ORIGIN AND EVOLUTION OF LIFE

- ✓ Planet earth existed 4-5 billion years ago
- ✓ Life evolved 3.5 billion years ago
- ✓ There are 5 million species (2 million identified)

Evolutionary science groups organisms based on similarities, differences, and their inter relationships.

LIST OF TOPICS

- Theory on origin of life
- Organic evolution
- Evidence for evolution

a. Morphological
b. Paleontological
c. Embryological
d. Molecular

- ✓ Modern theory of evolution

LIST OF TOPICS

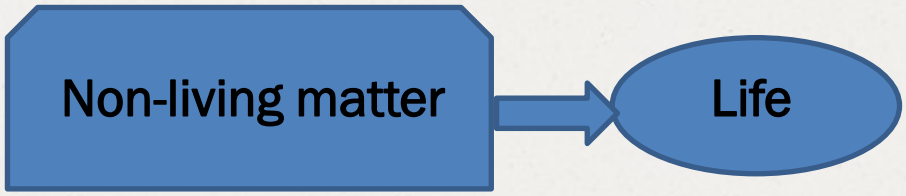
- Sources of organic variation
  a. Gene and chromosome mutations
  b. Recombination
  c. Gene flow
  d. Genetic drift
- Natural selection with example
- Role of isolation in evolution
- Mechanism of evolution

LIST OF TOPICS

- Speciation
- Classification
- Need for classification
- Basis for classification / changes

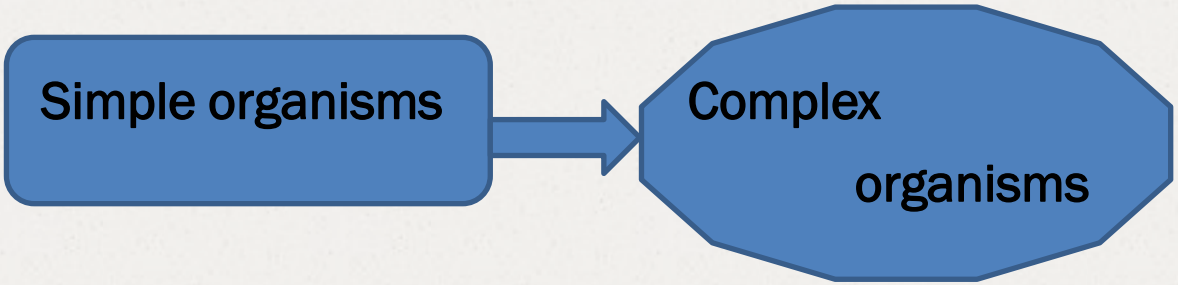
Definition- Origin of life

- ✓ Extreme heat made existence of life impossible during early formational stages of earth.
- ✓ Origin of life traces the onset of primordial life from non living matter.



Definition-Evolution of life

- ✓ Evolution of life traces the formation of complex organisms from simpler ones.



Origin of life: Theory

Chemosynthetic theory

- Proposed by A.I.Oparin
- Widely accepted theory

Series of combination of chemical substances with water over past many years led to the origin of life. There were nearly four stages involved in the process of origin of life.

Process of combination

Level 1						UV rays
NH3	H2	N2	CH4	CO2	H20	atmosphere
Level 2 Sugar, glycerol, amino acid, purines, pyrimidines, lactic acid, urea, acetic acid and fatty acid						
Level 3 Polysaccharides	fats	proteins	nucleic acids		peptides	starch

Origin of life - Stages

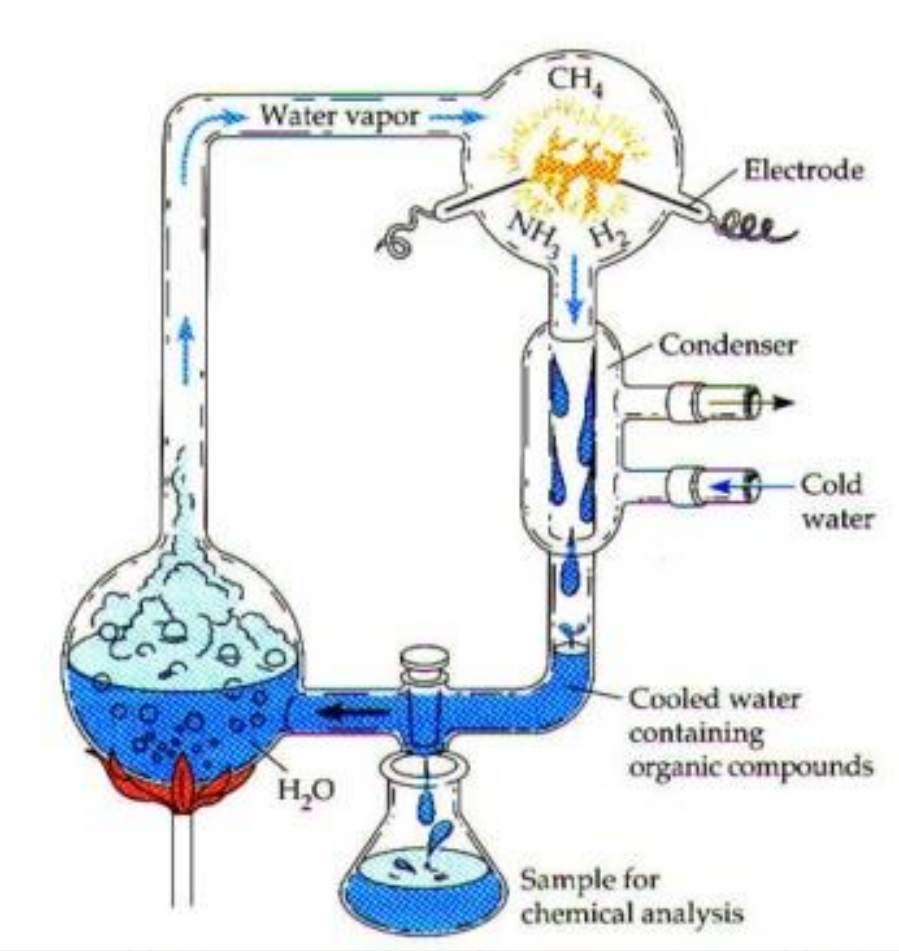
Stage 1

- Initially earth comprised of hot gases and vapours of chemicals like

  $NH_{3,}$ H_2O, H_2, CH_4 (found in jupiter and saturn now)
- However there was no free oxygen
- Heavy rain droplets accumulated on earth surface to create hot water bodies.

Origin of life: Stages

- $NH_3 + CH_4 + H_2 + H_2O \xrightarrow{\text{chemical reaction}}$ amino acids, nitrogenous bases, sugar, glycerol, purines, pyrimidines, etc.
- These further combined to form large molecules of life such as proteins, nucleic acids, etc.
- These observations are drawn from Stanley Miller and Harold C Urey's experiment conducted in 1953.


CH_4
Water vapor
Electrode
NH_3
H_2
Condenser
Cold water
Cooled water containing organic compounds
H_2O
Sample for chemical analysis

Origin of life: Stages

Stage 2

- Organic molecules such as lactic acid, acetic acid, urea, amino acids, purines, pyrimidines, sugar are thus formed,
- These organic molecules then combine to form larger molecules such as peptides(series of proteins), sugars, starches, fat molecules, and polysaccharides, etc.

Origin of life: Stages

Stage 3

- Large molecules combine to form multi-molecular complexes.
- Fat accumulates around these molecular complexes forming membranes.
- Big size complexes contain boundary separating them from surrounding solution.
- These complexes form coacervate or heaps that further combine molecules.

Origin of life: Stages

- These coacervate drops or heaps were precursors to the first living cell.
- Metabolism occurred with these coacervates leading to either synthesis or breakdown of substances.
- Breakdown of substances released energy.
- Earlier proteins acted as enzymes that speed up the rate of chemical reactions.

Origin of life: Stages

- RNA is one such example of enzymes in the primordial chemical soup of compounds,
- These RNAs are also known as ribozymes.

Stage 4

- The coacervate properties of chemical bodies led to the formation of nucleic acids
- These nucleic acids further underwent chemical reactions and duplication

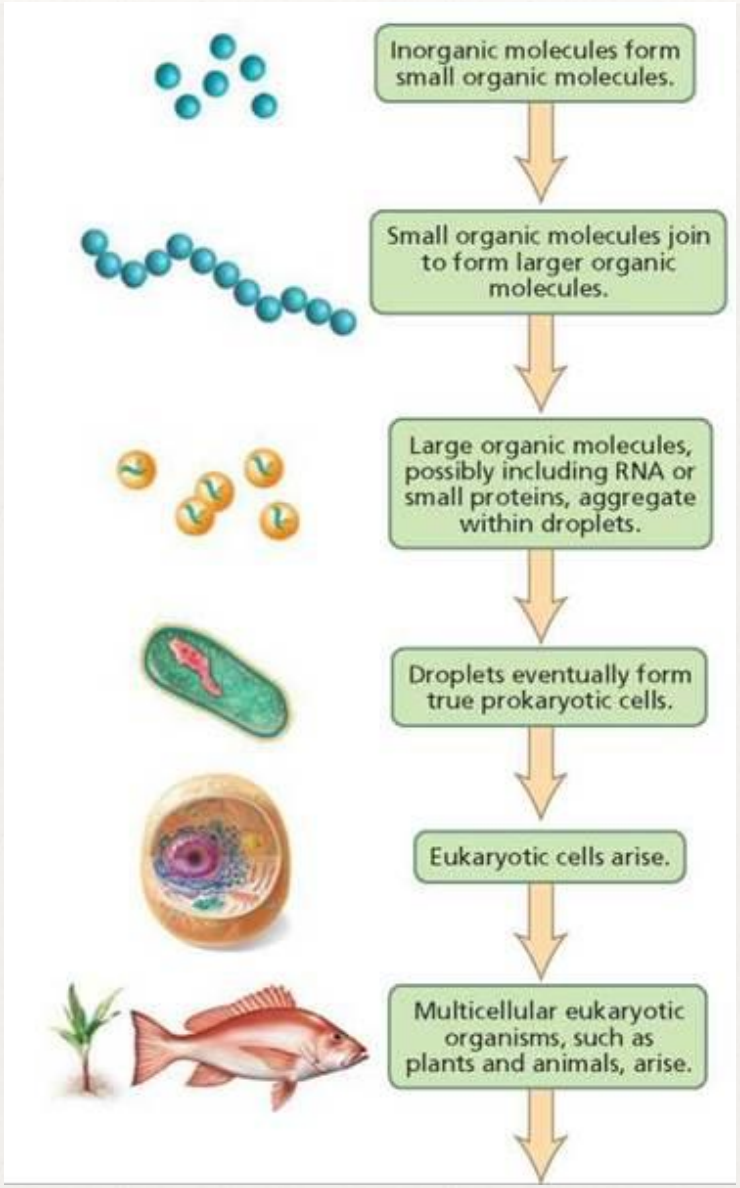
Origin of life: Stages

- Early drop like forms of life or heterotrophs were unable to produce own food and rather depended on environment,
- Heterotrophs then underwent chemical reactions to form chlorophyll (green colouring matter).

Chlorophyll + solar energy $\longrightarrow$ food + free O_2

Origin of life: Stages

- Before the existence of free oxygen only anaerobic living forms prevailed.
- After the release of free 02 from chlorophyll life evolved.


Inorganic molecules form small organic molecules.
Small organic molecules join to form larger organic molecules.
Large organic molecules, possibly including RNA or small proteins, aggregate within droplets.
Droplets eventually form true prokaryotic cells.
Eukaryotic cells arise.
Multicellular eukaryotic organisms, such as plants and animals, arise.

ORIGIN OF EUKARYOTIC CELLS

- Endosymbiotic theory –
  - Mitochondria and chloroplasts, the two energy related organelles, arose when a large eukaryotic cell engulfed independent prokaryotes
    - This explains why they have a double membrane and why they have genetic material separate from the nucleus