UNIT 3 FUNDAMENTALS AND SUB-FIELDS OF BIOLOGICAL ANTHROPOLOGY*

Contents

Learning Objectives

After going through this unit, you would be able to:

- describe the subfields of anthropology and the role of biological anthropology in them;
- summarize the origins of modern biological anthropology; and
- critically discuss the contemporary subfields of biological anthropology: human evolution, human variation and adaptation, human genetics, human growth and development.

3.0 INTRODUCTION

Biological Anthropology is the study of human biological evolution and human bio-cultural evolution. Every human is a product of evolutionary history, or all the biological changes that have brought humanity to its present form. Depending on their areas of interest, physical anthropologists might examine molecular structure, bones and teeth, blood types, breathing capacity and lung volume, genetics and genetic history, infectious and other types of disease, origin of language and speech, nutrition, reproduction, growth and development, ageing, primate origins, primate social behavior, brain biology and many other topics dealing with variation in both the living and the dead-sometimes the very long dead. In dealing with such topics, physical anthropologists apply methods and theories developed in other disciplines as well as in their own as they answer questions that help us understand who we are. For example, physical anthropologists might draw on the work of geologists who study the landforms and layering of deposits of soil and rock that tell us when earlier humans lived. Or they might obtain information from paleontologists, who study the evolution of life-forms in the distant past and thus provide the essential context for understanding the world in which earlier humans lived. Some physical anthropologists are trained in chemistry,

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so they can analyze the chemical properties of bone and teeth to determine what kind of food were eaten by those earlier humans. Or to learn how living humans adapt to reduced-oxygen settings, such as in the high altitudes of the Peruvian Andes Mountains, physical anthropologists might work with physiologists who study the ability of lungs to absorb oxygen.

> *"Physical Anthropology is the science that considers humans as biological organisms in terms of both their evolutionary history and biological variation. At the beginning of the 20th century, the field was first known as physical anthropology because the focus was on the physical variation of modern and fossil humans and nonhuman primates. Much of the early research was based on descriptions of physical variation with little or no theoretical background. In the 1950's, with the development of genetics and evolutionary science, research in physical anthropology became more focused on biological and genetic processes. As a result, the term "biological anthropology" became popular to emphasize the new focus on biological processes within a genetic and evolutionary framework" (Ryan, 2002).*

We will focus the outlines of Human Evolution, Human variation and adaptation, Human Genetics and Human Growth and Development in this unit.

3.1 HUMAN EVOLUTION

Evolution is a change in living organisms over time. Both cultural and biological evolution is of immense interest to the anthropologists. Although all living creatures ultimately share a common ancestry, they differ from one another through the process of evolution. Biological evolution refers to genetic change over successive generations. The process of change is characterized by descent with modification, as descendant populations diverge from ancestral ones. Thus, the process of evolution provides a mechanism to account for the diversity of life on earth.

Mechanism of Organic Evolution: Organic evolution pertains to the gradual changes that have taken place in living organisms for their better adaptability to the environment. Macroevolution focuses on the formation of new species (speciation) and on the evolutionary relationships among groups of species**.** It may involve the following processes:

- Speciation
- Parallelism
- Convergence
- Mosaic Evolution
- Extinction
- Speciation refers to the formation of species or separate groups of interbreeding organisms that are reproductively isolated from other organisms. An example of speciation is the Galápagos finch. These finches live on different islands in the Pacific Ocean and are adapted to different eating habits. These birds don't breed with one another and have therefore developed into different species with unique characteristics.

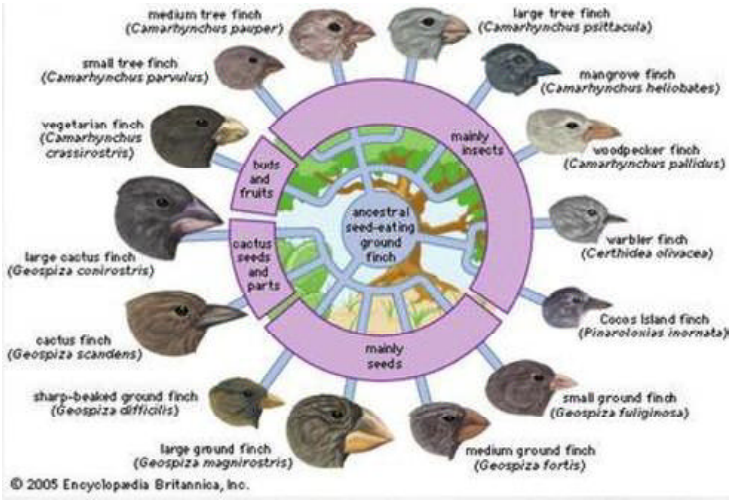

Fig. 1: Speciation in Galapagos Finches

Source: https://www.britannica.com/science/speciation

- Parallelism refers to the evolutionary development of similar traits and adaptations from the same ancestral trait in two related groups of animals. For example; the arm swinging locomotion of gibbons is parallel to the arm swinging locomotion of spider monkeys.

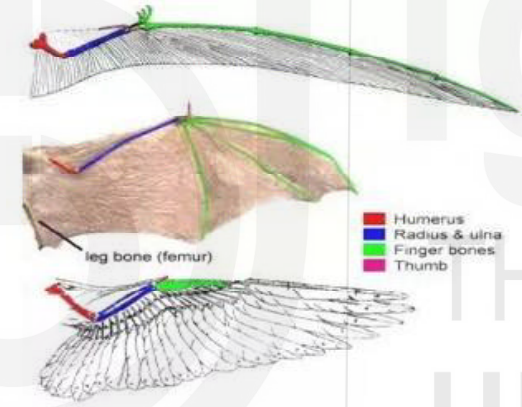

Fig. 2: Parallel evolution of vertebrate wings (pterodactyl, bat and bird)

Source: https://www.quora.com/What-are-some-impressive-examples-of-independent-parallel-evolution

- Convergence refers to the evolutionary development of similar traits and adaptations in two groups of organisms that are not closely related. For example; the wings of bats and wings of butterflies are convergent structures.

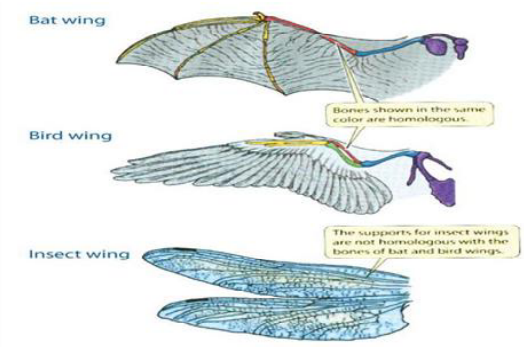

Fig. 3: Convergent evolution of bat, bird and insect wings

Source: http://peabody.yale.edu/exhibits/tree-of-life/convergent-evolution-recurrence-form

- Mosaic Evolution refers to the differential evolution of component parts of an organism. That is, all the parts of the organism do not change at the same rate in the course of evolution and all parts of the organism do not change in the same time period. For example, the foot and pelvis of the fossil ancestors of man was clearly transformed from quadrupedal to bipedal types in a relatively short time. The skull particularly the brain case of hominids changed relatively little until the erect bipedal structure had been perfected; then it changed rapidly relative to further changes in the pelvis and foot.

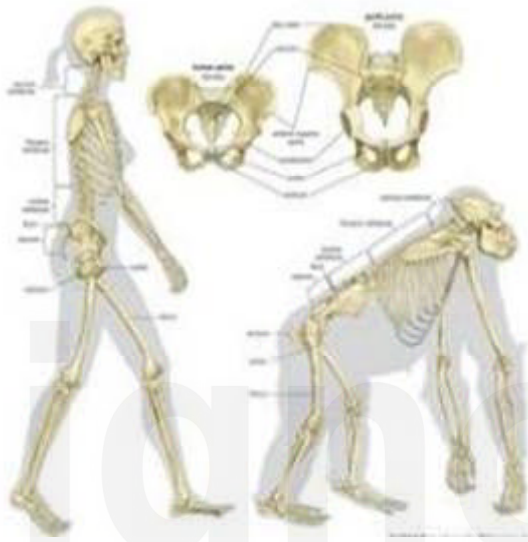

Fig. 4: Transformation from quadrupedalism to bipedalism

Source: https://www.britannica.com/science/bipedalism

- Extinction refers to the disappearance of a group or organisms from the evolutionary record. There are many ways in which a species can become extinct. A species may develop a way of life that would prevent its survival, should the environment change. For example, the wooly mammoths, well adapted to a glacial climate, became extinct as the climate grew warmer and as a major predator (man) appeared.

  Geologists have suggested that 'life' or living organic matter must have originated about 3-4 billion years ago on this earth. The term 'life' or 'living matter' is attributed to the organic molecules of nucleic acid. The first life must have originated in water, particularly, the sea, possibly in form of aquatic bacteria. 'Life' invaded only after evolving gradually in the course of several millions of years. The evolutionary scale of geologists comprises of three major eras: Palaeozoic, Mesozoic and Cenozoic. Of these, Cenozoic era is further divided into seven epochs: Palaeocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene and Holocene (Balter, 2005). It is during the epoch of Pleistocene that the ancestors of man evolved. Holocene or the present epoch is the time period of man or *Homo sapiens*.

  A brief look at the major theories of organic evolution that will help you to understand the process of evolution.

  Theories of Organic Evolution: The three major theories of Organic evolution are: Lamarckism, Darwinism and the Synthetic theory.

a) Lamarckism: The first theory of evolution, Lamarckism, was propounded by Jean Baptiste Lamarck, a French Zoologist in 1809. This theory

is popularly known as "Inheritance of Acquired Characters". Lamarck emphasized in his theory on the effects producing factors that influence evolution:

i) ***Effect of changing environment:*** Changes in environment leads to changes in needs and wants of organisms. This brings about changes in activities, thereafter leading to changes in organs of organisms for better adaptability. Lamarck believed that such changes could be inherited.

ii) ***Effect of use and disuse of organs:*** According to Lamarck, changed environmental conditions leads to the conscious effort on the part of the organism to either excessively use a particular organ or totally disuse an organ. He believed that excessive use of a particular organ led to its further development and specialization, while the disuse led to its atrophy. Such changed characters could be transmitted to their offsprings.

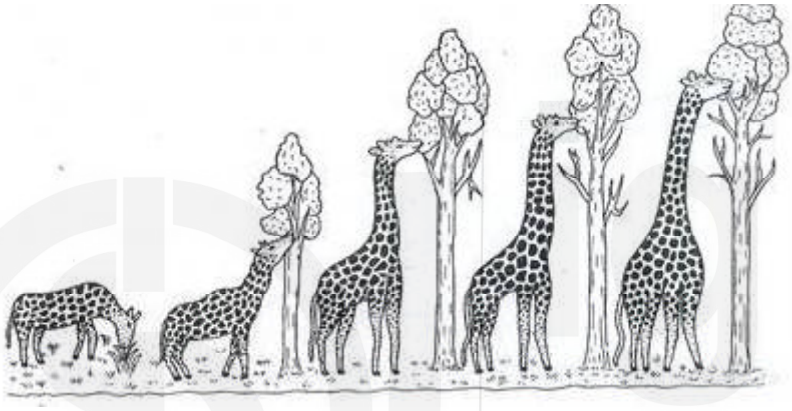

Fig. 5: Elongation of Giraffe's neck

***Source*:** http://www.yourarticlelibrary.com/theories/lamarckism

As an example of the specialization and modification acquired by an organ, Lamarck suggested the case of giraffes. Lamarck was of the opinion that the giraffes had small necks and were used to feeding on short herbs. When the herbs became scanty, the ancestral forms were obliged to browse on the leaves of trees. In attempting to do this, they had to stretch their necks. After continuous stretching, the change became substantial, resulting in an extraordinary long neck.

Lamarck's theory faced several crucial drawbacks. Weismann (1883), a German zoologist proved that use or disuse of organs does not bring any modification even after being operated for several generations. He conducted his experiments on rats by cutting off their tails for successive generations, but did not see tail-less rats in any of the upcoming generations. He therefore propounded the theory of "continuity of germplasm" wherein it was maintained that germplasm was heritable but not somatoplasm and since environment affects principally the somatoplasm, these changes cannot be inherited.

b) Darwinism: Charles Darwin, a British naturalist, in the year 1859 published his book on the 'Origin of Species' and proposed the "Theory of Natural Selection" and the concept of Organic Evolution. He attributed several factors to the cause of evolutionary changes.

i) ***Overproduction:*** Potentially, all living organisms have the ability to reproduce at a very high rate. Thus, any given population is usually

able to reproduce many more young individuals that can adequately be raised in the region they occupy.

ii) ***Variation:*** Darwin pointed out that all living organisms vary. No two organisms are exactly alike. There are always some variations. Since environment varies from region to region, the variations that living organism shows also differ from region to region. Such variations are preserved and transmitted to their offsprings. In nature, favorable variations are more prone to be inherited than the unfavorable ones.

iii) ***Struggle for existence:*** Since the amount of space, food, residential areas and other requirements of life are limited; there is a severe competition between the individuals for these essentials of life. In other words, there is a struggle for existence.

iv) ***Natural selection and the survival of the fittest:*** In the face of the struggle for existence, only those organisms that are most well adapted to the environment or fit in life can survive. Thus, nature eliminates the least fitted organisms by means of several natural calamities and preserves the well-adapted ones. Thus, natural selection maintains more or less constant number of every species.

Darwin also faced criticism because:

- His theory does not account for the presence or origin of variations among living organisms.
- Natural selection cannot carry a species beyond its natural range of variability.

c) **The Synthetic Theory/Neo-Darwinism:** In the late 1920s and early 1930s, biologists realized that mutation and natural selection weren't opposing processes, but instead they both actually contributed to biological evolution. The two major foundations of the biological sciences had finally been brought together in what is called the Modern Synthesis. From such a "modern" (that is, the middle of the twentieth century onward) perspective, we define evolution as a two-stage process. These two stages are:

- The production and redistribution of variation (inherited differences among organisms)
- *Natural selection* acting on this variation, whereby inherited differences, or variation, among individuals differentially affect their ability to successfully reproduce.

The synthetic theory considers evolution to be the result of changes in the gene frequency of population. These changes produce variations. These variations lead to effective adaptation to the environment. Changes in gene frequency occur through the impact of the forces of evolution such as selection, mutation, isolation, genetic drift and gene flow or migration or hybridization which will be dealt subsequently in the Unit.

The study of human variation considers how and why human populations differ genetically from each other. Biological anthropologists who study human variation have a wide range of interests, including human adaptation, genetics,

growth and development, demography, health, epidemiology, nutrition, life history and disease.

"Human beings differ from one another in a variety of ways. Intrinsic to the study of human variation is the recognition of human differences, that is, the study of what is often considered "race". Until the 1950's much of physical anthropology was devoted to racial description and classification. Because the concept of race was and still is, so ingrained in society, physical anthropologists have examined this issue in terms of evolutionary processes rather than racial classifications defined by society" (Ryan, 2002).

Check Your Progress 1

1) What is meant by Mosaic Evolution?

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2) Give one example of Lamarck's theory.

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3) Write a note on Synthetic theory.

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3.2 HUMAN VARIATION AND ADAPTATION

You have learnt in the previous section that biological anthropologists view human variation as the result of the evolutionary factors – mutation, genetic drift, gene flow and natural selection. To survive, all organisms must maintain the normal functions of internal organs, tissues and cells within the context of an ever changing environment. Even during the course of a single, seemingly uneventful day, there are numerous fluctuations in temperature, wind, solar radiation, humidity and so on. Physical activity also places stress on physiological mechanisms. The body must accommodate all these changes by compensating in some manner to maintain internal constancy, or homoeostasis.

An adaptation is a characteristic that enhances the survival or reproduction of organisms that bear it, relative to alternative characteristics (especially the ancestral condition in the population in which the adaptation evolved). Natural selection is the only mechanism known to cause the evolution of adaptations; so many biologists would simply define an adaptation as a characteristic that has evolved by natural selection. Three types of human adaptations exist:

- **Acclimatization**: short-term biological change, as with immune resistance to disease;
- **Genetic change**: long term biological change e. g. mutation; and
- **Cultural change**: non-biological change, as with technology.

Acclimatization is another kind of physiological response to environmental conditions and it can be short-term, long-term, or even permanent. These responses to environmental factors are partially influenced by genes, but some can also be affected by the duration and severity of the exposure, technological buffers (such as shelter or clothing), individual behavior, weight and overall body size. The simplest type of acclimatization is a temporary and rapid adjustment to an environmental change. Tanning is a kind of acclimatization. Tan fades once exposure to sunlight is reduced. In this example, the physiological change is temporary.

Contrary to acclimatization, genetic adaptations last for many generations. These changes occur due to long term exposure of a genetic stressor or mutations. Adaptations caused by genetical changes are mainly environmental specific. These genetic adaptations or changes can be advantageous in one environment while it can also have detrimental effect in another environment. One of the typical examples of genetic adaptions includes variation in size and shape of human body in different altitude and temperature conditions.

Cultural changes are non-biological changes consisting of changes in socio-cultural traits. Similar to genetic changes, cultural changes can be more or less adaptive depending on the environment. Technology plays an important role in mediating socio-cultural changes that occurs via multiple processes and at multiple scales. These cultural changes can also alter the cultural equilibrium, if there is one. For example, a game-changing cultural innovation, such as the transition from foraging to agriculture, could allow a population to feed many more people; thus, a cultural innovation can alter the size of the population (Creanza et al., 2017).

3.3 HUMAN GENETICS

The term "Genetics" is derived from the Greek word '*gen*' which means '*to become*' or '*to grow into*'. It is the science of inheritance which tries to explain how characters are transmitted through generations. Genetics is the scientific study of the laws of inheritance. Human genetics is defined as the study of how genetic inheritance takes place in the human species, or how inheritance of various characteristics from parents to children takes place.

Scientists began to understand the mechanics of heredity and how evolution works in populations long before molecular biologists identified the genetic basis of evolutionary change. With the discovery of DNA (deoxyribonucleic acid) molecule in 1953 by Watson and Crick, scientists came to understand how genetic information is stored in the chromosomes of a cell. Genes, specific portions of DNA molecules, direct the synthesis of the protein molecules upon which all living organisms depend. Through the process of biological reproduction, each of us inherits a combination of genes from our biological parents that creates a unique new individual.

Concept of gene

A gene is the basic physical and functional unit of heredity. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases. Genes are present in two copies, one inherited from each parent in every person. Most genes are the same in all people, but a small number of genes (less than 1 percent of the total) are slightly different between individuals. Alleles are forms of the same gene with small differences in their sequence of DNA bases. These small differences contribute to each human's unique physical features.

Each chromosome contains many genes which in turn are made up of DNA. James Watson and Francis Crick were the first scientists to formulate an accurate description of the molecule DNA's complex, double-helical structure. The inception of a three-dimensional, double-helical model for the structure of DNA by Watson and Crick in 1953 paved way to open up genetic components in detail. Let us learn the characteristic features of the DNA model:

- DNA is a double-stranded helix, with the two strands connected by hydrogen bonds. Adenine bases are always paired with Thymines and Cytosiness are always paired with Guanines.
- Most DNA double helices are right-handed; that is, if you were to hold your right hand out, with your thumb pointed up and your fingers curled around your thumb, your thumb would represent the axis of the helix and your fingers would represent the sugar-phosphate backbone. Only one type of DNA, called Z-DNA, is left-handed.
- The DNA double helix is anti-parallel, which means that the 5' end of one strand is paired with the 3' end of its complementary strand (and vice versa). As shown in Figure, nucleotides are linked to each other by their phosphate groups, which bind the 3' end of one sugar to the 5' end of the next sugar.
- Not only are the DNA base pairs connected via hydrogen bonding, but the outer edges of the nitrogen-containing bases are exposed and available for potential hydrogen bonding as well. These hydrogen bonds provide easy access to the DNA for other molecules, including the proteins that play vital roles in the replication and expression of DNA. Crick went on to do fundamental work in molecular biology and neurobiology. Watson became the Director of the Cold Spring Harbor Laboratory and headed up the Human Genome Project in the 1990s.

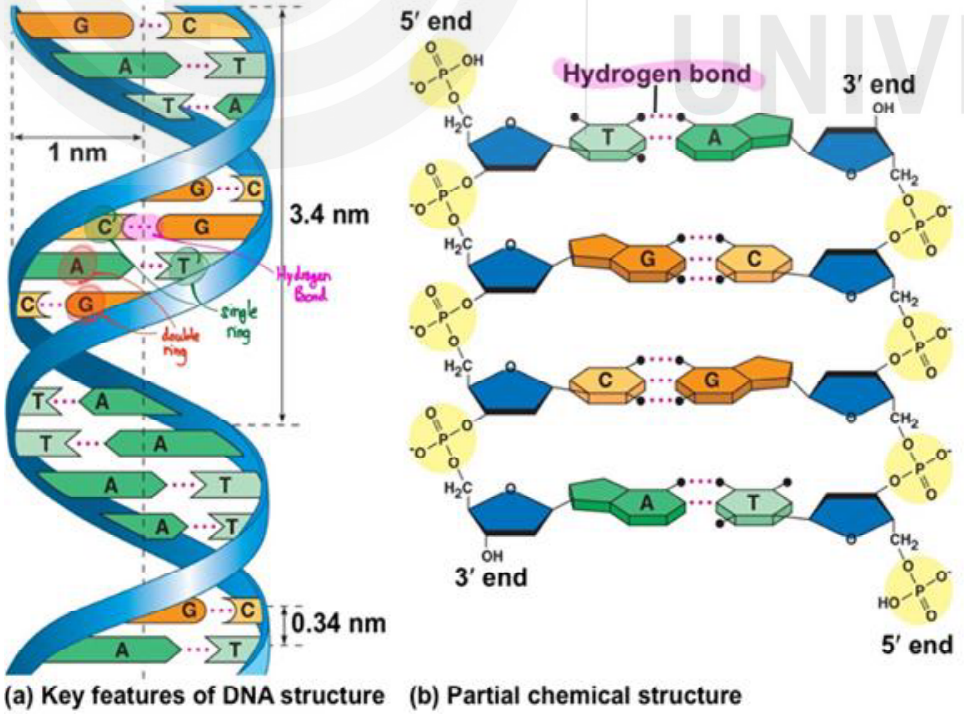

Fig. 1: Structure of DNA

Source: http://logyofbio.blogspot.com

Check Your Progress 2

4) Write a short note on the process of acclimatization.

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5) What is human genetics?

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3.4 HUMAN GROWTH AND DEVELOPMENT

Growth is the progressive increase in the size of a child or parts of a child. Development is progressive acquisition of various skills (abilities) such as head support, speaking, learning, expressing the feelings and relating with other people. "Though growth and development may occur simultaneously, they are distinct biological processes. Growth may be defined as a quantitative increase in size or mass. Measurements of height in centimeters or weight in kilograms indicate how much growth has taken place in a child. Additionally, the growth of a body organ, such as the liver or the brain, may also be described by measuring the number, weight, or size of cells present. Development is defined as a progression of changes, either quantitative or qualitative, that lead from undifferentiated or immature state to a highly organized, specialized and mature state" (Bogin, 1999). In short, in biological systems, *growth* is a quantifiable change in size, while *development* indicates a transformation of structure. A very simple example of this concept is a small caterpillar that eats lots of leaves and grows large.

The assessment of growth and development is very helpful in finding out the state of health and nutrition. Continuous normal growth and development indicates a good state of health and nutrition. Abnormal growth or growth failure is a symptom of disease. Hence, measurement of growth is an essential component of the physical examination. There are various measurements that are used to measure growth. These are: weight, height, head circumference, mid upper arm circumference (MUAC) Plan, the eruption of teeth, etc. The purposes behind monitoring of growth are manyfold viz. early detection of abnormal growth and development, facilitating early treatment or correction of any conditions that may be causing abnormal growth and development, providing an opportunity for giving health education and advice for the prevention of malnutrition.

The factors that promote development include good nutrition, emotional support, play and language training. In monitoring development, we notice at what age the child achieves various milestones, such as smiling at the mother, sitting without support, grasping objects with his/her hands, standing, walking and talking. It would be interesting record at what age the child has achieved the various milestones.

There is a set of principles that characterizes the pattern and process of growth and development. These principles or characteristics describe typical

development as a predictable and orderly process; that is, we can predict how most children will develop and that they will develop at the same rate and at about the same time as other children. Although there are individual differences in children's personalities, activity levels and timing of developmental milestones, such as ages and stages, but the principles and characteristics of development are universal patterns. The major principles that characterize the pattern and process of growth and development are as follows:

- Development proceeds from the head downward**:** This is called the cephalocaudle principle. This principle describes the direction of growth and development. According to this principle, the child gains control of the head first, then the arms and then the legs.
- Development proceeds from the center of the body outward: This is the principle of proximo-distal development that also describes the direction of development. This means that the spinal cord develops before outer parts of the body.
- Development depends on maturation and learning: Maturation refers to the sequential characteristic of biological growth and development. The biological changes occur in sequential order and give children new abilities.
- Development proceeds from the simple (concrete) to the more complex: Children use their cognitive and language skills to reason and solve problems. For example, learning relationships between things (how things are similar), or classification, is an important ability in cognitive development.
- Growth and development is a continuous process: As a child develops, he or she adds to the skills already acquired and the new skills become the basis for further achievement and mastery of skills.
- Growth and development proceed from the general to specific: The infant's first motor movements are very generalized, undirected and reflexive, waving arms or kicking before being able to reach or creep toward an object. Growth occurs from large muscle movements to more refined (smaller) muscle movements.
- There are individual rates of growth and development: Each child is different and the rates at which individual children grow are different. Although the patterns and sequences for growth and development are usually the same for all children, the rates at which individual children reach developmental stages will be different.

Human stages of growth and development are differentiated by age and key stages of scientifically supported psychomotor development. Psychomotor development is progress in mental and motor skill activity. The process of growing and developing begins on the cellular level even before conception in the womb and continues throughout life until death. Human growth can be divided into stages according to age. Most human stages of growth and development occur in infancy, childhood and adolescence (Beall, 2000). Important stages of human growth and development are given below (Human growth and development, n. d.).

a) **Infancy**

A baby is considered an infant from birth through the first year of life. During this first year, babies develop skills that will be lifelong resources. Learning how to control the head, move by crawling and sit are called gross motor skills. Using the thumb and finger to pick up pieces of food and hold a pacifier are called fine motor skills.

b) **Childhood**

After age of 1 year, a child's growth slows down considerably. The toddler years are more mobile and exploratory. Middle childhood occurs at about the age of 6 years and children have a better sense of right and wrong then.

c) **Juvenile**

As children approach the ages of 9 and 10 years, they become more independent and might start noticing the physical changes of puberty. A major growth spurt can occur at this time as the body begins sexual development.

d) **Adolescence**

From ages 12 to 18 years, children experience distinct mental and physical changes. It is the transitional period in a person's life between childhood and adulthood. Adolescence is commonly defined as the stage of life that begins at the onset of puberty, when sexual maturity or the ability to reproduce is attained.

e) **Adulthood**

Adulthood is often noted when a person is considered chronologically, legally and behaviorally ready to hold responsibilities such as operating a motor vehicle, voting, taking the vows of marriage, entering into a contract and serving in the armed forces.

f) **Senescence**

Senescence is considered the stage of negative growth. During this stage, structure and functions of organ of body decline or deteriorate. The biological ageing produces progressive and irreversible changes affecting most of the body organs and leading a gradual decline in all the activities of an individual.

Check Your Progress 3

6) What are the major stages of human growth? Explain any two stages.

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3.5 SUMMARY

Biological Anthropology is one of the major branches of Anthropology with several subfields. This branch majorly consists of Human Evolution, Human Variation and Adaptation, Human Genetics and Human Growth and

Development. The unit has tried to incorporate the types and mechanism of human evolution and the theories put forward by Lamarck, Darwin along with the criticism faced by them. The concept of adaptation to geographic variations and the physiological effects visible in form of skin color, high altitude adaptations, etc. temporary or long-term has been discussed. The discovery and structure of DNA and its use thereafter in studying human evolution are important aspects of biological anthropology. This units also gives a background in human growth and development from before birth, through childhood, into adulthood and through death and grief.

3.6 REFERENCES

Alemseged, Z., Spoor, F., Kimbel, W. H., Bobe, R., Geraads, D., Reed, D., & Wynn, J. G. (2006). A Juvenile Early Hominin Skeleton from Dikika, Ethiopia. *Nature*, *443*(7109), 296.

Balter, M. (2005). Are Humans Still Evolving? *Science*, *309*(5732), 234-237.

Beall, C. M. & Steegmann Jr. A. T. (2000). Human Adaptation to Climate: Temperature, Ultraviolet Radiation and Altitude. In Human Biology: An Evolutionary and Biocultural Perspective, eds. S. Stinson, B. Bogin, R. Huss-Ashmore and D. O'Rourke, pp. 163–224. New York: John Wiley.

Bogin, B. (1999). *Patterns of Human Growth* (Vol. 23). Cambridge University Press.

Creanza, N., Kolodny, O., & Feldman, M. W. (2017). Cultural Evolutionary Theory: How Culture Evolves and why it Matters. *Proceedings of the National Academy of Sciences*, *114*(30), 7782-7789.

Growth and Development Essay. (n. d.). Brightkite. Accessed on: April 18, 2018. Retrieved From: https://brightkite.com/essay-on/growth-and-development-4

Human Growth and Development. (n. d.). Accessed on: April 19, 2018. Retrieved from: http://courses.aiu.edu/Human%20Growth%20and%20Development/1/01.Human%20Growth%20Development.pdf

Relethford, J. H. (2010). *The Human Species: An Introduction to Biological Anthropology, (*Ed. 8). State University of New York. Mc Grew Hills.

Ryan, A. S. (Ed.). (2002). *A Guide to Careers in Physical Anthropology*. Greenwood Publishing Group.

3.7 ANSWERS HINTS TO CHECK YOUR PROGRESS

1) Mosaic Evolution refers to the differential evolution of component parts of an organism. That is, all the parts of the organism do not change at the same rate in the course of evolution and all parts of the organism do not change in the same time period. For further details kindly refer section 3.1

2) As an example of the specialization and modification acquired by an organ, Lamarck suggested the case of giraffes. Lamarck was of the opinion that the giraffes had small necks and were used to feeding on short herbs. When the herbs became scanty, the ancestral forms were obliged to browse on the leaves of trees. In attempting to do this, they had to stretch their necks. After continuous stretching, the change became substantial, resulting in an extraordinary long neck which was generation after generation.

3) The synthetic theory considers evolution to be the result of changes in the gene frequency of population. These changes produce variations. These variations lead to effective adaptation to the environment. Changes in gene frequency occur through the impact of the forces of evolution such as selection, mutation, isolation and genetic drift, gene flow or migration or hybridization. For further details kindly refer page no. 36.

4) Acclimatization is another kind of physiological response to environmental conditions and it can be short-term, long-term, or even permanent. These responses to environmental factors are partially influenced by genes, but some can also be affected by the duration and severity of the exposure, technological buffers (such as shelter or clothing) and individual behavior, weight and overall body size. The simplest type of acclimatization is a temporary and rapid adjustment to an environmental change. Tanning is a kind of acclimatization.

5) Human genetics is defined as the study of how genetic inheritance takes place in the human species, or how inheritance of various characteristics from parents to kids takes place.

6) Human growth can be divided into six stages according to age. These stages are: (a) Infancy (b) Childhood (c) Juvenile (d) Adolescence (e) Adulthood and (f) Senescence. For the details of stages kindly refer section 3.4.