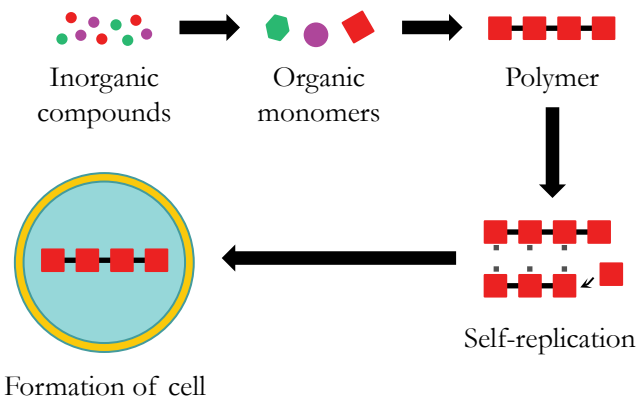
TOPIC 1.5: ORIGIN OF CELLS

Abiogenesis

The formation of living cells from non-living materials (abiogenesis) is theorised to involve 4 four key processes:

- Non-living synthesis of simple organic molecules
- Assembly of organic molecules into complex polymers
- Formation of polymers that can self-replicate
- Packaging of molecules into membranes to create an internal chemistry different from the surroundings

The Miller-Urey experiment replicated the conditions of a pre-biotic Earth in order to synthesize organic molecules



Biogenesis

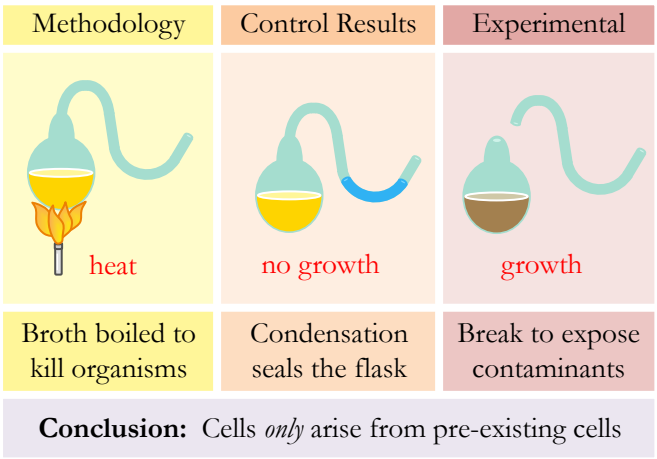
Abiogenesis requires specific conditions in order to proceed

- Including a reducing atmosphere (no oxygen) and either high temperatures (>100°C) or electrical discharges

As these conditions no longer commonly exist on Earth, cells can only be formed from division of pre-existing cells

This law of biogenesis was demonstrated by Louis Pasteur

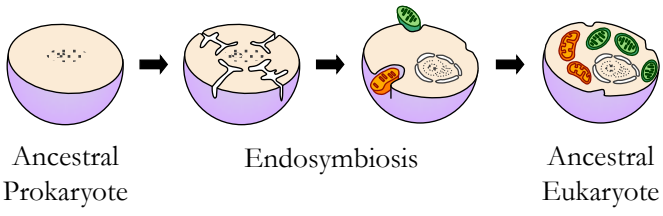
- Broths were stored in sealed vessels that were sterilised
- Bacterial growth occurred if vessel was unsealed, but did not occur if vessel stayed sealed (no contamination)



Endosymbiosis

Eukaryotic cells are believed to have evolved from aerobic prokaryotes that were engulfed by endocytosis

The engulfed cell remained undigested and contributed new functionality to the engulfing cell (i.e. it became an organelle)



Chloroplasts and mitochondria arose via endosymbiosis:

- **M**embranes (have a double membrane)
- **A**ntibiotics (show susceptibility)
- **D**NA (have naked and circular DNA)
- **D**ivision (occurs via a fission-like process)
- **R**ibosomes (have 70S ribosomes)

Oxygenation of Earth

The appearance of photosynthetic organisms lead to the rapidly increasing oxygenation of the Earth's environment

Oceans

- Originally, Earth's oceans had high levels of dissolved iron (released from crust by underwater volcanic vents)
- Oxygen chemically reacted with the iron to form an insoluble precipitate (iron oxide)

Rock Deposition

- Insoluble iron formed banded iron formations (BIFs)
- These deposits are not commonly found in rock that is younger than 1.8 billion years (hence, identifies when photosynthetic organisms first evolved)

Atmosphere

- When dissolved iron was completely consumed, oxygen started accumulating in the anoxic atmosphere