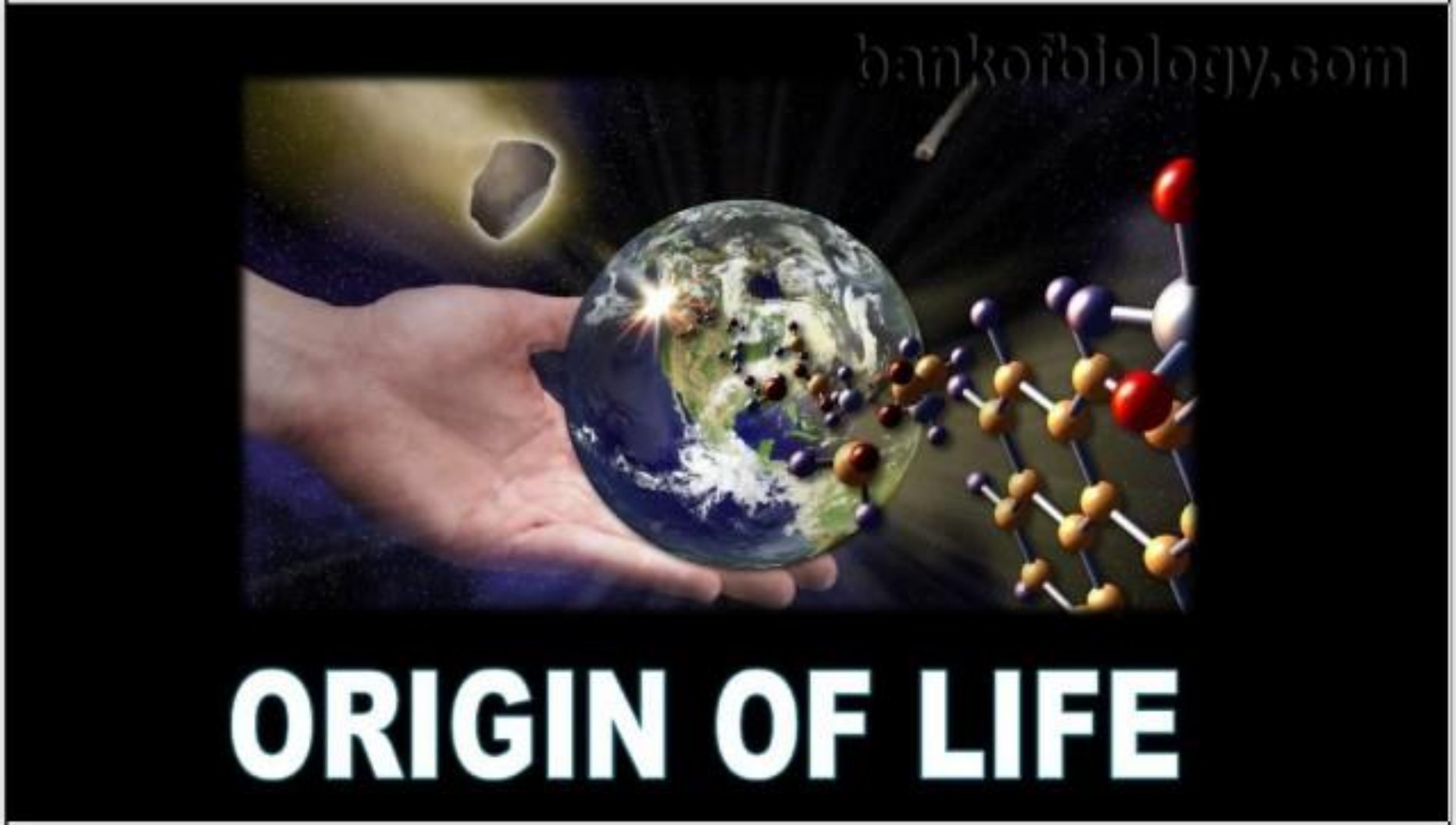
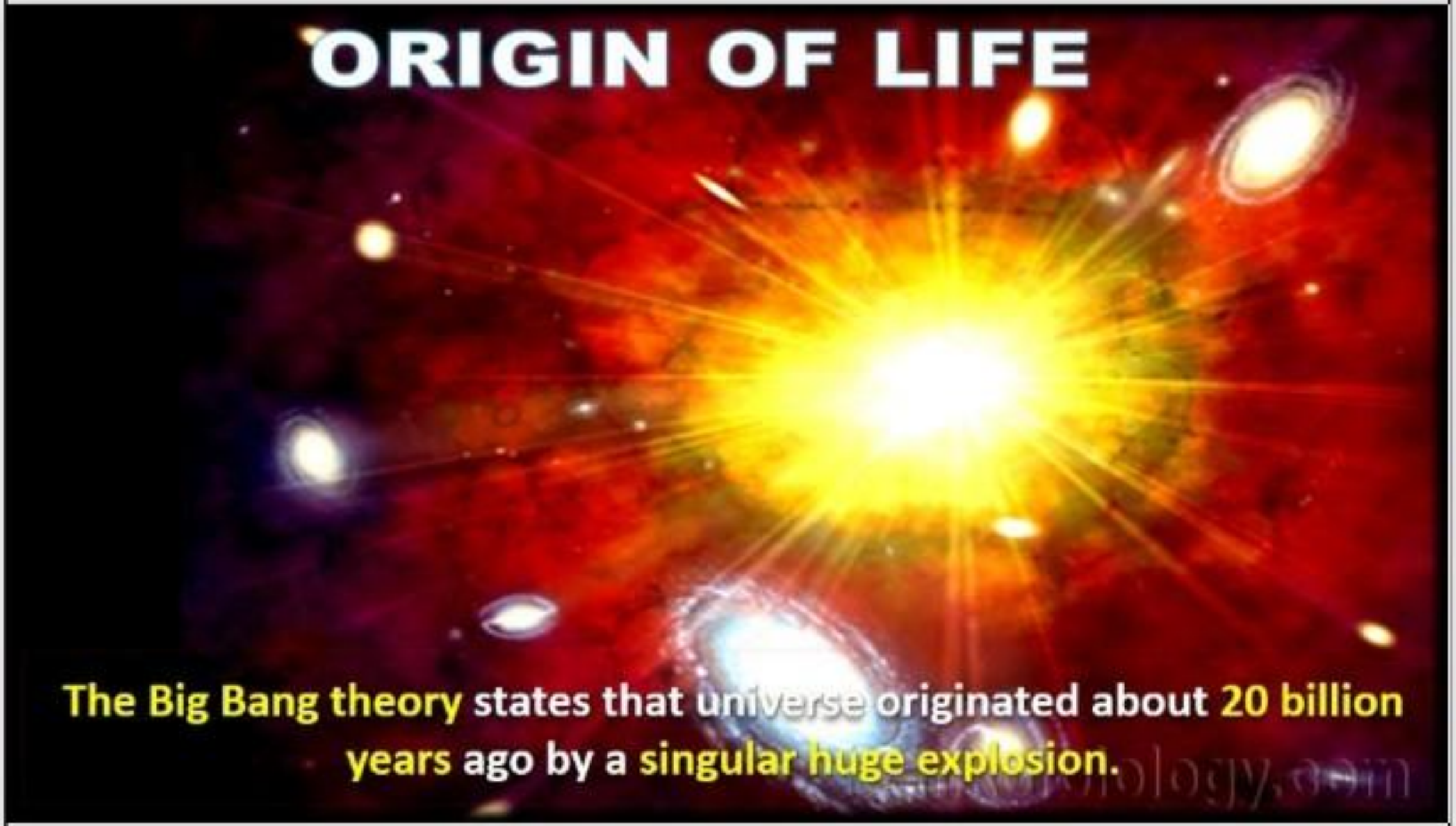
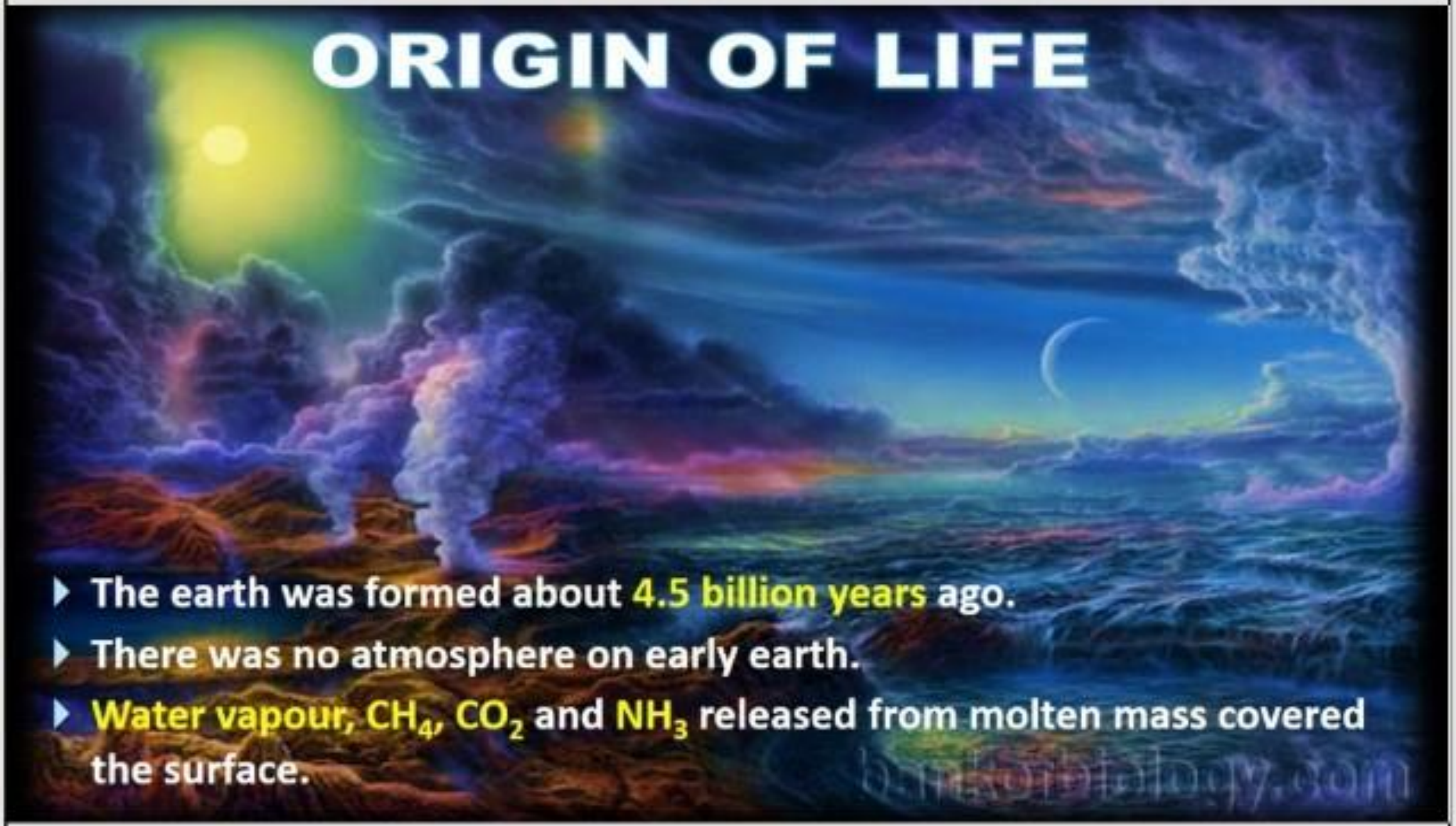

EVOLUTION

EVOLUTION

- **Evolution** is an orderly change from one form to another.
- **Evolutionary Biology** is the study of history of life forms on earth.



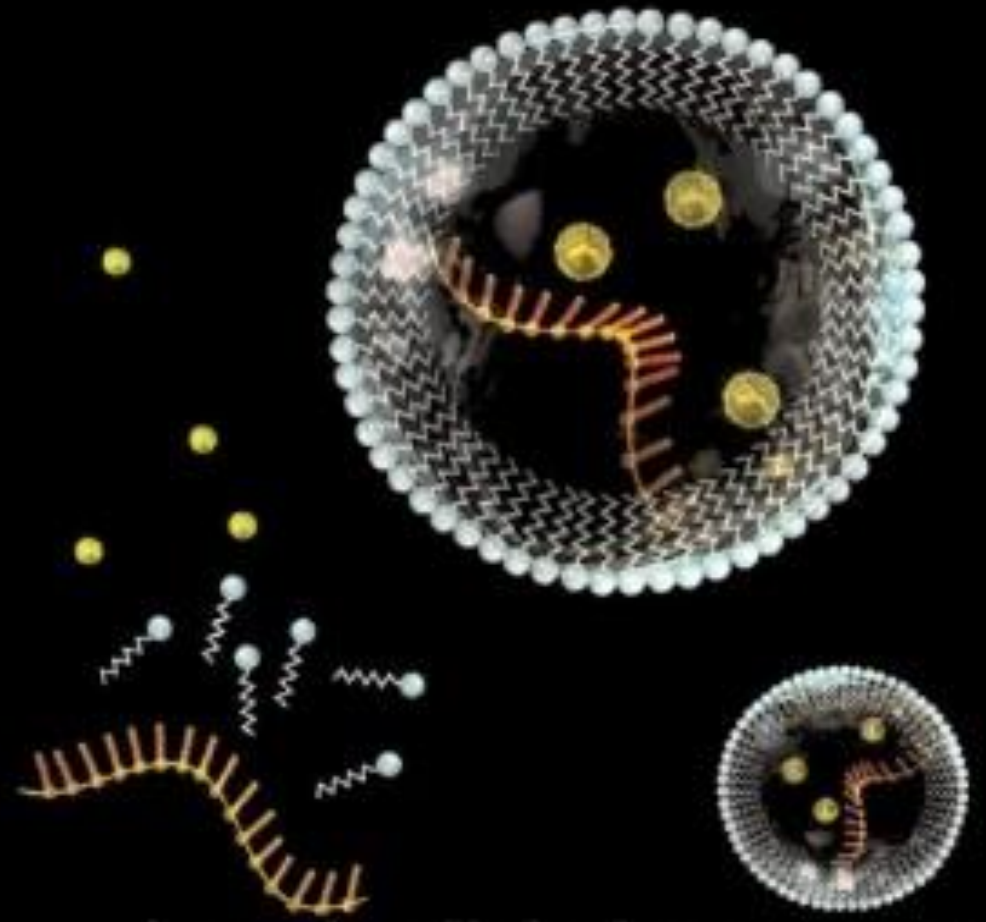

ORIGIN OF LIFE
The Big Bang theory states that universe originated about 20 billion years ago by a singular huge explosion.


ORIGIN OF LIFE
The earth was formed about 4.5 billion years ago.
There was no atmosphere on early earth.
Water vapour, CH_4, CO_2 and NH_3 released from molten mass covered the surface.


ORIGIN OF LIFE
The ozone layer was formed.
As it cooled, the water vapour fell as rain to form oceans.
Life appeared almost four billion years ago.

THEORIES OF ORIGIN OF LIFE

- Theory of Abiogenesis
- Theory of Biogenesis
- Theory of Panspermia
- Theory of Creationism
- Theory of Chemical evolution



THEORIES OF ORIGIN OF LIFE

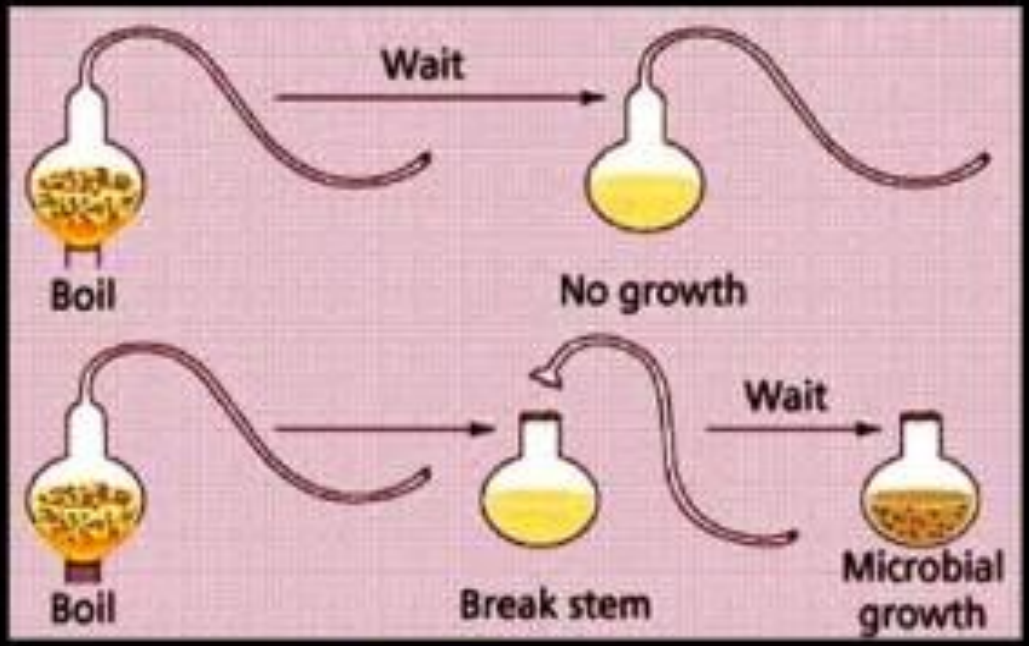
1. THEORY OF SPONTANEOUS GENERATION (ABIOGENESIS)

It states that, life came out of decaying and rotting matter like straw, mud etc.

THEORIES OF ORIGIN OF LIFE

1. THEORY OF SPONTANEOUS GENERATION (ABIOGENESIS)

Louis Pasteur disproved Abiogenesis theory.



- He demonstrated that life comes only from pre-existing life.
- He showed that life did not come from killed yeast in a closed pre-sterilized flask. But in an opened flask, life (microbes) appeared.

THEORIES OF ORIGIN OF LIFE

2. THEORY OF BIOGENESIS

- It is proposed by Francisco Redi, Spallanzani and Louis Pasteur.
- It states that, life originates from pre-existing life.
- But it does not explain origin of first life.

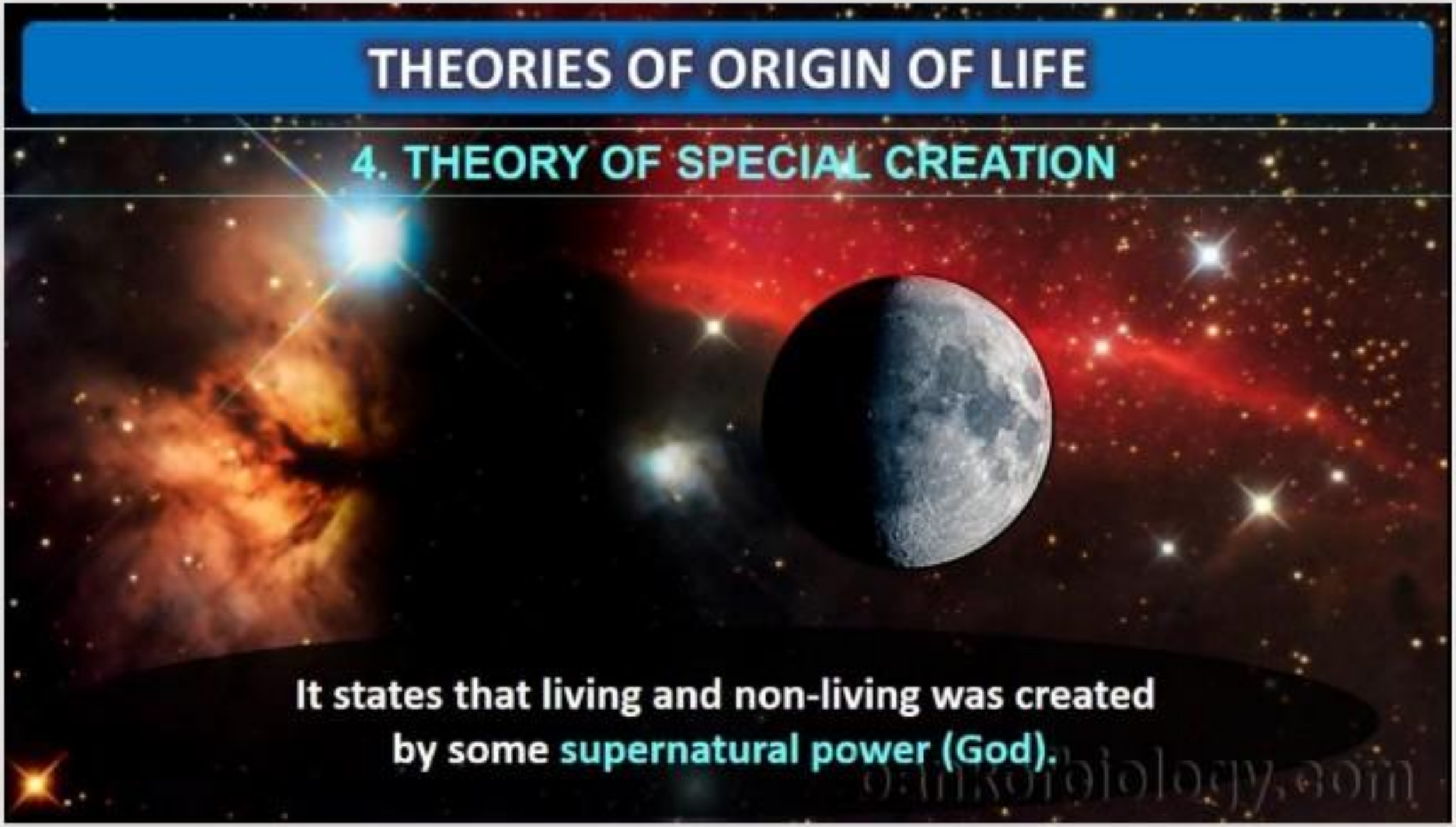
THEORIES OF ORIGIN OF LIFE

3. COSMIC THEORY (THEORY OF PANSPERMIA)

It states that, the units of life (spores) were transferred to different planets including earth.

THEORIES OF ORIGIN OF LIFE

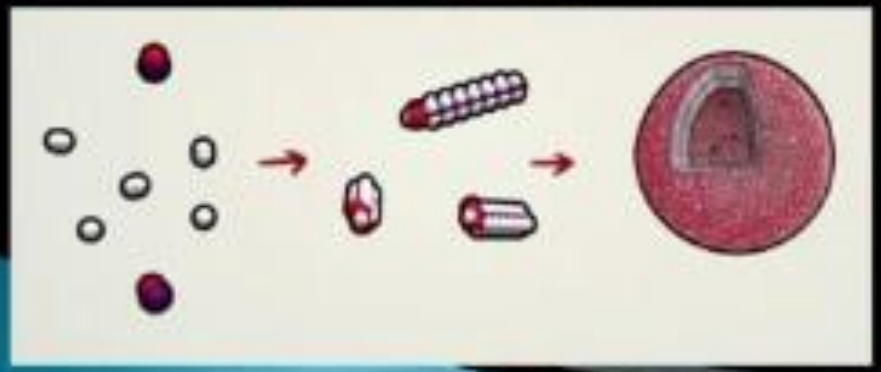
4. THEORY OF SPECIAL CREATION



It states that living and non-living was created by some supernatural power (God).

THEORIES OF ORIGIN OF LIFE

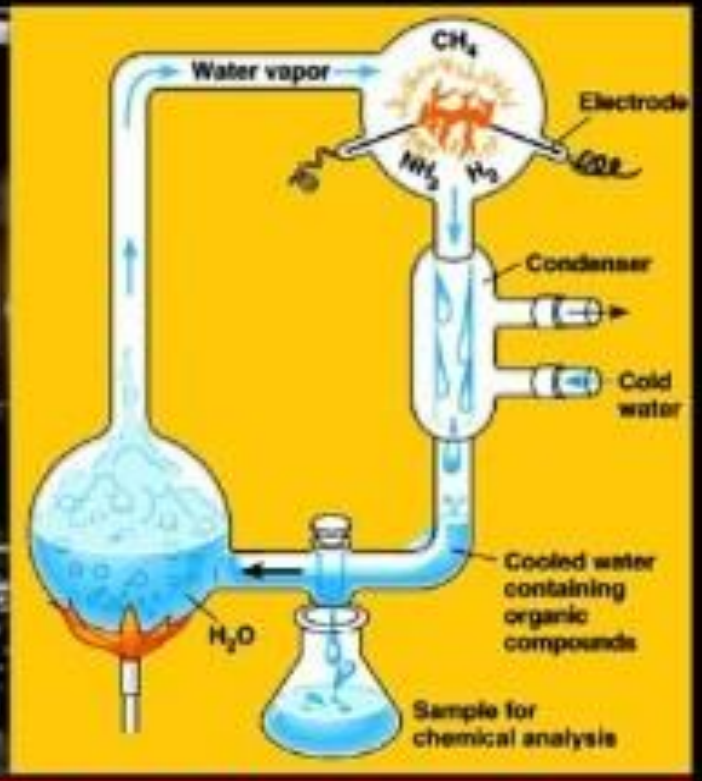
5. THEORY OF CHEMICAL EVOLUTION



- Proposed by **Oparin & Haldane.**
- It states that, the first form of life was originated from non-living inorganic and organic molecules such as CH_4, NH_3, H_2O, sugars, proteins, nucleic acids etc.
- i.e. ***"Abiogenesis first, but biogenesis ever since".***

THEORIES OF ORIGIN OF LIFE

5. THEORY OF CHEMICAL EVOLUTION



Experimental setup of Urey & Miller

UREY-MILLER EXPERIMENT

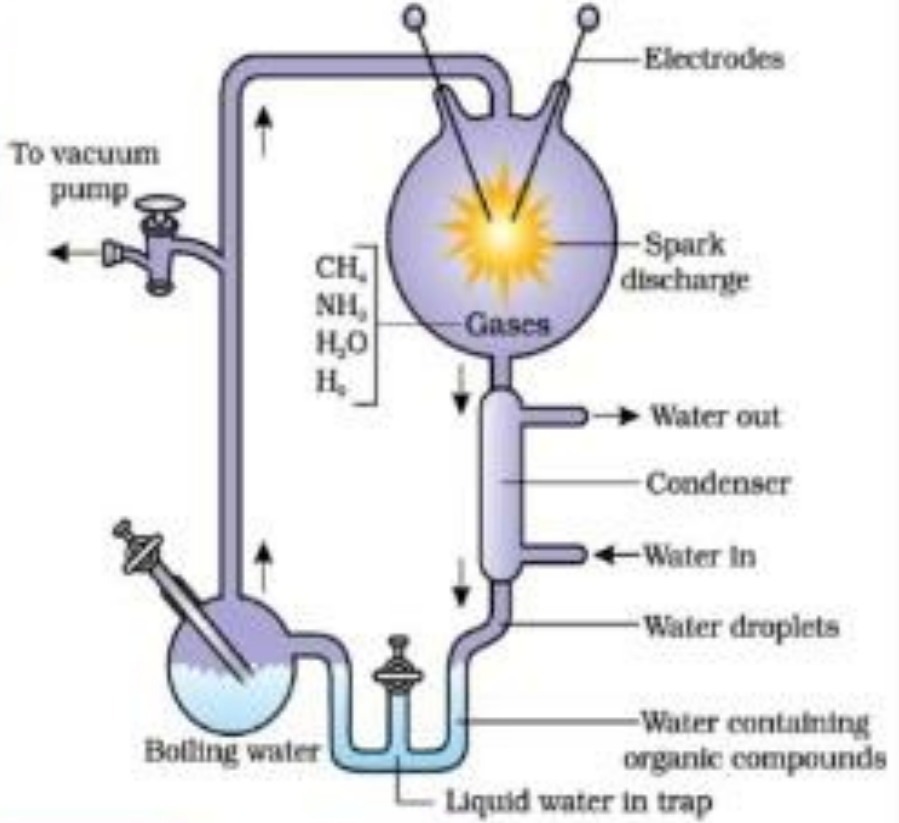
- **Harold Urey** and **Stanley Miller** experimentally proved theory of chemical evolution.
- They created a condition like that of primitive earth (i.e. high temperature, volcanic storms, reducing atmosphere with CH_4, NH_3, H_2O, H_2 etc).

THEORIES OF ORIGIN OF LIFE

5. THEORY OF CHEMICAL EVOLUTION

Stanley L. Miller

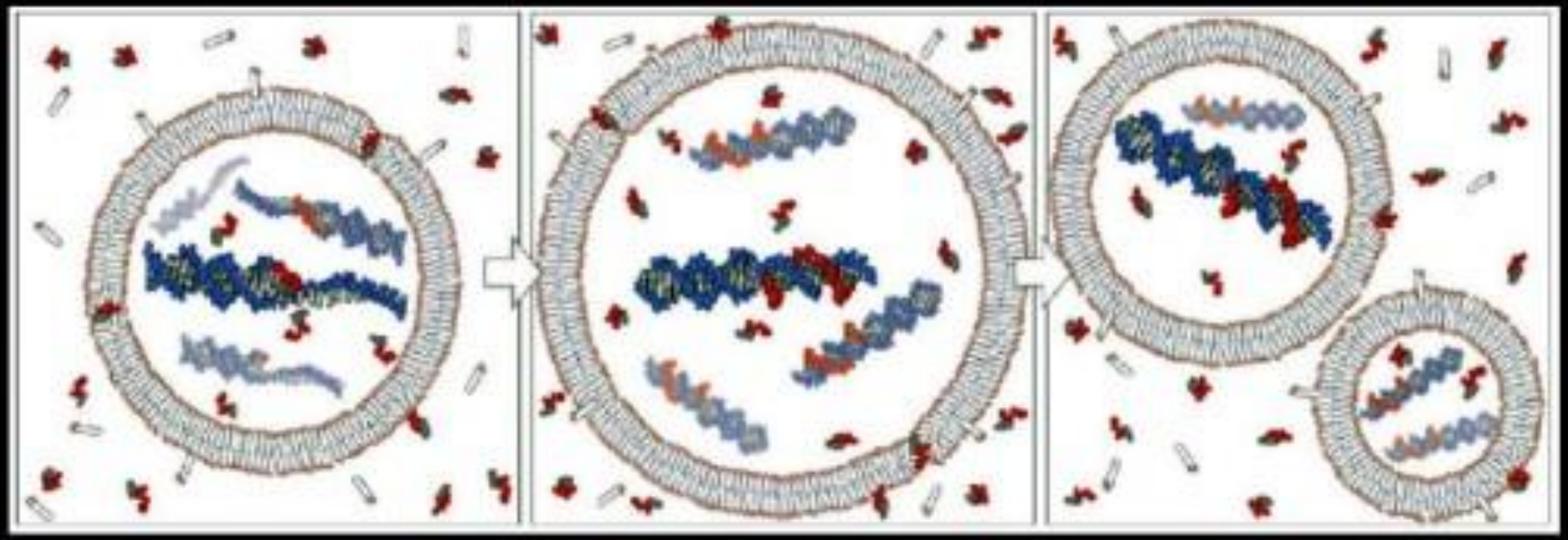
Harold C. Urey



UREY-MILLER EXPERIMENT

- They made electric discharge in a closed flask containing CH_4, NH_3, H_2 and water vapour at 800° C.
- As a result, some amino acids are formed.
- In similar experiments, others observed formation of sugars, nitrogen bases, pigment and fats.

THEORIES OF ORIGIN OF LIFE



- The first non-cellular forms of life originated 3 billion years ago.
- They were self replicating metabolic capsule containing macromolecules like RNA, proteins, Polysaccharides etc.


EVIDENCES FOR EVOLUTION

EVIDENCES FOR EVOLUTION

- Paleontological evidences
- Morphological and Anatomical evidences
- Biogeographical evidences (Adaptive radiation)
- Biochemical evidences
- Embryological evidences
- Evidences for evolution by natural selection

EVIDENCES FOR EVOLUTION

1. PALAEONTOLOGICAL EVIDENCES

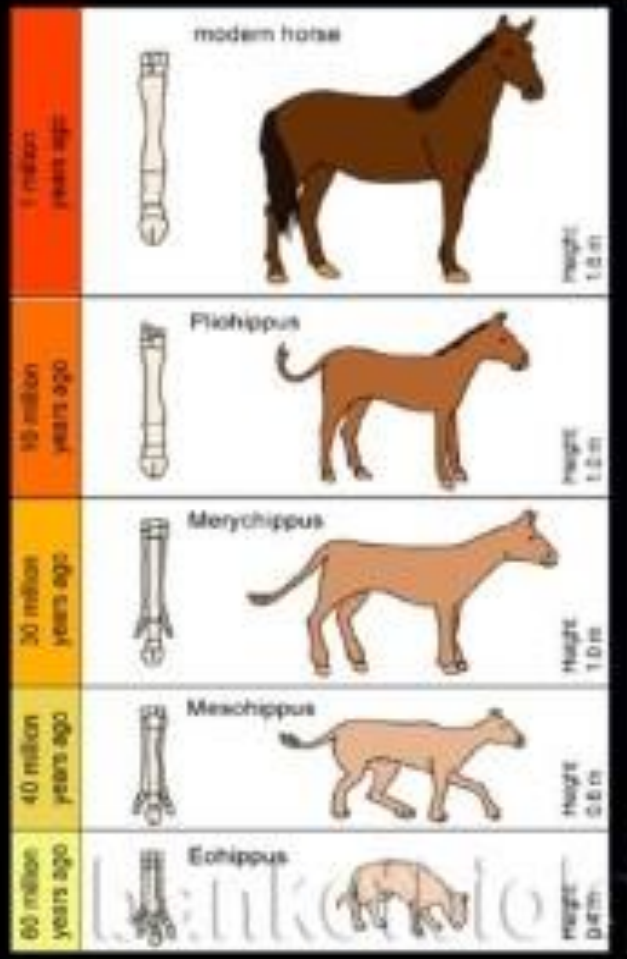
- **Palaeontology** is the study of fossils.
- **Fossils** are remnants of life forms found in rocks (earth crust).
- ***Fossils are written documents of evolution.***

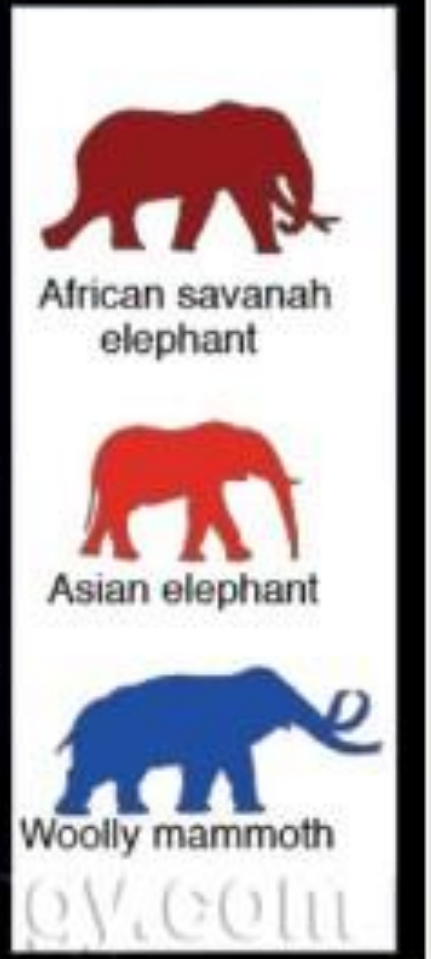
EVIDENCES FOR EVOLUTION

1. PALAEONTOLOGICAL EVIDENCES

SIGNIFICANCE OF FOSSILS

- ✓ To study phylogeny (evolutionary history or race history). E.g. Horse evolution.





EVIDENCES FOR EVOLUTION

1. PALAEONTOLOGICAL EVIDENCES

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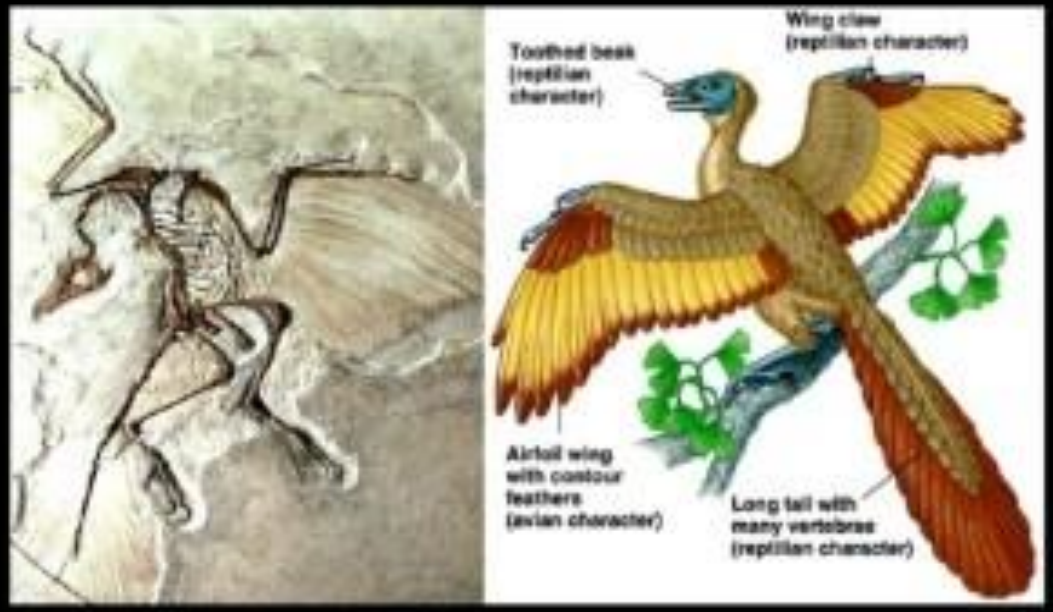
- ✓ To study phylogeny (evolutionary history or race history). E.g. Horse evolution.
- ✓ To study the connecting link between two groups of organisms. E.g. *Archaeopteryx.*



Archaeopteryx:

Connecting link between reptiles and birds

bankofbiology.com

EVIDENCES FOR EVOLUTION

1. PALAEONTOLOGICAL EVIDENCES

SIGNIFICANCE OF FOSSILS

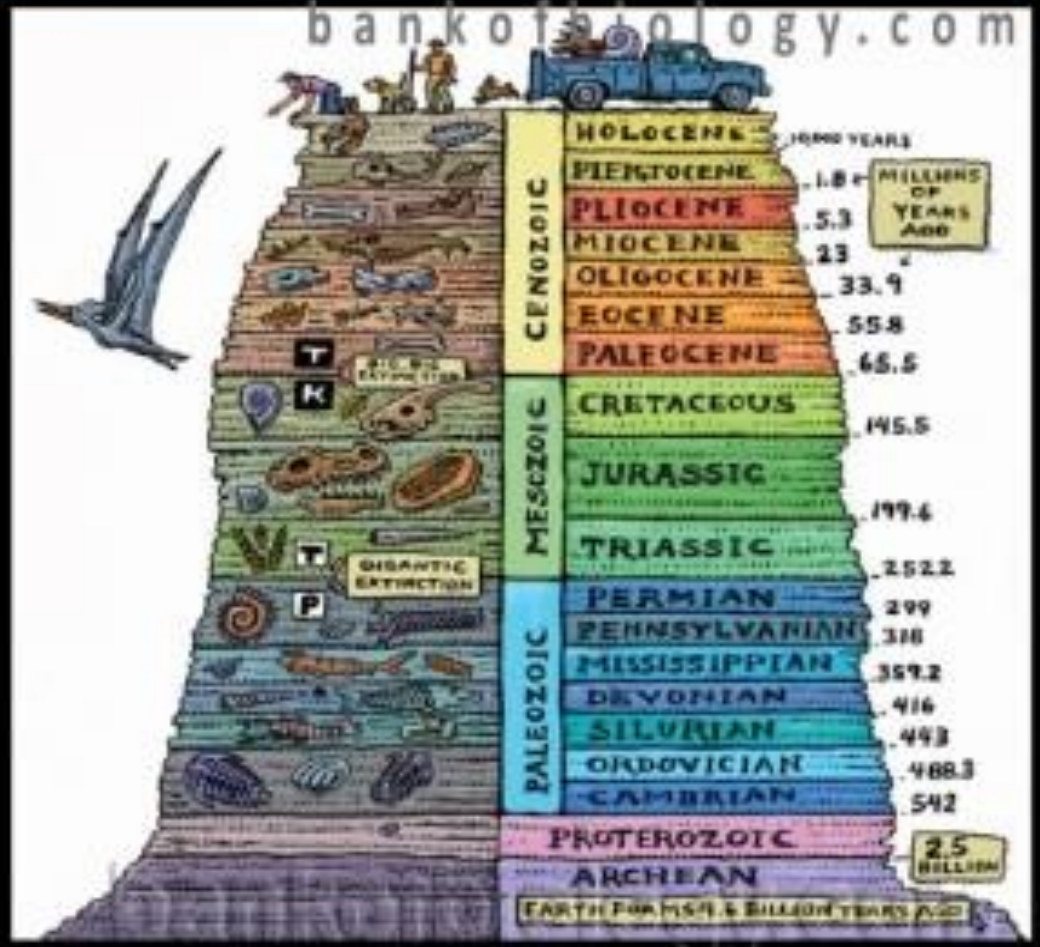
- ✓ To study **phylogeny (evolutionary history or race history)**. E.g. Horse evolution.
- ✓ To study the **connecting link** between two groups of organisms. E.g. *Archaeopteryx*.
- ✓ To study about **extinct animals**. E.g. Dinosaurs.

EVIDENCES FOR EVOLUTION

1. PALAEONTOLOGICAL EVIDENCES

SIGNIFICANCE OF FOSSILS

- ✓ To study phylogeny (evolutionary history or race history). E.g. Horse evolution.
- ✓ To study the connecting link between two groups of organisms. E.g. *Archaeopteryx*.
- ✓ To study about extinct animals. E.g. Dinosaurs.
- ✓ To study about geological period by analysing fossils in sedimentary rock layers. The study showed that life forms varied over time and certain life forms are restricted to certain geological time spans.



EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

- **Comparative anatomy and morphology** shows that different forms of animals have some common structural features.
- This can be explained as follows:

Homologous organs & Homology

Analogous organs & Analogy

EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

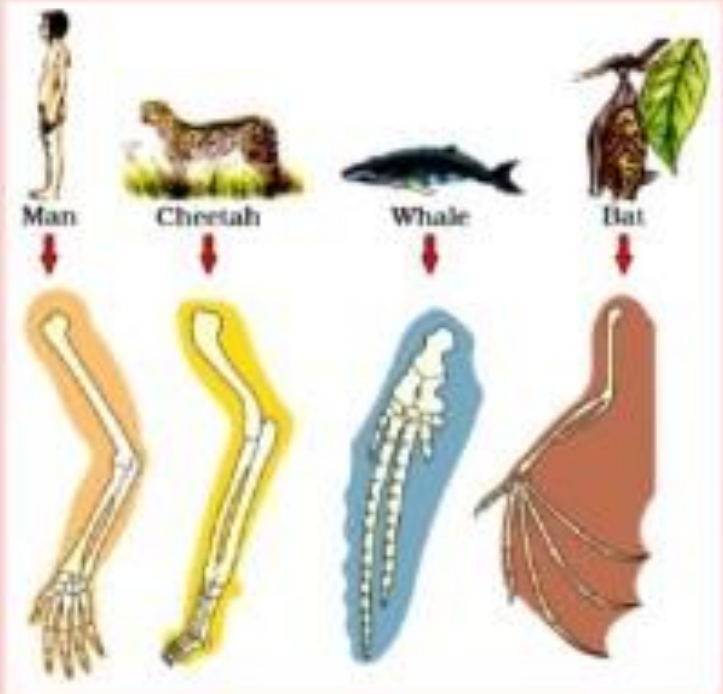
Homologous organs and Homology

- **Homologous organs:** The organs having fundamental **similarity in structure and origin** but **different functions.** This phenomenon is called **Homology.**

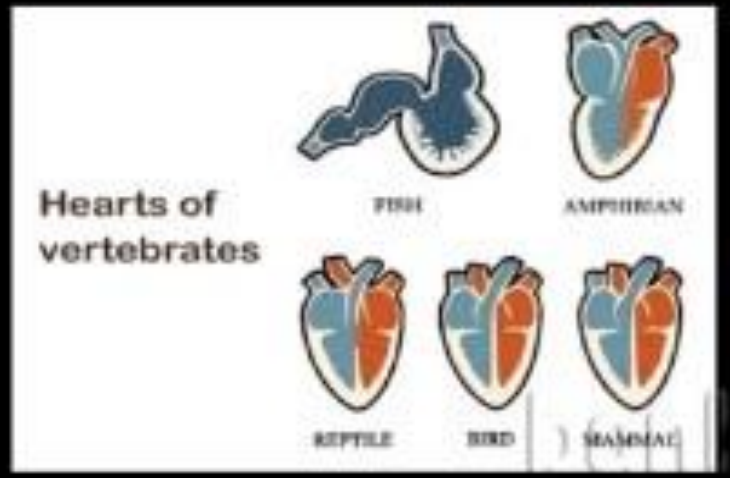
EVIDENCES FOR EVOLUTION

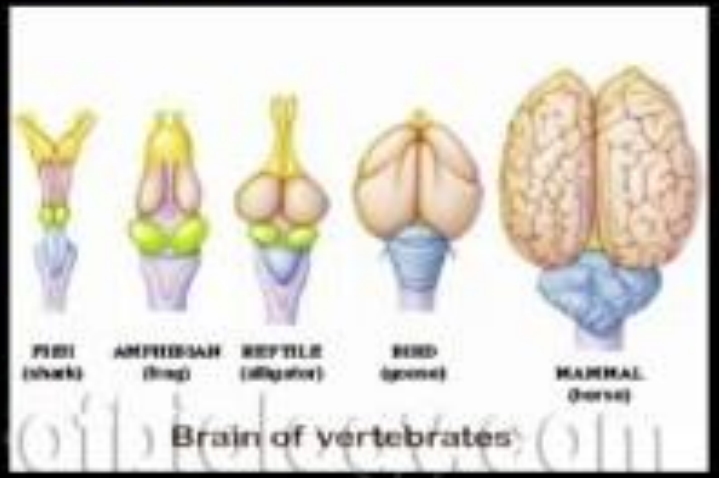
2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Homologous organs and Homology



- E.g. **Human hand, Whale's flippers, Bat's wing & Cheetah's foot.** These forelimbs have different functions but similar anatomical structures such as bones (e.g. humerus, radius, ulna, carpals, metacarpals & phalanges).
- Homology is also seen in **heart, brain etc.**





EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Homologous organs and Homology

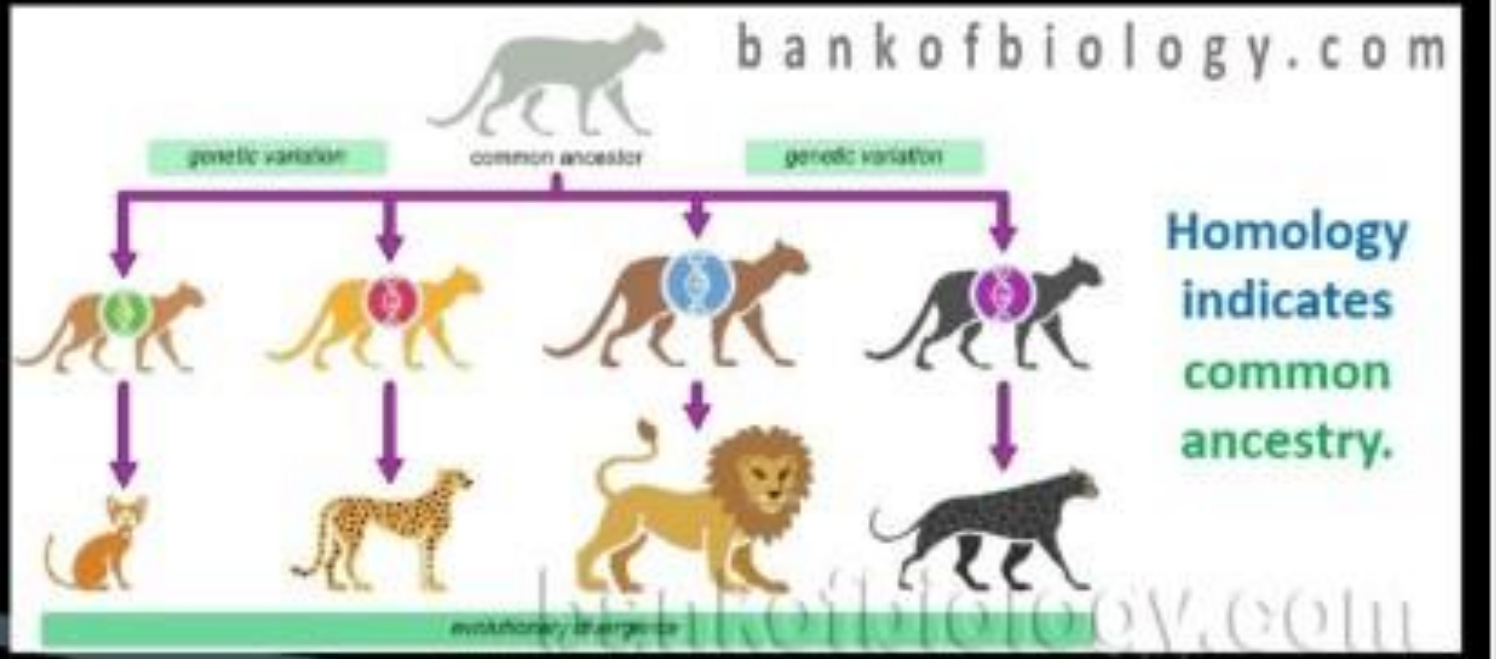
Homology in plants: Thorns and tendrils of *Bougainvillea* and *Cucurbita*.

EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Homologous organs and Homology

- Origin of homologous organs is due to **Divergent evolution.**
- **Divergent evolution** is the evolution by which **related species** become **less similar** to survive and adapt in **different environmental** condition.



EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

- **Analogous organs:** The organs having similar function but different structure and origin. This phenomenon is called **Analogy.**

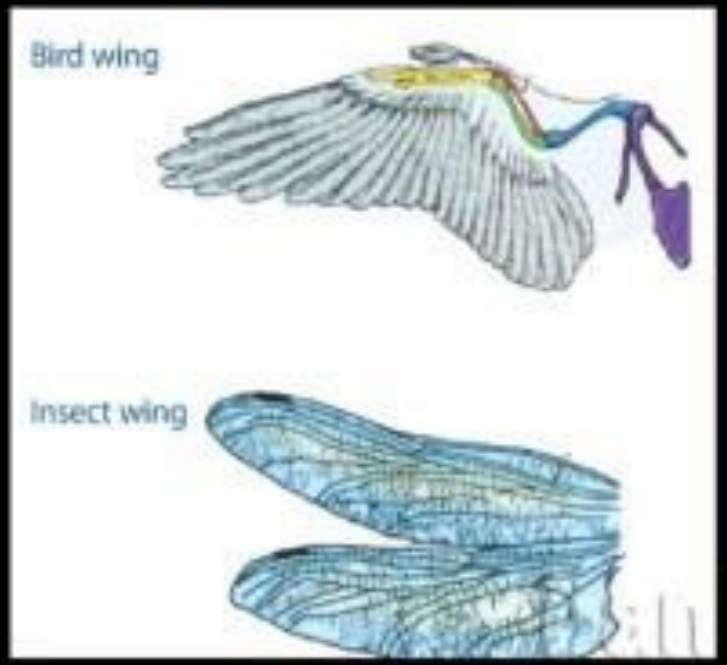
EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

Examples

- **Wings of insects** (formed of a thin flap of chitin) and **wings of birds** (modified forelimbs).



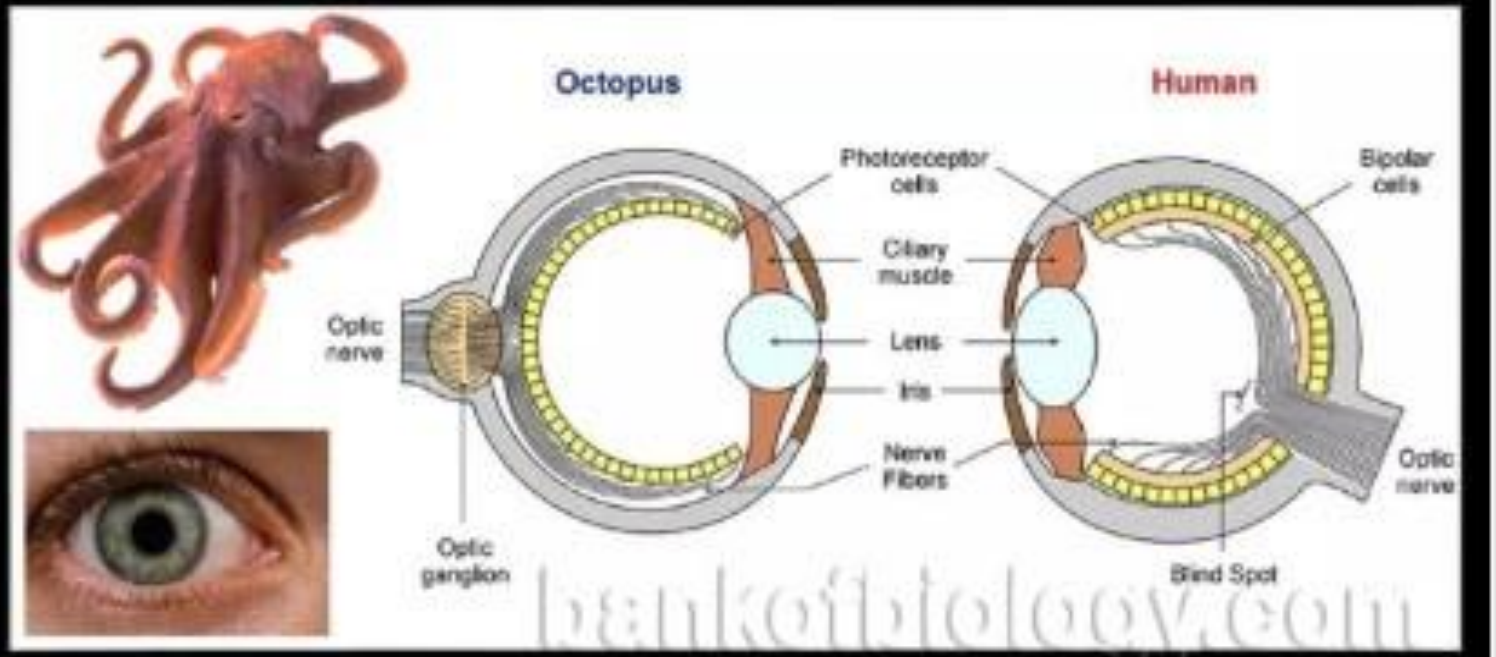
EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

Examples

- Eyes of Octopus (retina from skin) and mammals (retina from embryonic brain).



EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

Examples

- **Flipper** of Penguins and Dolphins.

EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

Examples

- Sweet potato (modified root) & Potato (modified stem).

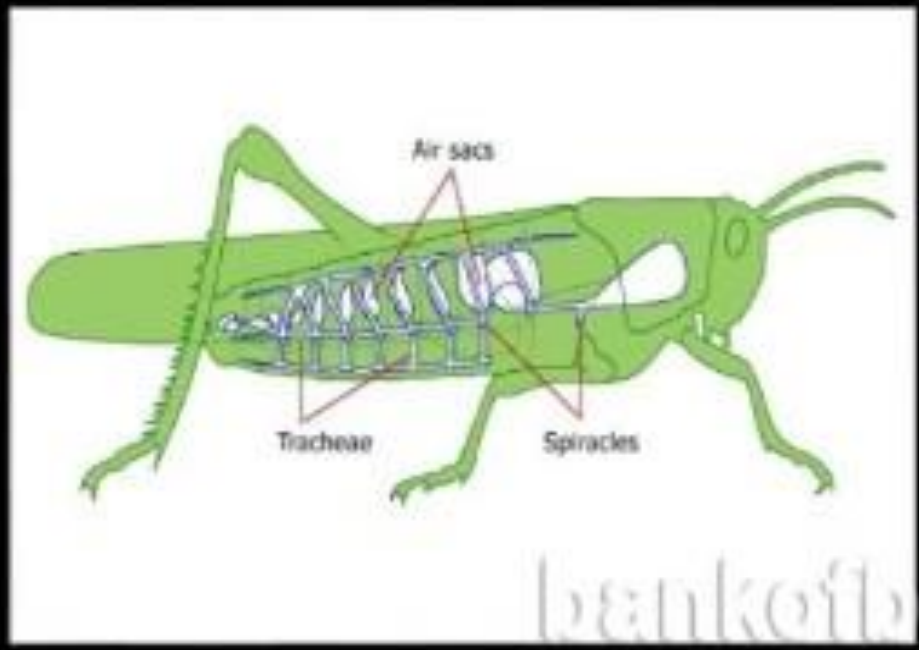
EVIDENCES FOR EVOLUTION

2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

Examples

- Trachea of insects (from ectoderm) and lungs of vertebrates (from endoderm).



EVIDENCES FOR EVOLUTION

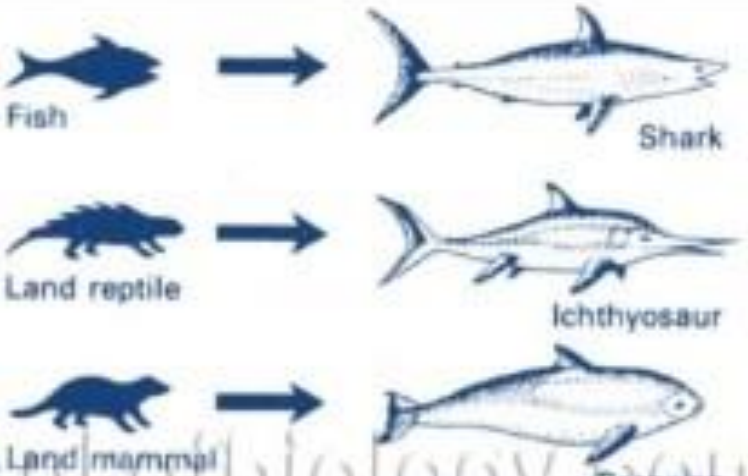
2. MORPHOLOGICAL & ANATOMICAL EVIDENCES

Analogous organs and Analogy

- Origin of analogous organs is due to Convergent evolution.
- Convergent evolution is the evolution by which unrelated species become more similar to survive and adapt in similar environmental condition.

Example for Convergent evolution:

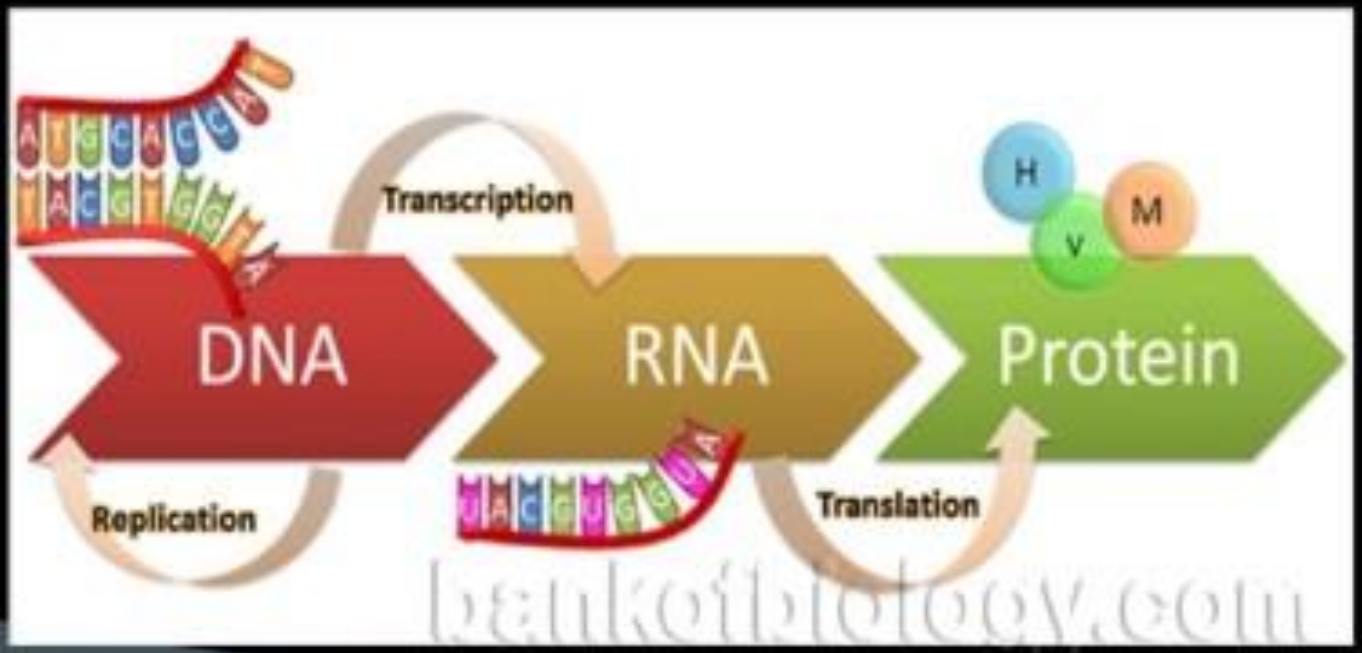
Fish, land reptile and land mammal are unrelated. But they evolved to more similar forms.



EVIDENCES FOR EVOLUTION

3. BIOCHEMICAL EVIDENCES

- Organisms show **similarities in proteins, genes, other biomolecules & metabolism.**
- **It indicates common ancestry.**



EVIDENCES FOR EVOLUTION

4. BIOGEOGRAPHICAL EVIDENCES (ADAPTIVE RADIATION)

- **Adaptive radiation** (evolution by adaptation) is the evolution of different species in a geographical area starting from a point.
- E.g.
  - ✓ **Darwin's finches in Galapagos islands.**

EVIDENCES FOR EVOLUTION

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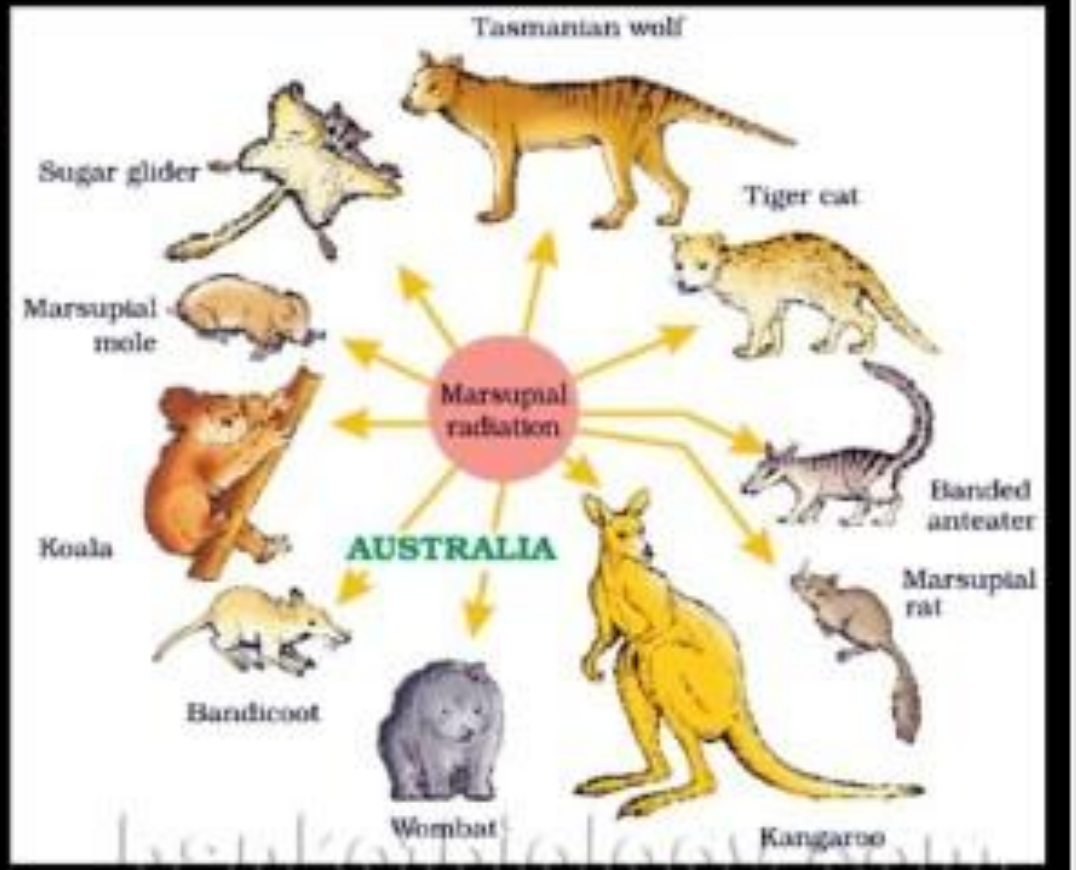
- E.g.
  - ✓ Darwin's finches in Galapagos islands.
  - ✓ Australian marsupials (Marsupial radiation).



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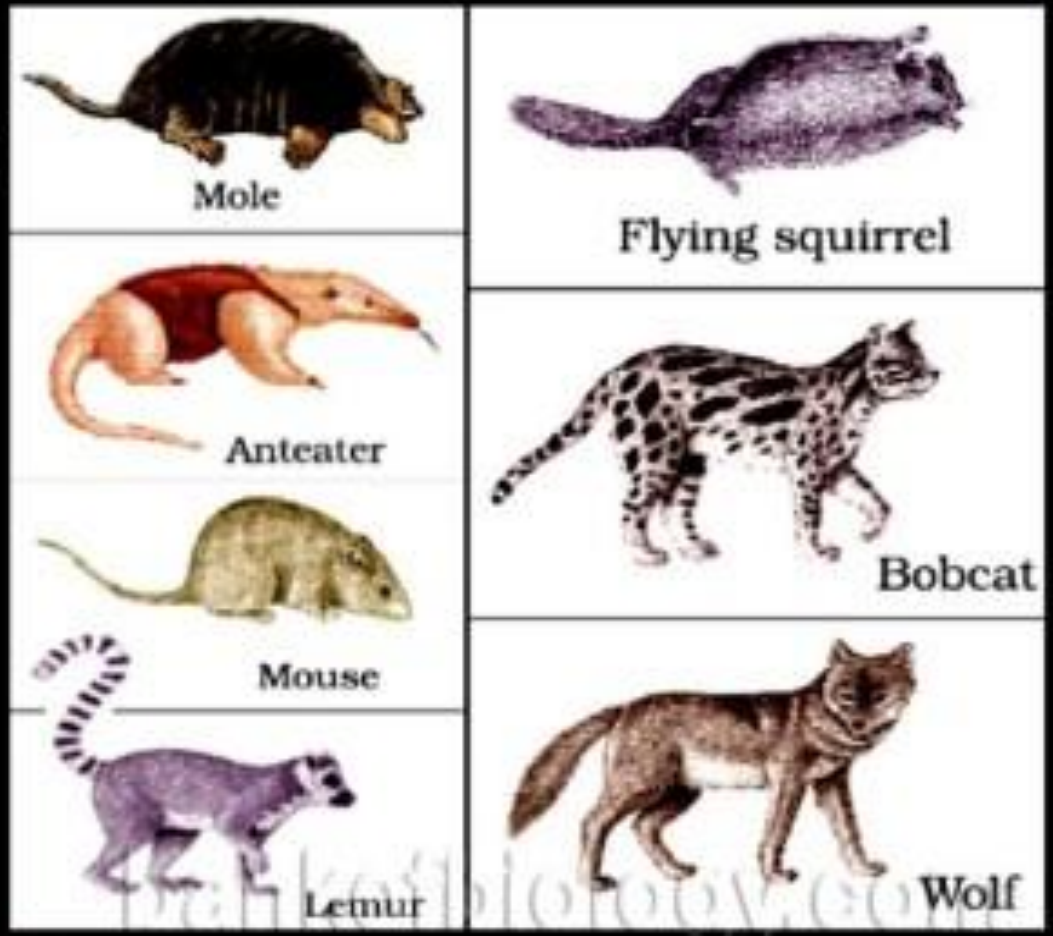
- E.g.
  - ✓ Darwin's finches in Galapagos islands.
  - ✓ Australian marsupials (Marsupial radiation).
  - ✓ Placental mammals in Australia.

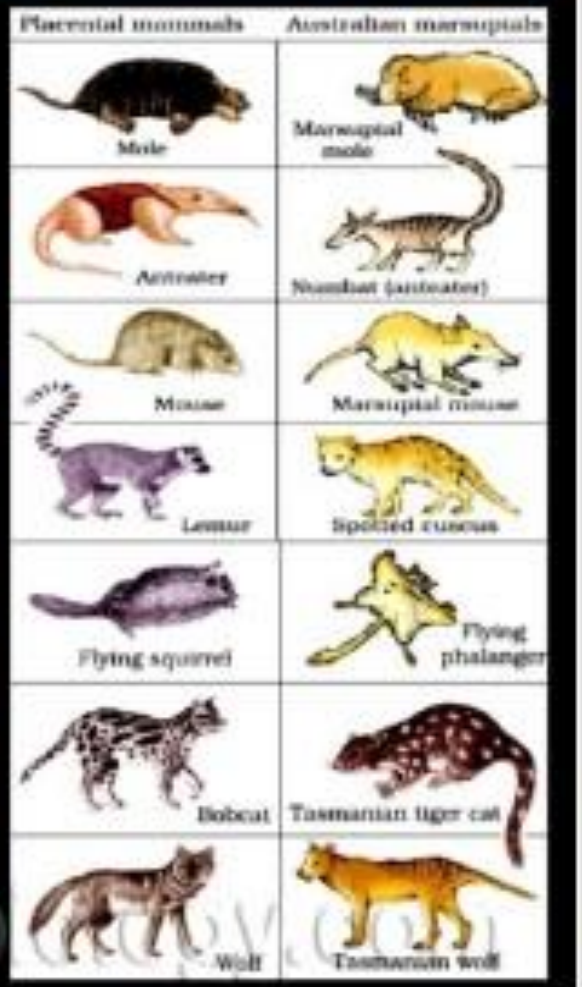


EVIDENCES FOR EVOLUTION

4. BIOGEOGRAPHICAL EVIDENCES (ADAPTIVE RADIATION)

- When more than one adaptive radiation is appeared in an isolated geographical area, it results in *convergent* evolution.
- E.g. Australian Marsupials and Placental mammals.

Placental mammals	Australian Marsupials
Mole	Marsupial mole
Ant eater	Numbat (Ant eater)
Mouse	Marsupial mouse
Lemur	Spotted cuscus
Flying squirrel	Flying phalanger
Bobcat	Tasmanian tiger cat
Wolf	Tasmanian wolf



EVIDENCES FOR EVOLUTION

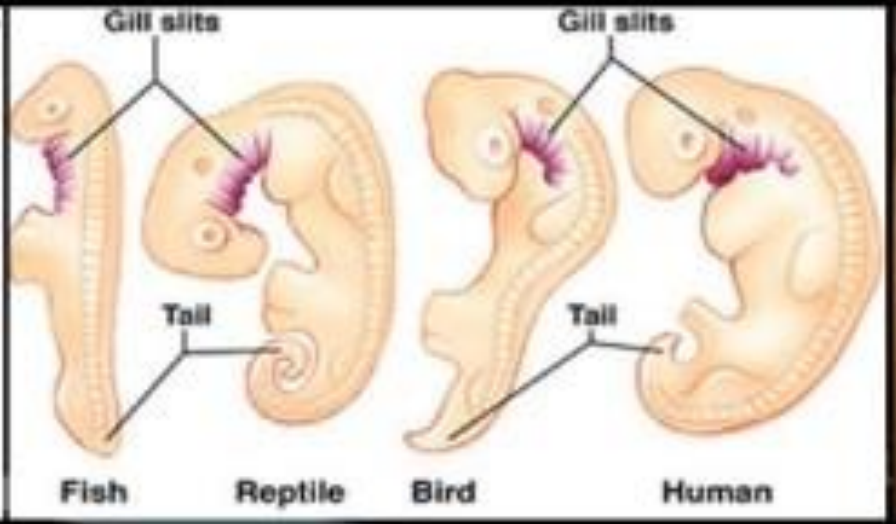
5. EMBRYOLOGICAL EVIDENCES

- Proposed by Ernst Haeckel.
- He observed that all vertebrate embryos have some common features that are absent in adult.
- E.g. all vertebrate embryos (including human) develop vestigial gill slits just behind the head. But it is functional only in fish and not found in other adult vertebrates.

EVIDENCES FOR EVOLUTION

5. EMBRYOLOGICAL EVIDENCES

- However, Karl Ernst von Baer rejected this proposal.
- He noted that embryos never pass through the adult stages of other animals.



EVIDENCES FOR EVOLUTION

6. EVIDENCES FOR EVOLUTION BY NATURAL SELECTION

- **Natural selection** is the process by which the organisms that are best suited for their environment survive and reproduce.
- Some examples are given below:

Industrial melanism

Development of resistant varieties in organisms against herbicides, pesticides, antibiotics or drugs etc.

These are the examples for natural selection by anthropogenic action (evolution due to human activities).

EVIDENCES FOR EVOLUTION

6. EVIDENCES FOR EVOLUTION BY NATURAL SELECTION

Industrial melanism

- **In England, before industrialization (1850s): There were more white winged moths (*Biston betularia*) on trees than dark winged or melanised moths (*Biston carbonaria*).**
- **After industrialization (1920): More dark winged moths and less white winged moths.**

Before industrialization

After industrialization

EVIDENCES FOR EVOLUTION

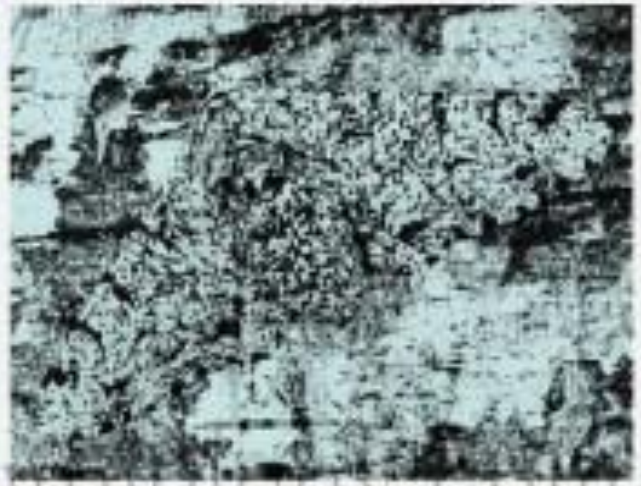
6. EVIDENCES FOR EVOLUTION BY NATURAL SELECTION

Industrial melanism

REASON

Before industrialization:

- There was thick growth of white coloured lichen covered the trees.
- In that background, the white winged moths survived but the dark coloured moths were picked out by predators.



EVIDENCES FOR EVOLUTION

6. EVIDENCES FOR EVOLUTION BY NATURAL SELECTION

Industrial melanism

REASON

After industrialization:

- Tree trunks became dark due to industrial smoke & soots. No lichens.
- Under this condition, white winged moth did not survive because the predators identified them easily.
- Dark winged moth survived because of suitable dark background, i.e. predators could not identify them.