

Transfers of energy and matter

**Distinguish open and closed systems.**

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**Give two ecosystems not sustained by sunlight.**

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**How is a scientific law different from a theory?**

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**What do arrows in a food chain show?**

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**Where do decomposers get their energy?**

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**How does chemical energy pass along a food chain?**

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**Define autotroph (IB wording).**

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**Name an example of a chemoautotroph and its energy source.**

Caves (e.g. Movile Cave) and deep-ocean hydrothermal vents below light penetration, sustained by chemoautotrophs.

Open: energy and matter can enter and exit (ecosystems). Closed: only energy can pass in and out.

The direction of transfer of energy and biomass, from the organism eaten to the organism that eats it.

A law is a generalised principle describing a pattern and allowing predictions; it does not explain it, unlike a theory.

A consumer feeds on the organism at the previous stage, taking in its carbon compounds and the chemical energy in them.

From carbon compounds in dead organic matter: faeces, dead parts of organisms and dead whole organisms.

Iron-oxidising bacteria: energy from oxidising iron(II) ions ( $\text{Fe}^{2+}$ ) to iron(III) ions ( $\text{Fe}^{3+}$ ).

An organism that uses an external energy source to synthesise carbon compounds from simple inorganic substances.

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**Define heterotroph (IB wording).**

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**How do both autotrophs and heterotrophs release energy?**

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**Name the trophic levels in order.**

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**What are the units on an energy pyramid?**

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**Can one organism occupy more than one trophic level?**

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**Give three causes of energy loss between trophic levels.**

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**When is heat produced in cells?**

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**Why are there few trophic levels?**

By oxidation of carbon compounds in cell respiration.

An organism that uses carbon compounds obtained from other organisms to synthesise the carbon compounds that it requires.

Energy per unit area per unit time, e.g.  $\text{kJ m}^{-2} \text{yr}^{-1}$ .

Producer, primary consumer, secondary consumer, tertiary consumer.

Not all organisms or parts are eaten; not all food is digested (faeces); energy converted to heat in respiration.

Yes: many organisms have a varied diet and occupy different trophic levels in different food chains.

Large energy losses at each transfer leave too little energy to support a further level; biomass falls, energy per gram does not.

Both when ATP is produced in cell respiration and when ATP is used, because energy transfers are not 100% efficient.

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**Define primary production and give its units.**

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**Why is secondary production lower than primary production?**

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**Which three processes recycle carbon in a carbon cycle diagram?**

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**When is an ecosystem a carbon sink?**

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**Name the carbon stores whose combustion releases CO<sub>2</sub>.**

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**Explain the annual fluctuation in the Keeling Curve.**

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**What causes the long-term rise in the Keeling Curve?**

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**How do photosynthesis and aerobic respiration depend on each other?**

Carbon compounds are converted to CO<sub>2</sub> and water in cell respiration, so biomass is lost before it reaches heterotrophs.

Accumulation of carbon compounds in biomass by autotrophs; g m<sup>-2</sup> yr<sup>-1</sup> (mass of carbon per area per time).

When photosynthesis exceeds respiration, giving a net uptake of CO<sub>2</sub>.

Photosynthesis, feeding and respiration (plus combustion).

CO<sub>2</sub> falls in the northern summer (photosynthesis > respiration) and rises in winter (respiration > photosynthesis).

Biomass, peat, coal, oil and natural gas.

Respiration uses O<sub>2</sub> produced by photosynthesis; photosynthesis uses CO<sub>2</sub> produced by respiration.

Combustion of fossil fuels (and deforestation), releasing CO<sub>2</sub> faster than it is removed.

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**Which elements are recycled in ecosystems?**

All elements required by living organisms,  
not just carbon; decomposers play a key  
role.