

LIFE

" Life - it goes on "

Robert Frost

Handwritten signature

Living things are distinguished from non-living in that they **have biological processes** (*functions such as metabolism, growth, reproduction, etc.*)



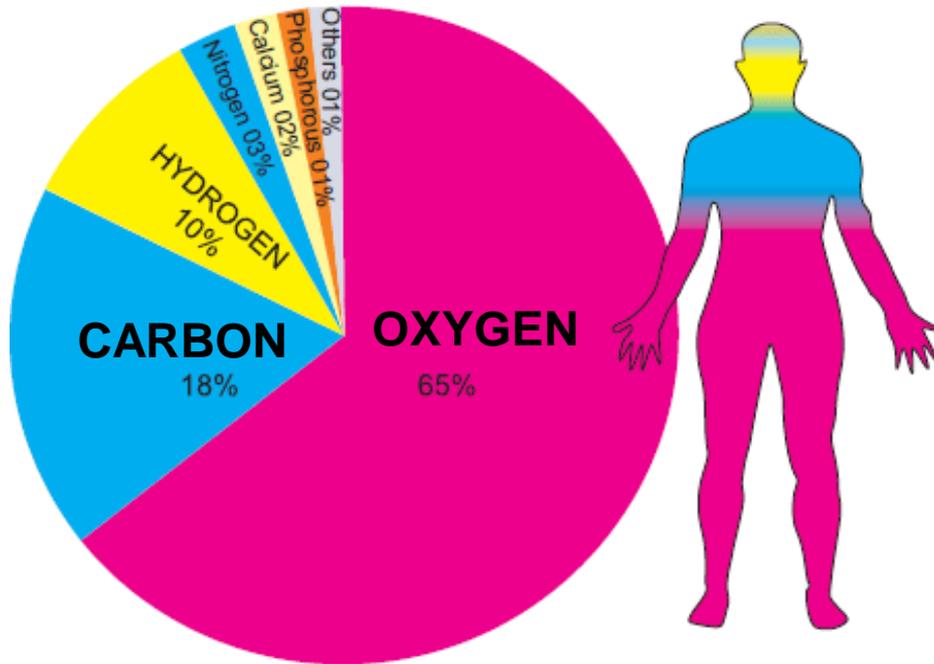
The smallest unit of life is called an **organism**.

Examples?

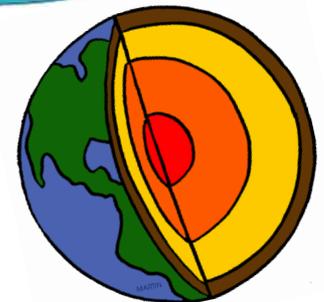
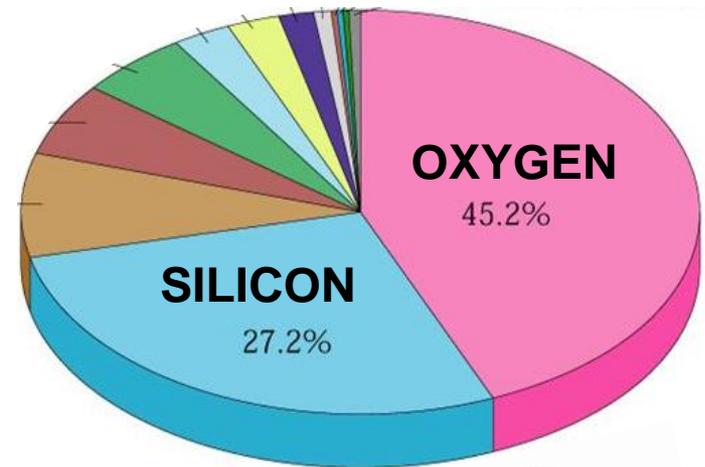
What is Life Made of?

Approximate elemental composition (% of chemical element by mass)

of a human body...



...vs Earth's crust

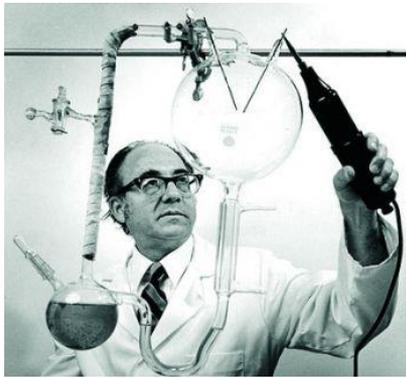


life is carbon-based

Origin of Life on Earth

The mechanism by which life began on Earth is unknown. Modern science is discussing at least TWO hypotheses:

1. A set of hypotheses stating that **life begun in another part of the Universe, arrived on Earth by chance** with the crash of a comet or a meteorite.
 - NASA findings in 2011, based on studies with meteorites found on Earth, suggest *DNA and RNA components may be formed in outer space*.
 - In March 2015, NASA scientists reported that, for the first time, such components *have been formed in the laboratory under outer space conditions*, using starting chemicals found in meteorites.
2. The most common – **life began about 3.5 billion years ago as the result of a complex sequence of chemical reactions**.
 - Let's take a look at **Miller Urey experiment...**



Miller–Urey experiment, 1953: chemical origins of life

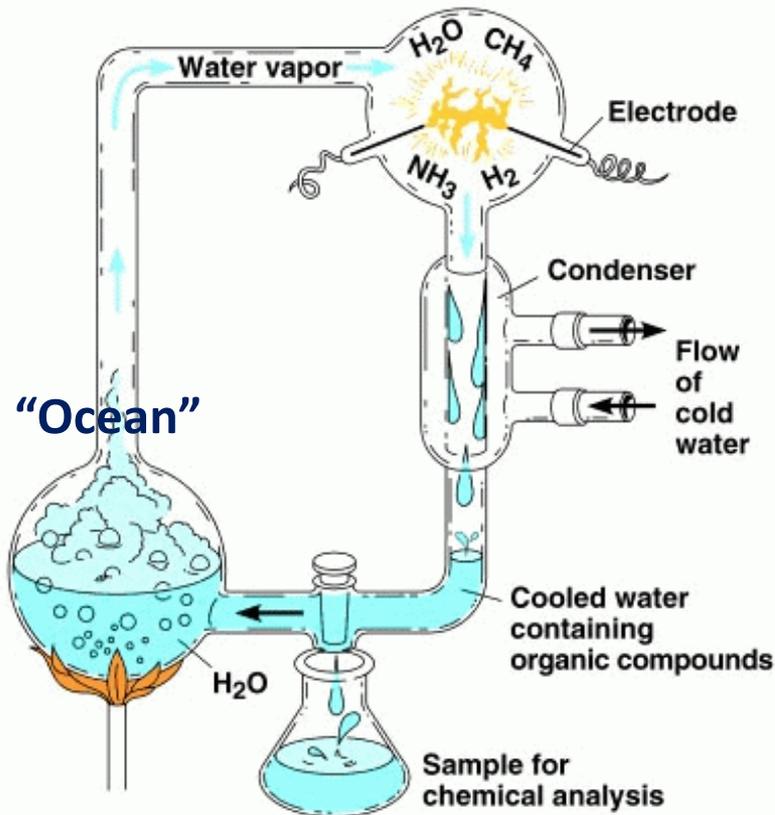


Stanley L. Miller



Harold C. Urey

“Atmosphere”



“Ocean”

- Test for the occurrence of chemical origins of life by simulating the conditions thought at the time to be present on the early Earth.
- The experiment used **water** (H_2O), **methane** (CH_4), **ammonia** (NH_3), and **hydrogen** (H_2) all sealed inside a sterile loop array of glass flasks; one flask was half-full of **liquid water** (“ocean”) and another flask contained a pair of electrodes. The liquid **water was heated** to induce evaporation, **sparks were fired** between the electrodes to simulate “lightning through the atmosphere” and water vapor; then water could “precipitate” that is **condense and trickle back** into the first flask in a continuous cycle.
- After two weeks: 10–15% of the carbon was now in the form of **organic compounds**; **>20 amino acids** formed; **sugars** were also formed. However, **nucleic acids were not formed** within the reaction...



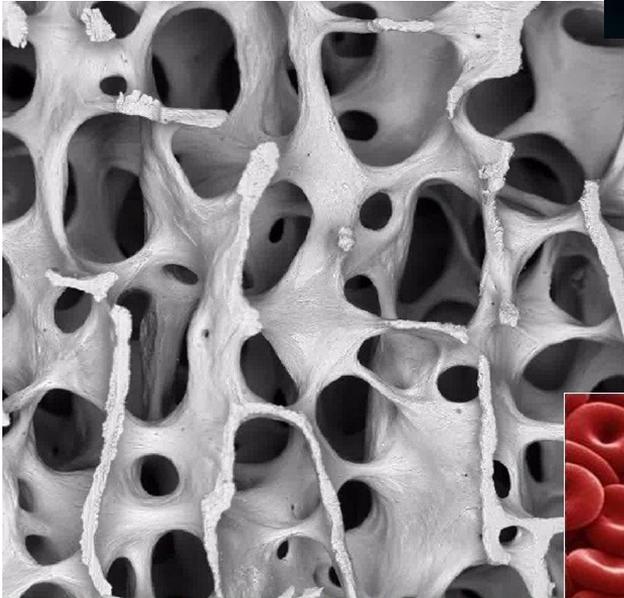
Life sciences comprise the fields of science that involve the scientific study of living organisms.

- General and unifying concepts recognized in modern biology:
 - the **cell** is the basic unit of life
 - **gene** is the basic unit of heredity
 - **evolution** is the engine that propels the synthesis and creation of new species
- Although **more than 99% of all species ever to have lived are estimated to be extinct**, there are **currently 10–14 million species** of living organisms on the Earth.

Cells are the **basic structural, functional, and biological units** of all known living organisms.



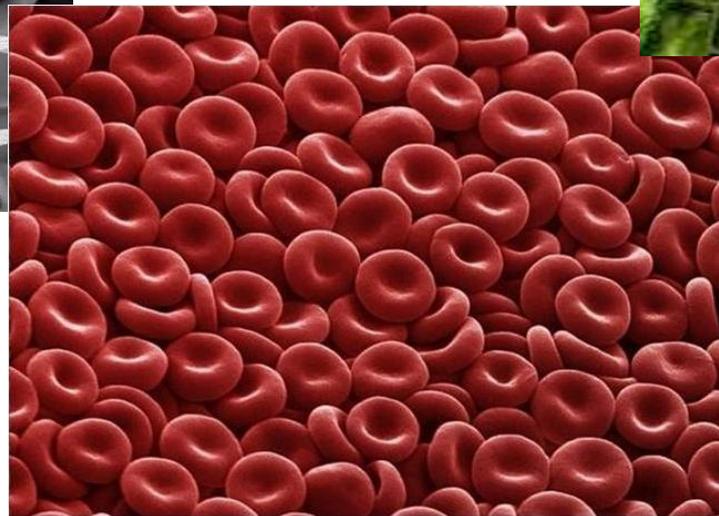
Cells are often called the **"building blocks of life"**.



Cells



The study of cells is called **cell biology**.



Knowing the **components** of cells and **how cells work** is fundamental to all biological sciences.