Ratna Sagar

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Education, Our Mission

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Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

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EDUCATION, OUR MISSION

ICSE
Living Science
Biology

Class 10

Chapter 15 Human Evolution

LEARNING OBJECTIVES

Evolution of human

- Place of origin of human
- Evolutionary changes in humans
- Ancestors of human beings
- *Australopithecus*
- *Homo habilis*
- *Homo erectus*
- *Homo sapiens neanderthalensis*
- *Homo sapiens fossilis*
- *Homo sapiens sapiens*

Theories of evolution

- Lamarck's theory of inheritance of acquired characters
- Darwin's theory of natural selection

What is evolution and what are its causes?

Evolution is defined as a naturally occurring slow, continuous and irreversible process of change.

The following are the causes of evolution:

1. **Variations in the gene pool** of members of a population.
2. **Natural selection** favouring accumulation of advantageous variations.
3. **Genetic drift** or chance selection.

Evolution of human

n order to study evolution of man, various tools such as time dating, excavation and studying fossils as well as determining DNA sequences have been used. All humans belong to a single species, *Homo sapiens*.

Place of origin of human

The family of humans (Hominidae), evolved about 20 million years ago. The fossils of prehuman and ancestral human forms are found in East Africa, Asia and Europe, indicating that human's centre of origin was probably in Africa. Humans, *Homo sapiens*, evolved about 1.5 million years ago. The *Homo sapiens* evolved further to the **Neanderthal man** followed by the **Cro-Magnon man** and further the **Modern man**.

How did they migrate?

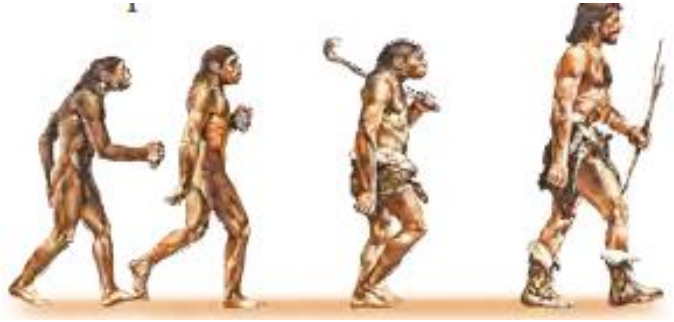
The genetic footprints of humans can be traced back to the African roots. About two–three hundred thousand years ago, some of human ancestors migrated from Africa to West Asia, then to Central Asia, Eurasia, South Asia and East Asia. Then, these ancestors travelled down the islands of Indonesia and the Philippines to Australia. From Australia, they crossed the Bering land bridge to America. They went forward and backward, even moving in and out of Africa.

Evolutionary changes in humans

1. Erect posture (to stand and walk straight)
2. Bipedal locomotion (to free forelimbs)
3. Forelimbs adapted to hold objects
4. Increase in brain size and its complexity (to think intelligently and logically)
5. Articulation of speech for better interaction and communication
6. Formation of chin
7. Reduction in size of canines
8. Loss of brow ridges.

Ancestors of human beings

The Lemur and Loris are said to be the early ancestors of human beings. Lemur is a small monkey-like animal with a long tail. It lives on trees. The Lemur is the oldest of living primates.



A fossil ape ***Dryopithecus*** is considered to be the common ancestor of humans and great apes (orangutan, chimpanzee and gorilla).

Australopithecus

Australopithecus are believed to have appeared some 3.9 million years ago in grasslands of East Africa. They were able to walk or run on

two legs but still retained many ape-like features including adaptations of tree-climbing (long arms, short legs), a small brain, a long protruding jaw, and cone-shaped ribcage. The cranial capacity was about 400–600 cubic centimetres (cc) and were 1.5 metres tall. They had a low, sloping forehead, brow ridges projecting over the eyes and a projecting face. Canine teeth were pointed and size between that of apes and humans.

Homo habilis (The handy man)

Homo habilis were the first early true man to have lived on earth between 2.3 and 1.5 million years ago. They had height of about 1.5 metres and cranial capacity of 650–800 cc. The face was slightly protruding, had round skull and teeth with small canines. Brow ridges were present, and had lightly built lower jaw. *H. habilis* had an erect posture and bipedal locomotion. Since they were the first fossil man to have used chipped stone tools, *H. habilis* were also known as toolmaker.

Homo erectus (The upright man)

Homo erectus lived between 1,00,000 and 1.6 million years back and were much larger than *H. habilis*, about 1.5–1.7 metres tall. *Homo erectus* had bigger brain with cranial capacity of around 900 cc and showed structure of brain similar to that of modern humans.

The bones of the skull were thick, had sloping forehead, flatter face, massive brow ridge, smaller chin and rounded jaw. Arms and legs were in proportion as in modern humans. They had small canines but molar teeth had large roots. *H. Erectus* successfully hunted large animals using flint and bone tools and cooked them over fire.

Homo sapiens neanderthalensis

The **Neanderthal man** lived in Europe and east and central Asia between 40,000–1,00,000 years ago. Compared to modern humans, they were short and had robust skeletons with muscular bodies adapted for cold. They had massive skulls with brain capacity of 1300–1600 cc and were 1.5 metres tall. They had protruding face, with thick but rounded brow ridge that lay under a flat and receding forehead. The Neanderthal man lived in caves and built hutlike shelters. They were skilled hunters, made flint-flake tools, cared for their sick and buried their dead.

Homo sapiens fossilis (Cro-Magnon man)

The fossils of **Cro-Magnon man** were discovered from Cro-Magnon cave in France, hence its name. They lived 20,000–50,000 years back and become extinct about 10,000 years ago. They were about 1.8 metres tall with less body hair. They had brain capacity of about 1650 cc.

They had large skull, broad flat face with high forehead, strong jaws with teeth and wisdom teeth, prominent chin and inconspicuous brow ridges. They were cave-dwellers; good hunters, made sophisticated tools like stone spears and arrows, knew the use of fires and used ornaments made of ivory.

Homo sapiens sapiens (Modern man)

The **modern man** appeared some 25,000 years back and spread all over the world about 10,000 years ago. They had undergone slight morphological and anatomical changes, such as thinning of skull bones, development of four curves in the vertebral column and brain capacity of about 1200–1600 cc.

H. erectus and *H. sapiens*

Face is reasonably small with a projecting nose, brow ridge is limited and tall forehead. The teeth are relatively small compared to earlier species. They underwent cultural evolution to adapt to and control surrounding environment. They started cultivating plants and domesticating animals.

Theories of evolution

From time to time, several theories have been put forth to explain the process of evolution of the plants and animals.

Lamarck's Theory of Inheritance of Acquired Characters

Lamarck stressed on adaptation as means of evolutionary modification. His theory is known as theory of inheritance of acquired characters or **Lamarckism**. The main features of his theory are:

1. Every living organism tends to increase volume of its body and hence increase size up to a certain limit.

2. The **development of an organ is directly proportional to its use**. The use and disuse of an organ by an organism leads to acquiring of variation or change in the feature of that organ. Continuous and extra use of an organ makes it more efficient while the continued disuse of other organs lead to their degeneration and ultimate disappearance. So, Lamarckism is also called **theory of use and disuse of organs**. This change occurs due to interaction with the environment. During its life span, the organism acquires certain new characters due to the environmental influences and are called **acquired or adaptative characters**.

3. All these changes or variations acquired during the life of an individual are transmitted to its offspring, i.e. they are inherited (hence the name **theory of inheritance of acquired characters**).

4. The favourable variations caused due to use and disuse after long period of time result in evolution of a new species.

Darwin's Theory of Natural Selection

Charles Robert Darwin (1809– 1882) explained the evolutionary principle in his famous book *The Origin of Species* in 1859 . He described the origin of species by means of natural selection. His theory is known as **Theory of natural selection** or **Darwinism**.

The main points of Darwin's theory of natural selection are as follows:

1. Living beings have a biotic or reproductive potential and their number grows geometrically.

2. Limited food and space together form major part of carrying capacity of environment, which is maintained by food chains and biogeochemical cycling. Despite having enormous potential of having large progenies, the size of population of any kind of organisms remains within a limit. This population size limitation is due to struggle between members of a species (intraspecific struggle) and within members of different species (interspecific struggle) for food, space and mate.

3. There is a competition amongst the organisms for obtaining resources. The struggle eliminates the unfit individuals. The fit organisms possess some favourable variations and they survive and reproduce. This is called **natural selection**.

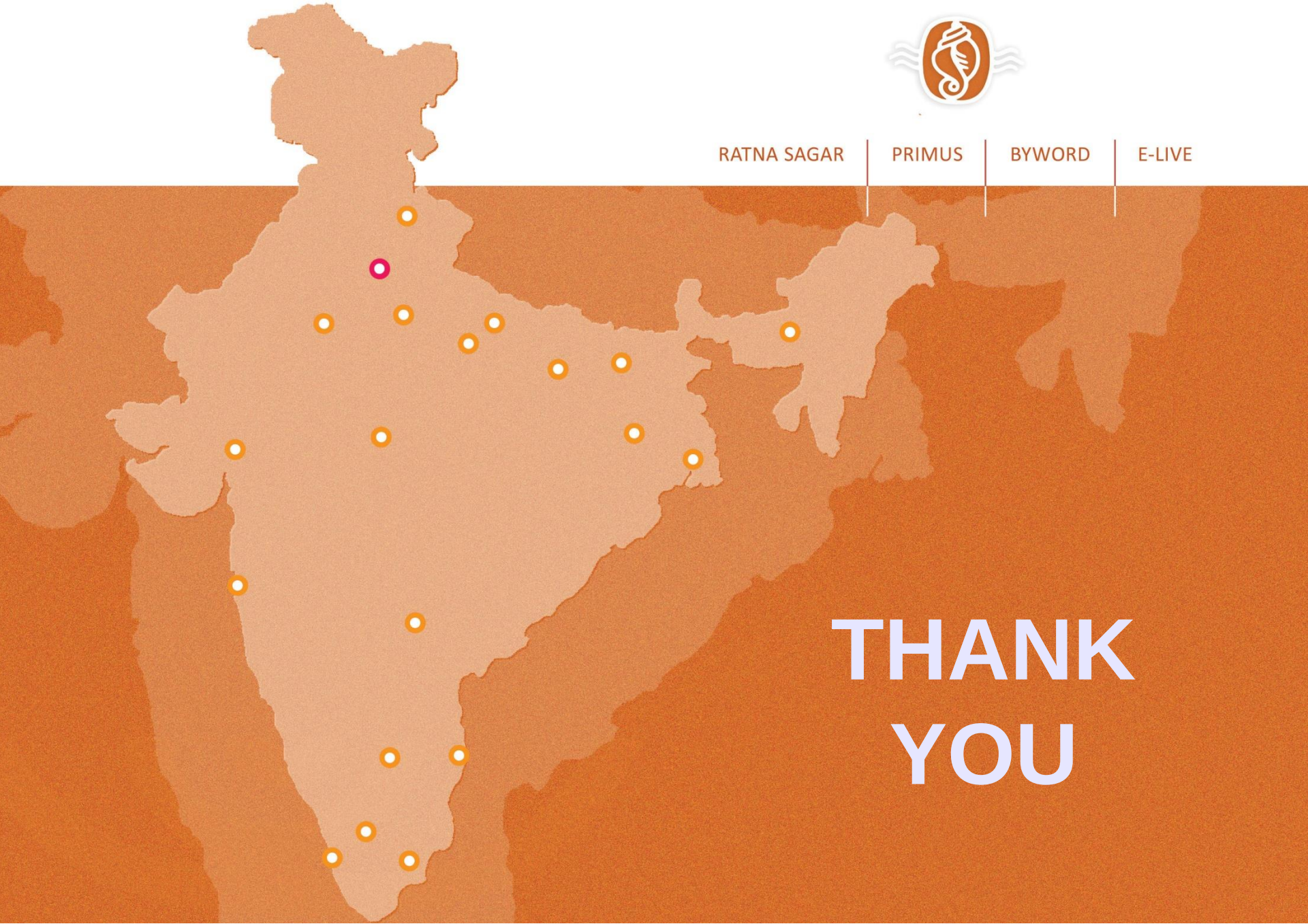
4. The organisms having favourable variations reproduce and pass on these variations to their progenies generation after generation. These variations, when accumulated for a long time, lead to origin of a new species.
Later on, with the progress in genetics, the sources of variations were explained and Darwin's theory was modified. This modified theory is known as **Synthetic theory of evolution** and nowadays, it is the most acceptable theory of evolution. This theory states that the origin of species is based on the interaction of genetic variations and natural selection.

Objections to Darwin's Theory

Although Darwin's theory of natural selection got wide acceptance, however, it had certain drawbacks, such as it could not explain how variations arise. Darwinism could not explain the origin of new characters. Scientists also claim that natural selection explains the survival of fittest but could not explain the arrival of fittest.

SUMMARY...

- The evolution is defined as a naturally occurring slow, continuous and irreversible process of change.
- *Dryopithecus* was more ape-like while *Ramapithecus* was more man-like.
- *Australopithecus* had cranial capacity of 400–600 cc, were able to walk or run, had projecting brow ridges over eyes and small brain.
- *H. habilis* had cranial capacity of 650–800 cc, having small canines and brow ridges were present.
- *H. erectus* had cranial capacity of 900 cc, massive brow ridges and small canines.
- The Neanderthal man were short and robust with brain capacity of 1300–1600 cc, round brow ridges and lived in caves and hut-like shelters.
- Cro-Magnon man were about 1.8 m tall with less body hair and cranial capacity of about 1650 cc.
- Modern man had a brain capacity of 1200–1600 cc and developed four curves in vertebral column.
- Lamarck proposed theory of inheritance of acquired characters, also called Lamarckism.
- Darwin proposed theory of natural selection, also called Darwinism.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