Annexure-I

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
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KARNATAKA STATE OPEN UNIVERSITY
MUKTHAGANGOTRI, MYSURU - 570 006

I Semester - M.A in Education

MEDHC-1.3
PSYCHOLOGY OF EDUCATION

Department of Studies and Research in Education

BLOCK-1 FOUNDATIONS OF BEHAVIOUR

KARNATAKA STATE OPEN UNIVERSITY

Mukthagangothri, Mysuru - 570006

Department of Studies in Education

I Semester- M.A in Education

MEDHC 1.3 PSYCHOLOGY OF EDUCATION

BLOCK-1 FOUNDATIONS OF BEHAVIOUR

Credit Page

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Block- 1

FOUNDATIONS OF BEHAVIOUR

Block Introduction:

What is the subject matter of psychology? It is the study of behaviour in which different behaviours are studied and how they are studied? What are the determinants of behaviour? etc. are the questions that may come to your mind. You will find the answers to such questions in this block.

This block consists of four units i.e. one to four. Meaning and definitions of psychology, branches of psychology and methods of psychology, meaning, scope and importance of educational psychology are dealt in the first unit of this block.

You already know that parents transmit some of their characteristics to their off springs. You will study about heredity mechanism, basics of heredity and implications of heredity in unit -2 of this block.

How is the behaviour of a child determined, controlled or modified? The system in human beings which is responsible for this function is the brain, technically known as central nervous system(CNS). You are familiar that a network of nerves starts from the brain and spreads throughout our body. This part is technically known as peripheral nervous system. You will learn about the basic nature, characteristics and functions of central nervous system in unit-3.

There are many chemicals within the human body which influence behaviour in very subtle manner. In fact, there is a bio-chemical environment which plays a vital role not only in the physiological functions but also in determining behaviour. You will study about endocrine glands, enzymes and vitamins, pre-natal and post-natal environment and their importance in unit-4.

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UNIT –1 EDUCATIONAL PSYCHOLOGY

Structure

1.0 OBJECTIVES

After studying this unit, you will be able to

- State the meaning of psychology.
- Define psychology.
- Explain about different branches of psychology.
- Describe different methods of psychology.
- Explain the meaning and scope of educational psychology.
- Bring out the importance of educational psychology.

1.1 INTRODUCTION

Most of us use the term psychology in our day to day conversation. The term psychology is quite familiar to many of you. We come across several people in life. These people do not behave in the same way in similar or same situation/s. Some are quiet, some are very active, some are talkative, some appear lively and cheerful etc. Psychology attempts to study how human beings behave. Different people behave differently with other people. For example, in the same family, brothers and sisters might vary in their behaviour. Each person is unique. Though they are born to the same parents each one has some uniqueness.

Human activities or behaviours have two dimensions- the external and the internal. The external activities are observable but the internal activities, which are related to the inner self, are not directly observable. Human beings constantly react with the environment surrounding them and gain experiences. These reactions also differ with respect to individuals. Individuals think, learn, remember, forget, understand, infer etc. All these are mental processes. All these aspects are studied under psychology. Psychology is such a subject, which has emerged as an independent discipline in recent years. It is interested in why and what of human behaviour. Earlier psychology was the branch of philosophy and used to study the human inner self. Later it emerged as an independent discipline. Today you can observe that psychology has developed into a vast subject with various branches.

In this unit you are going to study about the meaning, branches and methods of psychology. You will also study the meaning, scope and importance of educational psychology.

1.2 MEANING AND DEFINITIONS OF PSYCHOLOGY

Man has always evinced curiosity to understand the dynamics of human mind. Human mind is the mainspring of all progress of mankind. From primitive days to today's modern days, this basic urge to search one's self has led to a steady growth and development of the discipline called psychology. It has its roots in the mother discipline called philosophy. Psychology got separated from philosophy and has grown and advanced as an independent discipline. In just about a century psychology has grown by leaps and bounds and given rise to numerous branches and fields of application.

Whoever chooses to enter the teaching profession ought to be familiar with the subject and also with the subjects (students) to whom they have to teach. Study of psychology is doubly beneficial as it not only helps one to understand pupils but also to analyse one's own behaviour and self and perhaps improve oneself as well. Now let us study the meaning and definitions of psychology.

As mentioned earlier, psychology remained a part of philosophy for a long time. When it was the branch of philosophy it was defined as the study of 'Soul'. The term psychology, originally a Greek term, literally means 'science of soul'. 'Psyche' is a Greek word meaning 'Soul' or 'Atman' and 'Logos' means 'Science' or study. It was believed that every human being is endowed with a soul and that remains uncontaminated at all times. To a philosopher soul is the firm foundation upon which ethical values are erected and the realisation of one's soul was considered the chief mission of life.

Several questions such as 'Where is the soul?', 'How does it look like?', 'Does everyone has a soul?', 'Is soul blemish less?', 'Does soul has a physical entity or is it purely an abstraction – a kind of imagination?' etc. were raised. Definition of psychology as the study of soul became unacceptable primarily because no convincing proof or evidence of precise nature of soul was furnished by philosophers. It was discarded because of its meta physical nature. It was found inadequate to satisfy the canons of science. Hence psychology as a study of soul was given up. Then psychology came to be redefined as the study of mind. The concern was about mental phenomena – the structure, content and functioning of mind. Critics then raised questions on the nature and location of the mind. Nobody could give clear and specific answer to the question like 'what is mind?'. After all mind is only a construct inferred from certain phenomena, not an actual entity. Failure to clearly define and / or locate the mind compelled psychologists to revive their concern as internal non-biological phenomena – experiences. Hence psychology as a study of mind was rejected. People have experiences only when they are conscious of them in some way. So, psychology came to be defined as the study of consciousness. Consciousness means awareness or aware of what one does or feels. Every living organism is 'conscious' of the surrounding environment and responsive. Three primary states of consciousness were identified – knowing, feeling and willing (cognition, affect and conation). To analyse the state and process of consciousness psychologists depended on introspection. Introspection is nothing but looking within oneself and reporting by the subjects. Even psycho – physical phenomena, were studied partly through such methods. This connotation was severely criticized as human mind includes not only the conscious part but also sub-conscious and unconscious part. Then physics type experiments came into practice. Psychological laboratories were established. First psychology laboratory was established at Leipzig, Germany by Wilhelm Wundt and later on in several other places. With these developments, psychologists started claiming psychology to be accepted as a science. Science had and even now has high prestige and scientific methods have enjoyed acceptance as valid and valuable. So, Watson and many others insisted that psychology as a science should be concerned about and study only that which was observable. What was observable was behaviour. So, early in the twentieth century they redefined psychology as the science of behaviour. Behaviour is something visible, tangible, verifiable and was not objectionable to most of the psychologists. Study of animal behaviour

was also included in the definition of psychology and defined as the 'study of human and animal behaviour'. Behaviour includes both overt and covert behaviour. Asked about the thinking behaviour, Watson explained and almost proved thinking as silent speech. Watson brought even certain internal phenomena under the concept of behaviour – to make it legitimate subject matter of Behaviourist Psychology.

Regarding the meaning of the term behaviour, Woodworth said "Any manifestation of life is activity and behaviour is a collective name for these activities. Therefore, the term behaviour includes not only motor (conative or psychomotor) activities like walking, swimming, dancing etc., but also cognitive activities like thinking, reasoning, imagining and affective activities like feeling happy, sad, angry, jealous, sorrow etc. Along with the conscious behaviour and activities of the human mind, it includes the sub – conscious and unconscious behaviours also. It includes overt behaviours (behaviours which can be seen from outside) as well as covert behaviours (behaviours which cannot be seen from outside) involving all the inner experiences and mental processes. The behaviour of the animals, birds are also included in the subject of psychology. It also covers the behaviour of the normal human beings as well as abnormal individuals and of children and adults also, J.B. Watson defined behaviour as an action which can be seen and observed in an objective way. Behaviour can be observed and also measured.

As R.S.Woodworth has rightly said 'first psychology lost its soul. Then it lost its mind. Then it lost its consciousness. It still has behaviour of a sort'.

Definitions of Psychology

The term psychology is defined by many psychologists. Let us consider few definitions to get the clear idea about the nature of psychology.

According to William Mc Dougall, 'Psychology is the positive science of conduct of living creatures'.

In the year 1913 J.B. Watson the father of the behaviouristic school defined psychology as the 'positive science of behaviour' (taking into account the human as well as animal behaviour).

According to Skinner, 'psychology is the science of behaviour and experience'.

Feldman defined, 'psychology as the scientific study of behaviour and mental processes.

Jackson defined, 'psychology as the investigation of human and animal behaviour and of the mental and physiological processes associated with behaviour'.

1.3 BRANCHES OF PSYCHOLOGY

Psychology after defined as the study of human and animal behaviour, grew and developed and gave birth to several branches. Each branch extended its growth in several directions. Branches of psychology can be divided into two broad categories, namely pure and applied psychology. Pure psychology adopts its own principles, theories and strategies to study behaviour. Applied psychology applies the psychological rules, principles, theories and

techniques with reference to real – life situations. It suggests various methods and techniques and principles for analysis, assessment, modification and improvement of behaviour.

In applied psychology the theories and principles generated in pure psychology find their practical shape and use.

1. **General Psychology:** It deals with the behaviour of normal individuals. It is concerned with the fundamental rules, principles and theories of psychology in relation to the study of behaviour. It studies all the aspects of normal individuals. It comprises of individuals' heredity and environment, nervous system, sensations, perceptions, feelings, emotions, intelligence, attitude, aptitude, interest, remembering, thinking, problem solving, personality, mental health etc. Each branch extended its growth in several directions.

2. **Abnormal Psychology:** It is a branch of psychology which describes and explains the behaviour of the abnormal individuals. It is concerned with the behaviour of the abnormal individuals such as criminals, antisocial, delinquents, insane etc. Abnormal psychology is also called psychopathology. Various abnormalities of the human mind are dealt in detail. Abnormalities could be in major (severe) or minor (mild) form. Minor ones are termed as neurotic disorders and major ones are termed as psychotic disorders. This branch is intimately linked with the field of medicine. One who has undergone the basic course in medicine i.e. M.B.B.S later takes up post-graduation i.e. M.D. in psychiatry. They are called psychiatrists. Psychiatrist is a specialist related to the pathological conditions of the human brain. A non-medical person who is specialised in clinical psychology after his/her degree or post-graduation in psychology and who treats the mentally sick is called psycho therapist.

3. **Comparative Psychology or Animal Psychology:** It is the study of comparison of the behaviours of different animal species. It is the natural history of animal conduct. Study of animal behaviours is useful to understand the behaviour of human beings to some extent. Modern studies in psychology have shown that there are many common areas between man's and animal's behaviour. In spite of differences between man and animal the data collected on the animal behaviour are found to be useful to understand the human behaviour at its simplest levels. Results obtained from animal studies are applied to understand the human behaviour. Psychological studies conducted on animals in the laboratory have led to the formation of several theories. This branch of psychology has contributed to the development of scientific laboratory experiments and techniques to study psychological problems.

   Much of the productive experimental work on "learning" has been done with animals as the subjects. The fundamental process of learning can be seen more clearly from animal experiments and applied to human beings. Comparative psychology is a specialised branch of study and has contributed a great deal to the advancement of psychology as a science.

4. **Developmental Psychology:** It is the study of behavioural changes which accompany changes in age. This branch is exclusively concerned with the development of the

human organism from its birth, leading to stages such as infancy, childhood, adolescence and adulthood. Otherwise it is concerned with the developmental behaviour of the individuals from conception to death. Since behaviour and abilities change most rapidly during the first few years of life. Child Psychology is used as synonym for great deal of developmental psychology. Behavioural changes with old age (senescence) are also studied by developmental psychologists. Basic factors such as growth, development, maturation and learning are also studied in depth. The social, emotional, mental and physical changes during developmental stages are identified. This resulted in the framing of developmental norms and developmental tasks appropriate for each stage of development. A great deal of research has been done on the mental development and systematic changes taking place in the nature of thought in children as they grow older.

5. **Social Psychology:** We all belong to different kinds of groups, like our family, our social class, our professional group etc. Every society whether it is eastern or western has a culture, tradition, religions etc. A group of people constitute a society. We find cultural variations in society. We find several cultural groups with distinct patterns of behaviour of societies. Each individual is influenced by the society in every walk of life. Social psychology studies the behaviour of the individuals in different groups. It also studies the relation of groups to one another. Primary interest of the social psychologists is always the individual behaviour which is influenced by group membership. It is also concerned with the socialisation of the individual, intergroup and intragroup relationship, propaganda, public opinion, attitude, attitude change, prejudices, social problems etc. It is the study of the behaviour of the individual in a group and the relations of groups to one another. Social psychology deals with the group dynamics, likes and dislikes, interests, attitudes and prejudices of the people. It also deals with the social evils like unemployment, beggary, poverty, robbery, crimes etc.

6. **Industrial Psychology:** It is originated sometime around 1910 in Great Briton. It is concerned with the selection of appropriate workers for jobs (right person for right job), to arrange suitable working conditions, to minimise fatigue and maximise product or output, to harmonise the relation between labour and management and administering aptitude tests to the applicants to select the suitable potential candidate for the job. Further intelligence tests and personality tests were also used in the selection process. Selection is usually followed by training. Psychologists will design the appropriate training programs and evaluate the effectiveness of the training. Industrial psychology is concerned with not only selection but also training, placement, promotion, working climate etc. Industrial psychologists help to maintain the motivation of the workers. Industrial psychologists work to improve the growth of the industry and healthy attitudes. It is concerned with the industrial accidents, absenteeism and strikes. Harmonious human relations, proper labour and management relationship, leadership in organisation and human resource development are the key factors of industrial psychology.

7. **Advertising Psychology:** Whatever is produced in an industry must be sold to public. Advertising in itself is a big industry. Psychological principles are used in advertising and marketing. The mode of advertising, the media chosen, the frequency etc are decided by the psychologists. Advertising psychology is closely linked with consumer psychology and consumer psychology attempts to understand and predict human behaviours in the selling, buying process. It describes the characteristics of a seller as well as buyer.

8. **Clinical Psychology:** It deals with the symptoms, causes, diagnosis and treatment of the psychological disorders of the individuals. The Psychological disorders are treated by the psychotherapists or psychiatrists.

9. **Environmental Psychology:** It is concerned with the environmental perception, cognition and attitudes, changing attitudes toward the environment, natural disasters, noise pollution etc. Effects of different types of pollutions, effect of population density, changing the attitude to save the environment are the key factors of environmental psychology. Different ways and methods are suggested by environmental psychologists to save the environment.

10. **Military Psychology:** It deals with the proper selection of people for army or military. It was during the first world war, psychologists used Army Alpha test and Army Beta tests of intelligence to select proper individuals for the army. Psychologists have developed a number of situation tests to assess the capabilities of candidates to take quick spot decisions in times of emergency. Those serving in the border security force may have to stay for months away from plains and normal social life. Psychologists would assess the mental strength of candidates to withstand this isolation. They are also helped in rehabilitation.

Apart from these branches there are other branches which represent specialisation with detailed studies. They are para – psychology dealing with unusual psychic phenomena - Rebirth, sixth sense etc., physiological psychology concerned with the biological bases and dimensions of psychology, personality psychology deals with the development, structure, functioning etc of personality, differential psychology is concerned with the explaining individual differences, etc.

1.4 METHODS OF PSYCHOLOGY

You know that psychology is considered as a positive science of behaviour. It is concerned with studying the behaviour through scientific investigations. Human beings are curious and explorative. Unlike birds and animals, human beings are endowed capabilities of responding to environmental stimulations. Unless we observe carefully and select and make decisions, our behaviour would be erratic and unproductive. As you observe others you also reflect upon what you see and hear and arrive at some kind of judgement.

Psychology has suggested various methods to study behaviour of individuals in a scientific way. Methods used for the study are influenced by various factors such as nature of problem, aim and resourcefulness of the person using that method etc. To study the behaviour of the individuals scientifically psychology has given us many methods, some of them are

introspection, observation, experimental, case study, survey method etc. In this sub-section you are going to study about these methods.

Introspection Method

In the earlier days when psychology was the branch of philosophy, the study of the mind or consciousness was carried out by introspection. Introspection was the only method that was known to the early psychologists. It continued to be used as a reliable method till psychology came to be recognised as the science of behaviour.

Introspection was developed by structuralists. Introspection is composed of two words 'intro' and 'spection'.'Intro' means within or inward and 'spection' means 'looking'. Hence 'introspection' means 'looking within' or 'looking inward'. That is introspection means looking within oneself in order to examine one's own thoughts and feelings. It is like self-observation. To introspect subjects were supposed to look at their conscious experiences as objectively as possible and report their experiences. The subjects were required not only to report their sensations, perceptions, feelings, thoughts etc. but sometimes even to classify them and/or describe them in qualitative terms. This implied interpretation and judgement. As psychology sought to establish itself into a science, introspection became questionable and unacceptable. So, it was discarded. Still introspection in the modified form of 'self-reporting' has been employed all along. Inventories of interests, attitudes, values, adjustment, personality etc demands subjects to say somethings about themselves. They are supposed to present or reflect factual information - but as they see it, feel about it, and so on.

You know that one is said to introspect when one looks into one's own inner experiences and reports what one finds to be taking place in one's mind. This requires a higher order mental development as one has to concentrate completely on one's inner experiences. Let us consider an example when a person becomes angry many changes take place in the individual such as his/her face turns red, eyes become red, he/she begins to tremble. Along with these changes, there will be some change in the mental state also. The person himself/herself can only introspect these mental characteristics or changes that took place during anger and report how it has started and in what way it reached the maximum state and how it was reduced etc.

British psychologists Edward B.Titchener was the founder of this method 'introspection'. According to Titchener "it is not possible to study the invisible behaviour of the individual but it can be made possible only by the method of introspection".

Merits or Advantages

1) This method is very simple and requires no equipment or apparatus.
2) It can be applied or used anywhere or at any time and only our consciousness is required.
3) It helps in comparing the reactions of different people on the same phenomena.
4) It helps in improving oneself as one can look into his own actions and thus able to know his limitations.

5) It is a unique method to study the mental processes.

Limitations or Demerits

1) It cannot be applied in the case of animals, children, defective and abnormal persons.
2) This method is subjective and can reveal to us the mental processes of a single individuals only.
3) This method is unreliable because it is difficult to remember the mental processes. There is no way or tool or technique to test the reliability and appropriateness of the data.
4) Mental processes change so rapidly that the individuals fail to record them. Anger or any other behaviour is lost if the individual starts recording them.
5) For practicing introspection, one needs a proper training. A layman with less vocabulary cannot provide proper introspective report.
6) Two introspective reports given by the persons on the same experience or task, under the same conditions will not be same because they are given by two different persons.

Observation Method

Observation is one of the oldest techniques that man has made use of. Even today it is commonly used in many studies and in many fields as a method. With the development of psychology as the study of behaviour, the method of introspection was replaced by careful observation of human and animal behaviour. Observation is the basis of all sciences. Observation is not a haphazard, casual act of looking at things while looking around. During causal observation, you may not be all that serious or purposeful. You may not have clear-cut goal. You may not focus your attention. On the other hand, while you are observing you are more careful, systematic and goal directed.

Observation means critically looking at the external behaviour with a purpose and a plan. In the field of psychology observation is concerned with the perception of the individual's external behaviour by other individuals and interpretation and analysis of the perceived behaviour by them. It is believed that by the observation of the external behaviour of the individuals, we can infer their mental processes. For example, if a person frowns, grinds his teeth, closes his fists etc., by observing the external behaviour we can infer that the person is angry. If you visit a class and observe the children in the presence of the teacher and also in the absence of the teacher, you will observe the change in the behaviour of the students.

Observation method is very useful in studying the behaviour of children, in studying the effect of heredity and environment on the personality of the children, in studying the behaviour of the deprived children, juvenile delinquents etc.

You know that all observations have to be purposeful. In other words, the observer must be clear as to what kinds of behaviour or changes he is looking for and also where and how he can observe them. Observer should also have plans for noting and recording all those need to be observed. What is to be observed must be clearly defined and understood in terms

of behaviour or other observable features. One may note the facts and then record the events with the aids of modern technology. Then observe and analyse the recordings later, at convenience, noting all the relevant points. Observation schedules or proformas may be used.

Based on the nature of observation, it is classified as follows.

1) **Natural Observation:** In natural observation observer observes the specific behaviour of individuals in natural settings. Subjects do not become conscious of the fact that their behaviour is being observed by someone. The teacher can observe the behaviour of the students on the playground, in the classroom, while moving from one place to another etc. There the observer takes such a position as he/she is able to observe in detail the behaviour of the individual under observation.
2) **Participant Observation:** In this observation, observer becomes the part of the group which he wants to observe. Observer establishes perfect rapport with the group which he has to observe, so that they do not become conscious of the presence and may not hide their actual behaviour. Here the observer plays a double role.
3) **Controlled Observation:** In controlled observation some of the conditions are controlled and observation is under taken. That observation is done under controlled conditions.
4) **Structured Observation:** It starts with relatively specific formulations or objectives. The observer in advance sets up and decides the things to be observed.

Merits/Advantages of Observation

1. It is helpful in studying the developmental behaviour of the children.
2. It is efficient method as it allows the verification of observed facts.
3. It is useful in studying the behaviour of abnormal individuals and animals.
4. It is useful in studying the personality characteristics, habits interests of the children.
5. Based on the results of observation, suitable guidance can be provided, to the students.

Limitations/Demerits of Observation

1) To get the appropriate data one needs a training for observation.
2) Observation is useful only for collecting data about overt behaviour. This overt behaviour may not always provide reliable information regarding the internal mental processes. We can only guess or infer about the mental state of the individual on the basis of overt behaviour which may or may not be true.
3) People may hide their actual behaviour and exhibit some other behaviour. So that observed data may not be reliable.
4) Subjectivity is another limitation of observation. One interprets others' behaviour on the basis of one's own feelings, thoughts and tendencies.

5) Bias and prejudice also affect our behaviour. We seldom find fault with our beloved ones or affectionate or favourites, while we always find fault with our unfavourites or enemies. Unfavourites or enemies are always the victims of suspicion and doubt.

6) It is a lengthy process. It needs long time observation or many days' observation to draw some conclusions.

7) Observation does not include a vast range of sub-conscious, pre-conscious and unconscious levels of mind.

Suggestions for Improvement

Improvements can be brought in the method of observation to make it more objective and reliable. They are.

1) **Use of Mechanical Devices:** Use of mechanical devices such as camera, tape recorder, VCR etc., can help to improve the reliability of observation. Use of a system of notation or short hand may be used for recording purposes.

2) **Definite Objectives:** The investigator must in advance specify the objectives of the observation in clear and definite terms. A detailed analysis should be made of the behavioural characteristics which are to be observed.

3) **Schedule:** The investigator must decide the time and hour of observation and the schedule should be honestly followed. A detailed schedule in the form of questions or statements should be prepared in advance to note down the observations. The method of recording observations should be made clear.

4) **Training:** Observation is not a haphazard activity. It is a systematic and scientific method which requires skills, competencies, aptitude and proper training for observation is essential for carrying out the proper observation. Observer should be trained to counter act his emotional and intellectual biases in order to report accurate observation.

5) **Precise:** Observation report should be precise, concrete and unambiguous. If two observers observe the same individual in same situation with same objective, their recording or report, should not differ.

Experimental Method

This method is the most scientific and objective method of studying behaviour of individuals and animals. This method is the most dependable method of research. It involves accurate observation, collection of pertinent data, formulation of hypotheses and testing of hypotheses and developing tentative theories under controlled conditions. Actually, it is this method which is responsible for assigning the status of science to psychology. The experimental method is generally considered as the most sophisticated research method for testing the hypotheses.

This word experiment comes from the Latin word 'experimental', which means 'to try' or 'put to test'. In experimentation 'we try' or 'put to test' the material, characteristics or

consequences of which we wish to ascertain. In psychology we perform experiments to study the cause and effect relationship regarding the nature human behaviour.

The experimental method is considered to be the method of excellence for use in certain areas of educational psychology. It is the most precise, planned, systematic and objective method.

According to W.S. Manroe and M.D. Engelthart "Experimentation is the name given to the type of educational research in which the investigator controls the educative factors to which a group of children is subjected during the period of inequity and observes the resulting achievement".

S.W. Best describes 'experimental research as the description and analysis of what will be or what will occur, under carefully controlled conditions'.

According to Festinger 'the essence of an experiment may be described as observing the effect on a dependent variable on the manipulation of an independent variable'.

Experimental method is considered 'as a systematic observation of controlled conditions to find out the effect of independent variable upon dependent variable' {variable means liable to change}.

Here the emphasis is on experimentation. Experimentation is objective observation of actions or behaviours performed under pre-arranged or rigidly controlled conditions.

In an educational experiment a researcher systematically 'manipulates variable' in order to describe and discover the relationship between independent and dependent variable. In experiments you could control the conditions. For instance, if you wish to know the effect of distraction upon performance you could assign the students some work in a quiet place and assign similar work to similar students in a noisy place. The latter condition would have a lot of distraction.

Suppose you want to test the effectiveness of a new method of teaching social studies to 8^{th} standard students. You want to experiment upon different kinds of teaching methods. You select two sections A and B consisting of pupils with more or less equivalent abilities. Now you use some innovative method / technique group discussion or Flipping classroom to teach 'A' section considering a social studies unit. The same unit will be taught to 'B' section using the traditional method. After two weeks, you administer a common test to all the two section students. Score the test papers and find out the average achievement of 'A' and 'B' sections separately. Do you notice a significant increase in achievement? If there is sufficient difference in achievement of two groups and if there is considerable increase in the average score of students ('A' Section) taught through using innovative method of teaching, you can say that innovative method used for teaching 'A' section students is more effective than the traditional method.

The different methods employed by the teacher are technically called independent variables. The achievement of the students depends upon these methods or independent variables. Hence achievement is called dependent variable in this case. In other words, the aspects of environment which is experimentally studied is called independent variable, the

resulting change to behaviour is called dependent variable. The conditions that affect the dependent variable along with the independent variable is intervening variable. Therefore, an experiment is conducted to find out the effect of independent variables upon dependent variable. Statistical techniques are employed to interpret the data and draw meaningful inferences.

Steps of Experimental Method

Experimental method has typical steps which are followed while conducting experiments. They are as follows:

1) **Identifying or Defining the Problem:** The first step of an experiment is to define the problem in definite and clear terms, that one chooses to study. For example: To study the effectiveness of inductive method of teaching mathematics to 9^{th} standard students.

2) **Formulation of hypotheses:** Based on the problem in hand and previous knowledge of the experimenter regarding the problem, one or more hypothesis will be formulated. Hypothesis is an intellectual guess or conjunctural statement.

3) **Identifying the variables and controlling intervening variables:** Variables of the study should be identified. 'Control' is the essence – the heart – of experimentation. The independent variables to be manipulated have to be controlled in a thorough and systematic way. By this control we can eliminate irrelevant or intervening variables. This is usually done by formulating two or more equal or matched groups. By this we observe the causal relationship between independent and dependent variable by keeping the other conditions constant.

   The experimenter should identify and label the variables both in the hypothesis and elsewhere in the study. For example, the problem is "Effectiveness of inductive method for teaching mathematics to 8^{th} standard students". Here inductive method is independent variable. The effect of using inductive method on the performance of 8^{th} standard students in mathematics is dependent variable. Other variables such as intelligence, aptitude, study habits, health, etc are the intervening variables which will affect the achievement of students in mathematics.

4) **Manipulating and controlling variables:** To study the relationship between variables there is a need to both control and manipulate variables. Here the experimenter tries to change or vary the independent variable i.e. the experimenter tries to maximise the effect of independent variable on dependent variable.

5) **Data collection and testing of hypotheses:** After the treatment, relevant data will be collected. Based on the experimental results hypotheses will be rejected or accepted and conclusions will be drawn.

Merits or Advantages

1) This method has raised the status of psychology to science.

2) Experimental method is the most objective, scientific and systematic method used in educational research.
3) Experiment can be repeated for verification under same conditions.
4) It provides objective and precise information about the problem.
5) It enhances our stock of knowledge of cause and effect relationship in the behaviour of students.
6) It provides innovative ideas for further experimentation.
7) Results obtained are valid and reliable.

Demerits or Disadvantages

1) It is difficult to control the intervening variables adequately.
2) It is expensive and time-consuming method.
3) Behaviour under controlled conditions may not occur spontaneously or naturally.
4) It cannot be used for studying the covert behaviour of the individuals.
5) Certain natural states like joy, sorrow, fear, anger etc cannot be produced in the laboratory conditions.
6) All problems of psychology and all types of behaviour cannot be studied by this method. Moral behaviour, sexual behaviour and humanitarian behaviour etc cannot be studied through experimental method.
7) Experimental data do not provide insight into the total behaviour of the individual.
8) It is difficult to construct tools that will make accurate and sufficiently discriminating measurements of individual differences.
9) In many cases investigators cannot manipulate human beings and cannot adjust class schedules to meet the requirements of the research design that are most theoretically desirable.
10) Experiments in social sciences are not possible in the same sense as they are in physical sciences.

Case Study Method or Case History Method

Case study is a comprehensive study of individual child, made to understand him/her as a whole. Case study is defined as an in-depth study of the event, individual, institution or situation which has a problem. Case study is primarily used for diagnosing and treating a problem case and is used extensively in abnormal psychology and educational psychology.

Case study is also defined as the systematic account of past of the person in order to find out the causes of maladjusted individuals. Case study involves the intensive investigation of the particular case. It is a method of studying everything about something rather than something about everything. Case study method is usually used in the case of a problem

child. It takes into account all the pertinent factors especially of an individual, thing or situation.

According to Goods dictionary "A case study is a diagnostic and individual procedure based on thorough investigation of a person in order to shed light upon and to acquire knowledge of his history, his home conditions and all other influences that may cause his maladjustment or behavioural difficulties".

Odum defined case study method "as a technique by which individual factor whether it be an institution or just an episode in the life of an individual or a group is analysed in its relationship to any other in the group".

According to Pauline Young "A comprehensive study of a social unit be that unit a person, a group, a social institution, a district or a community".

Case study is also known as clinical study or clinical method because the problem of the child is diagnosed and treatment or therapeutic measures are provided by the psychotherapist or clinicians in the clinic. Case study is a technique of studying a problem child. The problem may be in the form of anti-social behaviour, emotional disturbances, backwardness in learning, underachievement, delinquency etc.

The main objective of case study or clinical method is to study individual case to detect and diagnose the specific problems and suggest remedial measures to rehabilitate them in their environment. The clinician or the investigator collects the information about the case in totality. The information about the past and the present conditions, information from friends, teachers, neighbours, parents etc are collected. Information collected from all these different sources are organised in a proper way i.e. a comprehensive case history of the case is prepared and causes of deviant or maladjusted behaviours are identified and appropriate remedial measures will be provided.

Steps of Case Study Method

1) **Identification of the problem:** Type of adjustment problem, deviant behaviour, maladjusted behaviour etc., is identified and depth of the problem is studied.
2) **Data collection:** Data pertaining to the maladjusted individual is collected from different sources like parents, friends, teachers, neighbours and from the case himself/herself. Several techniques are used for collecting the data.
3) **Analysis and interpretation of data:** Data collected from the different sources like parents, friends, teachers, neighbours etc., pertaining to the case is organised and case history is prepared or written. The data collected is analysed and interpreted to find out the causes for the deviant or problematic behaviour. This may provide considerable evidence as to sources that may have contributed to the difficulty. A diagnosis is simply a working hypothesis based on the symptoms of a problem and the results of a careful analysis of the data obtained.
4) **Treatment or remedial measures:** After the diagnosis there should be a definite systematic plan of treatment. Fruitful suggestions or appropriate remedial measures or

required treatment will be given to modify the behaviour of the case or maladjusted child.

5) **Follow-up:** Follow-up activities are taken up to assess the effectiveness of the remedial measures provided.

Sources of Information

To collect the complete data pertaining to a case various tools, methods and techniques such as questionnaires, different tests, interviews, observations, etc are used. Complete or detailed study of medical examination and administration of various psychological tests such as intelligence, attitude, aptitude, interest, personality etc, will be done. Detailed information pertaining to the case is collected from the following.

1) **Preliminary information:** Name, age, sex, parents' age, education, occupation, income, number of children (number of siblings), birth order of the child etc are collected.
2) **Past history:** Detailed information about the incidents that took place after the child's birth, developmental pattern of that child, mother child contacts, father child contacts, relationship with neighbours, diseases suffered, death of the affectionate if any, natural calamities that took place etc., are to be collected.
3) **Health conditions:** Mental and physical health of the child, any illness in the past, nature and duration of the disease, treatments provided, reports of medical examination etc., are to be collected.
4) **Family background:** Information about the individual's family, type of family, joint family or nuclear family, members and their relationships, socioeconomic status of the family, their way of life, parents' opinion about the child etc., are to be collected.
5) **Educational and academic information:** Age at which the child joined the school, child's academic achievements, position in the school, failures if any etc., is collected.
6) **Neighbours and Friends:** Information about the problematic child is collected from his/her neighbours and friends. Their opinion about the child and their relationship with the child is collected.
7) **Teachers:** Child's behaviour in the class, his/her nature etc., are to be collected.
8) **Data from the case:** Child's interest, special abilities, habits and hobbies, opinion of the child about his/her teachers, friends, parents and other members of the family etc., are collected. If necessary various psychological tests like intelligence, aptitude, attitude, interests etc., may also be administered.

Merits or Advantages

1) Useful for diagnosing adjustment problems.

2) It provides an opportunity to understand an individual or a unit in depth.

3) It is useful in studying the problematic child.

4) With the help of this method problems of the child can be diagnosed and remedial measures can be provided.

5) It provides insight to the investigator about the probable incidents in the school situation and in turn helps to modify the educational settings accordingly.

Limitations or Demerits

1) We cannot arrive at the generalization based on a single case.
2) The method expects a lot of expertise in handling the case.
3) It is laborious and time-consuming method.
4) Difficult to know the whole history of the case objectively.
5) The information given by parents particularly illiterate may be incomplete or incorrect. They may hide the defects and exaggerate their sons and daughters.
6) If the diagnosis made is wrong then it will lead to a wrong remedial measure.

Survey Method

The word survey is derived from two terms 'sur' or 'sor' which means over. So, the term survey means seeing over or look over. Survey studies are conducted to collect detailed description of existing phenomena to know and understand the existing status or correct conditions and practices and to make intelligent plans to improve them. Surveys are conducted to gather three types of information. i) Data concerning to existing status. ii) Comparison of existing data with the established status and standards. iii) Means of improving the existing status.

Survey is broadly used in social science researches. But it has a prominent role in psychological research also. According to Bogardus 'Survey is the collection of data concerning the living and working conditions broadly speaking of the people on a given community'.

Survey method gathers data from relatively large number of cases at particular time. It is concerned with the generalised statistics that result when data are abstracted from a number of individual cases. Survey studies may take different forms depending upon the scope, nature and purpose of the problem under investigation. Some surveys encompass several countries, states or regions, may be restricted to one state, district or town or village etc. Survey data may be collected from every unit of population or from representative sample.

Survey studies describe and specify the properties of educational phenomena. They include i) School surveys. ii) Public opinion surveys. iii) Social surveys. iv) General and specific surveys. v) Census and sample survey etc.

School surveys are generally comprehensive study of existing conditions of the schools. These surveys are concerned with the students' enrolment in government and private schools, schools possessing required number of classrooms, laboratory, library, proper playground etc. You can have achievement testing, intelligence testing, personality testing etc for collecting data.

Public opinion surveys are conducted to collect the opinion of the public regarding several aspects or issues. These surveys are conducted to find out the type of products or advertising appeals to purchasers or customers, what programs people like to watch on T.V, which social media is liked by most of the public, etc.

Social surveys are generally undertaken to study health service, employment conditions, causes of juvenile delinquency, housing problems etc.

General surveys are type of surveys where the data collected is of general nature without any specific objective or hypothesis. For example, 'Survey of school going children in a specific city'. Specific surveys are confined to some specific aspect such as 'a survey of visually impaired school going children in a particular city'.

Census survey is studying the entire population or social group. In this type of survey entire part or group of individuals is studied. In sample survey, representative units of the population are selected for the study. Sample survey is conducted when the size of the population is large.

Advantages of Survey Method

i) The inferences drawn by survey method are based on the direct contact with the people. Data is collected directly from people.

ii) The data collected is objective. Its data is not influenced by the investigator's beliefs and prejudices.

iii) Survey method brings to the light number of problems and propositions that would have not been possible by pure theoretical analysis.

iv) This method helps in understanding the emotional impact of social situation, especially when it is based upon participant observation.

v) It is a reliable method.

vi) Useful in making a comparative study.

Disadvantages or Demerits

i) It is expensive and laborious method. Because data has to be collected usually from large number of units or individuals.

ii) It is a time-consuming method.

iii) If the sample selected for the study is not true representative of the population, then the results drawn from the data collected from this sample may not be correct.

1.5 MEANING AND SCOPE OF EDUCATIONAL PSYCHOLOGY

Educational psychology is an applied branch of psychology which combines the two different fields, education and psychology. Educational psychology is the application of psychological findings in the field of education. It is the course within the field of education in which the subject matter, researches and procedures of psychology are applied to solve the

problems of education, specially teaching – learning and classroom problems. It is the systematic study of the development of the individual within the educational settings.

According to Morgan 'Educational psychology' is the study of the development of individuals and tells us 'What to teach', 'How to teach', 'Why to teach' and 'When to teach'.

Skinner defines 'educational psychology as the branch of psychology which deals with teaching and learning'.

According to Stephen "educational psychology is the systematic study of the educational growth and development of a child".

Carter V. Good defines "educational psychology as the investigation of psychological problems involved in education, together with the practical application of psychological principles to education".

The aim of psychology is to understand, predict, control and improve behaviour, the aim of educational psychology is to change, modify the behaviour of the learner in the most desirable and socially approved directions.

Scope of Educational Psychology

You know that educational psychology deals with the behaviour of the learner in relation to educational environment. Educational psychology is an applied branch of psychology and is concerned with applying the principles of pure psychology to solve the problems of education. By applying the principles, laws, methods and techniques of pure psychology, educational psychology tries to study the behaviour and experiences of the learner. So, the key factors of educational psychology are:

1) The learner.
2) Learning process.
3) Learning situation or environment.
4) The teacher.

1) The Learner: Educational psychology is concerned with the learner's ability, attitude, aptitude, interest, intelligence, motivation etc. It is also concerned with individual difference and influence of heredity and environment on the learner. It examines the various stages of growth and development of the children. Educational psychology studies the various aspects of the learner.

2) Learning Process: Educational psychology studies the nature of learning and the way it takes place in the learner. It also deals with the various theories of learning such as remembering and forgetting, perceiving, concept formation, thinking and reasoning process, problem solving, transfer of training etc. Educational psychology provides the ways and means of effective learning. It helps in achieving maximum learning in minimum time more effectively.

3) Learning Situation or Environment: Educational psychology is concerned with the classroom management and discipline. It provides the various aids and

techniques to facilitate learning in the classroom. We apply different theories and laws of psychology to make teaching learning more effective and meaningful. It provides us with the different methods of teaching for below average, average and above average intelligent students. Educational psychology also deals with the new techniques of evaluation and their effective use.

4) **The Teacher:** Educational psychology deals with the essential personality traits required to become a successful teacher. It also studies the conflicts, motivation, anxiety, adjustment level of aspiration, interests, aptitudes of the teacher to help him acquire effective teaching techniques and skills.

As educational psychology is a growing subject, its scope has not been clearly defined but scholars have outlined the scope. Scope of educational psychology is wide and ever increasing. Educational psychology deals with the behaviours of the learners in educational situation. Even though scholars have outlined the scope of educational psychology, its boundaries must be left free for future expansion to include what is created in future to solve the problems of education and smoothening of teaching learning process.

1.6 IMPORTANCE OF EDUCATIONAL PSYCHOLOGY

Following are some of the reasons which indicate the importance of educational psychology to a teacher.

1) **To understand the learner:** The scholar Pestalozzi has aptly said unless you understand the learner, any amount of teaching is of no use. Educational psychology helps the teacher in understanding the student's abilities, potentialities, learning capacity, interest, motivation, mental status, overt and covert behaviours etc. It informs the teacher the needs and requirements of the learners at different stages of development.

2) **To understand the individual differences:** Knowledge of educational psychology helps the teacher to understand that there are marked differences among the children and every child is endowed with the specific potentialities by nature, which the teacher can only help to develop. By understanding the individual differences teacher can adopt different methods and techniques for his/her teaching to help each child develop potentialities to its maximum.

3) **To select and organise the content:** Educational psychology provides ways and means to construct curriculum and select appropriate methods and strategies to organise and to teach particular content.

4) **To know the learning process:** Educational psychology explains the process of learning and suggests the ways for effective and enduring learning. It helps in maintaining the interest of the learner in learning process.

5) **Suggest the techniques and art of teaching:** Educational psychology suggests different methods and techniques for teaching all kinds of learners in all circumstances.

6) **Help to create proper learning situation:** The knowledge of educational psychology equips the teacher for taking care of desirable learning situations.

7) **Help in maintaining discipline:** Educational psychology helps the teacher to maintain proper classroom discipline as it acquaints the teacher with the nature of the child, his strengths and weaknesses, his interests, aptitudes etc on the one hand and with methods and techniques of teaching on the other hand. Knowledge of group dynamics, group behaviour gives the teacher necessary tools for teaching to the different types of groups.

8) **Help in rendering guidance services:** The knowledge of educational psychology helps the teacher in rendering guidance services to the pupils. Knowledge of the needs, drives, fatigue, motivation, personality characteristics and behavioural pattern of the learner helps the teacher in the process of guidance services.

9) **Help in evaluation and assessment:** With the knowledge of educational psychology teacher can perform the task of evaluation with proper professional skills.

10) **Helps in solving classroom problems:** There are innumerable problems like backwardness, bullying, cheating in the class-room situations which are faced by the teachers. Educational psychology helps in solving these problems.

11) **To identify special needs children:** The special needs children's needs are identified and adopted learning instructions, adopted learning environment or adopted learning processes are used for them.

12) **To know the teacher himself/ herself:** Knowledge of educational psychology helps the teacher to know about himself / herself. He / She can know his / her own behavioural pattern, personality characteristics, likes and dislikes, motivation, anxiety, conflicts, adjustment etc. It also informs the teacher the traits of successful teacher and characteristics of effective teaching.

13) **To enable teachers for curriculum development:** Curriculum should be designed and developed based on the needs and wants of the individual student. It should help the students to accommodate themselves to the present world of development. Educational psychology helps the teachers to develop suitable curriculum to cater to all types of students.

1.7 CHECK YOUR PROGRESS

I. State whether the following statements are true or false.

i) Psychology has its roots in the mother discipline called sociology.

ii) The term psychology is originally a Latin term.

iii) General psychology deals with the behaviour of normal individuals.

iv) Animal psychology is also known as comparative psychology.

v) Industrial psychology is concerned only with the selection, training, placement, promotion and follow up of industrial employees.

vi) Consumer psychology deals with selling and buying behaviours of the individuals.

vii) Introspection means looking within oneself.

viii) The Experimental method is responsible for assigning the status of science to psychology.

II. Fill in the blanks with appropriate word / words.

a) First Psychological laboratory was established at _____ in Germany.

b) The term behaviour includes motor activities, cognitive activities and _____ activities.

c) Abnormal psychology is also called _____.

d) Industrial psychology is originated sometime around 1910 in_____.

e) Introspection is composed of words _____ and _____.

f) Introspection method was founded by British psychologist _____.

g) Observation means critically looking at the _____ behaviour.

h) The Latin word experimentum which means 'to try' or _____.

III. Answer the following questions

1) State the present meaning of psychology.
2) What is abnormal psychology?
3) What is the concern of social psychology?
4) List any five branches of psychology.
5) State the meaning of observation.
6) Enumerate different types of observation.
7) What is experimental method?
8) Enumerate the steps of experimental method.
9) List the sources of information for undertaking case study.
10) How is school survey different from social opinion survey?

ANSWERS TO CHECK YOUR PROGRESS

I	i)	False	ii)	False	iii)	True	iv)	True
	v)	False	vi)	True	vii)	True	viii)	True.
II	a)	Leipzig	b)	affective	c)	psychopathology		
	d)	Great Briton	e)	introspection	f)	Edward B. Titchner		

g) external h) put to test.

III 1) Psychology is the study of human and animal behaviour.

2. Abnormal psychology is the branch of psychology which describes and explains the behaviour of the abnormal individual.
3. Social psychology is concerned with the study of behaviour of the individuals in different groups.
4. Referring to sub-section 1.3 write any five branches of psychology.
5. Observation is critically looking at the external behaviour with a purpose and a plan.
6. Different types of observation are
    i) Natural observation.
    ii) Participant observation.
    iii) Controlled observation.
    iv) Structured observation.
7. Experimental method is systematic observation of controlled conditions to find out the effect of independent variable upon dependent variable.
8. Steps of experimental method.
    i) Identifying or defining the problem.
    ii) Formulation of hypotheses.
    iii) Identifying the variables and controlling the intervening variables.
    iv) Manipulating and controlling of variables.
    v) Data collection and testing of hypotheses.
9. Sources of information for case study
    i) Preliminary information.
    ii) Past history.
    iii) Health conditions.
    iv) Family background.
    v) Educational and academic information.
    vi) Neighbours and friends.
    vii) Teachers.
    viii) Data from the case.

10. School survey is concerned with the comprehensive study of existing conditions of the schools where as public opinion survey is concerned with the collection of opinion of the public regarding several aspects or issues.

1.8 SUMMARY

In this unit you have studied about the meaning, definitions, branches and methods of psychology. You have also studied the meaning, scope and importance of educational psychology.

1.9 GLOSSARY

Psychology: It is the study of human and animal behaviour.

Introspection: It is looking within oneself.

Observation: Critically looking at the external behaviour with a purpose and a plan.

Experimental method: It is the systematic observation of controlled conditions to findout the effect of independent variable upon dependent variable.

Case study: It is an in-depth study of the event, individual, institution or situation which has problem.

1.10 QUESTIONS FOR SELF-STUDY

1) Explain the different definitions of psychology.
2) Describe any two branches of psychology.
3) Describe observation as a method of psychology. Bring out its merits and demerits.
4) Discuss why experimental method is considered as the method of excellence.
5) Explain the steps of experimental method.
6) Describe the case study method of psychology.
7) Explain different types of survey method.
8) Explain the meaning and scope of educational psychology.
9) Bring out the importance of educational psychology to teachers.

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UNIT –2 GENETIC DETERMINANTS OF BEHAVIOUR

Structure

2.0 OBJECTIVES

After studying this unit, you will be able to

- Trace the origin of life from cell consisting of genes.
- Identify the basic mechanism of heredity in the chromosomes and genes.
- Distinguish the process of the birth of identical and fraternal twins.
- Bring out the implications of heredity on the growth and development of the individuals.

2.1 INTRODUCTION

Having studied the meaning, branches and methods of psychology and also about educational psychology now let us have a glance at the very origin of human life. There is no greater miracle in all of biology than the nine-month journey that begins with the union of two cells and ends in the birth of a human being. The questions like how have we become what we are today? How does life originate? How does a single cell, that can only be perceived through a powerful microscope, multiply and become a fully developed baby within a span of nine-nine and half months? Why do we find resemblances of grandparents in the new born? What are the determinants of various physical and mental characteristics? You will find the answers to these questions in this unit.

2.2 HEREDITY MECHANISM

Individual's life starts with a cell (zygote) of about 1/200 inch in diameter, which is visible only through powerful microscope. This cell zygote or fertilized ovum, formed by the union of the ovum from the mother and sperm from the father, in the mother's womb, grows and develops amazingly. From the moment the sperm and egg unite and unfolds a wonderful process of multiplication of cells. This multiplication process goes on every second without rest. There is an inbuilt mechanism which ensures that every nutrient required is provided at the right time in the right quantities. Before learning about heredity mechanism, let us understand the meaning of heredity.

According to Douglass and Holland "One's heredity consists of all the structures, physical characteristics, functions or capacities derived from parents, other ancestry or species".

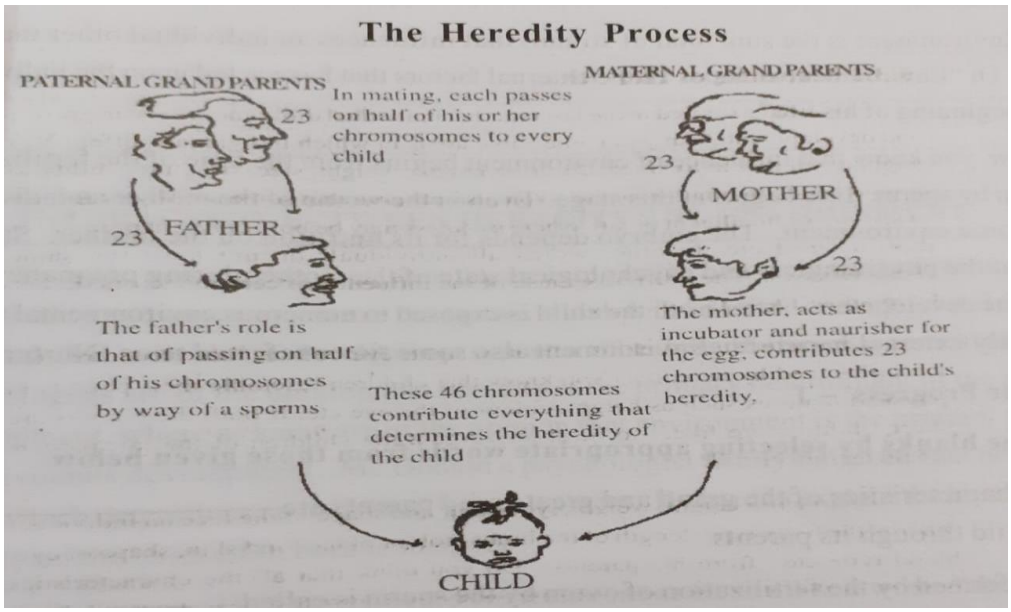
B.N. Jha defines heredity as the sum total of all the inborn individual traits.

We can say that heredity is the transmission of characteristics from one generation to the other by means of genes. Genes are the determiner of heredity. One's heredity is determined at the time of conception only. It is when the child is in the mother's womb, about nine months before the birth.

Heredity or nature is an inherited quality or tendency. An individual is formed by the union of the ovum from the mother and the sperm from the father to constitute a tiny cell called fertilized ovum or zygote. This zygote is about $1/200^{th}$ of an inch in diameter. One's heredity is determined at the time of conception. The fertilized ovum divides into two, these

two into four, four into eight and so on within the protected atmosphere of the mother's womb. Millions and billions of cells are formed by the time a baby is born. One of the nature's wonder is how a single fertilized egg cell develops into an adult human being with billions and trillions of highly differentiated cells and complex organ systems and functions.

Within each cell there are substances called chromosomes or coloured bodies. A normal human cell contains 23 pairs of chromosomes which are worm like structures made up of DNA (Deoxyribonucleic Acid) molecules. Which in turn contains the specific carriers of heredity, called genes. Out of 23 pairs – one set from father and another from mother. The first 22 chromosome pairs match rather closely. The 23rd pair, which determines the sex of the baby, always X in woman, X or Y in man. An X – X combination in fertilization makes a girl, and an X – Y integration a boy. So the determinant of sex of the offspring comes from the father (though he has no control over it) and the mother has no role or contribution in it.



Each chromosome consists of thousands of smaller particles called genes. The gene is considered to be the basic unit of heredity. The genes are too small to be seen with the microscope. These genes are the actual carriers of heredity. These are responsible for the transmission of the various inheritable physical and psychological traits from generation to generation. During the process of cell-division each gene is also duplicated and the new genes pass into the new cell resulting from the division. Thus, the process of gene duplication and distribution is harmonised with the process of mitosis and meiosis. It has been estimated that the number of genes in each chromosome in man may range from 20,000 to 42,000. The term 'gene' may be related to the Greek word 'Genos' meaning race or offspring.

The fertilized cell contains 46 chromosomes. A process of chromosome reduction takes place during the maturation process of the germ cell. This process of reduction is called meiosis. During the process of 'meiosis' any 23 of the 46 chromosomes from the female side and any 23 from the male side are discarded. Which 23 of the male combines with which 23 of the female cells depends purely on chance. Thus, we see that a particular child receives only half of the ovum's chromosomes and half of sperm's chromosomes on a pure and simple

chance basis. The basic heredity substance is the DNA. It contains the 'genetic code' – the programme of potentials for development.

2.3 BASICS OF HEREDITY

You know that heredity is an inherited quality or tendency. You also know that members of the species resemble one another and possess characteristics that are common to their species. It is also true that individual differences exist among the members of the same species.

Basics of heredity is concerned with how human traits are determined and passed on to the next generation. Human beings and also all other living beings have DNA, which contains hereditary information. Information in one's DNA gives cells instructions for producing proteins. Proteins drive important body functions like digestion of food, building cells, moving muscles etc. One's DNA is the most unique and identifying factor about him/her. It helps in determining the individual's colour of the eyes, tallness, health problems etc of the individual.

You know that unicellular zygote divides itself into two, then into four, then into eight and so on. Each cell duplicates itself. This is how the foetus grows assuming different shapes, and finally the human form. This kind of cell division is called mitosis. Paradoxically it can be explained as multiplication through division. Here each chromosome duplicates itself without any loss in the original. The basic heredity substance is the DNA. It contains the 'genetic code' the programme of potentials for development. The RNA plays a significant role as a messenger in the transmission and translation of the genetic code. Strangely, an extra – chromosome, as found in rare cases, is said to cause serious mental deficiency. Shortage of a chromosome may cause abnormalities, like deformity. The chromosomes contain thousands of genes. They are the basic determinants of characteristics. Each individual gets a unique combination of genes. A characteristic may be determined by one or more pairs of genes. Each pair being formed by a combination from the mother and the father. Some characteristics like colour blindness and haemophilia (blood not clotting) are said to be determined by sex-linked genes. Complex characteristics are determined by a set multitude of gene-pairs.

An abnormal number of chromosomes results in serious disorder. A particular type of mental retardation known as the down's syndrome involves an extra chromosome. Studies have shown that about 95 percent of persons with Down's syndrome have 47 chromosomes instead of the normal set of 46. In one out of every 3000 births, a person inherits a normal X sex chromosome but no second X or Y sex chromosome. This condition is known as 'turner's syndrome'. Individual resembles females, short in stature, impaired sexual development, poor abilities to visualise three dimensional objects in space.

In the human female usually one ovum ripens at a particular time and has the chance of becoming fertilised by a sperm. This is what ordinarily takes place when a child is conceived. However, sometimes two or more ova may mature simultaneously and separate sperms to fertilise them. In such a case more than one child will be conceived at the same time. When twins are born because of two ova getting simultaneously fertilised they are

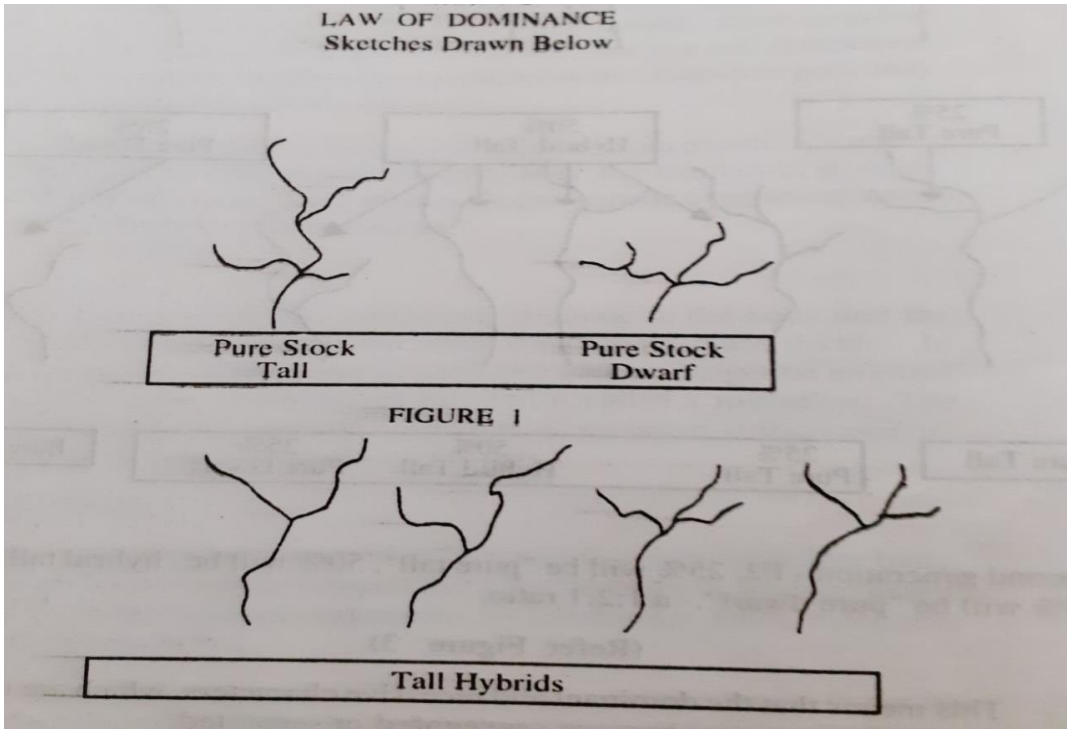
called fraternal twins. Since they emerge from two zygotes, they are called dizygotic twins. They are actually like two children conceived at the same time. The particular combination of chromosomes need not be similar in the case of these two fertilised ova. Since the chromosomes determine heredity, these two children or the twins need not have identical heredity. Their resemblance to each other will at best be just like the resemblance of two siblings in a family. Such a pair of twins need not even be of the same sex.

Twins may be conceived in another manner also. When the first mitotic division of the fertilised ovum takes place the two daughter cells thus produced, each complete by itself, may further split and develop into two different individuals. Since the two individuals have developed out of one fertilised egg, the two will be exactly alike with regard to their chromosome content. In the process of mitosis, the cells always divide in such a manner that each cell maintains its uniform structure. Such a pair of twins is called identical twins. Since they emerge from the same zygote, they are called monozygotic twins. Since they have the same set of chromosomes they have common heredity. They would always be of the same sex and they will resemble each other very closely with regard to physical characteristics.

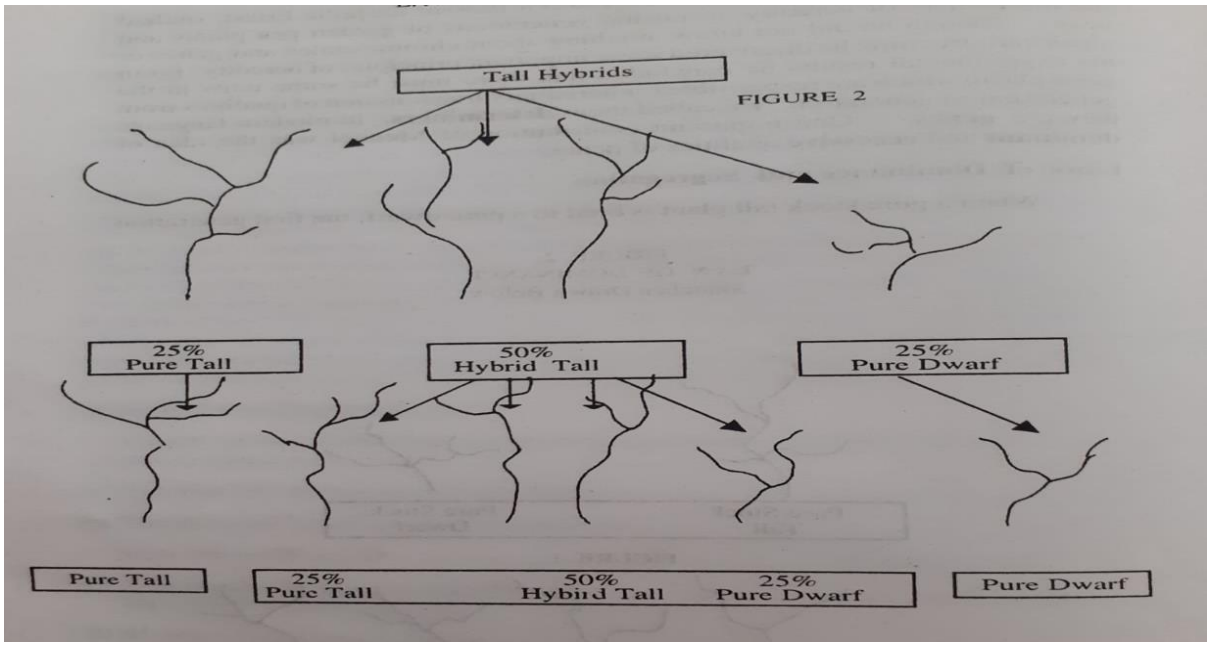
Heredity Endowment

Heredity determines both the general species characteristics and the individual's unique characteristics. Hereditary transmission or endowment follows certain laws. Like begets the like; parents of certain species will produce offspring of the same species. There is a tendency for regression towards the average. For example: Unusually tall parents may get children shorter than they are and short parents are likely to have children taller than they are. The offspring gets half its chromosomes/genes from the father and the other half from the mother, so the changes of children resembling either or both of the parents in many characteristics is high. The probability of siblings (children of the same parents) resembling one another in many respects is also relatively high-compared to similarities with unrelated persons.

Laws of Mendel: Gregor Mendel (1822-1882) a Roman Catholic Priest, studied the mechanism of heredity by raising generations of garden pea plants and beans. He discovered the laws of inheritance in hybrid peas growing in the garden. From his experimental results he concluded that there must be some units in the germ plasm which are responsible for hereditary transmission of qualities from generation to generation. He called them determiners. In modern language dominant and recessive qualities of genes. Under laws of dominance, when a pure stock tall plant is bred to a pure dwarf, the first generation of offspring – F1 will be tall hybrids. That is, the gene for "tallness" will be dominant in them but the gene for "smallness" will also be carried. We can summarise the Mendellian Law of Inheritance as, "If a man who is homozygous for blue eyes marries a woman homozygous for brown eyes; the children of this couple will have only brown eyes". If heterozygous man marries a heterozygous woman, the distribution of children from this marriage will be one-fourth of them will be homozygous for brown eyes (BB) one half of them will be heterozygous (Bb) and one fourth will be homozygous for blue eyes (bb).



If the members of the F1 generation are bred together, giving rise to the second generation – F2, 25% will be "pure tall", 50% will be 'hybrid tall' and 25% will be 'pure dwarf' – a 1:2:1 ratio.



This means that the dominant and recessive characters, which are mixed in generation F1 have now become segregated or separated. If the "pure tall" plants of F1 mate, all their offspring will be tall. If the "tall hybrids" mate, their offspring will show the same 1:2:1 ratio that we noted in F2 and the pure dwarf plants of F2 mate, all their offspring will be "pure dwarf" stock.

Most of the physical trails of human beings are now found to follow the Mendellian principles of inheritance. Colour of the eye, hair characteristics, skin pigmentation, colour blindness etc are transmitted through heredity.

The issue of dominant and recessive genes is also useful in explaining how heredity produces differences as well as similarities. An individual with a dominant gene for a particular characteristic displays that characteristic. Whether one or both gene in the same pair are dominant. If a gene is recessive, the characteristic associated with it does not show up unless both genes in the gene pair are recessive. If only one gene in a pair is recessive its effect will be masked by its dominant partner but that recessive gene may still be passed on to the individual's offspring.

2.4 IMPLICATIONS OF HEREDITY

We are concerned primarily with the influences of heredity upon growth and development of individuals. Let us now list some of the implications of heredity.

i) Hybrid experiments with animals as well as experiments on selective breeding in animals show the striking influence of heredity on development of traits.

ii) Maturation which is that phase of development which relates to the unfolding of characteristics incorporated in the genes transmitted to the individual from ancestors, also exhibits the influence of heredity.

iii) The role of heredity in determining offspring of superior, intelligence has been made clear in Galton's studies of genius in which he identified great men from British families. Sir Francies Galton (1869) a great hereditarian, studied the family histories of 977 famous persons of various western countries. Almost all of them were discovered to be belonging to great families. Results of the study led him to believe that their greatness was due to their heredity.

iv) H. H. Goddard (1912) studied a Kallikak family. Kallikak was a soldier. He married a feeble – minded woman. Later he married a quakress of a good family. The family line established by the feeble-minded woman contained 480 direct descendants, among which only 46 normal individuals were found, the others were criminals, drunkards, feeble minded, patients, sexually perverted and illegitimate etc. Whereas among 496 direct descendants of the normal woman all were normal and many were doctors, teachers, tradesmen, lawyers and administrators. This study throws light on the inheritance of feeble mindedness from generation to generation.

v) Kellogg and Kellogg conducted a research on their son and a chimpanzee. The age of their son Donald was ten months and that of chimpanzee GUA was seven and half months. Both were reared in the same environment with same facilities. The chimpanzees' rate of development especially physical and motor development was at first so rapid that in many respects it was actually ahead of the child. By the end of the first year it was falling behind in many functions. This investigation showed that a great deal of human socialization can be accomplished, in an animal which

in their natural state is very different. But it also indicates very definite limits in what can be achieved by social pressure against the limits set up by biological make-up.

With respect to the influence of heredity on development it influences one's physical growth, intelligence, personality characteristics, vocational efficiency etc. Individual's physical characteristics like size, height, form, structure of the body, face, appearance, colour of the skin, eye, hair etc., are mostly inherited. Strength of the muscles, certain diseases like diabetics, haemophilia (blood does not clot), mental illness etc., are also inherited. Personality characteristics like honesty, dishonesty, introversion, extraversion etc., are inherited. Case studies of certain families reveal that certain tendencies to commit crime is also inherited. Some of the intellectual characteristics like ability to sing, write, learn, easily etc., are believed to be inherited.

2.5 CHECK YOUR PROGRESS

I. State whether the following statements are true or false.

i) One's heredity is determined at the time of conception.

ii) Each cell contains coloured substances called chromosomes.

iii) Each gene consists of thousands of smaller particles called chromosomes.

iv) The term 'gene' is related to the Greek word 'Genius'.

v) The DNA is the basic substance of heredity.

II. Fill in the blanks with appropriate word / words.

1. Cell formed by the union of ovum from the mother and sperm from the father is called _____.

   a) Mutant b) Zygote c) Chromosome d) Egg.

2. The fertilized ovum or zygote is about _____ of an inch in size.

   a) $1/50^{th}$ b) $1/100^{th}$ c) $1/150^{th}$ d) $1/200^{th}$.

3. A normal human cell contains _____ of chromosomes.

   a) 46 pairs b) 92 pairs c) 23 pairs d) 69 pairs.

4. Heredity is also called_____.

   a) Nature b) Nurture c) Environment d) Atmosphere.

5. The number of genes in each chromosome in man ranges from _____.

   a) 10,000 to 20,000 b) 15,000 to 30,000 c) 20,000 to 35,000

   d) 20,000 to 42,000.

III. Answer the following questions

1) What is heredity?

2) Write the expansion of DNA.

3) Who are fraternal twins?

4) Who are identical twins?

5) Write any two implications of heredity.

6) Cite the illustration for Mendellian law of inheritance.

ANSWERS TO CHECK YOUR PROGRESS

I i) True ii) True iii) False iv) False

v) True.

II a) Zygote b) $1/200^{th}$ c) 23 pairs

d) Nature e) 20,000 to 42,000

III 1) One's heredity consists of all the structures, physical characteristics, functions or capacities derived from parents, other ancestry or species.

2) Expansion of DNA – Deoxyribonucleic Acid.

3) When two ova get fertilised simultaneously and two babies thus born are called fraternal twins.

4) Identical twins are twins born from one fertilised egg by getting divided into two cells, each complete by itself and develop into two different individuals exactly alike with regard to their chromosome content.

5) Write any two implications of heredity referring to the sub-section 2.4.

6) The Mendellian law of inheritance is if a man who is homozygous for blue eyes marries a woman homozygous for brown eyes, the children of this couple will have only brown eyes.

2.6 SUMMARY

- Individual's life starts with a cell (zygote) of about $1/200^{th}$ of an inch in diameter.
- Cell zygote or fertilized ovum is formed by the union of the ovum from mother and sperm from the father in the mother's womb.
- Heredity is the sum total of all the inborn individual traits.
- One's heredity is determined at the time of conception.
- Heredity or nature is an inherited quality or tendency.
- Within each cell there are substances called chromosomes.
- Chromosomes are made up of DNA (Deoxyribonucleic Acid) molecules.
- DNA contains genes which are the real carriers of heredity.

- The number of genes in each chromosome in man may range from 20,000 to 42,000.
- Basics of heredity is concerned with how human traits are determined and passed on to the next generation.
- The process of chromosome reduction which takes place during the maturation process of the germ cell is called meiosis.
- Unicellular zygote divides itself into two, then into four, then into eight and so on. Each cell duplicates itself. This kind of cell division is called mitosis.
- An abnormal number of chromosomes results in serious disorder.
- A particular type of mental retardation known as the down's syndrome involves an extra chromosome.
- Like begets the like: parents of certain species will produce offspring of the same species.
- Mendel's laws: Some units in the germ plasm which are responsible for hereditary transmission of qualities from generation to generation.
- Most of the physical traits of human beings are now found to follow the Mendellian principles of inheritance.
- Heredity influences one's physical growth, intelligence, personality characteristics, vocational efficiency etc.
- Individual's physical characteristics like size, height, form, structure of the body, face, appearance, colour of the skin, eye, hair etc. are mostly inherited.
- Strength of the muscles, certain diseases like diabetics, haemophilia (blood does not clot), mental illness etc., are also inherited.
- Personality characteristics like honesty, dishonesty, introversion, extraversion etc are inherited.
- Some of the intellectual characteristics like ability to sing, write learn easily etc are believed to be inherited.

2.7 GLOSSARY

- **Heredity:** Sum total of all the inborn individual traits.
- **Zygote:** The product of the union of a sperm from the father and an egg (ovum) from the mother.
- **Mitosis:** Cell division into which unicellular zygote dividing itself into two, then into four, then into eight and so on is known as mitosis.

- **Meiosis:** A process of chromosome reduction taking place during the maturation process of the germ cell is called meiosis.
- **Fraternal twins:** Are twins born from one fertilized egg by getting divided into two cells, each complete by itself and develop into two different individuals exactly alike with regard to their chromosome content.

2.8 QUESTIONS FOR SELF-STUDY

1. Describe the heredity mechanism.
2. Distinguish the process of the birth of identical and fraternal twins.
3. Differentiate between meiosis and mitosis.
4. Explain the laws of heredity.
5. Bring out the implications of heredity on development.

2.9 REFERENCES

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UNIT –3 INTRODUCTION TO HUMAN NERVOUS SYSTEM

Structure

3.0 OBJECTIVES

After studying this unit, you will be able to,

- Describe the structure of peripheral nervous system.
- Explain the functions of peripheral nervous system.
- Identify the different parts of central nervous system.
- Explain the structure and functions of central nervous system.
- Describe the parts of autonomic nervous system.
- Explain the functions of autonomic nervous system.

3.1 INTRODUCTION

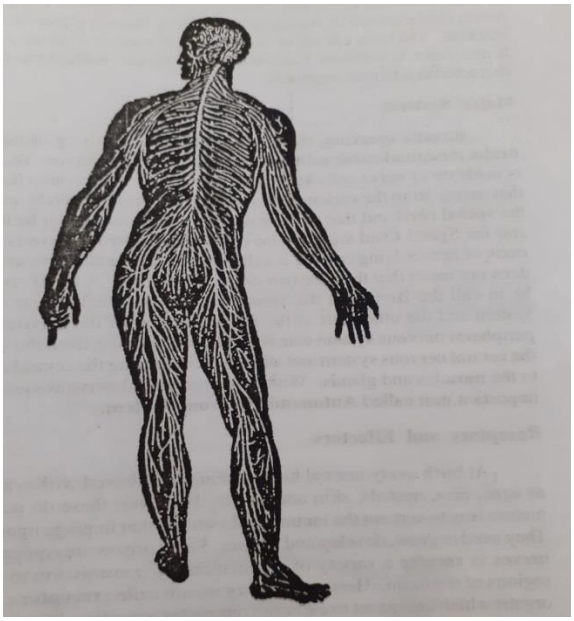
In the previous unit you have studied in detail about heredity mechanism and implications of heredity on human development. You know that we have accepted behaviour as the subject matter of psychology. In order to understand the dynamics of human behaviour we must study the anatomy and physiology of human body. Different parts of the body carrying out different functions are called different systems of the body. The word system denotes an inbuilt orderliness in structure and function of different parts of the body.

You know that human body consists of the brain in the head with a protective shield the skull. Its intervention is required in every step of our life. There are quite a few vital functions that are needed for the survival such as digestion, blood-circulation, respiration and so on. Whether we are awake or asleep these functions are carried out automatically. The inclusion of Nervous System as a topic in this course is only to provide a rudimentary knowledge of human body. Behaviour cannot be studied in isolation because the instrument of behaviour is the Nervous System.

Our focus in this unit will be three principal segments of human nervous system, namely peripheral nervous system, central nervous system and autonomic nervous system. Each one has specific structure and functions.

3.2 PERIPHERAL NERVOUS SYSTEM-STRUCTURE AND FUNCTIONS

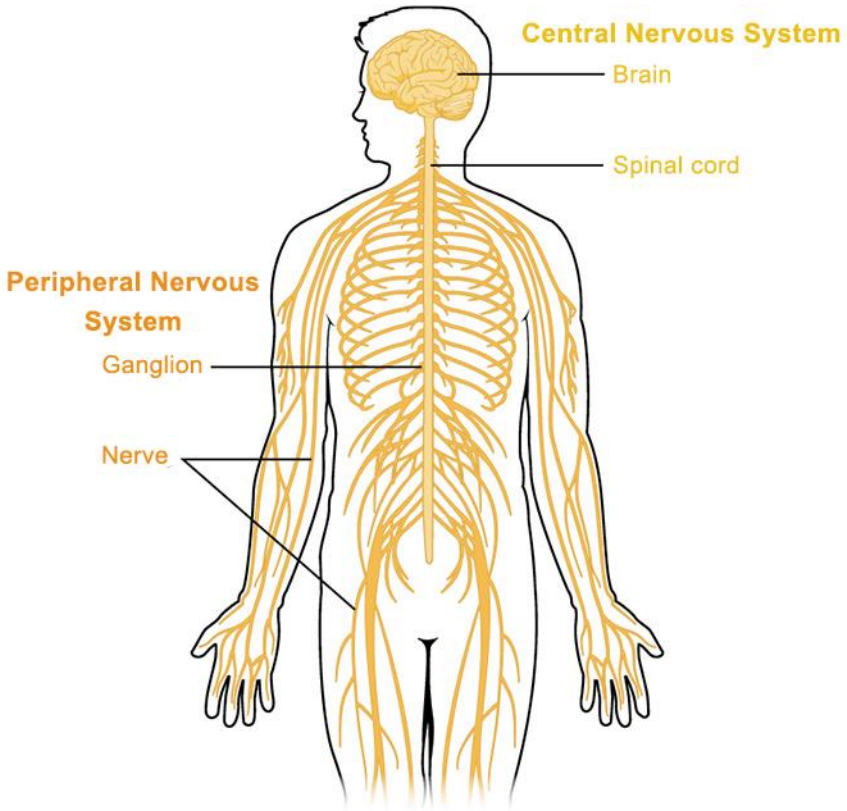
You know that the human body is made up of different types of cells like bone cells muscle cells, body cells, nerve cells etc. The duty of carrying message from one part of the body to other, has been assigned to nerve cells. The nerve cell with all its branches is called a neuron. Our nervous system is made up of these nerve cells. Individual's Nervous System consists of millions of neurons. They carry messages or impulses in the form of nerve currents. When you look at the picture of human nervous system given below, we find numerous nerves interconnecting various parts of the body.



Human Nervous System (Courtesy: freesvg.org)

It has been estimated that there is an assortment of more than 200 bones, about 800 muscles and many other highly specialised structures in the body. This complicated assortment work efficiently and harmoniously because of a still more complicated inter connecting nervous system. Electro-chemical conduction is involved in nervous stimulation; the communication is carried on by nerve cells which are all centres of electrical activity. For the sake of convenience, nervous system is divided into various parts and each part studied in detail. It must be remembered that it is the whole system that acts always.

The nervous system is made up of three parts: the brain, the spinal cord and mass of interconnecting nerves. The entire system is made up of nerve cells know as neurons. Numerous nerves from the various limbs and the organs of the body are connected to the spinal cord and that the spinal cord runs direct to the brain. The brain and the spinal cord together are called the central nervous system. The mass of nerves lying outside is called the peripheral nervous system. The peripheral nervous system consists of nerves passing from the sense organs to the central nervous system and all nerves connecting the central nervous system to the muscles and glands. All the nerves (thread like fibres) which are spread outside the central nervous system are known as peripheral nervous system. Within this peripheral nervous system, we have an important unit called autonomic nervous system.

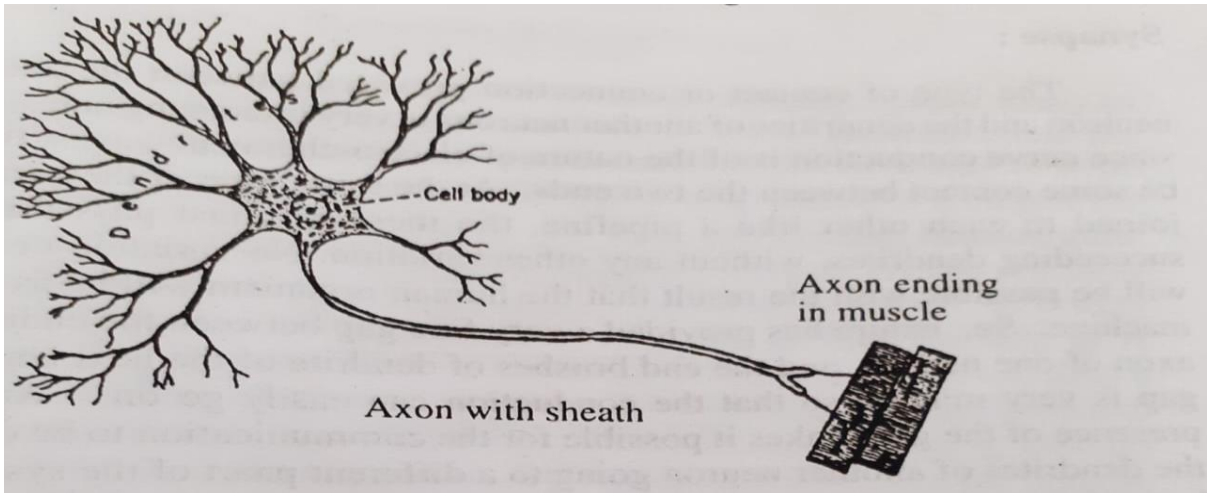


Peripheral Nervous System (Courtesy: commons.wikimedia.org)

You know that nerve tissues are spread all over the body under the skin, these thread-like numerous fibres are known as nerves. These masses of nerves lying outside are called the Peripheral Nervous System. You also know that at birth every normal human being is endowed with sense organs such as eyes, ears, nostrils, skin and so on. Sense organs are equipped with minute nerves to receive a variety of stimulation for transmission to the specialised regions of the brain. Hence sense organs are called receptors. There are also organs which are meant to carry out our motor activities. These are the muscles and they are called effectors. Receptor means organs by which we receive the outside stimuli and effector means organs by which we effect changes in the outside environment Effectors cannot work without the receptors. Therefore, there should be easy communication between the receptors and effectors. The communication is provided by the nerves on neurons.

The neuron

The nerves themselves have a very complicated structure. Every single nerve consists of numerous minute fibres. This unit of nerve fibre i.e. the nerve cell with all its branches is called a neuron.



The neuron

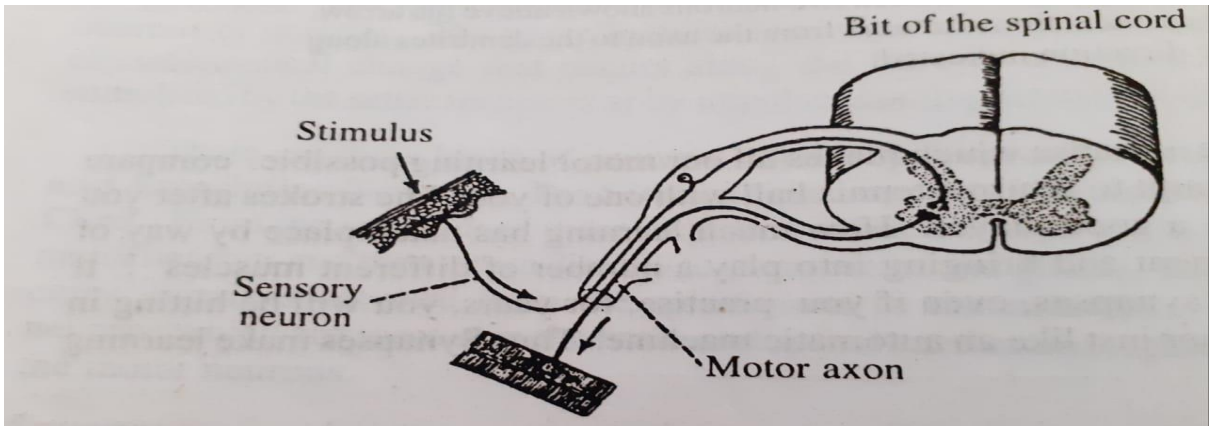
The neuron is the basic structural unit of the nervous system. It is composed of a cell body containing the nucleus of the cell and two types of fibres branching off from the cell body. The branching fibres are called dendrites and axons. The dendrites are the short fibres around the cell body. The axon is the long fibre extending toward the next neuron. The dendrites receive nerve impulses from receptors or from adjacent neurons and conduct them to the cell body. The axon transmits the impulses from the cell body to the other neurons or muscles. While nervous system can be compared to the telephone network spread over different parts. In the nervous system message runs only in one direction. Therefore, there are three types of neurons. Sensory Neurons, Motor Neurons and Association Neurons. All those neurons that run towards the brain are called Sensory neurons. They carry messages from the different parts of the body to the brain. The other types of neurons that run from the brain to different parts of the body are called motor neurons. Neurons which are located in the brain and spinal cord connecting the sensory and motor neurons are called association neurons.

Reflex Action and Reflex Arc

When a fly or dust is coming towards the eye, in a fraction of a second the eyelids close as a protective measure. The organism has many other quick, instantaneous reactions such as withdrawal of the hand from the burn, coughing, sneezing etc. It does not take time and the particular activity has not been learnt from anybody. These are called Reflex Actions. Reflex actions are innate and are mostly ready at birth itself. "A reflex is an immediate muscular or glandular response to specific sensory stimulus". Example: The flow of saliva in response to tasting a substance in the mouth, and the flow of tears when we peel an onion, belong to this category. These reflex actions are helpful in maintaining the safety and welfare of the organism.

In a deliberate response to a stimulus the message is taken to the brain through the spinal cord and the brain sends out the message for a particular response involving some amount of thinking. This of course takes some time. But, a reflex action proceeds directly from the spinal cord.

The reflex depends on certain definite connections laid down in the growth of nerve centres between the incoming sensory fibres and the outgoing motor fibres. The path from a sense organ through the nerve centre to a muscle is called a Reflex Arc.



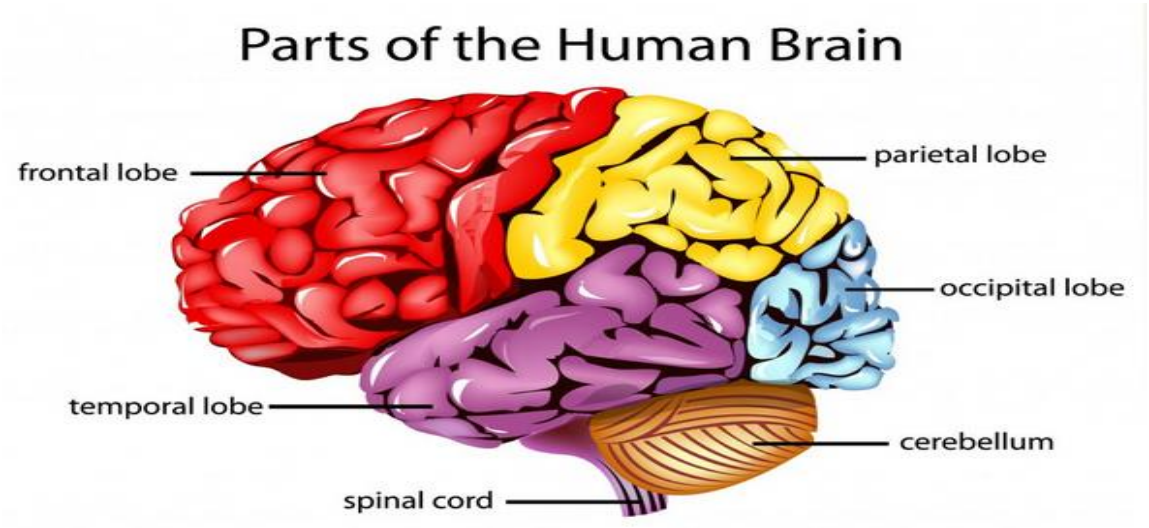
A Two Neuron Reflex Arc.

3.3 CENTRAL NERVOUR SYSTEM-STRUCTURE AND FUNCTIONS

The Central Nervous System is the part of the nervous system. It is situated within the bony case formed by the skull and spine. The central Nervous System is divided into brain and spinal cord.

The Brain and its Parts

The Brain is the most highly developed part and most complex structure of the nervous system. Scientists have estimated that the adult human brain is composed of 18 billion nerve cells, 50 billion of which are devoted to processing information. The higher centres of the Nervous System are located in the brain. It acts as the integrating and co-ordinating agency for all behaviour. It is well protected by the encasing skull. Its outer layer is grey and inner whitish. The brain is the central room of the huge complicated system of the body.



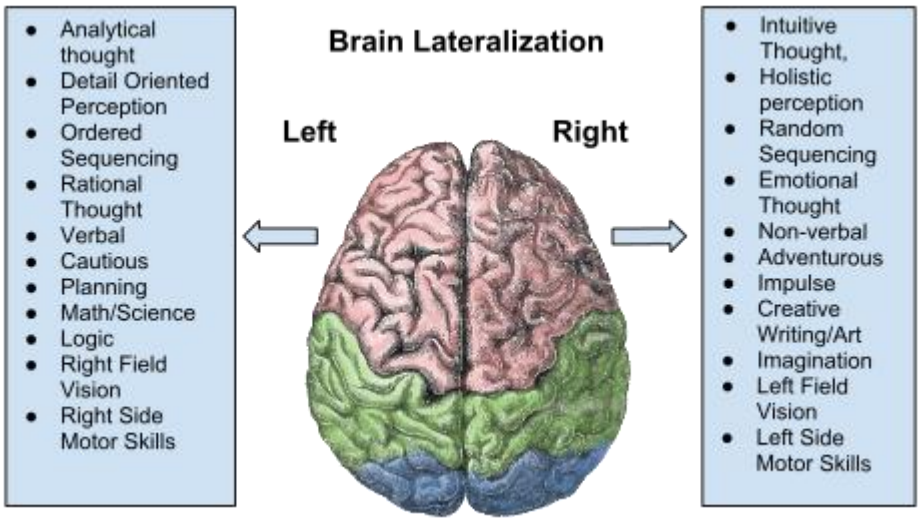
Courtesy: blog.mindvalley.com

Brain is composed of three main parts: 1) Fore brain 2) Mid brain 3) Hind brain.

1) Fore Brain: It is composed of three main parts i) Cerebrum ii) Thalamus and iii) Hypothalamus.

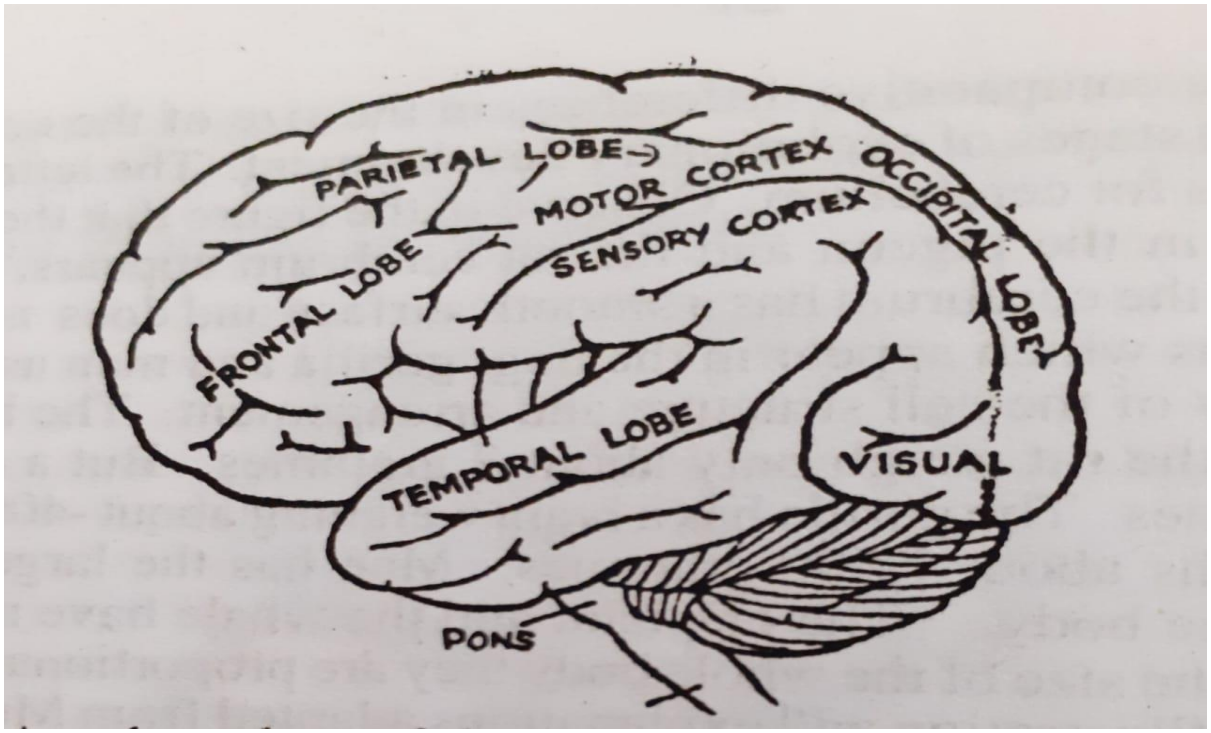
i) **Cerebrum:** The cerebrum is the upper part of the brain and forms the largest part of the brain. The cerebrum appears to be the seat of complex mental functions. That is, it is the seat of all mental control. The cerebrum in man is much larger than all the rest of the nervous system put together, it fills most of the skull. The cerebrum controls all the higher psychological processes such as perceiving, voluntary activities, learning, thinking, understanding, judging, remembering our experiences. The outer surface of the cerebrum is formed by hard and strong neurons which is a layer of greyish material called the cerebral cortex. This part receives the messages, and sends the message to the different parts of the body. It plays a significant role in controlling the behaviour of the organism through its nerve centre. Cerebral cortex alone contains about 14,00,000,000 nerve cells. For all purposes of intelligent activity this cortex or the grey matter is the most important part of the human brain.

The cerebrum consists of two symmetrical halves called the right and the left cerebral hemispheres.



Courtesy: en.wikipedia.org

The two hemispheres are connected at the bottom by a mass of nerve fibres called the Corpus Collosum. It is interesting to note that the right hemisphere is connected to the left side of the body and the left hemisphere with the right side of the body.



Based on the differences of the cell structure, the brain is divided into various anatomical as well as functional areas. We are interested in the functional areas. Each hemisphere has four areas or lobes as they are usually called

i) Frontal Lobe

ii) Parietal Lobe

iii) Temporal Lobe

iv) Occipital Lobe

Figure of the brain showing different Lobes

Different areas of the brain deal with motor activities, perceptual processes, memory etc. But this differentiation is not absolutely exclusive. The lobe of these areas are not physically separate from each other since they all form one mass underneath. Though these areas mostly control different kinds of responses the differentiation is not very strict. When necessary, the brain functions as a whole, other parts coming to the rescue of one.

Frontal Lobe

The frontal Lobe lies in the front part of the brain. It contains three functional areas. At the further end of the frontal lobe we have the motor area which controls the voluntary movements of the various parts of the body such as leg, arm, face etc. Each hemisphere is connected with the opposite side of the body. Thus, if there is any defect in this motor area of the left hemisphere, the right limbs will be paralysed.

Parietal Lobe

In the back half of the brain lies the Parietal Lobe. The most important functional area in this lobe is the somaesthetic area. All the sensory impulses coming from the various parts of the body reach this area. We may call this the Body Sensitivity area.

Temporal Lobe

It is concerned with auditory sensitivity. If we stimulate this area electrically, all sorts of noises will be heard by the subject. Destruction of this area results in deafness. Directly beneath the temporal lobe and connected with it we have the Gustatory area, that is concerned with taste sensation. At the one end of the temporal lobe we have the oleactory area also, that deals with smell sensation.

Occipital Lobe

At the back portion of the brain almost in a triangular shape is the Occipital Lobe. The important functional area located in this lobe is the visual area. The retina is connected to the Occipital Lobe.

ii) **Thalamus:** It is located midway between the cerebrum and cerebellum towards the centre of the brain – A mass of grey matter which acts as the sensory relay station directing sensory stimuli to their appropriate brain centres. All sensory impulses pass through it to higher nervous centre. It works like a relay station.

iii) **Hypothalamus:** It is located just below the thalamus. It is a small structure which is closely connected with the emotional behaviour, pleasant or unpleasant. Hypothalamus also controls functions such as temperature, metabolism and endocrine balance. It also controls motivational behaviour and eating, drinking and sleeping etc.

2) **Mid - Brain:** It provides connection between fore brain and hind brain. It controls the functioning of eye and ear, vision and hearing.

3) **Cerebellum or Hind Brain:** The Cerebellum is located just below the occipital lobe, behind cerebrum. It is responsible for muscle tone, body balance, co-ordination of voluntary movements as of fingers and thumb and the like, awareness of space, direction and distance. Damage to cerebellum affects standing up, walking etc.

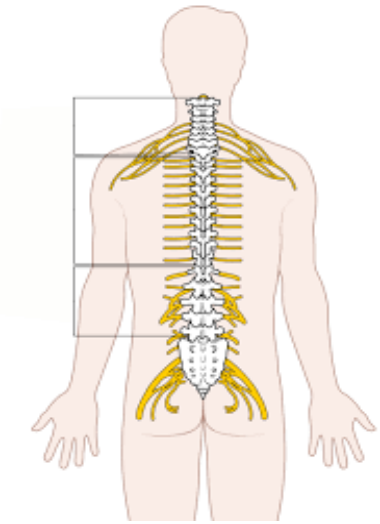
Functions of Brain

- Monitors and controls the life supporting systems like breathing, digesting, circulation etc.
- Controls and directs movements, postures and balance the body equilibrium.
- Interprets information received.
- Memorises information received.
- Problem solving, use of language, thinking etc.
- Enables to feel soft, hot, cool, hard etc.

- Works together with other systems and glands.

Spinal Cord: It is situated inside the spine. Spinal Cord is very important part of the central nervous system. It is connected from neck to the waist. It forms the channel for all messages to the brain and from the brain to different parts of the body. That is every information passes through the spinal cord.

Spinal cord controls the reflex action. Example is withdrawing the hand when you touch the hot thing or electric shock. Involuntary, actions which take place without our knowledge is controlled by spinal cord.



Spinal Cord(Courtesy: commons.wikimedia.org)

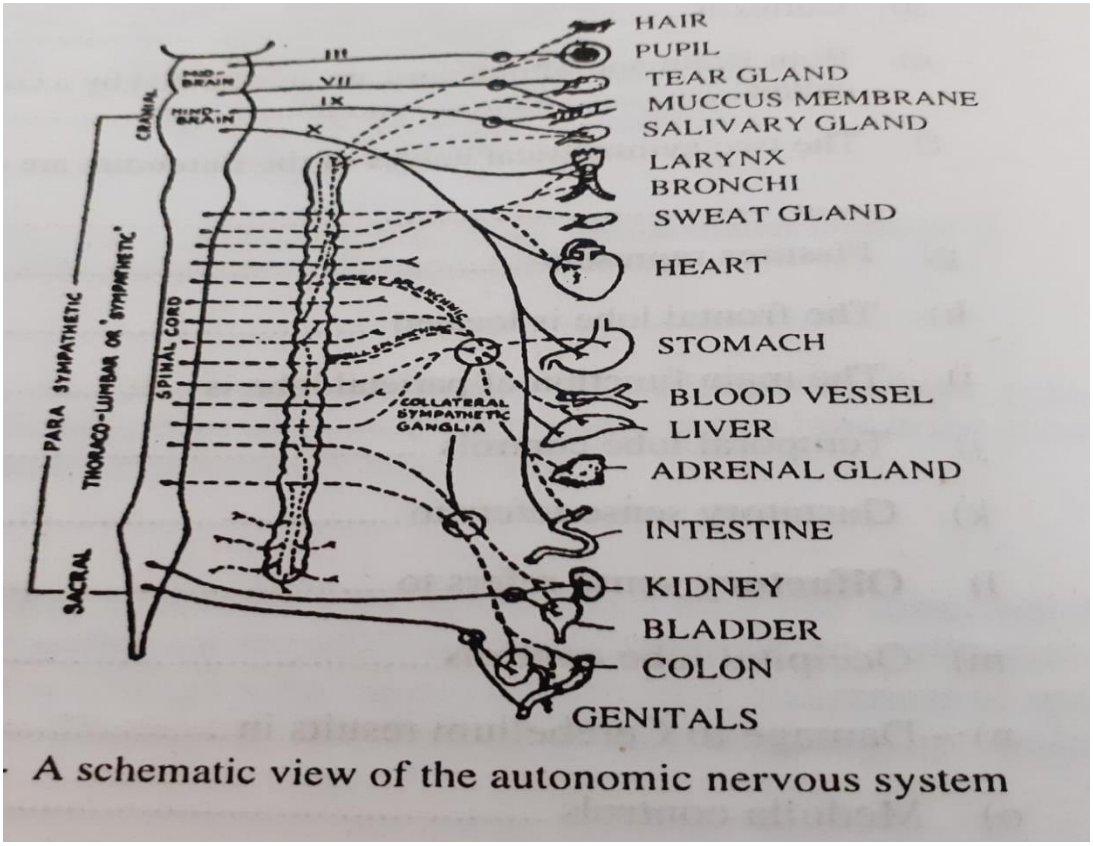
3.4 AUTONOMIC NERVOUS SYSTEM-STRUCTURE AND FUNCTIONS

There is another system called the Autonomic Nervous System. It is actually a part of the central nervous system, but has an autonomy of its own. This is controlled more by the hypothalamus. It is directly involved in our emotional life. Most of the organic changes in connection with emotions and the endocrine glands are all controlled by the automatic nervous system. It has its own nerves that are connected to the various glands and internal organs such as heart, lungs, liver, stomach, kidneys etc.

The autonomic nervous system has got two functional divisions called parasympathetic division and sympathetic division. Both these divisions are connected with all the internal organs and glands. The parasympathetic division controls glandular activities that are needed for the health of the organism while not in any dangerous or critical situation. These needs include nutrition, oxidation, promoting growth, sex functions etc. In the normal state all these biological functions are controlled and promoted by the parasympathetic part of the autonomic nervous system.

The sympathetic division comes into activity when the individual is in a state of danger or emergency. The extra energy which is needed in a dangerous situation is released and controlled by this sympathetic system through the relevant endocrine glands. The

liberation of Adrenalin from the adrenal glands in an emergency is largely controlled by this sympathetic division of the autonomic nervous system.



A schematic view of the autonomic nervous system

The glands served by the autonomic nervous system are of two kinds: Diet glands, like the salivary glands and Ductless (Endocrine) glands such as the adrenal glands. Smooth muscles do not have the stripes found in voluntary muscles of the skeleton. Smooth muscles are the ones located in the stomach, the intestines and the walls of the blood vessels. The muscles of the iris of the eye that control pupil size are also smooth muscles.

In most but not all cases, the two systems serve the same organs. A gland like salivary gland and the heart. In general the two systems have opposite effects on the organs they serve, For example: When the sympathetic system is aroused, the pupil of the eye dilates, the salivary gland stops secreting (that is what makes your mouth dry when you are frightened), the heart beat increases, blood vessels in the stomach and intestines contract, blood pressure rises, the electrical resistance of the skin falls and the adrenal gland secretes the hormone known as adrenalin or epinephrine.

On the other hand, impulses in the parasympathetic system cause the pupil of the eye to contract, the salivary gland to secrete saliva, the heart to slow down, blood vessels in the stomach and intestine to dilate and blood pressure to fall. The adrenal gland is served only by the sympathetic system, so that its output hinges entirely on sympathetic activity.

In the body system the sympathetic system acting pretty much as a whole, for physiological arousal. It has sometimes been called **emergency system** because all the things

it does prepare you for actions required meeting emergencies. It mobilises energy for the extreme exertion required to run away in a frightening situation or to fight at an attack. The parasympathetic system, on the other hand opposes the sympathetic system and so is the system of conservation.

Functions of Autonomic Nervous System

Organ	Sympathetic Function	Parasympathetic Function
Heart	Speeded up	Slowed down
Surface arteries	Dilated, more	Constricted, less blood
Visceral arteries	Constricted, less blood	Dilated, more blood
Pupil of eye	Dilated, more light	Constricted, less light
Sweat glands	Sweat Secreted	----------
Hair on skin	Hair erected	----------
Adrenal gland	Adrenalin secreted	----------
Liver	Sugar liberated into blood	Insulin secreted, Blood sugar reduced
Salivary glands	Salivation stopped	Salivation increased
Stomach	Contraction and secretion stopped	Dilation and secretion increased
Intestines	Contraction and secretion stopped	Dilation and secretion increased
Rectum	Defecation inhibited	Faeces expelled
Bladder	Urination inhibited	Urine expelled
Genital organs	Seminal vessels contracted	Erection induced.

3.5 CHECK YOUR PROGRESS

I. Answer the following questions.

1. What is peripheral nervous system?
2. What are nerves?
3. State the meaning of neuron.
4. Differentiate between motor neurons and sensory neurons.
5. List the main parts of brain.
6. Write any four functions of brain.

II. State whether the following statements are true or false.

1) The fibres branching off from the cell body are called dendrites and axons.
2) Short fibres around the cell body are axons.
3) Long fibres extending toward the neuron is called dendrites
4) Sense organs are called receptors and muscles which carry out the activities are called effectors.
5) Reflex actions are learnt and are mostly learnt after birth itself.
6) Brain is well protected by the encasing skull.
7) Cerebrum is the upper part of the brain.
8) Thalamus is the seat of all mental control.
9) Cerebral cortex alone contains about 14,00,000,000 nerve cells.
10) The cerebrum consists of two symmetrical halves called the right and the left cerebral hemispheres.
11) The frontal lobe lies in the front part of the brain.
12) Temporal lobe is concerned with visual area.
13) Thalamus is closely connected with emotional behaviour.
14) Hypothalamus is a mass of grey matter which acts as the sensory relay station.
15) Autonomic nervous system is controlled more by the hypothalamus.

III. Select the correct choice from among the given choices for the following statements.

1. The brain and spinal cord together are called the _____.
   a) Peripheral nervous system.
   b) Autonomous nervous system.
   c) Central nervous system.
   d) Sympathetic nervous system.
2. The message is carried from one part of the body to other is done by _____ cells.
   a) bone b) muscles c) body d) nerve.
3. The nerve cell with all its branches is called a _____.
   a) cord b) neuron c) nervous d) tissue.
4. The mass of nerves lying outside the central nervous system are called _____.
   a) Peripheral nervous system.

b) Inner nervous system.

c) Autonomic nervous system.

e) Sympathetic nervous system.

5. All those neurons that run towards the brain are called _____ neurons.

   f) motor b) sensory c) receptive d) effective.

6. A reflex is an immediate muscular or glandular response to specific _____ stimulus.

   a) sensory b) motor c) nervous d) nerve.

7. The Central Nervous System is the part of the _____ system.

   a) spinal cord b) brain c) nervous d) reflex.

8. The outer surface of the cerebrum is formed by hard strong neurons called _____.

   a) cerebellum b) cerebral cortex c) thalamus d) hypothalamus.

9. Mid brain provides connection between forebrain and _____.

   a) cerebrum b) thalamus c) hind brain d) cerebral cortex.

10. Automatic nervous system is controlled more by the _____.

    a) hypothalamus b) thalamus c) cerebrum d) cerebellum.

Answers to Check Your Progress

I 1) All the nerves (thread like fibres) which are spread outside the central nervous .

system are known as peripheral nervous system

2) Thread like numerous fibres spread all over the body under the skin are known as nerves.

3) The nerve cell with all its branches is called a neuron.

4) All the neurons that run towards the brain are called sensory neurons and all the neurons which carry messages from the different parts of the body to the brain are called motor neurons.

5) Main parts of the brain are a) Fore brain b) Mid brain c) Hind brain

6) Write any four function neurons of brain referring to the sub-section 3.3

II i) True ii) False iii) False iv) True v) False

vi) True vii) False viii) False ix) True x) True

xi) True xii) False xiii) False xiv) False xv) True

III 1) a. Central nervous system

2) d. nerve

3) b. neuron

4) a. peripheral nervous system

5) b. sensory

6) a. sensory

7) c. nervous

8) b. cerebral cortex

9) c. hind

10) a. hypothalamus

3.6 SUMMARY

- The nervous system is made up of three parts: the brain, the spinal cord and mass of interconnecting nerves.
- The mass of nerves lying outside the central nervous system all over the body are known as central nervous system.
- The neuron is the basic structural unit of the nervous system.
- A reflex is an immediate muscular or glandular response to specific sensory stimulus.
- The brain and the spinal cord together are called the central nervous system.
- The higher centres of the nervous system are located in brain.
- The brain and the spinal cord are situated within the bony case formed by the skull and spine.
- The brain is composed of three main parts 1. Forebrain 2. Mid brain 3. Hind brain.
- Fore brain is composed of three main parts I. Cerebrum ii. Thalamus and

  iii. Hypothalamus.
- Mid brain provides connection between fore brain and hind brain.
- Cerebellum or hind brain is located just behind the cerebrum and responsible for muscle tone, body balance, co-ordination of voluntary movements.
- Spinal cord is connected from neck to the waist.
- Autonomic nervous system is a part of nervous system and it has an autonomy of its own. It is directly involved in our emotional life.
- The autonomic nervous system has got two functional divisions called parasympathetic division and sympathetic division.
- The sympathetic division comes into activity when the individual is in a state of danger or emergency.

- The parasympathetic system on the other hand opposes the sympathetic nervous system.

3.7 GLOSSARY

Peripheral Nervous System: The mass of nerves lying outside the central nervous system all over the body is called peripheral nervous system.

Neuron: The nerve cell with all its branches is called a neuron.

Sensory neurons: All those neurons that run towards the brain are called sensory neurons.

Motor neurons: The other type of neurons that run from the brain to different parts of the body are called motor neurons.

Reflex: A reflex is an immediate muscular or glandular response to specific sensory stimulus.

3.8 QUESTIONS FOR SELF-STUDY

1. Explain the structure and functions of peripheral nervous system.
2. Explain the different parts of the brain.
3. Describe the structure and functions of spinal cord.
4. Describe the parts of autonomic nervous system.
5. Explain the functions of autonomic nervous system.

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UNIT –4 BIOCHEMICAL AND ENVIRONMENTAL DETERMINANTS OF BEHAVIOUR

STRUCTURE

4.0 OBJECTIVES

After studying this unit, you will be able to

- State the meaning of duct glands.
- State the meaning of ductless glands.
- Explain the role of endocrine glands.
- Explain the role of enzymes and nutrition.
- Bring out the environmental factors influencing pre-natal stage (embryo).
- Discuss the factors influencing post – natal environment of the individual.

4.1 INTRODUCTION

In the previous unit you have studied about nervous system. You have studied about peripheral nervous system, its structure and functions, central nervous system, its structure and functions, autonomic nervous system, its structure and functions.

You know that organism is always in the process of developing. Physical and psychological changes occur in the individual throughout his/her lite-span. Individual's development or changes are influenced or caused by different factors. You have already studied about genetic factors influencing the individual's development. In this unit you will study the biochemical and environmental factors determining the behaviours of the individuals. In other terms you will study the bio-chemical and environmental determinants of behaviour. You will learn about the role of endocrine glands, role of enzymes and nutrition and environmental factors influencing pre-natal and post-natal development of the individual.

4.2 ROLE OF ENDOCRINE GLANDS

You know that an individual is the result of heredity and environment. Individual grows and develops by the constant interaction with heredity and environmental factors. You also know that biochemical factors are also responsible the individual's development, behavioural changes and personality development. Few mysterious substances in minute quantities control the chemistry of the human body. These substances are the hormones, those powerful chemicals secreted in the body by the endocrine glands, the enzymes which turn one chemical substance into another. These magic chemicals maintain an extraordinary balance among forces so powerful that any of them could be destructive if unchecked.

Gland is an organ in the body, the function of which is to produce a specific substance exercising an important influence on the bodily functions. In our body there are a number of glands which maintain and stimulate the normal process of growth and development. This unit deals with all these in detail.

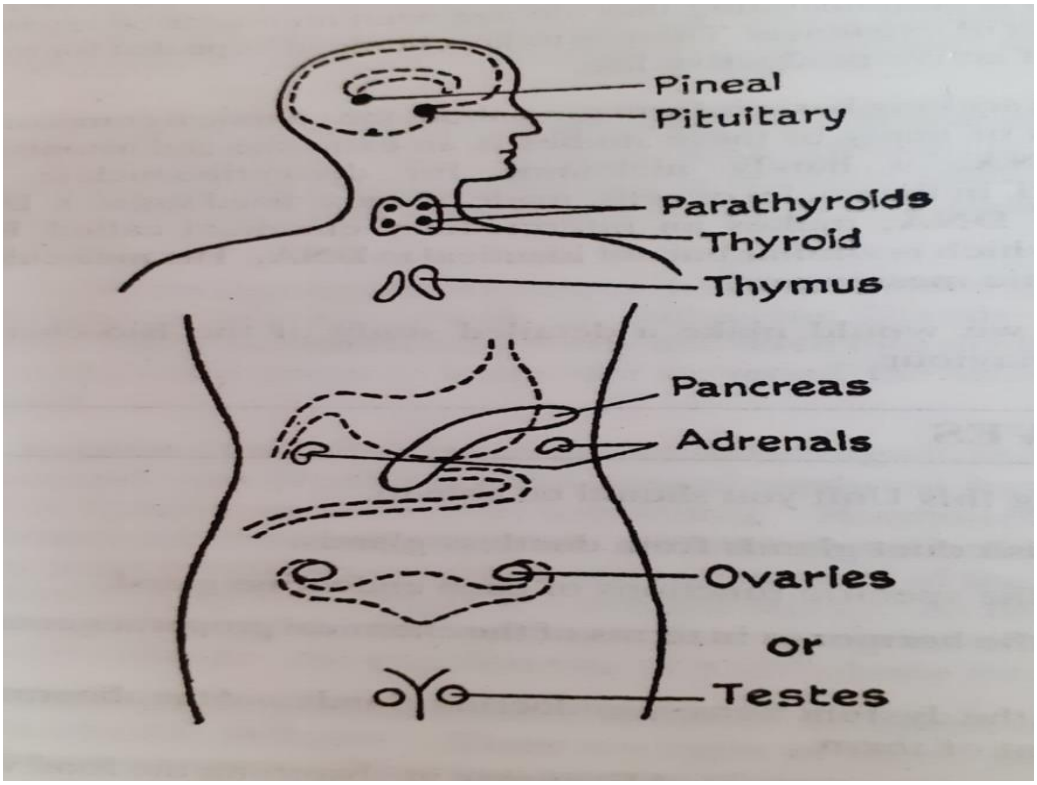
Glands are of two kinds. Duct glands and ductless glands. Duct glands like the tear gland, salivary gland, sweat gland are glands whose secretions are distributed at appropriate parts in the body through little tubes or ducts. For example, sweat glands squeeze the perspiration through little ducts to the surface of skin where rapid evaporation takes place.

In psychology we are more concerned with other type of glands that is ductless glands or tubeless glands or endocrine glands. They are glands of internal secretion. Their secretions

are directly delivered into the blood stream. These hormones have the power to 'accelerate' or 'retard' the activity of the body and its organs.

In general, the endocrine glands are small organs and not at all important in appearance, but physiology and clinical medicine have found these little chemical factories to be of vital importance. Hormones circulating in your blood stream are extremely important almost beyond belief. During the child bearing years of woman, her ovaries secrete an amount of the hormone estrogen approximately equal in weight to a postage stamp. At the time of puberty an amount equivalent to the tiniest corner of the stamp is sufficient to bring about an amazing change – the transforming of a girl's body into that of a woman.

When all the glands function normally or properly within the normal range and in a balanced way, it is possible to have a proper development. We call this condition as a good "Endocrine Balance". There are eight of them which together weigh only about two ounces. This tiny amount tissue acts as a kind of council of ministers for the body, directing myriad activities. All these glands should work together harmoniously perform different functions, of the body. Malfunctioning of these glands i.e. over or under secretion of hormones leads to abnormalities in behaviour and development.



Endocrine Glands

You know that endocrine glands are ductless glands which secrete chemical substances called hormones. They are called glands of internal secretion. There are altogether eight endocrine glands. Four of them are not studied much. Following figure depicts the location of different glands in the body.

The function of the pancreas is to secrete insulin. Millions of little cells secrete insulin and insulin promotes the utilisation of sugar which is already known to you. The parathyroid,

like four wheat grains attached to the thyroid seem to have one function – that of governing the amount of calcium, phosphorus and other electrolytes circulating in the blood and rarely give trouble. The pineal gland is a tiny cone-shaped gland attached to the underside of the brain. It is thought to be remnant of a third eye, man inherited from some primordial ancestor. The thymus in the upper chest is similarly mysterious, although it appears to play some role in the maturing process. The remaining four glands with which we are more concerned are the thyroid, the adrenals, the gonads and the pituitary glands. They are the body's major chemists, producing hormones of enormous complexity. Let us study about each one of these in the following sections.

The Thyroid Gland

The thyroid, a butterfly – shaped gland is located at the base of the neck in front of the windpipe and normally weighs less than an ounce. It behaves something like a car's accelerator; it speeds up or slows down bodily activity. Whether we live in a sluggish, sleepy, half-alive world, or in a racing, energy-charged world depends on thyroid hormone – thyroxin – secreted normally at the rate of 1/2800 of an ounce a day. Thyroxin is essential for the metabolism or the chemical activity of the body. Its enlargement into goitre (a swelling) may or may not indicate any thing seriously wrong in its functioning. When this gland is destroyed by disease, the individual loses his former vim and alertness and sinks into sluggish condition known as myxoedema. In this condition the skin will be puffy, the muscles and brain are inert. The individual is slow, stupid, forgetful and unable to concentrate or to think and act effectively. If the gland is defective from birth or is lost in childhood, growth is stunned and intelligence does not develop. In worst cases called cretins, the individuals remain dwarf, misshapen and imbecile, though placid in disposition.

The Thyroid Gland which is Located in the Neck Region

(Courtesy: commons.wikimedia.org)

Latest discoveries lead to the cure of myxoedema and restored to the normal state. Even the cretins can be helped if the use of thyroid substance is begun early enough. Their IQs can be brought far above the level of the untreated cretin although it cannot be pushed above the normal level.

The thyroid hormone – thyroxin – has been chemically analysed and found to have a composition indicated by the formula C15 H11 O4 N14. The carbon, hydrogen, oxygen and

nitrogen in this formula are the commonest chemical elements in the body, while the iodine is almost peculiar to thyroxin. The iodine taken into the body in food and drinking water, in very small amounts, is concentrated by the thyroid gland into this chemical compound. In the regions where the iodine has almost all been leached from the ground and carried down to the sea – as in Switzerland and the Great Lakes region of North America – the task of the thyroid gland is made doubly hard by the scarcity of Iodine taken in. Thyroid deficiency is common in these regions, but can be forestalled by iodizing the table salt.

You know that thyroid glands which are a pair located in the neck region and their primary function is to speed up the metabolism or chemical activity of the body, especially the process of oxidation. Thyroid secretion affects the structure and functioning of nervous system and development of intelligence. Over production of thyroxin leads to hyperactivity, restlessness, over-excitement and irritability. Over production of thyroxin also makes individual tense, worried and unstable. If he/she is still in the growing period, his / her growth is rapid, especially in length, and he/she becomes physically just the opposite of cretin dwarf. When the thyroid produces an excess amount of hormone, the condition is hyper thyroidism and the rate of metabolism is above the normal level.

Hyperthyroidism, (over activity) adulterates the metabolic processes and leads to weight loss, tremors, tenseness, insomnia, emotional instability and impairment in concentration and other cognitive processes. Psychotic symptoms which occur commonly include intense anxiety agitation and transitory delusions and hallucinations.

When this hormone is deficient in amount hypothyroidism occurs. Here the metabolism sinks to a low level, less oxygen is consumed and less carbon dioxide given off. Hypothyroidism (underactivity) results in severe depression. Whybrow et.al (1969) described a female patient who was seriously depressed, had frequent thoughts of suicide and become preoccupied with memories of her son who had been killed in an automobile accident some years ago.

In general, the impairment in both cognitive and emotional functioning appears more severe in hypothyroidism than in hyperthyroidism. Treatment of the latter leads to marked improvement. There is evidence that long-standing hypothyroidism may lead to a residual impairment in cognitive functioning. Fortunately, present methods of diagnosis are highly efficient and early treatment has made severe cases of hypothyroidism extremely rare.

Besides the extreme cases of thyroid excess or deficiency, there are probably many cases deviating moderately up or down from the norm. As far as known, there is little correlation between such deviation and intelligence, but there is some evidence that children's school achievement may drop below their intelligence level because of the apathy induced by moderate thyroid deficiency and indicated by a low metabolism.

The Adrenal Glands

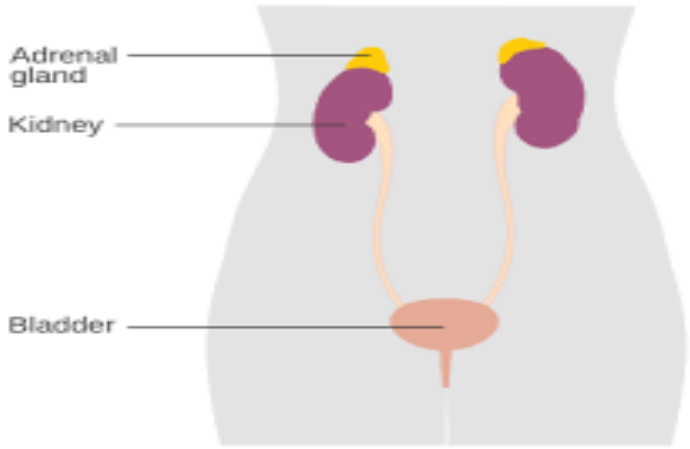
These little glands are named from their location close to the kidneys, though they are quite distinct in their function. Each adrenal consists of an outer part called the Cortex (bark) and an inner part called the Medulla (pith or marrow). The two parts differ in structure and

function. The hormone produced by the medulla is Adrenalin. The hormone produced by the cortex is cortin.

Adrenalin is a powerful hormone, very small quantises in the blood is sufficient to produce the following effect.

- Strong rapid heartbeat
- High blood pressure
- Forcing blood predominantly through the muscles and the brain rather than through the skin or viscera
- Suspended activity of the stomach and intestines.
- Wide opening of the air passages in the lungs.
- Release of the stored sugar from the liver.
- Delay of the muscular fatigue.
- Free perspiration and dilation of the pupil of the eye.

These effects are also produced by activity of the sympathetic division of the autonomic nervous system. The sympathetic nerves produce these results quickly and for short periods of time, while adrenalin, discharged from the gland into the blood, gives the same results more slowly but for longer periods. Because of their role in preparing us for emergencies, they have been called the 'Fight or Run' glands. For example, a man badly injured himself, rushes into a burning plane and saves others then collapses. It was the adrenals that provide energy for the act. The blood supply that comes to the adrenals is an indication of their importance. Each minute they receive blood six times their weight. The adrenals also quicken the clotting time of blood to reduce loss if bloodshed ensues.



The Adrenal Glands(Courtesy: commons.wikimedia.org)

The hormone secreted by the outer part of the cortex of the adrenal gland is called Cortin. Cortin is involved in the bodily utilization of sodium, potassium and sugar and has marked influence on muscular and sexual functions. It is necessary for life as it tones up the system. Complete destruction of the adrenal cortex in man, usually by tuberculosis, results in a fatal disease, named after is discoverer (1855), Addison's disease. The symptoms are: Progressive weakness and lassitude, loss of sex interest, low metabolism and low resistance

to any infectious disease. The skin darkens: The patient cannot endure heat or cold and suffers from insomnia. Individual's behaviour is marked by poor judgement, irritability and lack of cooperation. These symptoms are removed by administration of Cortin.

Over-activity of the adrenal cortex seems to be one cause of an excess of masculine characteristics in either man or woman. In a woman it causes loss of rounded feminine contours. Hypersecretion of the adrenal cortex may lead to a number of rare and dramatic changes in secondary sex characteristics. An over secretion of adrenal steroids in the male leads to the development of female characteristics, a condition referred to as feminism. On the other hand, an over secretion of adrenal steroids in the female results in a deepening of voice, shrinking of breast, growth of beard, and other masculine changes, a condition referred to as virilism. In children the over secretion of adrenal steroids accelerates puberty. The latter condition is referred to as puberty peacocks and children subject to it may develop adult status and reach sexual maturity at a very early age. Although still immature in other areas of development, such youngsters are usually extensively and aggressively interested in sexual matters.

In cases of tumour or abnormal growth of the adrenal cortex, there may be an excessive secretion of cortisone. The resulting clinical condition is referred to as crushing's syndrome. Typical symptoms include muscle weakness, fatigability, reduced sex drive, headache and a number of disfiguring bodily changes such as obesity, changes in skin colour and texture and spinal deformity. In some cases, there is an excessive growth of body hair. Crushing syndrome is relatively rare, occurring most often among young women.

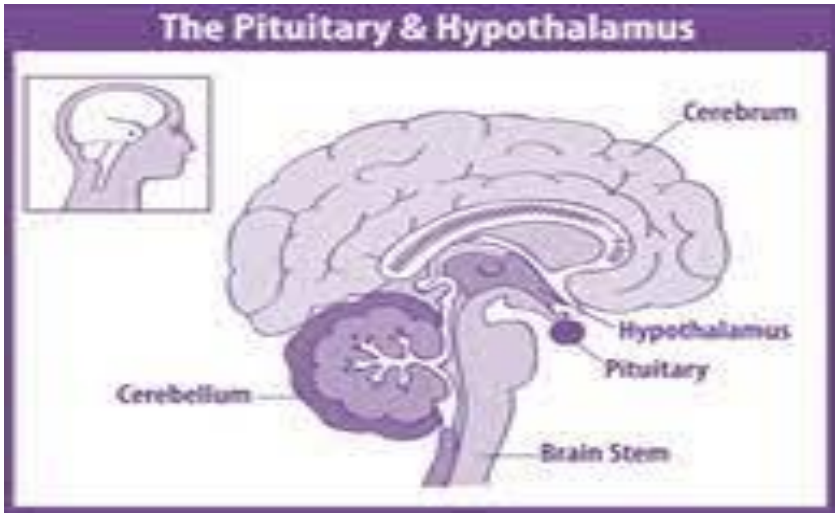
Treatment in adrenal dysfunction is primarily a medical matter. Cortisone and drugs which suppress adrenal cortex secretions are heavily relied on. In cases of tumour and related condition, surgery may be indicated. With early detection and treatment, the prognosis in adrenal disorders is usually highly favourable. These glands work together with sex glands or gonads.

The Gonads

The primary sex organs – female ovary, and male testis – besides producing the reproductive cells (ovum and spermatozoon) also secrete hormones that have important effects on growth and behaviour. There are several of these hormones and some of them are present in both male and female. Two important hormones secreted by gonads are androgen – the male hormone and oestrogen – the female hormone. A balance in favour of male hormones steers development in the direction of masculinity. At puberty these sex hormones promote the development of the genital organs and of such sex characteristics as mammary glands of women and the beard and deep voice in men. The internal reproductive processes in the female, including the menstrual or ovulation cycle, pregnancy and lactation are controlled very largely by hormones. Even the urge to give material care to the infant seems to depend on hormones, although the efficiency of maternal behaviour depends on the brain. In brief secretion of sex hormones affects the development of primary and secondary sex characteristics. It also affects the physical development and production of sex cells.

The Pituitary Gland

This is called the Master Gland because it regulates the working of other endocrine glands. The pituitary gland is a small structure attached to the underside of the brain at the centre of the head. Part of it, the posterior lobe, produces hormones which regulates bodily processes such as blood pressure and water metabolism. The anterior lobe supplies hormones that stimulate the thyroid, the gonads, the adrenal cortex and perhaps other glands. Without the pituitary hormones these glands do not develop or function normally. The most important hormone secreted by this gland is phyone the growth hormone.



Courtesy : Commons.wikimedia.org

The anterior pituitary also has great influence on bodily growth. If this gland is over active in childhood, the bones and muscles grow rapidly and the individual may become a giant, seven to eight feet tall. The gland after this period of over-activity is likely to become exhausted with the result that the giant loses muscular strength and dies young. If this same gland functions normally active during the growth period, becomes over-active during adult life, the individual without growing any taller, develops large hands, feet, nose, lower jaw etc. a condition known as Acromegaly (meaning big extremities) Over production of growth hormones results in gigantism.

Underactivity of the pituitary during the growth period is known to produce dwarfs of a symmetrical type, midgets, who are quite attractive in appearance and normal in intelligence. While they are still young their growth can be increased by pituitary extracts. Unbalanced production leads to over growth of certain parts of the skeleton or body. It also controls metabolism.

The relation of pituitary to behaviour and personality is very difficult to discover, partly because this gland works so largely by stimulating other glands. Endocrinologists are convinced that moderate over-activity of the pituitary makes the individual muscular, aggressive, self-controlled and calculating, while under –activity of this gland produces muscular weakness, sluggishness, easy discouragement and a tendency to give up and cry. These states of the organism may be produced however, not by excess or deficiency in the

pituitary hormones alone but by a lack of proper balance of all the hormones. Diagnosis of a particular endocrine disturbance is scarcely possible from the individual's behaviour alone.

4.3 ROLE OF ENZYMES AND NUTRITION

The human body is a chemical laboratory. To be alive and healthy we need food, water, air etc. There must be a system that can process whatever we consume and absorb the nutrients so that the cells within the organism can grow and multiply. This breaking down process is accomplished by nature's laboratory – the Human Body. Let us study about these chemical processes.

Enzymes: Nature's "Converters"

Enzymes are large protein molecules, present in all living things. From conception to death enzymes play a supreme role. Enzymes work on all the foods we eat to break down the complex foods into simpler substances which can be absorbed easily into the blood stream. All the activities of living things depend on the enzymes – the greening of leaves in the spring, the wagging of a dog's tail or illumination of a firefly. Enzymes play the supreme role in all life processes. They change sugar into glycogen. Enzymes help in building-up the new muscles. They take amino acids from the blood and produce new human muscles. When we chew a piece of food for some time it becomes sweet. It is because enzymes in saliva convert starch into sugar. Enzymes are the large protein molecules catalyse the biochemical reactions like digestion; they regulate the various body functions, carry different substances from the blood to various tissues of the body, help in the contraction of muscles, formation of cells and tissues of our body and fight infection in our body.

Enzymes perform chemical transformations that are difficult or impossible to perform in the laboratory. To digest a piece of steak in the laboratory to break it down into its component amino acids – it is necessary to boil the steak for nearly a day in concentrate acid. A body temperature enzyme accomplishes the same thing in a few hours! No one knows for sure how enzymes achieve their chemical wizardry. But each enzyme is specific in its action-it usually acts on only one substance. Thus, the enzymes which are known to be able to break up a fat of butter are powerless to break up sugar and sugar enzymes are unable to split proteins.

Enzymes do not merely break substances down; they also build up new ones. From the blood – stream they take amino acids and use them as building blocks to produce human muscle – quite a different substance. They change sugar into glycogen, which the liver can store to supply energy needs as they arise.

Chew a piece of food for a few minutes. You will note that it gradually becomes sweet. This is enzyme action. The body cannot utilise starch, but it can absorb certain sugars. So an enzyme in saliva has converted some of the starch into sugar, a process completed by enzymes of the digestive tract.

Pour a little hydrogen peroxide on a small wound. It foams up. The enzyme in the skin is breaking down the chemical into water and free oxygen, which makes the foam. In a

single second one molecule of this enzyme can split 80,000 molecules of peroxide. In the intestine, a molecule of the enzyme can break down a million times its own weight of sugar.

There are more than 650 enzymes are known to the scientists and they guess that many more are likely to be discovered. There are countless millions of cells in the body. But even the smallest is estimated to contain at least 100,000 enzyme practices. If a cell is regarded as a factory, the enzymes are the machinery that makes the factory work.

Some of the enzymes are oxidants – fuel burners. They take a minute fragment of food and start it on a series of chemical reactions that produce one of the most extraordinary substances on earth. "Adenosine Triphosphate or ATP for short. In effect ATP is minute storage battery which releases stored energy to make muscle fibres contract. Every time your heart beats, every time your eyelids blink, every time you take a breath it is ATP that provides energy for that action!

Today, may scientists be convinced that number of diseases can be traced to missing or faulty enzymes. Enzyme deficiencies lead to several problems and disorders. Without enzymes our body cannot break down foods so that nutrients can be fully absorbed. A lack of digestive enzymes can lead to variety of gastrointestinal symptoms. If can also leave you mal nourished, even if you eat the nutritious diet. In the same way various enzyme deficiencies will lead to different disorders or diseases. Enzyme deficiencies could be eventually be possible to make up the lack with synthetic enzymes.

Nutrition: Key to Good Health

The human body requires a combination of foods for its maintenance, growth and repair etc. These foods are chemically divided into five groups: carbohydrates, fats, proteins, vitamins and minerals. Ideally our diet should therefore contain all these constituents of food in the right proportions. Such a diet is called a need diet.

However, scientific surveys reveal that the Indian diet is deficient or ill balanced as regards certain essential food factors. This often happens due to the fact that we eat to satisfy our appetites and not to fulfil the needs of our body. May suffer from diet deficiency of which we may not be aware.

Food is basic to our existence and is the sustaining power behind all our body movements both in sickness and health. The need for extra nourishment cannot be over looked, especially since our diets may lack the right balance.

Balanced Food(Courtesy: flickr.com)

A diet that is lacking in the vital foods a body needs may lead to tiredness and lethargy and may leave the body open to infection and sickness. A diet supplement that is an ideal balance of carbohydrates, fats, proteins, vitamins and minerals, helps restore a sense of well being and guards against illness.

Growing children spend more energy than their food alone can provide and they renew their energy at the expense of body tissue. This hampers growth. A body building and energy giving food is essential to supplement their diets.

Why are some children poor eaters and others not? Sometimes it is simply a case of lack of activity. Often the cause is a deficiency of vitamins play a vital role in life. Food plays a vital role in stimulation of appetite and better utilization of carbohydrates in the food. For children who are indifferent eaters, a daily dose of a tonic containing vitamin B, can make all the difference.

The food quantity only is not enough and quality of food children eat is the determining factor of this growth – both mental and physical. The right kinds of food are milk, milk products, cheese, eggs, meat, chicken, fish, dals, pulses, peas, nuts, leafy green vegetables and fruits. Vegetarians must take a lot of milk, dals, peas, nuts, grams and cheese to make up the protein deficiency.

'Vitamin B' is required to stimulate the appetite, encouraging growth and to prevent stomach and intestinal complaints. 'Vitamin B 6' is required for metabolism of proteins and fats. 'Vitamin B12' is required for the formation and growth of red blood cells, thereby improving vigour. 'Iron' is required for its role in formation of haemoglobin in blood. It is especially important in a country like ours where anaemia is a frequent childhood complaint 'Lysine' which is one of the essential amino acids that go to make up proteins. It is often lacking in the Indian diet and without it the body cannot fully absorb the other proteins we eat – Proteins build the body and the brain – there would be no life without proteins.

Some of the vitamin deficiencies lead to different diseases or abnormalities in individuals. Vitamin A deficiency leads to night blindness, vitamin B deficiency leads to beriberi, vitamin C deficiency leads to scurvy, vitamin D deficiency leads to rickets etc.

Minerals

Body requires large number of minerals in small quantities. Minerals such as iron, iodine, calcium, phosphorus, sodium, potassium etc are required by the body. Iron deficiency leads to anaemia, iodine deficiency causes goitre, calcium and phosphorus deficiency leads to bones and teeth problems.

NUTRITIOUS FOOD PHYRAMID (Courtesy : Commons.wikimedia.org)

4.4 ENVIRONMENTAL FACTORS – PRE - NATAL

Human life begins as a tiny cell almost about 1/200 of an inch in diameter and called zygote or fertilized ovum. This zygote grows and develops amazingly in the mother's womb. An individual is the result of both heredity and environment.

Before learning about the prenatal environment let us learn the meaning of environment. Environment is everything that affects the individual except his genes.

Environment is the sum total of stimuli that influences the individual. Environment includes all the factors that act upon the individual since he begins his life.

At the moment of fertilization, the existence of a new human being has been determined. By the union of sperm and ovum an individual has inherited a mixture of the physical traits of both parents as well as those hereditary traits which he/she in turn will transmit to his/her offspring. Environment surrounded by the foetus after conception till birth is called pre-natal environment. After conception for the next nine, nine and half months the zygote is profoundly influenced by the environment surrounding it. It is called the prenatal environment – environment before birth.

Out of the unknown into the image of man – this is the miraculous change which occurs during the first month of human life. One grows from a so small fertilized cell or ovum which is barely visible, to a young human embryo almost one fourth of an inch long, increasing fifty times in size and nearly ten thousand times in weight. This growth occurs by cell division. The fertilized ovum divides into two cells, which then divide into four and so on until the millions of cells of human body have been formed.

In the first month this cell division causes us to change from a small egg cell in to a creature with a head, a body and with a heart that beats and blood that circulates, with beginnings of arms and legs, eyes and ears, stomach and brain. For the purpose of food a special 'feeding layer' forms on the outer edge of the little ball of cells and 'eats its way' into the tissues of the uterus. As these tissues are digested, the uterus form is a protective wall the placenta – which helps in feeding the growing embryo.

The maternal blood carries food, oxygen (the essential components of the air we breathe) and water to the placenta where they are absorbed by the feeding layer and passed on to the embryo through the blood vessels in the umbilical cord. In return, the waste products of the embryo are brought to the placenta and transferred to the mother's blood, which carries them to her kidneys and lungs to be thrown out.

Maternal Drug and Foetal Stress

Increasing number of women of child bearing age habitually use, one or more psychoactive drugs (Opiates, LSD, Cocaine) to alleviate the stress. Infants born to narcotic addicted mothers tended to be more irritable, less well co-ordinated, less alert, less stable in mood and less responsive to cuddling. Anything that is likely to harm the foetus will have its greatest effects early, when the zygote or embryo has relatively few cells and is most vulnerable.

Women who drink alcohol excessively during pregnancy have a greater than normal tendency to bear low birth weight infants. It could result in Foetal Alcohol Syndrome. Retarded physical growth, a small head and sub-normal intelligence, problems in motor co-ordination, heart defects and facial abnormalities appear.

Children of mothers who smoke during pregnancy are relatively likely to be physically or mentally slow for their ages. Smoking causes uterine and placental vessels to contract, reducing the foetus's nutrition and oxygen supply. Smoking also raises the mother's Vitamin – A level, in large amounts vitamin – A causes deformities.

Exposure to radiation also causes birth defects. Infants born after the atomic bombing of Hiroshima and infants born to mothers who had received heavy dosages of X-rays during pregnancy had defects at the foetal stage.

Drugs given just prior to and during delivery to anesthetize the mother or reduce her discomfort may have several unfortunate consequences. They pass through the placental, enter the foetus blood – stream and tissue, reduce the available oxygen and affect the child's Central Nervous System.

In brief, nutrition is received by the embryo through the blood stream of the mother. Physical and mental state of the mother, habits of the mother like smoking, consuming alcohol, taking drugs etc will have the effect on the embryo. Several medicines, strong antibiotics taken during pregnancy, serious diseases like chicken fox, small fox etc will also have the effect on embryo development. Severely distressed mothers appear to create problems for their unborn children. Pregnant women respond to emotions such as rage or anxiety with a massive outpouring of adrenal hormones. These secretions may enter the foetus's blood stream and affect the growth of the foetus.

4.5 ENVIRONMENTAL FACTORS – POST - NATAL

The term ‘environment’ is broad and general which include physical environment as well as social environment. . Physical environment is concerned with nutrition and climatic conditions. Social environment refers to the culture surrounding an individual. Sometimes it is called social heredity or social heritage, because it is handed down to us from successive generations of human beings. Language, customs, manners and traditions represent the accumulated wisdom of the past, handed down to the present generation.

In much the sense that man receives a genetic inheritance which is the end – product of millions of years of biological evolution, he/she also receives a socio – cultural inheritance which is the end – product of many thousands of years of social evolution.

After birth child is exposed to the numerous environmental forces that are purely external in nature.

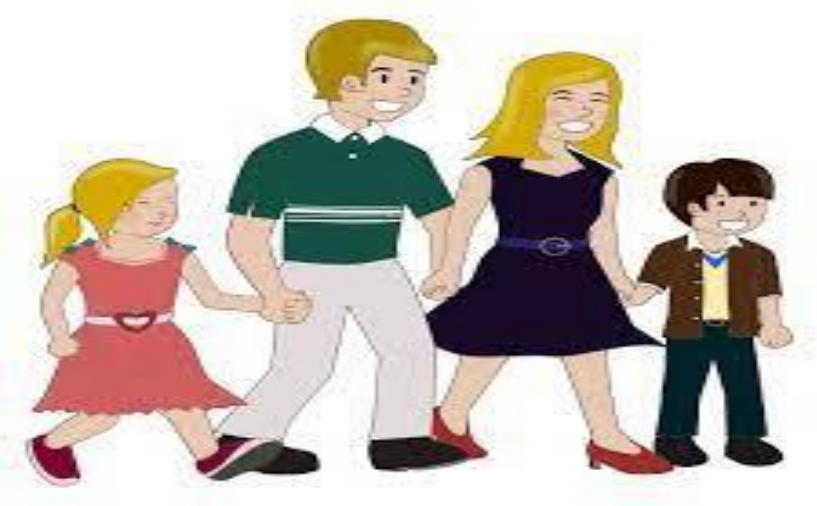
Home and Family Environment

Every child has a house; few have homes. A supportive, warm, permissive parenthood would result in the development of personality – traits of self – esteem, autonomy and amiability. An authoritarian, restrictive and overbearing parental domination can make one meek, submissive and dependent. Child – rearing practices could be ‘facilitative’ or ‘inhibitive’. Working class families would emphasise obedience and punish severely whereas middle class families are more permissible and stress independent, self – control and consideration for others. Affluent families could be indulgent and spoil the youth. Regardless of the heredity status, family environment leaves a definite imprint on one’s personality.

Family moral behaviour has profound effect upon the youngsters. A home with low moral behaviour does not present a good model for imitation or emulation. Children from homes where good moral behaviour prevailed were better adjusted than those from homes showing family discord.

The language – delayed children in contrast to the normal children, had mothers who showed less emotional and verbal responsiveness, tended to employ more restriction and punishment. They were provided with fewer adequate play materials, displayed fewer opportunities for variety in daily stimulation.

You know that home is the child’s world at the earlier stages of development. The food and nutrition supplied influences the child’s physical and physiological development. Health care, child rearing practices, climate, physical atmosphere etc also influences the physical development of the child.



HAPPY FAMILY (Courtesy: pixabay.com)

Children deprived of parental love, children who are typically neglected or rejected or given less attention suffer from inadequate care and concern at home. Rejecting and severely punishing may cause tension and unsatisfaction and may gradually result into behaviour problems. Cruel and abusive treatment towards children tend to develop aggressiveness, impulsiveness, inferiority, fearfulness, lack of capacity to form meaningful relationships and have difficulty in giving and receiving affection.

The traumatic or unpleasant experience inflicts serious psychological damage on the individual. Such traumas leave psychological wounds that never completely heal. Social support and parental support given to the children may help to heal it.

Over protection and Restrictiveness will also have impact on child's behaviour. Parents who are over protective will watch over their child constantly and protect them over slightest problems and risks. Many children who are over protected have excessive anxiety and fear. Over protected child is not provided the opportunity to test the reality and development of essential competencies and skills. It makes the child incapable of coping with day – today problems.

Restrictiveness is rigidly or strictly enforcing the strict rules and standards on the child. Restrictiveness hardly gives any freedom or autonomy to the child for growing in his/her own way. Restrictiveness may foster well controlled, socialised behaviour but it can also nurture fear, dependency, submission, repressed hostility etc. As an adolescent, such child may be rebelling against restrictiveness or restrictions.

Unrealistic Demands on the part of the parents may create problems in children. Some parents place excessive pressures on their children to live up to unrealistically high standards. For example, a child may be expected to excel in school and other activities. If the child has the capacity for exceptionally high-level performance, things may workout. If the child is not able to live up to parental expectations and demands the effort to achieve more will only bring more painful frustrations and self-devaluation. High parental expectations are good and helpful for children if they are realistic. Both unrealistically low demands and no care and

unrealistically high demands of parents may lead to faulty development and maladjustment of the child.

Over permissive parental behaviour makes children to have a stubborn (perverse) tendency to exploit any such parental weakness. Overly indulged children are usually spoiled, selfish, inconsiderate and demanding. When they are grown up, they tend to exhibit anti-social and aggressive behaviour. They exploit people to their own purpose or in achieving their own goals. They tend to be impatient and approach problems in a aggressive and demanding manner. Pampered children will have difficulty in facing the world.

Some parents may punish children one day and ignore or reward them the other day for doing the same act. Inconsistency in parental discipline and behaviour may lead to maladaptive behaviour. Overly severe and harsh punishment may have fear and hatredness for the punishing person.

Undesirable parental model will have the influence on children's behaviour as children tend to observe and imitate parents, parental model will have impact on child's feelings, thinking and learning to perceive and act. Undesirable parental models may lead to delinquencies, crimes and other forms of maladaptive behaviours. Example – an alcoholic parent.

In discordant family one or both of the parents are not satisfied with their relationship. He/she or both may express their feelings of frustration in hostile ways such as nagging, battling, quarrelling etc. Serious disagreements and differences of opinion may likely to create frustration and hurtful situations. Children brought up in such families may develop behavioural problems.

Disrupted family is an incomplete family. It is incomplete because of death, divorce, separation or some other reasons. Single parent family creates lot of stress for children. Delinquency and maladaptive behaviour are much more persistent among children and adolescents from disrupted families than among those from intact homes.

Inadequate families are unable to cope with the ordinary problems of the life and who lack resources to meet the demands of the family. These families rely heavily on outside assistance and support in solving everyday problems.

A neat and clean home, parents with more years of education differs from a home of dirty and soiled clothes, less educated parents. High educated parents are likely to create an environment that is intellectually stimulating for a child. Stimulation of the right kind – conversation, attention, fondling and playing has facilitative effect on cognitive development.

Security is one of the needs required for the well being of the children. It is fostered by parents in the home atmosphere by the right kind of upbringing. A child who is deprived of love and affection at home would feel insecure and is likely to carry over this feeling to the outside world. Case-studies of delinquent children reveal the fact; by and large they emerge from broken homes and unhappy families. Deprived of love and affection and acceptance, they tend to be suspicious of everyone in the world. They do not have a sense of belongingness.

Another important need that promotes healthy development is freedom. One may be totally deprived of freedom or left free to behave in an unbridled manner. Children grown in an atmosphere where complete freedom is given, they expect similar atmosphere outside the house also. Such children are likely to become rebellious and aggressive when things happen contrary to their whims and fancy.

4.6 CHECK YOUR PROGRESS

I. State whether the following statements are true or false:

1. Individual grows and develops by the constant interaction with heredity and environment.
2. Few hormones in minute quantities control the chemistry of the human body.
3. Ductless glands are glands whose secretion are distributed at appropriate parts in the body through little tubes.
4. The thyroid gland is located at the chest area.
5. The hormone secreted by thyroid gland is called thyroxin.
6. The impairment in both cognitive and emotional functioning appears more severe in hyperthyroidism than in hypothyroidism.
7. Adrenal glands are called master glands.
8. Enzymes are large protein molecules present in all living things.
9. Environment surrounded by the foetus after conception till birth is called neo-natal environment.
10. Family moral behaviour has a propound effect upon the youngsters.

II. Answer the following questions:

1) What is a gland?
2) Differentiate between ductless glands and duct glands.
3) Which are 'fight or run' glands?
4) What happens if the pituitary gland becomes over-active?
5) List any five minerals required by the body.
6) What is environment?
7) List any four factors affecting the embryo in the mother's womb.
8) List any four family factors affecting the behaviour of the child.

ANSWER TO CHECK YOUR PROGRESS

I i) True ii) True iii) False iv) False v) True

vi) False vii) False viii) True ix) True x) True

II 1) A gland is an organ in the body with a function of producing a specific substance exercising an important influence on the bodily functions.

2) Ductless glands are glands which secrete their secretions directly into the blood stream and duct glands are glands whose secretions are distributed at appropriate parts in the body through little tubes or ducts.

3) The adrenal glands are called 'fight or run' glands.

4) Over – active pituitary gland makes the bones and muscles grow rapidly and the individual may become a giant.

5) Iron, iodine, calcium, phosphorus and sodium are five minerals required by the body.

6) Environment is everything that affects the individual except his/her genes.

7) Use of psycho active drugs (opiates, LSD etc), drinking alcohol, smoking, exposure to radiation and X-ray, nutrition received etc are some factors affecting the embryo in the mother's womb.

8) Family factors such as moral behaviour of the family, parental love, affection and care, rejection or severe punishment given to the children, over protect and restrictiveness etc affect the behaviour of the children.

4.7 SUMMARY

In this unit you have studied about the role of endocrine glands, enzymes and nutrition. You have also understood about environmental factors influencing the embryo and child after birth.

4.8 GLOSSARY

Gland: It is an organ in the body with a function of producing a specific substance exercising an important influence on the bodily functions.

Enzymes: These are the large protein molecules which catalyse the biochemical reactions like digestion in our body.

Environment: It is everything that affects the individual except his/her genes.

Pre-natal environment: It is the environment surrounded by the foetus after conception till birth.

4.9 QUESTIONS FOR SELF-STUDY

1. Discuss the role of endocrine glands in human development.
2. Explain the enzymes and nutrition in human body.
3. What is pre-natal environment? Discuss the factors influencing embryo.
4. Explain how family environment influences children's behaviour.

4.10 REFERENCES

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