UNIT 3 PRINCIPLES OF DEVELOPMENT

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3.1 INTRODUCTION

In the earlier Units you have been reading about the experiences of children and some basic concepts in Child Development. You learnt that there are universal patterns in development. Development also follows certain principles that are common for all individuals. In this Unit you will read about these principles. Development is influenced by many factors. These factors can be grouped under the two main heads of heredity and environment. In this Unit you will also read how heredity and environment influence development.

Objectives

After studying this Unit, you will be able to:
• describe the principles of development
• understand the meaning of ‘heredity’ and ‘environment’ and explain how they interact to influence development in all areas

3.2 PRINCIPLES OF DEVELOPMENT

In the second Unit of this Block, you read about certain characteristics of development. Can you recall them? They are as follows: development is orderly, progressive and results in changes that are long lasting. In this Section, you will read about the principles that govern development.

3.2.1 Direction of Development

Physical and motor development follow two directions. One direction is the head-to-toe direction. Development proceeds from the head to the feet. In other words, improvements in structure and functions come first in the head region, then in the trunk, and finally in the leg region. This principle is applicable in the case of prenatal (before birth) as well as postnatal (after birth) development. It has been observed that in the embryo, the head region is the first to develop, followed by the trunk and then the limbs. In fact, at eight weeks after conception, the head comprises half the entire length of the embryo. In the entire prenatal life, head continues to be the fastest growing part of the body. This is not to say that the rest of the body is not developing simultaneously. It is simply that the head is developing faster.

As a matter of fact, in the context of direction of development in general, it is important to point out that when one part of the body is growing rapidly, the other parts are also developing at the same time, but at a slower rate compared to the part which is the focus of growth and development.

Since the head developed fastest in prenatal life, it is obviously more developed than any other part of the body at birth. After birth, the focus of development shifts
downwards to other areas of the body. The focus first becomes the torso, followed by the arms and the legs. This is clear when we look at the growth in size of the different body parts from birth to maturity. While the head only doubles in size between birth and maturity, the lower parts of the body have to do more growing to reach adult size. The torso triples in length, the arms and hands increase in length by about four times, and the legs and feet increase by about five times.

Motor development also follows the head-to-toe direction of development. The muscles of the head region come under control first leading to the control of movements of the eyes and mouth. Then the neck muscles come under control, later the arms and torso and finally the legs. As a result of this, you would have seen that babies learn to hold their head up before they acquire the ability to sit, and they are able to sit before they are able to walk.

The second direction that physical and motor development follow is from the centre of the body to the ends, that is, development proceeds outwards. Figure 3.1 shows the central axis of the body. The body parts and the muscles which are near the axis grow earlier and those which are the farthest are the last to develop. In the prenatal period the head, spinal cord, heart and the trunk which are towards the centre of the body are the first to develop. The arms and the legs, which are away from the axis, develop later. The fingers and toes that are at extreme ends are the last to develop. This principle is also evident in motor coordination. The movement of the arms which the child can control earliest are those which use the shoulder muscles (nearer the centre of the body). Gradually, the child learns to control the muscles of the elbow, then the wrist and last of all the fingers. This will become clear if you observe an infant reaching for an object lying near her. At three months the baby uses her whole arm while reaching for the object. As she grows older she is able to reach for the object by using only the elbow. Similarly, to pick up an object the child initially uses her whole hand. She can

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**Fig. 3.1** : Central axis

**Fig. 3.2** : Centre-to-periphery and head-to-toe directions of development
pick it up using the fingers only at a later stage. This shows that the child uses the muscles of her shoulders, which are close to the centre, before she is able to use the muscles of the fingers which are at the periphery of the body. Similarly, the child is able to control the movements of her legs before she can use the toes. These examples show that the child first achieves the coordination of large muscles (such as shoulders) of the body since they are closer to the axis, before she can coordinate the small muscles (such as fingers and toes) which are towards the periphery. Figure 3.2 illustrates the head-to-toe and centre-to-ends directions of development.

3.2.2 Rate of Development

Individual differences in rate of development: You have read that development of all children follows a particular sequence. For example, in the case of motor development all children will first learn to roll on their backs, then sit, creep, walk, run, climb and so on. Each child's development will pass through these stages. You would also recall reading in the earlier Unit that the ages at which children acquire these abilities are different. One child may begin to walk at nine months and another may do so at 13 months of age. This means that while development follows the same sequence, there are individual differences in the rate of development. Consequently, there are differences in the age when children reach a particular milestone of development or acquire a particular ability. Because of these individual differences in development, some children may recognize and name colours at three years of age while others may do so at five years of age. One girl may start menstruating at 10 years of age and another at 13 years. One boy may grow fast and attain his full height by 12 years while another's growth may be slow and he may achieve his height only by 16 years.

Sex differences in rate of development: There are differences in the rate of development of boys and girls. In prenatal period the skeletal system of girls grows faster as compared to boys. Therefore, at birth girls are ahead of boys in their skeletal development. The period of puberty is about two years earlier for girls than for boys.

3.2.3 Differentiation and Integration

Development follows the principles of differentiation and integration. Let us understand these through the following example. The fertilization of the ovum with the sperm results in a single cell, which is called a zygote. The zygote then starts multiplying at a very fast rate into cells that are all of the same kind. These cells then acquire different characteristics and form different tissues like nerves, bones, blood and so forth, each having a special function. These different tissues subsequently coordinate with each other to form complex systems like the digestive, circulatory and respiratory systems.

When the similar cells of the zygote change to form different tissues like nerves and bones, the process is differentiation. Differentiation means that development proceeds from simple to complex, from general to specific. In the above process, development was seen to proceed from identical cells to complex tissues, each of which had its own specific functions. When different tissues coordinate to form a system, the process is called integration. Integration means coordination of various parts to form an increasingly complex structure. It also refers to coordination of different behaviour patterns that result in a higher level of complexity.

The principles of differentiation and integration can be seen in all areas of development. Let us see how this principle applies to social development. Initially, the infant smiles at all faces. This is because she cannot recognize different people. A little later she learns to differentiate the mother's face from the faces of others and smiles only at her. Gradually the infant recognizes other people who interact with her regularly and smiles only at those people who are familiar to her. Thus she learns to differentiate the faces of people she knows from ones she does not know. She can also differentiate the mother's touch and smell from that of the others. Then she integrates the mother's face, voice, smell and touch and so learns that all these aspects belong to one person.

Cognitive development also proceeds through differentiation and integration. The child first learns to differentiate between more and less. This later helps her to learn the more specific concept of number, that is, understand the meaning of one, two, three and so on. Using these concepts she then integrates them to learn new and complicated concepts of addition, subtraction, division and multiplication.
Similarly, the child learns to walk and as she grows older the walking differentiates into hopping, running, skipping, and so forth. When the child learns to walk, she walks simply for the pleasure of it. Later she walks to take an object from one place to another. Walking thus becomes integrated with the purpose of carrying things from one place to another.

3.2.4 Critical Periods

There are some periods in the life of the child that are crucial for development and learning. During these periods if the child has favourable experiences, her development will be fostered. If in these periods experiences are unfavourable, development suffers. At times, the damage done because of unfavourable experiences may be irreversible. These periods when a child is particularly sensitive to the conditions in her environment are referred to as critical periods or sensitive periods.

A critical or sensitive period is that time period in life when an environmental influence has its greatest impact on the development of the child. During this period, specific experiences affect the development of the child more than they do at other times.

Such periods are critical for development because during these periods the child is ready to learn a particular skill. For example, a child begins to speak only when she is able to control the movements of the tongue, lips and vocal chords and the brain has developed further. That is, the child must be biologically ready to speak. This biological readiness refers to maturation. However, besides being mature the child needs to hear language in order to be able to speak. Therefore, in order to learn speech the child must be biologically ready as well as get opportunities to hear language and speak it. You may have noticed that by and large it is around twelve months of age that the child utters the first word. Before this, though the child understands words, she cannot speak them and no amount of effort will help her speak since she is not biologically mature. But opportunities to hear and practise speech are also important. If she does not have them, she will not be able to speak in spite of being biologically mature. This is clear from the study of deaf children. A child who cannot hear speech will not be able to talk. Thus children who are deaf or hard of hearing in the early years of life do not learn to speak unless efforts are made to enable them to hear language, for instance through hearing aids. It is observed that children generally have a readiness to distinguish sounds and thus learn speech in the early years of life. The first few years are thus considered critical for acquiring language.

You would have understood that a critical period is one when the child is maturationally ready to acquire a skill. During this period the child must have favourable experiences (in the above example, opportunities to hear and practise speech), which will help her to acquire the skill. If the favourable experiences come after the critical period is over, the child finds it difficult to learn.

There are critical periods in prenatal development as well. It has been observed that the first three months of pregnancy are by and large critical for most body systems and exposure to harmful environmental factors during these months can cause major developmental defects. The first three months of pregnancy correspond to the embryonic and early foetal periods of prenatal development. It is during this time that cell differentiation, tissue specialization and organ formation is taking place. As a result, most of the harmful environmental elements have maximum impact on the unborn child during this period. In subsequent months, the foetus is less susceptible and vulnerable to environmental influences. Let us consider an example. German measles may cause blindness, deafness, heart defects, brain damage or limb deformity in a child developing in the mother's womb, depending upon the particular time in the developmental sequence when the mother contracts the disease. While considerable damage is caused in the first three months of pregnancy, the disease does not harm the foetus in any significant way if the mother contracts it in later months of pregnancy. Thus in this particular example, unfavourable conditions had an impact only during the period critical for development.

Critical periods are observed in social and emotional development also. The infant forms her first relationship with the caregiver, who is usually the mother, during the first six
months of life. Research shows that the child can form this relationship only if the caregiver is loving and nurturant. Children who are unable to form an emotional attachment during the first six months show distress. They cry more, are fearful, do not respond to people and withdraw from social contact. If this neglect of the child continues, she may find it difficult to form strong relationships later in life. Thus the first six months are critical for social development.

Though you have been reading that critical periods are the best time for learning, you must remember that they are not the only time for learning. Human beings are very resilient and a child can learn after a critical period is over, though with some difficulty. In one particular case a six-and-a-half year old girl had been isolated with her mute mother from the time of her birth. The girl could not speak. She was then given special instruction. Gradually she learnt to speak and at 14 years of age she appeared to be normal. According to recent research, in fact the brain is particularly capable of learning language till one reaches puberty.

Similarly, that children can recover from unfavourable emotional experiences is seen from the experiences of children who were deprived of a loving caregiver in the first six months of life. Though these children started showing the symptoms described above, when they were provided a loving environment after this period, they recovered. Most of their symptoms disappeared and they learnt to relate to people and form relationships.

Check Your Progress Exercise 1

1) Match the items given in column 1 with those in column 2.

<table>
<thead>
<tr>
<th>COLUMN 1</th>
<th>COLUMN 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Head-to-toe development</td>
<td>i) the child initially uses the whole arm to reach for an object. Gradually she learns to use muscles of the wrist and fingers to pick up an object.</td>
</tr>
<tr>
<td>b) Centre-to-ends development</td>
<td>ii) first the child learns to control the movements of the neck and later develops the coordination of lower limbs because of which she learns to crawl and walk.</td>
</tr>
<tr>
<td>c) Differentiation</td>
<td>iii) the understanding of numbers leads to learning of more complex concepts like addition and subtraction.</td>
</tr>
<tr>
<td>d) Integration</td>
<td>iv) the child learns to recognize the mother’s voice from other people’s voices.</td>
</tr>
</tbody>
</table>

2) Fill in the blanks in the following sentences with appropriate words.

a) The rate of development of the various parts of the body is .........................

b) There are ......................... in the rate of development of boys and girls.

c) There are ......................... in the ages at which children reach a particular milestone of development.

3) Read the following statements carefully. Write whether they are true or false in the space provided after each statement.

a) Maturation refers to the biological readiness to perform a task or learn a skill. ( )

b) Both biological readiness and experiences and opportunities to practise are essential for any learning or development. ( )

c) Critical periods are the only times for learning particular skills. ( )
3.3 INFLUENCES ON DEVELOPMENT

You have read in the earlier subsection on critical periods that development and learning take place when the child is mature or ready to learn and when opportunities for learning are available. The biological readiness or maturation is mainly determined by heredity. The child also inherits many other traits and characteristics. Heredity is one factor that influences development. The other factors are the experiences of the child and opportunities available to her. These are determined by the child’s environment. Development and learning are the result of interaction between heredity and environment. Let us now read what is meant by these two terms.

Environment refers to the external conditions that influence development. We can consider environment as prenatal and postnatal. The prenatal environment is the mother’s womb. The foetus is affected by the kind and amount of food the mother eats, physical work done by her, illnesses she may have during pregnancy and drugs consumed by her. The mother’s feelings and emotions will also affect the foetus.

After birth the environment influences the development of the child in many ways. We refer to this as the postnatal environment. The postnatal environment can be divided into physical and social influences. Physical environment refers to the ecological conditions: the type of food eaten, the occupation of the people, the amount of living space, the surroundings, facilities (hospitals, electricity, water, etc.) and media (television, radio, newspapers, etc.). Social environment refers to the settings in which the child has interactions with other people. The interaction is influenced by size and type of family, gender, culture, religion and social class. Environment provides the experiences to the child.

Heredity refers to the inborn traits and characteristics. These characteristics are transmitted to the child from the parents. The colour of one’s hair, skin and eyes, the shape of one’s nose and the body structure are determined by heredity. A person’s mental capacity and some personality traits are also determined by heredity to a certain extent. Genes transmit the hereditary characteristics from parents to children. They carry the codes of the biological development of an individual. The maturation of different parts of the body is also determined by genes. At what stage in life a particular organ/system matures is determined by genes. Some genes are common to all human beings such as for two arms, two legs, a heart, a digestive system, and a code for the pattern of development. These genes make human beings different from a tree or a horse.

However, the length of the arms and legs, the size of fingers and toes, colour of eyes, hair, skin etc. are unique for every individual. This makes each person different from every other. No two people have an identical set of genes except in the case of identical twins. Identical twins are two babies born from the division of a single zygote. Some time two ova are fertilized by two sperms at the same time, which results in two zygotes and the twins are called fraternal twins. Each of these twins has different genetic material because they result from the fusion of a separate ovum and sperm.

Let us now understand the complex roles of heredity and environment in human development. There have been many views concerning the relative influence of heredity and environment on development. At one time environment was regarded to be playing a greater role than heredity. At another time the role of heredity was considered greater than that of environment. Neither view is now central. The issue is not whether it is heredity or environment that influences development, neither is it how much of the development is to be attributed solely to heredity or environment. Both heredity and environment interact to influence various aspects of development. It is not easy to separate the effects of the two since interaction between them is continuous and complex.

In the case of physical development, characteristics like height, weight, rate of growth, physical features, blood pressure and heart beat are to a large extent determined by genes. However, environment does have an effect on these. For example, if one of the identical twins suffers from a severe infection at an early age and is seriously ill for a long time, it is most likely that she will not have the same gain in weight and height as the healthy twin. This may result in the sick twin being shorter and lighter than the healthy twin in spite of the fact that both had the same genes for height and weight.
In relation to motor development you have read that a child needs to be biologically ready or mature to learn motor skills. A child's muscles, bones and nerves must be developed to a certain level to allow walking. Thus acquiring of motor skills is greatly determined by maturation. Further evidence for this is obtained when you read that motor development follows a universal pattern and sequence. This shows the role of genes. However, the role of environment cannot be ruled out. The environment provides opportunities for practice which is very essential for acquiring motor skills. A child will learn to ride a cycle only if she gets the opportunity to do so. The interaction between heredity and environment is continuous.

Studies have been done to understand the interaction of heredity and environment on cognitive development. In one particular study infants living in orphanages were observed. In these institutions one caregiver looked after many children. She, therefore, did not have enough time to talk to or play with the children. The cognitive development of these children was found to be below the norms for their age. Subsequently, thirteen of these children were put in the care of women in an institution where they got nurture, care and attention. These women had time to play with them. After a period of two years all the thirteen children showed an increase in their cognitive functioning compared to children who had remained in the orphanage. After twenty years it was found that all thirteen children were economically independent. The children who had stayed continuously in the orphanage were still dependent on adult help and institutional care. This study illustrates the role of a nurturing and stimulating environment in cognitive development.

Intelligence is influenced by genes as well. A certain genetic abnormality results in the absence of a gene because of which a particular enzyme is not produced in the body. Due to the lack of this enzyme, toxic substances get accumulated in the body. These toxic chemicals affect the nervous system and may cause mental retardation. But environment has a role to play here also. If the condition is identified early and the needed treatment is given, in general the harm to the nervous system can be controlled and the child will not be mentally retarded. Heredity provides a certain potential for intelligence and the environment determines how much of the individual’s potential is realized.

The interaction of heredity and environment can be observed in language development also. Children who are born deaf do not learn to speak in the normal course of life. But it has been observed that the infant did babble in the early months but the frequency of babbling decreased because she could not hear the response of the caregivers. Thus she had no feedback regarding the sounds she was producing and failed to develop speech. If the problem is detected early and hearing aids provided, the child can learn to speak and gradually catch up with others of her age.

How do heredity and environment influence the behaviour and personality of an individual? You have read that the height of a person is determined by heredity to a large extent. One’s height can influence one’s self-image. If a person is less than the average height she may feel self-conscious or inadequate, which may interfere with her social interactions. From the earlier Units you will remember that environment determines the type of experiences the child has. These experiences will also influence the child’s personality development.

One cannot say that personality is directly influenced by heredity. Genes do not directly produce anger, likes and dislikes, jealousy, a love of fun or a serious nature. Genes may act on the physiology of an individual which leads to the development of certain personality characteristics. For example, the level of activity of a child seems to be determined by heredity. Studies also reveal that children who are active at birth may start walking earlier and they continue to be more active than other children. This may influence development in other areas and specific aspects of the personality.

The genetic make-up of an individual may also account for certain emotional disturbances. It has been observed that children whose parents are suffering from an emotional disturbance are more likely to have an emotional problem. In the case of identical twins, if one twin develops a problem the chances are that the other will also develop it. It can not be said that the child inherits the emotional disturbance itself. What is actually inherited is the level of stress a person can tolerate. Whether the disturbance is manifested or not will depend on the experiences of the child. If the environment is stressful, the child is likely to be emotionally disturbed. In a favourable setting the child can be normal despite a genetic predisposition to emotional problems.
From the above discussion one can conclude that heredity and environment interact in all areas of development. Heredity sets the limits to what a person can achieve and environment determines how much of this potential is realized. In no case can we say that development is a consequence of only heredity or only environment. It is a result of the interaction between the two. The different genetic material that each one of us inherits and the varied experiences we have account for the differences among us.

Check Your Progress Exercise 2

1) The following figure includes the factors that influence development. Complete the blanks in the figure.

Factors influencing development

Heredity  Environment

Prenatal environment  Physical environment

2) Fill in the blanks in the sentences given below with appropriate words.

a) Environment refers to the .................... conditions that influence development.

b) .......................... are transmitted from the parents to the children.

c) No two individuals have the .................... genetic material except in the case of .................... twins.

d) Heredity and environment .................... to influence all areas of development.

3.4 SUMMING UP

In this Unit you read about the principles of development. The direction of physical and motor development is governed by two principles. These are; that development proceeds from head-to-toe and centre-to-ends. The rates of development of the various parts of the body at any one period of life are different. Though there is a universal pattern in development, there are differences in the pace at which every individual develops. There are sex differences as well in the aspects of development. Development follows the principle of differentiation and integration. Differentiation means that development proceeds from simple to complex, from general to specific. Integration means coordination of various parts to form an increasingly complex structure. It also refers to coordination of different behaviour patterns that result in a higher level of complexity. Both processes are involved in growth and development.

In the course of development there are some periods when the child is mature, i.e., biologically ready, to learn a particular skill. At this time it is important that the child has the appropriate experience so that learning takes place. These periods are referred to as critical periods. Critical periods are the best time periods to learn. However, even after the critical period, learning can take place but it requires more effort. It may at times be impossible to learn a skill after the critical period is over.

You have also learnt that environment and heredity are the two factors that influence development. Environment can be categorized as prenatal and postnatal. Postnatal environment includes physical settings and social experiences. Heredity refers to the traits and characteristics that the child is born with. These are transmitted from the parents to the children through genes. Human development is a result of the interaction between heredity and environment.
3.5 GLOSSARY

Self-Image: One's views about one's personality. It includes what one feels, thinks and imagines about oneself. One may think oneself to be a person who is friendly, outgoing or shy, intelligent, brave, serious natured, immature in dealing with people, straightforward, one who speaks too much, etc.

Milestones of Development: Significant behaviours which are used to mark the progress of development. Walking is a milestone in motor development; understanding that things are present somewhere even if not visible is a milestone in cognitive development and learning to recognize the mother in social development, etc.

Periphery: External boundary.

Resilient: Capable of recovering from hardship.

Torso: The human body without the head and limbs.

Creeping: Moving on hands and knees with the abdomen raised from the surface.

3.6 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) a) ii  
   b) i  
   c) iv  
   d) iii

2) a) different  
   b) differences  
   c) individual differences

3) a) True  
   b) True  
   c) False. Critical periods are the best times for learning particular skills.

Check Your Progress Exercise 2

1) Factors influencing development

   Heredity
     
     genes

   environment
     
     Prenatal environment
     Postnatal environment

     Physical environment
     Social environment

2) a) external  
   b) Genes  
   c) same, identical  
   d) interact