

**Topic 1.5 The Origin of Cells**

1.5.U1 Cells can only be formed by division of pre-existing cells.

1. State the three core ideas of cell theory.
2. Aside from Pasteur’s experiments what evidence do Biologists have that cells can only be formed by division of pre-existing cells? Outline the evidence below:
  - Cells are highly complex structures ...
  - All known examples of growth ...
  - Viruses are produced from simpler subunits ...
  - Genetic code is universal ...

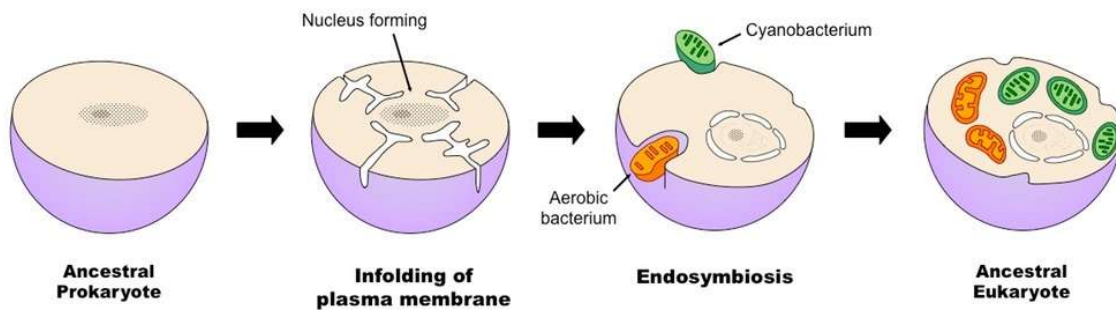
1.5.U2 The first cells must have arisen from non-living material.

If we accept that there were times in the history of the Earth when cells did not exist then it is an obvious point that ‘The first cells must have arisen from non-living material’. The only other possible explanation is that life, in the form of cells, was transported here from elsewhere in the universe. It is extremely difficult (and given our level of technology currently impossible), to generate cells from anything but other cells. So how did the first cells arise?

3. We have evidence and ideas how some of the key problems might have been solved. Outline the following points:
  - a. The non-living synthesis of simple organic molecules, e.g. sugars and amino acids.
  - b. The assembly of these organic molecules into polymers.
  - c. Formation of membranes to package the organic molecules.
  - d. The formation of polymers that can self-replicate (enabling inheritance).

1.5.U3 The origin of eukaryotic cells can be explained by the endosymbiotic theory.

4. State the definition of endosymbiotic theory.
5. As shown by the diagram below, there are several key stages in the theory:



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- a. Outline the formation of the nucleus
- b. Outline the endosymbiosis and state the organelles that may well have been formed as a result of the process.
6. Describe the evidence supporting the theory for mitochondria and chloroplasts.

## Simulations on The Origin of Cells

1.5.A1 Evidence from Pasteur's experiments that spontaneous generation of cells and organisms does not now occur on Earth. AND Nature of Science: Testing the general principles that underlie the natural world - the principle that cells only come from pre-existing cells needs to be verified. (1.9)

Use the following resources to explore the different experiments scientists did to hypothesize how life first formed on Earth and disprove the theory of spontaneous generation.

[phschool.com/atschool/phsciexp/active\\_art/redi\\_pasteur\\_experiment/](http://phschool.com/atschool/phsciexp/active_art/redi_pasteur_experiment/)  
[ucsd.tv/miller-urey/](http://ucsd.tv/miller-urey/)  
[visionlearning.com/en/library/Biology/2/Origins-of-Life-1/226/reading](http://visionlearning.com/en/library/Biology/2/Origins-of-Life-1/226/reading)

## Spontaneous Generation and Abiogenesis

1. State the definitions of spontaneous generation and abiogenesis.
2. A roman poet Virgil wrote a recipe for bees in a *The Georgics* his second major works.
  - a. Research and write down another "recipe" for another organism.
  - b. Evaluate how people may have believed that this "recipe" could produce living organisms.
3. State the name of the technological development that allowed scientists to further study spontaneous generation.
4. There are many hypotheses about how life began on earth. Describe why abiogenesis is generally accepted as a theory but spontaneous generation is not.



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## Francesco Redi and Louis Pasteur

1. Outline the similarities between Redi's and Pasteur's experiments.
2. Describe how Redi's and Pasteur's experiments refute the theory of spontaneous generation.
3. Give reasons why these experiments were necessary for the advancement of

## Stanley Miller – Harold Urey

1. Outline what the Miller-Urey experiment hypothesized.
2. List the gases that were used to produce organic molecules in the experiment.
3. Describe possible outcomes of using the incorrect reactants.

## Going Beyond: Protocells Experiments by Martin Hanczyc

Find out more about what early cells may have looked liked and behaved.

[youtu.be/dySwrhMQdX4](http://youtu.be/dySwrhMQdX4)