

Name: _____

Date: _____

Class: _____

IB Environmental Systems and Societies

2.3 Flows of Energy and Matter

Significant ideas:

Ecosystems are linked together by energy and matter flows.

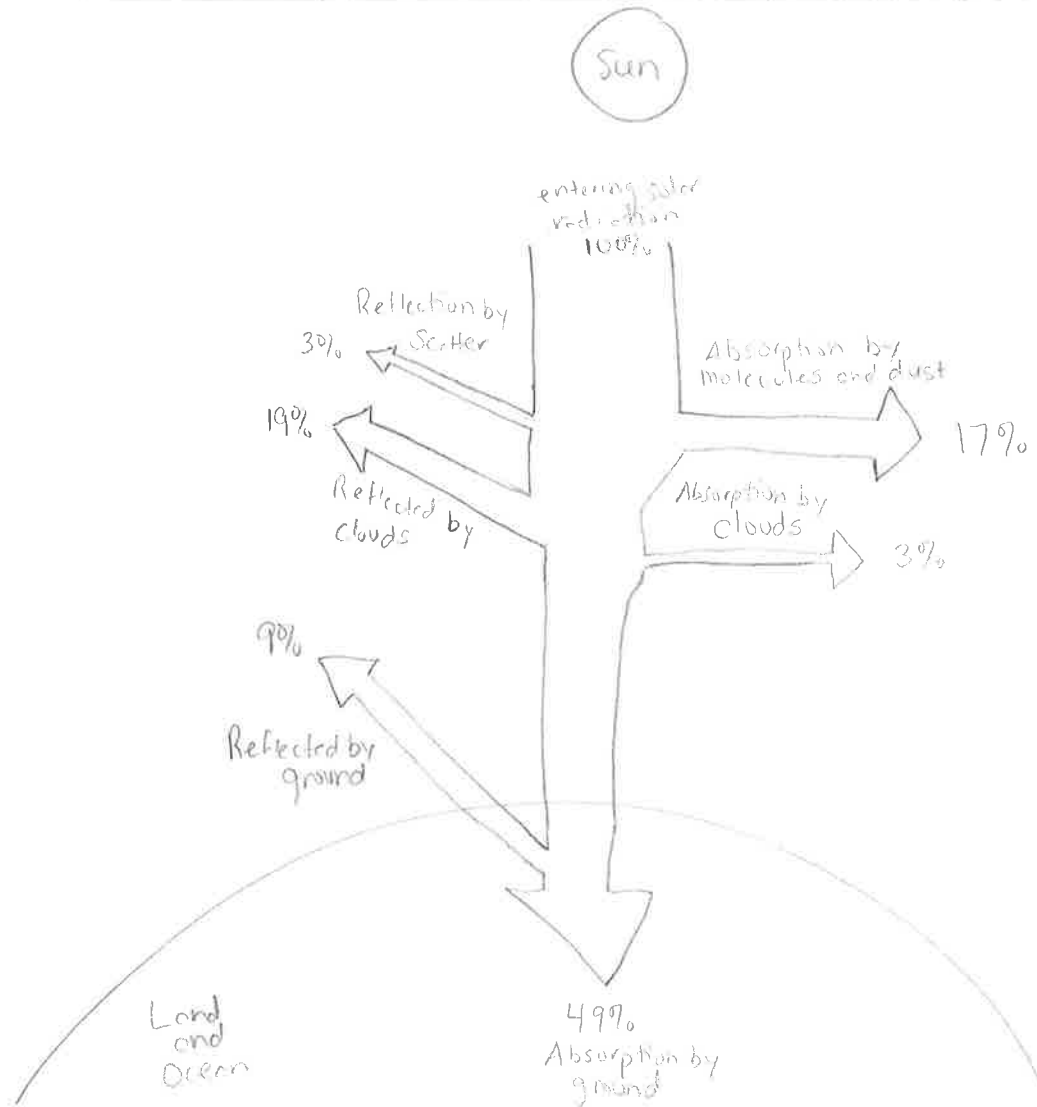
The Sun's energy drives these flows and humans are impacting the flows of energy and matter both locally and globally.



Energy Transfers

1. Draw a diagram to summarise the transfers and transformations of solar energy that occur as it reaches the Earth. Use the details listed below:

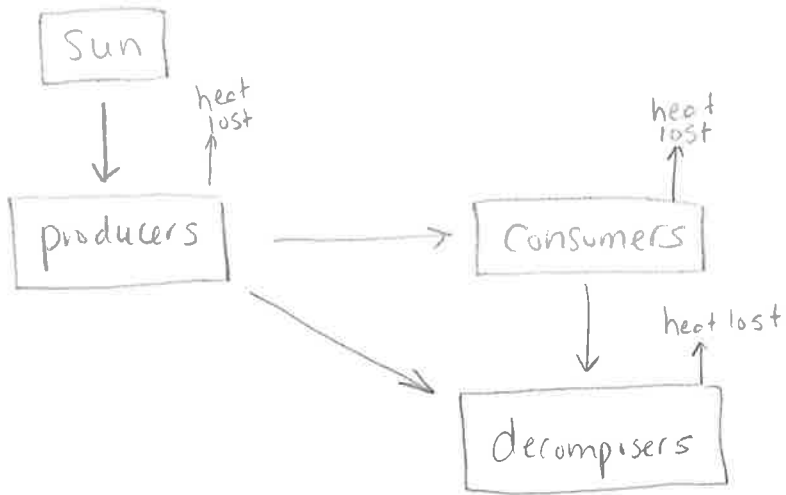
3% reflection by scatter	17% absorption by molecules/dust
19% reflection by clouds	3% absorption by clouds
9% reflection by ground	49% absorption by the ground



2. Roughly what percentage of the Sun's radiation is available to plants for photosynthesis?

1%

3. Draw a systems diagram to summarise the pathways of energy through an ecosystem.



Productivity

1. The sentences below each describe one of the phrases in the box. Write the correct phrase below each sentence.

Net primary productivity **Gross primary productivity**
Net secondary productivity **Gross secondary productivity**
Maximum sustainable yield

The total amount of stuff (energy or biomass) that's taken in and assimilated by a consumer. An example is: all the food that an animal takes in, subtracting what it releases as faeces.

Gross Secondary productivity

The total amount of energy/matter assimilated by a producer (e.g. a plant), before it gets used by the plant for respiration.

Gross primary productivity

The food that an animal consumes, with fecal losses AND respiration subtracted. This is basically what is available to the next trophic level.

Net Secondary productivity

The amount of energy/biomass that a producer takes in that is actually keeps (and doesn't use for respiration).

Net primary productivity

This is equivalent to NPP or NSP. It's basically the amount of "useful" stuff that is produced by a system.

Maximum Sustainable yield

2. Complete the table below summarizing the details of productivity:

Productivity type	Abbr.	Calculation	Units
Net primary productivity	NPP	$GPP - R$	$g\ m^{-2}\ yr^{-1}$
Gross secondary productivity	GSP	Food eaten - fecal loss	$g\ m^{-2}\ yr^{-1}$
Net Secondary productivity	NSP	$GSP - R$	$g\ m^{-2}\ yr^{-1}$



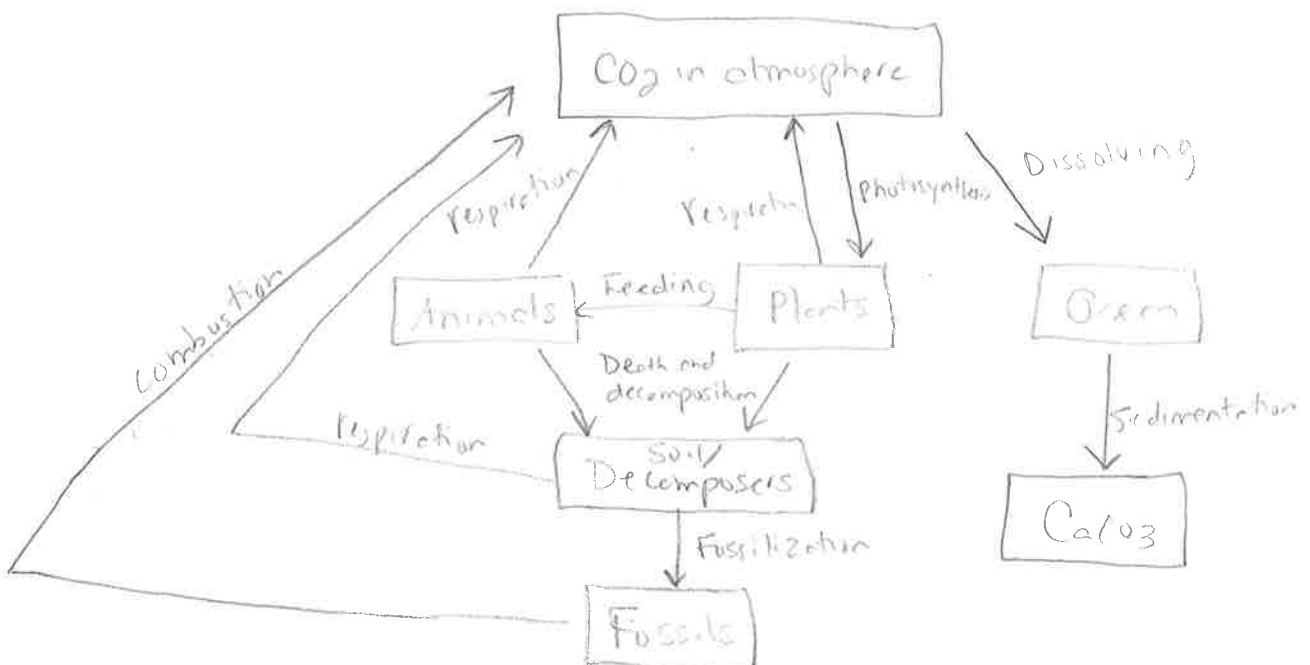
The carbon cycle

1.

a) Complete the table to list the flows and storages in the carbon cycle.

Storages	Flows
Producers / Plants	Photosynthesis
Consumers / Animals	Respiration
Decomposers	Feeding
Fossils and sediments	Death and decomposition
Atmosphere	Fossilization
Ocean	Combustion
Soil	Dissolving sedimentation

b) Draw a systems diagram to represent the carbon cycle. Include all storages and flows.



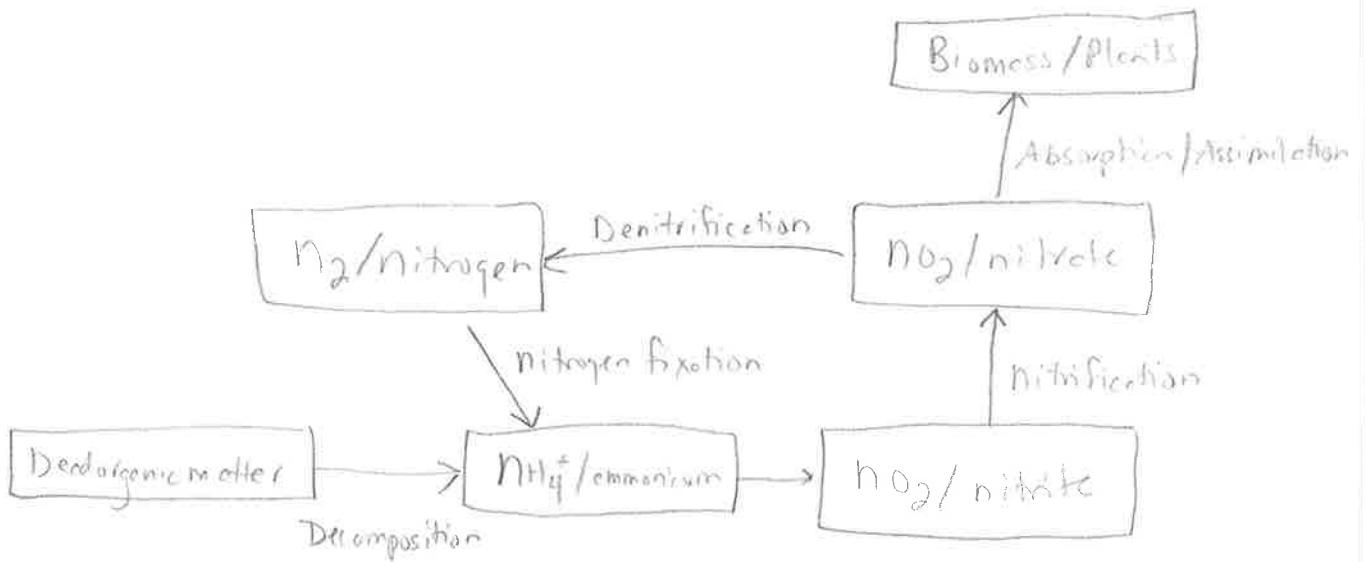
The nitrogen cycle

1.

a) Complete the table to list the flows and storages in the nitrogen cycle.

Storages	Flows
Organisms Soil/Dead organic matter Fossil fuels Atmosphere Water	Nitrogen fixation Nitrification Denitrification Feeding Excretion Death and decomposition

b) Draw a systems diagram to represent the nitrogen cycle. Include all storages and flows.



Human Impacts

1. Outline ways in which humans influence **energy** flows.

Hints:

- Greenhouse gases.
- Increased water vapour (clouds are reflective!)
- Deforestation.
- CFCs, ozone and UV light.
- Agriculture: disrupting the natural flow through a food chain/web.
- ... (any others you can think of?)

Our use of fossil fuels has allowed us to use the sun's energy that was previously trapped by plants and inaccessible for millions of years. This increased amount of energy available to humans has allowed us to massively increase our agricultural output, which has in turn led to increases in human population growth. It has also led to many environmental issues, including climate change and habitat destruction.

Fossil fuel combustion has also altered the way in which the Sun's energy interacts with the atmosphere and the surface of Earth. Increased carbon dioxide along with increased temperatures has reduced the amount of reflected sunlight energy. Pollution in the atmosphere has also led to increased interception of radiation from the sun, through changes in reflection by scatter from tiny atmospheric particles, and absorption by molecules and dust in the atmosphere.

2. Explain the impact of the industrial revolution on the **carbon** cycle.

The industrial revolution meant an increased amount of carbon stored as fossil fuel was removed from storage and added to the atmosphere as carbon dioxide through combustion, a process that has continued to present day.



3. Outline the ways in which the agriculture industry has influenced the **nitrogen** cycle.

Agriculture removes biomass from one area and transports it to another, so that the nitrogen cannot be cycled.

In agriculture, nitrogen is also added to the system as fertilizer.

