxa; branch lengths do not encode time

A **clade** contains an ancestor and all its descendants; node rotation preserves ancestry.

Simpson's reciprocal index

- Site A has 10, 6 and 4 individuals; site B has 18, 1 and 1.
- Same richness, but A is shared more evenly.

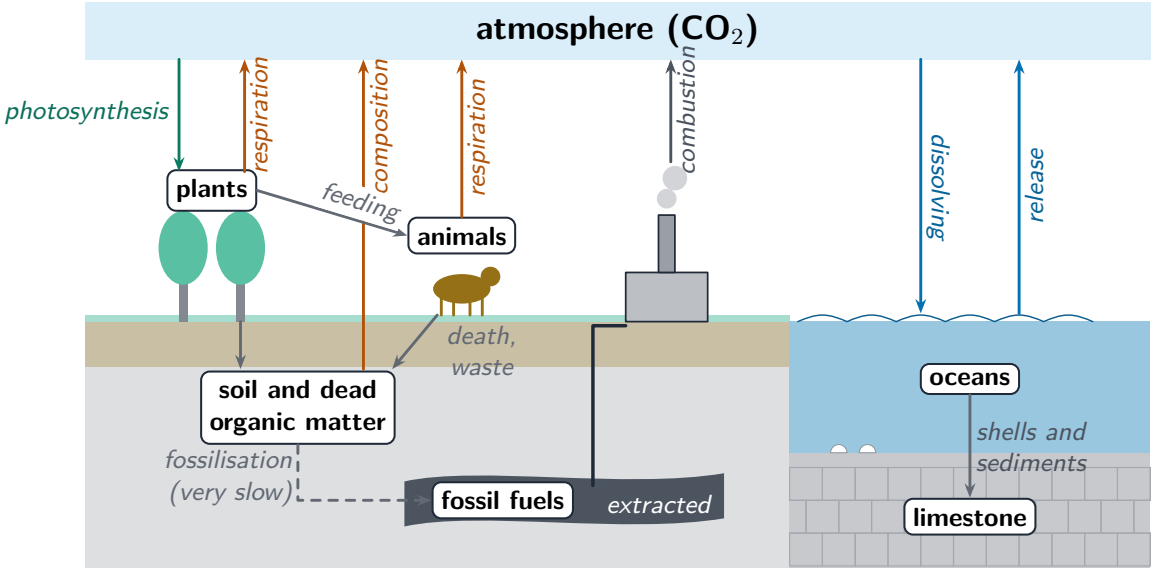
$$D = \frac{N(N-1)}{\sum n(n-1)}$$

$$D_A = \frac{380}{132} = 2.88$$

$$D_B = \frac{380}{306} = 1.24$$

These invented samples have equal richness and different evenness; compare like sampling.

The carbon cycle

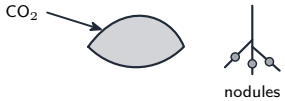


storages in boxes, flows on arrows; not to scale

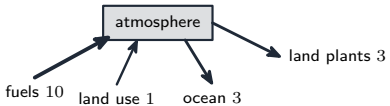
A store is an amount; a net **sink** is defined by the balance of flows over time.

Exercises 2.1·2.2

2.1 Name the process: (i) CO_2 is taken from the air into a leaf to make glucose; (ii) N_2 gas is changed to ammonium in root nodules. [2]

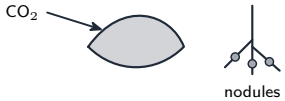


2.2 Each year, about 10 GtC of carbon is released by burning fossil fuels and 1 GtC by land clearing; the oceans absorb 3 GtC and land plants 3 GtC more than they release. (i) Calculate the yearly change in atmospheric carbon. (ii) Identify **one** sink and **one** source in the data. [3]



Exercises 2.1·2.2

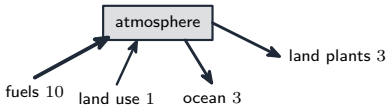
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2.1

(i) photosynthesis; (ii) nitrogen fixation

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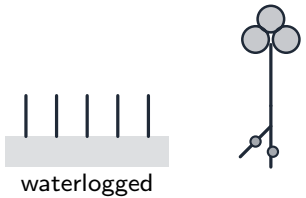
2.2

(i) $10 + 1 - 3 - 3 = +\mathbf{5}$ GtC a year; (ii) sink: oceans or land plants; source: fossil fuel burning or land clearing

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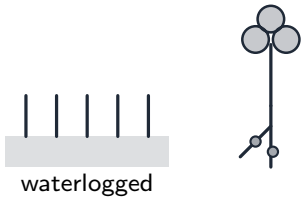
Exercise 2.3

2.3 Explain why farmers on waterlogged soils lose nitrate faster, and why planting legumes such as beans or clover can reduce the need for fertilizer. [3]



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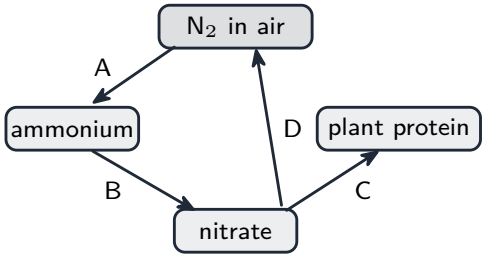
2.3

waterlogged soil has little oxygen; denitrifying bacteria then change nitrate to N_2 gas, which is lost to the air; legumes have nitrogen-fixing bacteria in root nodules, which add ammonium to the soil when the plants die or are ploughed in

Exercise 3.1 (a)

3.1 The diagram shows part of the nitrogen cycle.

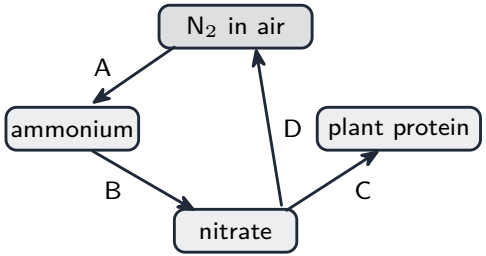
(a) Name processes A and B. [2]



Exercise 3.1 (a)

3.1 The diagram shows part of the nitrogen cycle.

(a) Name processes A and B. [2]



(a) A: nitrogen fixation (N_2 to ammonium); B: nitrification (ammonium to nitrate)

Exercise 3.1 (b)

3.1 The diagram shows part of the nitrogen cycle.

(b) Explain why ploughing that lets air into soil increases the nitrate in the soil. [2]

Exercise 3.1 (b)

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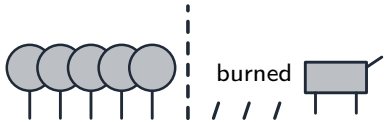
(b) Explain why ploughing that lets air into soil increases the nitrate in the soil. [2]

(b) nitrifying bacteria need oxygen; more oxygen speeds up nitrification, and denitrification slows

Exercise 3.2 (a)

3.2 A large area of tropical rainforest is cleared and burned for cattle pasture.

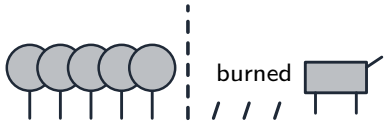
(a) Explain **two** ways this changes the carbon cycle. [4]



Exercise 3.2 (a)

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(a) Explain **two** ways this changes the carbon cycle. [4]



(a) burning moves carbon from biomass into the atmosphere quickly as CO_2; the forest was a sink, so less CO_2 is removed by photosynthesis in future, and soil carbon is lost as the soil is exposed and decomposes

Exercise 3.2 (b)

3.2 A large area of tropical rainforest is cleared and burned for cattle pasture.

(b) State **one** other effect of the clearing on a biogeochemical cycle. [1]

Exercise 3.2 (b)

3.2 A large area of tropical rainforest is cleared and burned for cattle pasture.

(b) State **one** other effect of the clearing on a biogeochemical cycle. [1]

(b) any one: nutrients (nitrogen) are lost in runoff and leaching; cattle release methane; less transpiration changes the water cycle

Exercise 3.3 (a)

3.3 The ocean has absorbed about a quarter of the CO_2 released by human activity.

(a) Describe how the ocean takes in CO_2 and becomes more acidic. [2]

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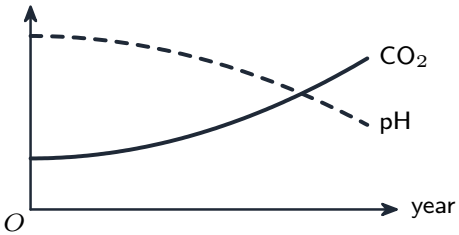
(a) Describe how the ocean takes in CO_2 and becomes more acidic. [2]

(a) CO_2 dissolves in surface water; it reacts with water to form carbonic acid, so the pH falls

Exercise 3.3 (b)

3.3 The ocean has absorbed about a quarter of the CO_2 released by human activity.

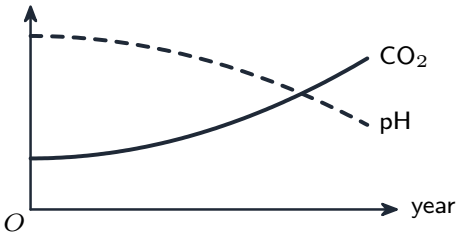
(b) Discuss the claim that the ocean "solves" the problem of carbon emissions. [4]



Exercise 3.3 (b)

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(b) Discuss the claim that the ocean "solves" the problem of carbon emissions. [4]



(b) award up to [4]: the ocean slows the rise of atmospheric CO_2 and so slows warming; but acidification harms corals, shellfish and plankton with carbonate shells, and the food webs that depend on them; warmer water dissolves less CO_2, so the sink may weaken; conclusion: the ocean delays the problem and creates another, so emissions still must fall

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