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# Biology

ENGLISH MEDIUM



## Unit 3

### Evolution and Diversity of Living Organisms

- 3.1.0 Explores Evolution of Life
- 3.1.1 Uses the theories of origin of life and natural selection to analyze the process of evolution of life.



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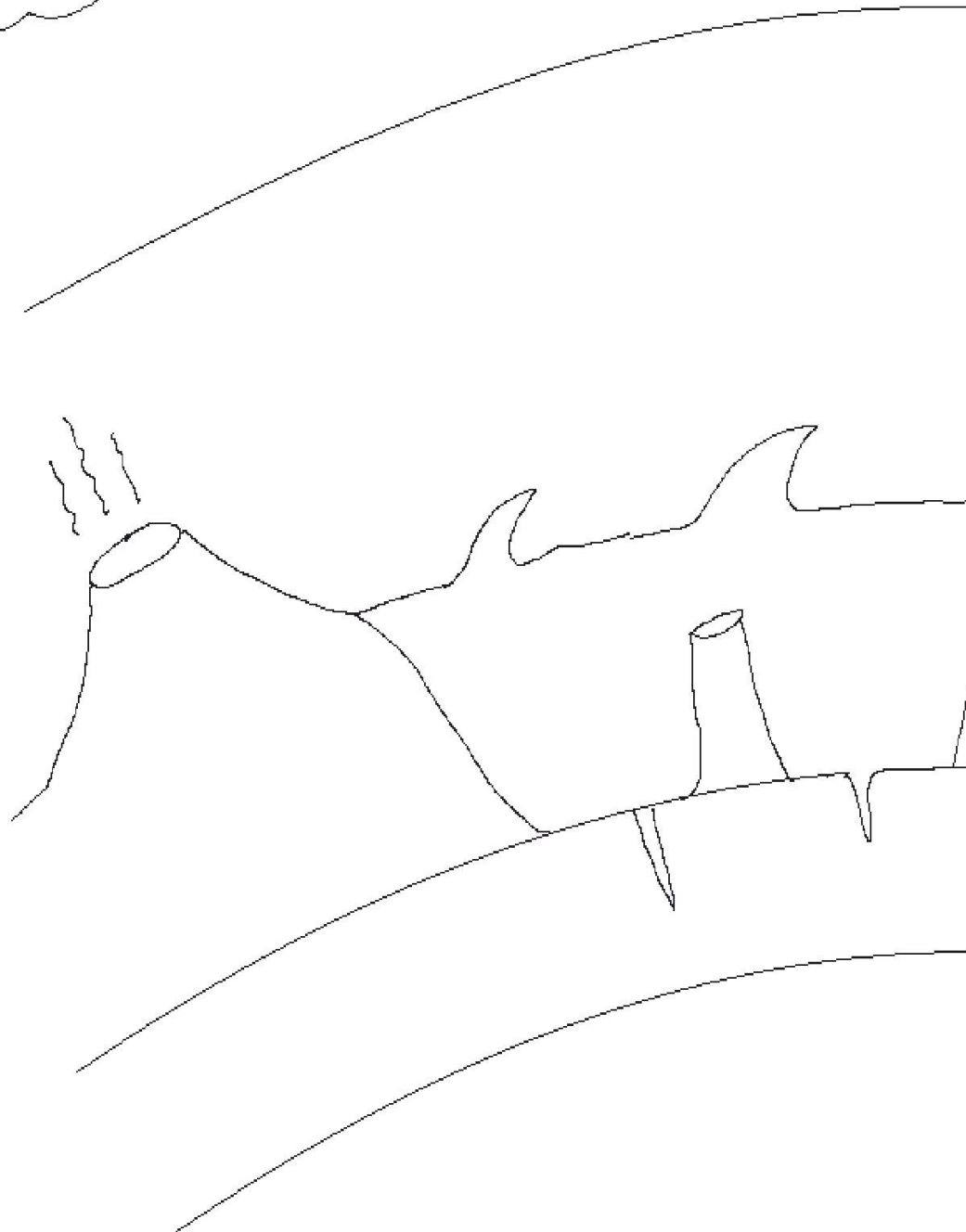
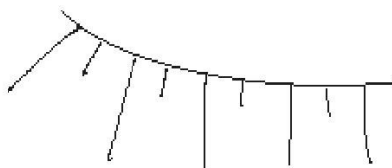
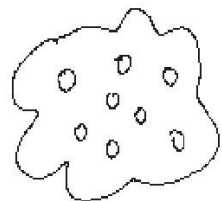


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#### Essay 01

##### (a) Briefly describe the sequence of main stages in the origin and evolution of first cell

1. The emerging force of natural selection could have produced the first cells
2. Atmospheric conditions of early earth
3. facilitated the abiotic synthesis of
4. small organic molecules such as amino acids
5. and nitrogenous bases
6. from inorganic molecules
7. Polymerization
8. of the above small organic molecules leads to the formation of organic macromolecules.
9. Amino acids → proteins
10. N-base + sugar + phosphate → Nucleic acids
11. Organic macromolecules were packed into membranes,
12. to produce protocells
13. Nucleic acids gained self replicating capability,
14. which made inheritance possible for the cells.
15. early oceans were a solution of organic molecules "primitive soup" in which life arose.
16. the volcanic-atmosphere
17. and alkaline vents
18. show the abiotic synthesis of organic molecules.
19. Another source of organic molecules may have been meteorites.
20. RNA accumulated into lipid bound vesicles
21. and formed "protocells"
22. which exhibited enzyme catalyzed activities
23. and were able to grow,
24. replicate
25. and evolve.
26. The early genes
27. and enzymes
28. would have been RNA
29. which enabled replication of RNA.
30. Other molecules that were in the primitive soup were also collected in the protocell.
31. Growth occurred by addition of lipids to the membrane
32. by collision of micelles.
33. When the protocell becomes too large,
34. it divided
35. to form two protocells with RNA included.
36. the first photosynthetic organism, today's cyanobacteria,
37. originated before 2.7 billion years ago.
38. The increase of photosynthetic bacteria contributed to the increment of the amount of atmospheric oxygen
39. which had accelerated the origin of chloroplast.
40. first eukaryotic organisms were from about 1.8 billion years ago.
41. These eukaryotic single cellular organisms later evolved in to multicellular organisms.

#### Essay 02

##### (a) Briefly describe the major theories of evolution.

1. Evolution can be defined as a change in the genetic composition of a population from generation to generation (descent with modification) over a long period of time.
2. Theories of evolution are
3. Theory of Lamarck.
4. Darwin - Wallace theory (Theory of Natural selection)
5. Neo Darwinism
6. Lamarck explained his hypothesis using two principles.
7. Use and disuse
9. Inheritance of acquired characteristics
10. The parts of the body that are used extensively become larger and stronger.

11. If not used, they deteriorate.

12. e.g.- Giraffe stretching its neck to reach leaves on higher branches.

13. Inheritance of acquired characteristics – Organism acquired adaptation during their life time according to the needs of environment

14. off spring is better adapted to live in that environment

15. e.g. long muscular neck of the giraffe had evolved over many generations as giraffes stretch their necks even higher

16. Darwin observed two phenomena from the environment.

17. His observations were; The populations of a species vary in characteristics among their inheritance traits.

18. Each species produces more offspring than their environment could accommodate.

19. The above observations were interpreted by Charles Darwin as,

20. Certain traits of a population which are capable of exhibiting qualities for better survival and their reproduction can produce more offspring.

21. Variation in abilities for survival and production among a population may enhance the abundance of favorable characteristics in that population.

22. Some favorable characteristics for survival and reproduction are;

23. Escaping from predators - defense

24. Tolerating physical conditions – stress conditions

25. Obtaining food

26. Resistance against disease

27. Fertilizing probability

28. Number of offspring produced

29. Natural selection of favorable traits.

30. Neo-Darwinism generally denotes the integration of Charles Darwin's theory of natural selection,

31. Mendelian genetics as the basis for biological inheritance

32. and knowledge of population genetics.

#### Essay 03

##### (a) Theory of natural selection

1. This is one of the theories of evolution

2. put forward by Darwin and Wallace. This theory is based on the following observations made by Darwin

3. Each species produces more offspring than the environment could support/over production.

4. The (individuals of a) population/ a species vary in characteristics /among their inheritance traits/there is variation. The above observations were interpreted by Darwin as follows to explain the process of natural selection

5. Certain (inherited) traits/characters of a population are capable of exhibiting better survival and reproduction.

6. They are successful in competition (with others).

7. Individuals with such favourable traits/characters/ those who are successful in competition can survive and produce more offspring (than others)/ survival of the fittest thus

9. enhancing the abundance of favourable characteristics/traits (for survival and reproduction) in that population (gradually / over several generations) Some favourable characteristics for survival and reproduction are

10. Escaping from predators/defense

11. Tolerating physical/ stress conditions

12. (Successful in) obtaining food

13. Resistance against diseases

14. (High) fertilizing probability

15. (Large) number of offspring produced.

16. Favourable traits are selected naturally/natural selection.

Any 14 pts



by diverse fungi, plants, and animals/Diversification of vascular plants/Diversification of bony fishes, first tetrapods and insects appeared/Amphibians dominated/Extensive forests of vascular plants/First seed plants appeared/Origin and radiation of reptiles/Origin of most present-day groups of insects/Extinction of many marine and terrestrial organisms

17. Cone-bearing plants (gymnosperms) dominated/Dinosaurs evolved, radiated/Origin of mammals/ Gymnosperms continued as dominant plants, dinosaurs dominated/Flowering plants (angiosperms) appeared and diversified/Many organisms including dinosaurs become extinct
18. First photosynthetic organisms (today's cyanobacteria) originated before 2.7 billion years ago. As a result: Iron (Fe 2+) ions were oxidized, Once dissolved iron precipitated, additional O<sub>2</sub> dissolved in water, Water bodies became saturated with O<sub>2</sub>, This increased photosynthetic bacteria and atmospheric oxygen, Accelerated the origin of chloroplast
19. First atmosphere was thick with water vapor and various compounds/Formation of organic molecules essential for life through:/Simple organic molecules polymerized to form macromolecules/Development of self-replicating organic molecules
20. First eukaryotic organisms appeared about 1.8 billion years ago/Started as single cellular organisms/ Evolved into multicellular organisms/Developed structurally complex cells/Led to greater morphological diversity/Evolved into varieties of algae, plants, fungi and animals/Oldest known protists similar to small red algae dated 1.2 billion years ago
21. Colonization began after about 500 million years ago/Fungi, plants and animals began colonizing together/ Plants that colonized land developed: /Vascular systems to transport water and minerals/Water proof coating of wax to prevent water loss/Large trees emerged later/First group of animals to colonize were arthropods (insects and spiders)/First tetrapods formed about 365 million years ago from lobed-finned fish
22. "a change in the genetic composition of a population from generation to generation (descent with modification) over a long period of time.
23. Theory of Lamarck/Darwin-Wallace theory (Theory of Natural Selection)/Neo Darwinism
24. Neo-Darwinism is the integration of Charles Darwin's theory of natural selection Mendelian genetics as basis for biological inheritance Knowledge of population genetics
25. The populations of a species vary in characteristics among their inheritance traits/Each species produces more offspring than their environment could accommodate/Certain traits capable of exhibiting qualities for better survival can produce more offspring/Variation in abilities for survival and reproduction may enhance favorable characteristics
26. Escaping from predators - defense/Tolerating physical conditions – stress conditions/Obtaining food/ Resistance against disease/Fertilizing probability/Number of offspring produced
27. Over production/Variation/Competition and survival of the fittest/Natural selection of favourable traits
28. Use and disuse - The parts of the body that are used extensively become larger and stronger. If not used, they deteriorate./Inheritance of acquired characteristics - Organisms acquire characteristics during their life time as adaptations to that environment and pass those characteristics to the next generation.

**Essay Aid**

**Essay 01**

- Briefly describe the sequence of main stages in the origin and evolution of first cell

**Essay 02**

- Briefly describe the major theories of evolution.

**Essay 03 (2019 AL/New)**

- Write short notes on Theory of natural selection

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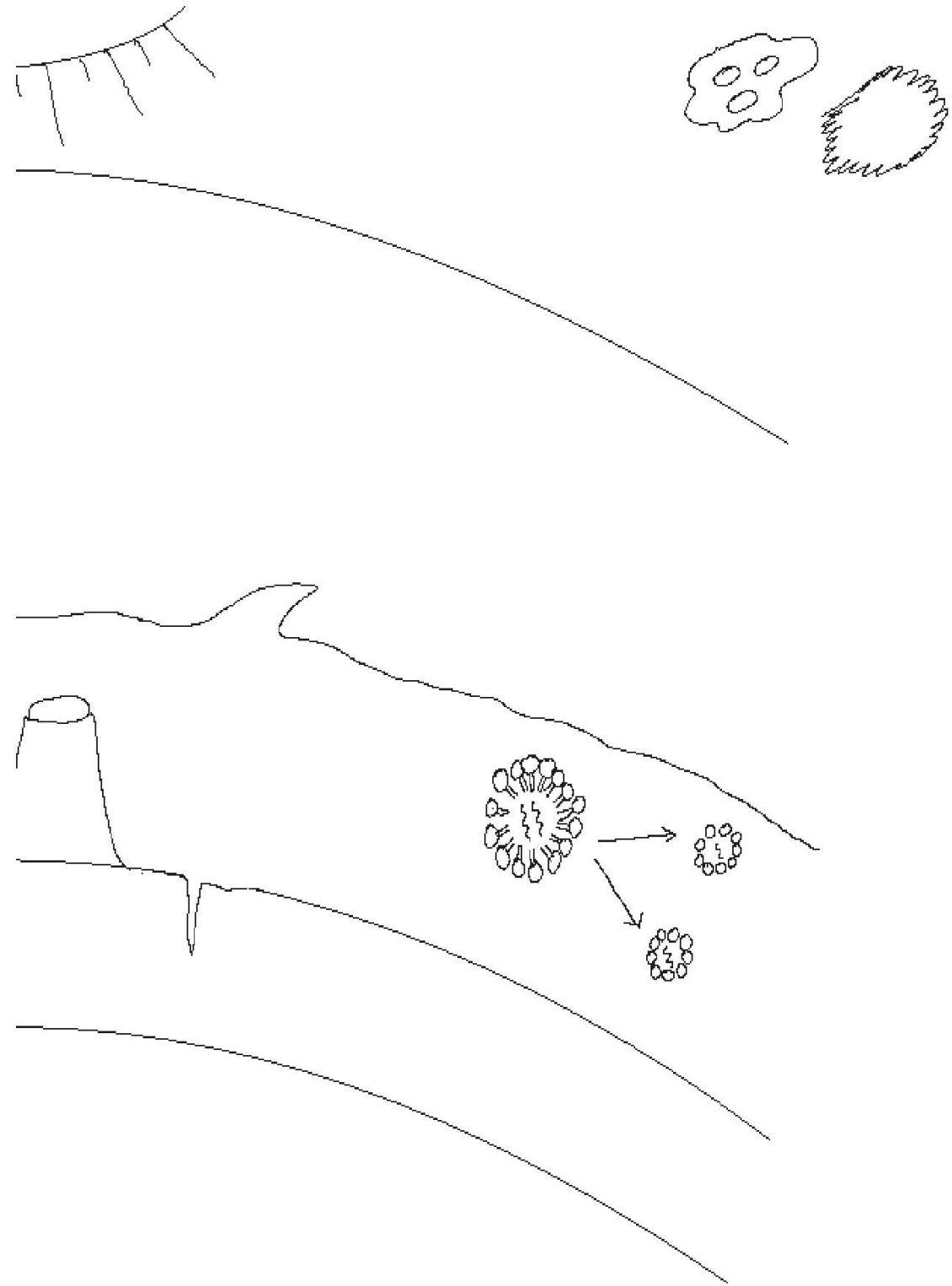
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**The theories of origin of life and natural selection to analyze the process of evolution of life**

**Origin of life on earth**

**Condition of earth before life**

Earth and the other planets of the solar system were formed about .....  
At the beginning of the solar system, planet Earth was being bombarded by chunks of rocks and ice.

The first atmosphere was probably thick with ....., along with various compounds released by volcanic eruptions, including nitrogen and its oxides, ....., ....., ....., and ..... That atmosphere then turned to be a reducing one. Later earth was cooled down and the water vapour condensed into the ocean. Much of the hydrogen escaped into the space. Volcanic eruptions, lightning, ....., ....., ....., vents and ..... vents along with the Earth's ..... atmosphere favored the synthesis of organic molecules essential for the origin of life. These simple organic molecules then polymerized to form macromolecules such as ..... and ..... Further, the formation of self-replicating organic molecules made life possible on earth.

**Evolution of Biological Diversity**

**1. Biochemical evolution**

Direct evidence for life on early earth comes from ..... of micro-organisms that are about .....billion years old. Observations and experiments in ....., ..... and ..... have provided evidence, for the appearance of the first ..... cells. The theory of the biochemical evolution arose from the ..... based on chemical and physical processes on early earth. The emerging force of natural selection could have produced the first cells through a sequence of four main stages.

1. ....  
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2. ....

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26. What are some favorable characteristics for survival and reproduction?  
.....  
.....  
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27. What is the process of natural selection?  
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28. What are Lamarck's principles?  
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**Structured Essay AID ANSWERS**

1. Water vapor, nitrogen and its oxides, carbon dioxide, methane, ammonia, hydrogen, and little Oxygen.
2. Fossils of micro-organisms that are about 3.5 billion years old.
3. Observations and experiments in chemistry, geology and physics.
4. 1. Atmospheric conditions facilitated abiotic synthesis of small organic molecules  
2. Polymerization of small organic molecules leads to macromolecules  
3. Organic macromolecules were packed into membranes to produce protocells  
4. Nucleic acids gained self replicating capability
5. Haldane suggested early oceans were a solution of organic molecules called "primitive soup."  
Recent studies relate to the volcanic-atmosphere and alkaline vents showing abiotic synthesis of organic molecules.
6. Events happened: 4.6 billion years ago: Earth formed/3.5 billion years ago: First evidence of life (fossils of microorganisms)/2.7 billion years ago: First photosynthetic organisms appeared/1.8 billion years ago: First eukaryotic organisms appeared/1.2 billion years ago: Oldest known protists similar to red algae/700 million years ago: Sponges evolved/670 million years ago: Ancestors of arthropods, chordates, other animal phyla/500 million years ago: Land colonization by fungi, plants, animals/365 million years ago: Earliest tetrapods formed/6-7 million years ago: Human lineage divergence/195,000 years ago: Origin of human species
7. Palaeozoic era
8. Mesozoic era
9. RNA accumulated into lipid bound vesicles which exhibited enzyme catalyzed activities and were able to grow, replicate and evolve.
10. Diversification began since 380 million years ago, and they continued to develop with emergence of large trees.
11. In the Mesozoic era.
12. Major radiation of mammals, birds, and pollinating insects/Dominance of angiosperm increased and their radiation continued/Radiation of most present day mammalian orders/Origins of many primate groups/ Continued radiation of mammals and angiosperms/Earliest direct human ancestors/Appearance of bipedal human ancestors/Origin of genus Homo
13. Hadean, Archaean, Proterozoic, Phanerozoic
14. Oldest known rocks on Earth's surface/Oldest fossils of cells (prokaryotes) appeared/Concentration of atmospheric oxygen begins to increase
15. Diverse algae and soft-bodied invertebrate animals appeared/Oldest fossils of eukaryotic cells appeared
16. Sudden increase in diversity of many animal phyla/Marine algae becomes abundant; colonization of land

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17. What were the key developments in the Mesozoic era?  
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18. When did photosynthetic organisms first appear and what was their impact?  
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19. What were the major events in evolution of early life?  
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20. When did eukaryotes first appear and how did they evolve?  
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21. What is the chronological sequence of colonization of land?  
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22. What is evolution?  
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23. What were the theories of evolution?  
.....  
.....  
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24. What is Neo Darwinism?  
.....  
.....  
.....

25. What is the Darwin-Wallace theory (Theory of natural selection)?  
.....



a. Amino acids



Proteins

b. N-base + sugar + phosphate



Nucleic acids

3. ....  
.....

4. ....  
.....

### 2. Origin of protocell

Haldane suggested that the early oceans were a solution of organic Molecules called "....." in which life arose. Recent studies related to the volcanic-atmosphere and alkaline vents show the abiotic synthesis of organic molecules. Another source of organic molecules may have been meteorites. .... into lipid bound vesicles and formed "protocells" which exhibited enzyme catalyzed activities and were able to grow, replicate and evolve. The early ..... and ..... would have been ..... These RNA molecules enabled self replication of RNA. Other molecules that were in the primitive soup were also collected in the protocell. Growth occurred by addition of lipids to the membrane by collision of vesicles. When the protocell becomes too large, it ..... to form ..... protocells with RNA included.

### 3. Origin of photosynthetic organisms

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Once all of the dissolved iron has precipitated, additional O<sub>2</sub> dissolved in the water until the water bodies became saturated with O<sub>2</sub>. The increase of photosynthetic bacteria contributed to the increment of the amount of atmospheric oxygen which had accelerated the origin of chloroplast.



#### 4. The origin of first eukaryote

The fossils of the first ..... organisms were estimated as from about ..... billion years ago. These eukaryotic single cellular organisms later evolved in to multicellular organisms. The appearance of structurally ..... eukaryotic cells sparked the evolution of greater ..... diversity than was possible for the simple prokaryotic cells. After the first eukaryotes appeared, a great range of ..... forms evolved. It gave rise to diversity of some single-celled eukaryotes which evolved in to multicellular forms, such as the varieties of ..... and .....

Fossils of the oldest known protists similar to small red algae were dated as 1.2 billion years ago.

#### 5. Diversification of Eukaryotes

Many present day animal phyla appeared in the early ..... era. Several animal groups which include, ....., ..... (Sea anemones and their relatives) and ..... appeared in the late ..... According to the DNA analysis, sponges evolved ..... million years ago. Ancestors of ....., ..... and other animal phyla originated ..... million years ago. The ..... on earth appeared when animals started to depend on ..... or ..... as consumers and with the arrival of many groups of animals, functioning ..... began to appear. Colonization of land by ....., ..... and ..... began after about ..... million years ago. Plants that colonized land possess vascular systems to transport water and minerals and ..... of wax to prevent the water loss. With the emergence of large ..... differentiation as ....., ..... and ..... began and diversified since ..... million years ago. Plants and fungi colonized the land together by interacting with each other. .... (insects and spiders) were the first group of animals to colonize the land. The earliest ..... formed about ..... million years ago which were evolved from lobed-finned fish. The divergence of human lineage from other primates was initiated ..... million years ago. The origin of the human species took place ..... years ago.

- 1.8 billion years ago: .....
- 1.2 billion years ago: .....
- 700 million years ago: .....
- 670 million years ago: .....
- 500 million years ago: .....
- 365 million years ago: .....
- 6-7 million years ago: .....
- 195,000 years ago: .....

7. What was the era that the reptiles were dominant?  
.....

8. What was the era that mammals originated?  
.....

9. What are protocells?  
.....  
.....

10. When did vascular plants appear and diversify?  
.....  
.....

11. When did flowering plants (angiosperms) appear?  
.....

12. What were the major events of the Cenozoic era?  
.....  
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.....

13. What are the geological eons in order?  
.....

14. What were the key events in the Archaean eon?  
.....  
.....

15. What were the characteristics of the Proterozoic eon?  
.....  
.....

16. What were the major events of the Palaeozoic era?  
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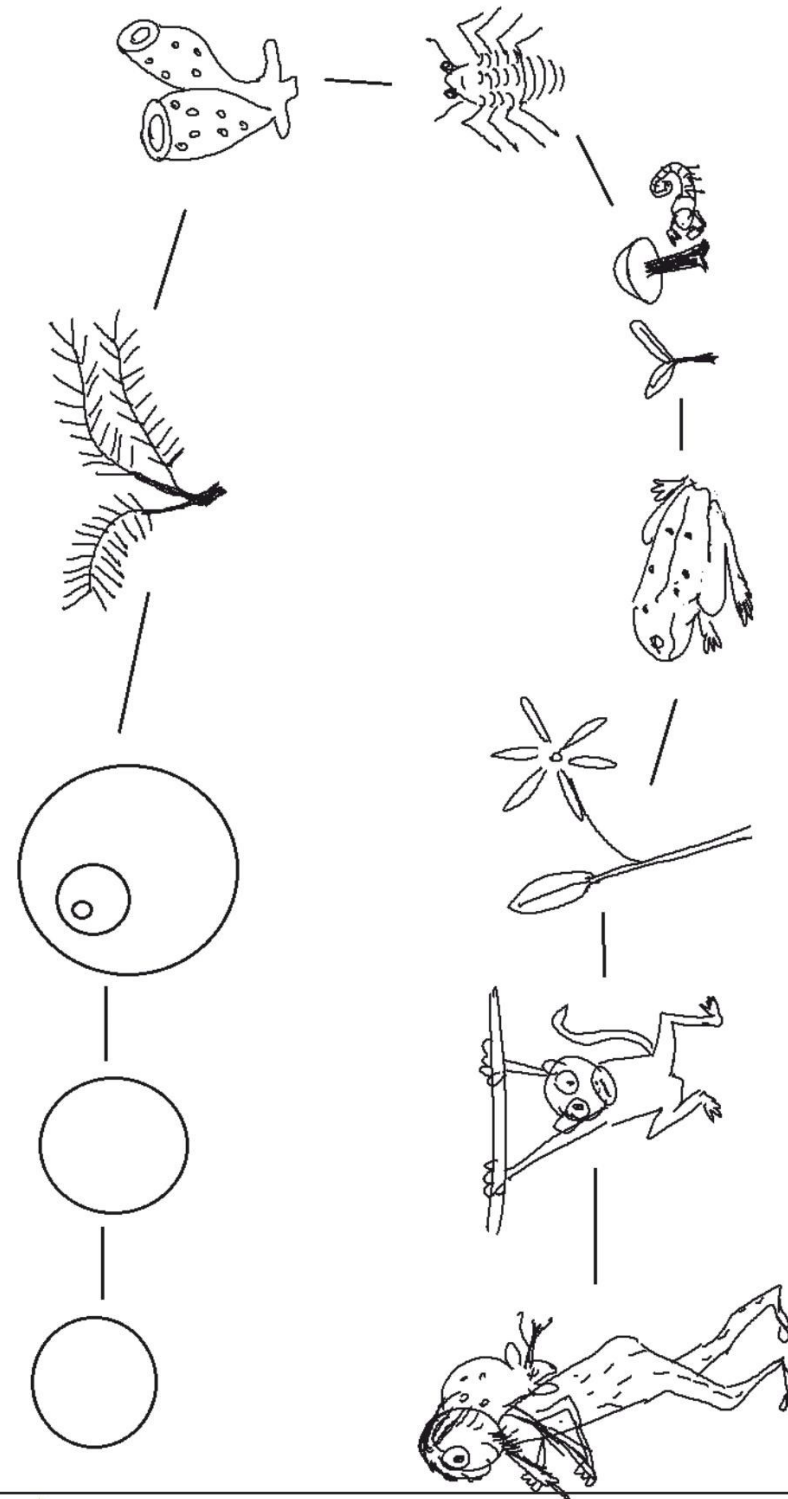


29. "Features which are developed by an organism within the life time as adaptations to environment are transmitted to the offspring." Which one of the following is correct regarding above statement?  
 (1) This is a view believed by Charles Darwin. (2) This is a theory put forward by Lamarck.  
 (3) This is an essential part of theory of natural selection.  
 (4) This is a theory put forward by Wallace.  
 (5) This is necessary for survival of the fittest. (2007/31)
30. Which one of the following is not an observation made by Darwin or Wallace in natural populations?  
 (1) Natural populations have high reproductive potential.  
 (2) Genetic modification result change in populations.  
 (3) Individuals in a population show variations.  
 (4) There is much competition among members of a population.  
 (5) Many individuals of a population do not reproduce. (2009 AL/32)
31. Which of following statements is most important in explaining the Darwin-Wallace theory?  
 (1) Organisms acquire suitable adaptations according to the needs of the environment during their life-time.  
 (2) Adaptations acquired during the lifetime are passed on to the next generation.  
 (3) Favourable characters are passed to offspring through genetic factors.  
 (4) Each species produce more offspring than the environment can accommodate.  
 (5) Adaptations result in changes in genetic material. (2021 AL)

(1) 3	(2) 3	(3) 2	(4) 3	(5) 3	(6) 4	(7) 4	(8) 3	(9) 3	(10) 3
(11) 2	(12) 2	(13) 2	(14) 3	(15) 3	(16) 2	(17) 4	(18) 2	(19) 1	(20) 1
(21) 1	(22) 1	(23) 4	(24) 3	(25) 4	(26) 1	(27) 5	(28) 1	(29) 2	(30) 2
(31) 4									

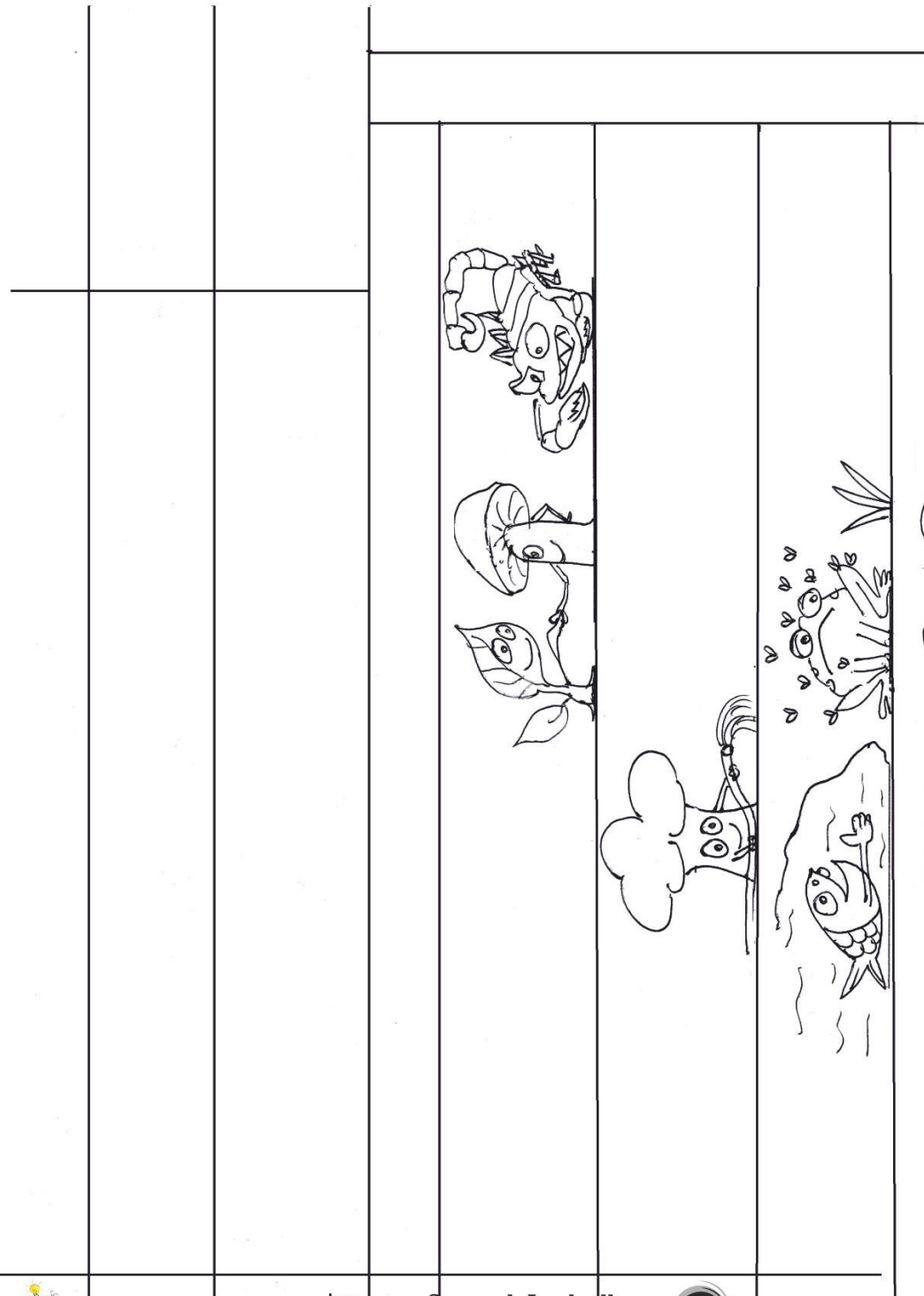
#### Structured Essay AID

- What were the gases present in the first atmosphere of earth?  
 .....
- What provide the direct evidence for life on early earth?  
 .....
- What provide evidence for the appearance for the first living cell?  
 .....
- State the main four points of biochemical evolution  
 .....  
 .....
- What was the suggestion of Haldane regarding early oceans. How this idea differs from the modern understanding of synthesis of organic molecules?  
 .....
- Give events happened I following time periods:  
 • 4.6 billion years ago: .....  
 • 3.5 billion years ago: .....  
 • 2.7 billion years ago: .....



**Geological eons and eras of evolution**

*Students are expected only to name the Geological eons and eras of evolution. The content given*



16. Which combination of events occurred in the Paleozoic era?  
 (1) Origin of mammals and dinosaurs (2) Marine algae abundance and first seed plants  
 (3) Flowering plants and extinction of dinosaurs (4) First prokaryotes and eukaryotes (5) Origin of birds and mammals
17. What was the first evidence for life on early Earth?  
 (1) RNA molecules (2) Protocells (3) Organic molecules (4) Fossils of micro-organisms  
 (5) Self-replicating molecules
18. Which one of the following **organisms lived about 3.5 billion years ago**  
 (1) Autotrophic bacteria (2) Heterotrophic bacteria (3) Unicellular algae (4) Ciliates (5) Viruses (2001/6)
19. Which one of the following is the most accepted chronological sequence of origin of organisms on earth?  
 (1) heterotrophic bacteria, cyanobacteria, algae, fishes  
 (2) bacteria, algae, invertebrates, land vertebrates, aquatic vertebrates  
 (3) green algae, cyanobacteria, invertebrates, fishes, amphibians  
 (4) bacteria, algae, cartilaginous fishes, amphibians, bony fishes  
 (5) algae, invertebrates, fishes, reptiles, amphibians (2004/5)
20. Which of the following become bases for Darwin to present the theory of evolution?  
 (1) Natural selection (2) Competition (3) Survival of the fittest (4) Fight for existent (5) Over production
21. The three eras of the Phanerozoic eon (A- C) and five events that took place in those eras (P-T) are given below. Select the answer that indicates the correct era-event combinations.  
 Era                      Event  
 A - Paleozoic      P - Origin of mammals  
 B - Mesozoic        Q - Origin of reptiles  
 C - Cenozoic        R - Dominance of gymnosperms  
                               S - Dominance of amphibians  
                               T - Radiation of birds  
 (1)A- S, B- R, C-T, A- Q, B - P (2) A - Q, B-P, C-R, B-S, B - T (3) A- S, B- R, C - Q, B-T, C - P  
 (4) A-Q, B - S, C- P, A - R, B-T (5) A- S, B- R, C-T, B - Q, C-P (2022 AL)
22. Which theorist first published their hypothesis in 1809?  
 (1) Lamarck (2) Darwin (3) Wallace (4) Mendel (5) Haldane
23. Which is NOT mentioned as part of Darwin's natural selection process?  
 (1) Overproduction (2) Variation (3) Competition (4) Genetic mutations (5) Survival of the fittest
24. What concept combines Darwin's theory with genetics?  
 (1) Lamarckism (2) Natural Selection (3) Neo-Darwinism (4) Modern Evolution  
 (5) Biochemical evolution Theory
25. Which of the following reptile in a population is most successful evolutionary?  
 (1) One that lays eight eggs, seven hatch and two progeny reproduce.  
 (2) One that lays three eggs, all three hatch and all three progeny reproduce.  
 (3) One that lays six eggs, five hatch and four progeny reproduce.  
 (4) One that lays six eggs, all six hatch and three progeny reproduce.  
 (5) One that lays five eggs, four hatch and three progeny reproduce.
26. Which of the following scientists presented a mechanism for evolution first?  
 (1) Lammark (2) Charls Darwin (3) Russel Wallace (4) Aristotal (5) Schwann
27. Which of the following idea is not included in Darwin's theory of evolution  
 (1) Overproduction (2) Competition (3) Natural selection (4) Survival of the fittest  
 (5) Heredity due to genes
28. Which of the following is essential for evolution  
 (1) Variations (2) Climatic Changes (3) Environmental changes (4) Interspecies competition  
 (5) Reduction of Population density

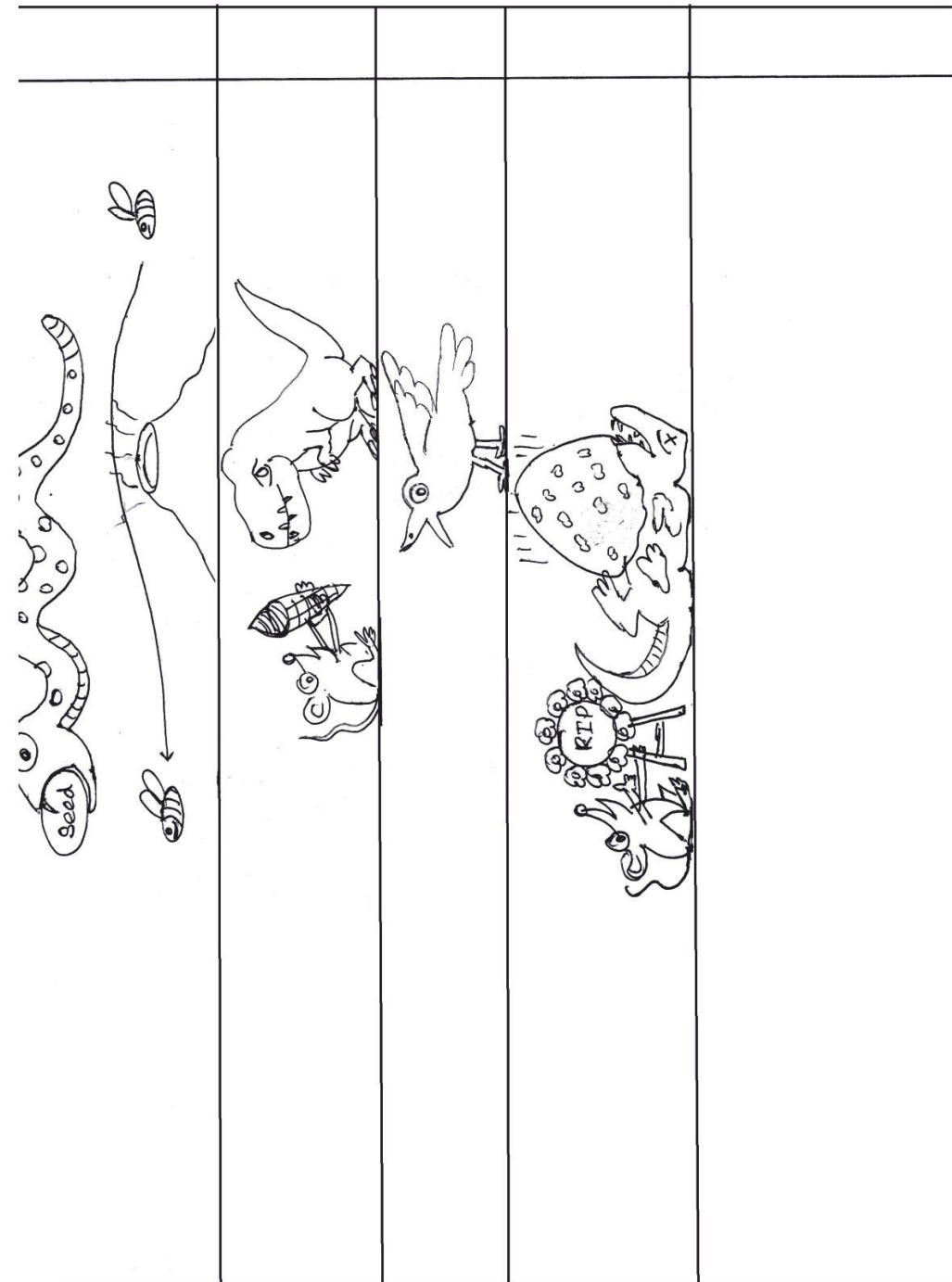




### MCQ AID

- Which of the following was present in smallest amount in Earth's first atmosphere?  
(1) Water vapor (2) Carbon dioxide (3) Oxygen (4) Methane (5) Nitrogen
- When was Earth formed according to given data?  
(1)  $15 \times 10^9$  years ago (2)  $10.1 \times 10^9$  years ago (3)  $4.6 \times 10^9$  years ago (4)  $3.3 \times 10^9$  years ago (5)  $6.6 \times 10^9$  years ago
- What was Haldane's suggestion about early life?  
(1) Spontaneous generation (2) Primitive soup theory (3) Mutation theory (4) Natural selection (5) Inheritance theory
- Which of these eras marked major radiation of mammals and birds?  
(1) Paleozoic (2) Archeozoic (3) Cenozoic (4) Mesozoic (5) Proterozoic
- When did the first photosynthetic organisms appear?  
(1) 4.6 billion years ago (2) 3.5 billion years ago (3) 2.7 billion years ago (4) 1.8 billion years ago (5) 1.2 billion years ago
- Which is a correct combination of era and event?  
(1) Mesozoic - Origin of birds (2) Paleozoic - Origin of mammals (3) Cenozoic - First seed plants (4) Paleozoic - Amphibians dominated (5) Mesozoic - First vascular plants
- When did the human species originate?  
(1) 6-7 million years ago (2) 2 million years ago (3) 500,000 years ago (4) 195,000 years ago (5) 100,000 years ago
- Which groups colonized land together?  
(1) Only plants and animals (2) Only fungi and plants (3) Fungi, plants and animals (4) Only animals and fungi (5) Plants only first
- When did eukaryotic organisms first appear?  
(1) 3.5 billion years ago (2) 2.7 billion years ago (3) 1.8 billion years ago (4) 1.2 billion years ago (5) 700 million years ago
- Which is not a favourable characteristic for survival?  
(1) Escaping predators (2) Obtaining food (3) Genetic mutations (4) Disease resistance (5) Fertilizing probability
- What was the first stage of biochemical evolution?  
(1) Formation of protocells (2) Synthesis of organic molecules (3) Polymerization (4) Self-replication (5) RNA formation
- Which era saw the dominance of gymnosperms?  
(1) Paleozoic (2) Mesozoic (3) Cenozoic (4) Proterozoic (5) Archaean
- Which sequence of events is correct according to the timeline?  
(1) Prokaryotes → Eukaryotes → Photosynthetic organisms → Multicellular life  
(2) Prokaryotes → Photosynthetic organisms → Eukaryotes → Multicellular life  
(3) Eukaryotes → Prokaryotes → Photosynthetic organisms → Multicellular life  
(4) Photosynthetic organisms → Prokaryotes → Eukaryotes → Multicellular life  
(5) Multicellular life → Prokaryotes → Eukaryotes → Photosynthetic organisms
- Which feature distinguishes Neo-Darwinism from Darwinism?  
(1) Natural selection (2) Competition (3) Mendelian genetics (4) Survival of fittest (5) Overproduction
- When did tetrapods first appear?  
(1) 500 million years ago (2) 380 million years ago (3) 365 million years ago (4) 195,000 years ago (5) 670 million years ago

here is for extra knowledge.



## Theories of evolution

This may take millions of years. Theories of evolution are

1. Theory of Lamarck.
2. Darwin - Wallace theory (Theory of Natural selection)
3. Neo Darwinism

### Theory of Lamarck

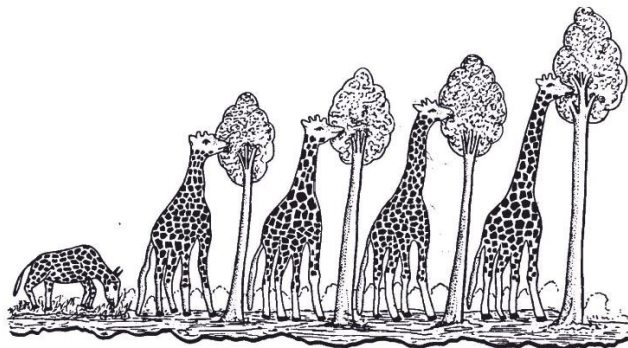
Lamarck published his hypothesis in 1809. He explained his hypothesis using two principles.

1. ....
2. ....

1. **Use and disuse** - The parts of the body that are used extensively become larger and stronger. If not used, they deteriorate.

Eg. Giraffe stretching its neck to reach leaves on higher branches

2. **Inheritance of acquired characteristics** - Organisms acquire characteristics during their life time as adaptations to that environment and pass those characteristics to the next generation. Eg. Long muscular neck of the giraffe had evolved over many generations as giraffes stretch their necks even higher.



### Darwin - Wallace theory (Theory of natural selection)

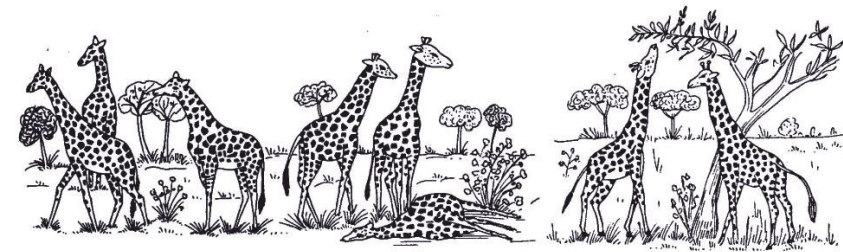
Darwin observed two phenomena from the environment. His observations were;

- .....

- .....

The above observations were interpreted by Charles Darwin as,

- .....



Some favorable characteristics for survival and reproduction are;

- Escaping from predators - defense
- Tolerating physical conditions - stress conditions
- Obtaining food
- Resistance against disease
- Fertilizing probability
- Number of Offspring produced

### Process of natural selection

- Over production
- Variation
- Competition and survival of the fittest
- Natural selection of favorable traits

### Neo-Darwinism

- Neo-Darwinism generally denotes the integration of Charles Darwin's theory of natural selection, Mendelian genetics as the basis for biological inheritance and knowledge of population genetics.

