

Origins of cells **HL only**

Why was there no ozone layer on early Earth?

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Why were temperatures higher on early Earth?

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Miller-Urey experiment: what was used and what formed?

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Two limitations of the Miller-Urey experiment

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Why are cells the smallest units of self-sustaining life?

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Three reasons viruses are considered non-living

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Four requirements for the evolution of the first cells

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Why are hypotheses about the origin of cells hard to test?

Higher concentrations of carbon dioxide and methane caused a strong greenhouse effect.

There was no free oxygen, and ozone forms from oxygen. So ultraviolet light reached the surface.

The early atmosphere was probably less reducing (more CO_2 and N_2), and only monomers formed, not polymers or cells.

Water vapour, methane, ammonia and hydrogen with electric sparks as lightning. After about a week, amino acids and other carbon compounds had formed.

They are not cells (no cytoplasm), have no metabolism of their own, and cannot reproduce outside a host cell.

A cell can carry out all the functions of life on its own; nothing smaller can.

Pre-biotic conditions cannot be replicated exactly, and the first protocells did not fossilise.

Catalysis, self-replication of molecules, self-assembly and compartmentalisation.

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How do fatty acids form vesicles?

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Why was a membrane-bound compartment needed?

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Why is RNA presumed to be the first genetic material?

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What is a ribozyme? Give an example.

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What is LUCA?

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Two pieces of evidence for LUCA

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Why do no other early forms of life survive?

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How does a molecular clock estimate dates?

It allows internal chemistry to become different from that outside the compartment.

In water, amphipathic fatty acids coalesce spontaneously into spherical bilayers, with hydrophobic tails inside the bilayer.

An RNA molecule with catalytic activity, such as the rRNA in ribosomes that catalyses peptide bond formation.

It can be replicated and has some catalytic activity, so it could act as both genes and enzymes.

The universal genetic code and genes shared across all organisms.

The last universal common ancestor: the most recent organism from which all living organisms are descended.

Base differences in conserved genes build up at a roughly constant rate; calibrated with dated fossils, they estimate when lineages split.

They probably evolved but became extinct due to competition from LUCA and its descendants.

Evidence that LUCA lived near hydrothermal vents

Microbe-like fossils in ancient sea-floor vent precipitates, and conserved genes for anaerobic, hot, hydrogen-using life with iron-sulfur proteins.