

UNIT-III ANIMAL BEHAVIOUR (ETHOLOGY)

INTRODUCTION:

The scientific study of the characteristic behaviour patterns is called Ethology. **It is a branch of science that deals with the study of scientific, biological and specific patterns of behaviour in animals.** Ethology is originated from two Greek words i.e. **Ethos=character/habit, logos=study.** Ethology is a branch that analyses the reactions of animal to its environment, trying to determine its specific cause and effect relationships between the animal's actions and events and conditions experienced by the animal thus, behaviour is the study of what animals do as they react to their environment with particular patterns of muscular and glandular activity. An animal's behaviour is of primary importance particularly for its survival. It must find its food and shelter; it must escape from predators and should compete successfully with others of its kind.

A scientific study of animal behaviour involves a variety of approaches. It can be explained in terms of its evolutionary history, in terms of benefits it brings to the animals in terms of psychological mechanisms. How an animal reacts to the changes in its environment and how it behaves with the other organisms around is behaviour. Behavioural changes are not passive. They are directed actions that promote survival. There are two factors that determine the way an animal responds in a particular circumstance, its genetic makeup and its previous exposure to similar circumstances.

HISTORY:

The history of ethology is as old as pre-historic man, because at that time, human beings were hunters they had to study the behaviour of animals. This fact is revealed in' paintings on the walls of excavated caves. **Aristotle (372 BC)** wrote for the first-time, excellent descriptions of animal behaviour in his book **Historia Animallum.**

In 18th century, naturalists like **Gilbert White (1720 -1793), Charles Leroy (1723 -1789)** and **Charles Darwin (1809-1882)** have described certain aspects of animal behaviour. **Charles Darwin is regarded as the first one to make scientific study, of animal behaviour.** Darwin wrote his first text book on behaviour "**EXPRESSION OF EMOTION IN MAN AND ANIMALS**" in 1872. In this book, he concentrated on the use of facial expressions as a means of communication.

Famous ethologists of 19th century were **Herbert Jennings, Douglas A. Spalding, Charles Whiteman and Ivan Pavlove.** Pavlove, a Russian physiologist got Nobel Prize for his experiments in conditional reflexes.

During 20th century, **Oskar Hemroth** wrote his major papers in imprinting in ducks and geese. In 1918, **J.S. Szymanski** demonstrated the existence of biological clocks in animals. In 1925, **W. Rowan** proposed photoperiodism hypothesis of bird migration.

Classical ethology reached its peak with the works of **Konrad Lorenz** (1903-1989) and **Niko Tinbergen** (1907-1983), two European ethologists who together with **Karl Von Frisch** (1886-1983) shared Nobel prize in 1973 for physiology.

CONTRIBUTIONS:

I. KONRAD LORENZ:

- i. He is founder father of Ethology
- ii. He was lecturer in Animal psychology at the university of Vienna, Austria
- iii. He got this initial inspiration from his teacher Oskar Hemroth
- iv. Lorenz in his farmhouse observed shrews, frogs, monkeys, dogs and mainly greylag geese on which he carried out extensive studies and developed a theory of imprinting or childhood learning during critical period.
- v. His popular works were King Solomon's ring, Man meets dog etc.

II. KARL VON FRISCH:

- i. He was born in Vienna but spent his life in Germany.
- ii. His initial days of living was in farm land which allowed him to study on different types of animals and insects.
- iii. He carried out experiments using colour cards on insects.
- iv. His observations on honey bees enabled him to discover fascinating things on their attraction toward coloured things.
- v. His most significant discovery was about the bee dance i.e. bees have 2 types of dancing behaviours, they were wagging and circular dance.
- vi. He also studied behaviour of bees during total solar eclipse.

III. NIKO TINBERGEN:

- i. He was born in Holland but lived in England.
- ii. He studied variety of animals from butterflies to gigger wasps to three spined stickle back fish and gulls.
- iii. Few of his books are; Animal Behaviour, The study of Instincts (1954), The animal in its world, Social Behaviour in Animals (1965).
- iv. His contribution on details of sign stimuli which are needed to elicit a specific instinctive behaviour is still appreciated.

STUDY AND SCOPE:

In general, behaviour can be defined as the way an organism reacts when it has been exposed to some change in its environment. Such changes are usually termed as 'stimuli'. The simplest response to a stimulus is kinesis or an increase in the activity of the individual. Opposite to kinesis is immobilization which inhibits the activity.

Depending upon the complexity of the system and its part within the given organism for receiving and evaluating the stimuli, following types of behaviour can be recognized;

1. **Stereotyped behaviour. Ex. Taxis, kinesis.**
2. **Learning behaviour. Ex. Imprinting, habituation.**
3. **Complex behaviour. Ex. Social behaviour.**

Modern study of behaviour follows the principle of good experimentation applicable in any field. Tests are made in a standardized situation kept as uniform as possible in one respect. One environmental factor is varied, which is the controlled stimulus. Responses, mainly motions are observed. Stimuli are varied in kind and intensity. Finally, the mechanism between stimulus and response are studied.

Branches of ethology are;

- ❖ **Etho-endocrinology** - study of relationship between hormones and behaviour.
- ❖ **Neuro-ethology** - relationship between sensory processes with a particular act.
- ❖ **Behavioural genetics** - study of genetic basis of behaviour.
- ❖ **Eco-ethology** - environmental influences on a species and its behavioural changes.
- ❖ **Human ethology** - recent branch of ethology dealing with human behaviour
- ❖ **Socio-biology** - study of social behaviour of an organism.

CLASSIFICATION:

Behaviour may be broadly classified into two types;

1. Stereotyped (innate) behaviour and
2. Acquired (learned) behaviour.

STEREOTYPED BEHAVIOUR:

Behaviour is called stereotyped when an individual repeats the same pattern of behaviour again and again. It is inherited and is necessary for survival. In case of stereotyped behaviour, the animal is stimulus bound. A pattern of stimuli triggers a sequence of responses. Such a kind of behaviour is the outcome of inherited properties of the nervous system of the animal. It is also called as **innate or inborn or inherent behaviour**.

Stereotyped behaviour is classified into 4 types;

- i. Orientation,
- ii. Instinct,
- iii. Reflexes,
- iv. Motivation.

A. ORIENTATION:

Orientation can be defined as special adjustment of animals in response to various stimuli. It involves single animal. Orientation is of two types.

- a) Kinesis and
- b) Taxis.

KINESIS:

The simplest form of spatial orientation is kinesis. **This type of orientation is un-learned and the movement of animal in response to stimuli is un-directed.** The response of an animal is proportional to the intensity of the stimuli. Kinesis is further distinguished into;

- 1) Orthokinesis and
- 2) Klinokinesis.

ORTHOKINESIS: It is the orienting mechanism where speed of locomotion is related to the intensity of stimulation. Example - *Ammocete larva of Petromyzon* is found buried in the bottom of water bodies like lakes and ponds with their head pointed below. If the light intensity is increased and they are exposed to it they exhibit active swimming with their heads pointing below. This movement helps them burrow again and move away from light.

KLINOKINESIS: In this type of orientation, the rate of change of direction increases in proportion to the increase in light intensity. It can be seen in the flat worm *Dendrocoelum lacteum* which is found in wet damp conditions and prefers dark places. If it is kept in diffuse or dim light, it turns occasionally but when the light intensity is increased, the rate turning in the animal also increases. This increase helps the animal to locate a darker place.

TAXIS:

Taxis is the orientation of the body with respect to the source of stimulation. It is simple movement influenced by the direction of the stimulus. In taxis, the animal's body takes up a particular direction which may be combined with locomotion, so that the animal moves **towards, away from or at the fixed angle to the source**. Ex: Movement of Earthworm to the surface after a heavy rainfall.

Taxis are distinguished into;

- 1) Klinotaxis.
- 2) Tropotaxis.
- 3) Telotaxis,
- 4) Menotaxis and
- 5) Mnemotaxis.

KLINOTAXIS: Klinotaxis is shown by the **animals which do not possess paired receptors**. Hence, they are not able to compare the intensity of stimulus on all sites simultaneously. Example, maggot has primitive eyes on its head that are capable to registering changes in light intensity but cannot provide information about the direction of the source of light. When the light on the left side is brighter than on the right, it tends to crawl more towards the right, away from the light source. If the light intensity is increased, the maggot increases the rate of head turning.

TROPOTAXIS: It is shown by those **animals which possess paired receptors**. With the help of receptors, they can compare the intensity of the stimulus in all sites simultaneously. Tropotaxis enables the animal to steer a course directly towards or away from the source of stimulation. Ex. Pill wood louse. It lives under stones or fallen trees and shows a positive photo-taxis after periods of starvation. With its two compound eyes, it is able to move directly towards a light source. When one eye is blocked out, it moves in a circle. When presented with two light sources, it turns towards one source.

Thus, in klinotaxis and tropotaxis, **the animals show the presence of a balance**.

TELOTAXIS: This type of taxis does not depend on the simple balance. If there are two sources of stimulation operating through the same modality, **the animal orients towards one or another and not in an intermediate direction**. This suggests that the influence of one stimulus is inhibited. Ex: Orientation of dragonfly towards its prey. Orientation of hermit crab towards one source or the other.

MENOTAXIS: It involves **orientation at a constant angle to the direction of the source of stimulation**. The path of homing ant is guided partly by the direction of the sun. If an ant is captured and placed in a dark box for some time till the sun moves at 37° , the ant deviates from the path to the nest by 37° when released. Another example of menotaxis is seen in honey bees. The round and waggle dances are performed at a particular angle to the Sun which gives the information about food.

MNEMOTAXIS: This type of **orientation does not involve configurational stimuli**. Some orientation responses in invertebrates depend on complex stimulus situation. Ex: The hunting wasps. It uses a number of land marks simultaneously when returning home. Experiments conducted by **Nico Tinbergen** showed that the return of insects was guided by the relation of the nest entrance to the whole configuration of land marks. If the nest entrance was changed, the wasp was not able to locate it.

B. INSTINCTS

Instincts are more complex and fascinating form of stereotyped behaviour. There are 3 criteria for instinctive behaviour;

- i. They are unlearned,
- ii. They are adaptive,
- iii. They are characteristic of species.

Instinct is an inherited pattern of fixed responses which are independent of an environment and learning. Instinctive behaviour of organisms is based genetically. Genes are responsible for all the behavioural patterns and these are modified and preserved with natural selection.

Ex 1: Food begging behaviour in gull chicks. Shortly after emerging from the egg, the gull chick begins to peck at the tip of its parent's beak. The pecks in turn induce the adult gull to regurgitate a mass of half-digested food. This serves as first meal for the chick. The pecking response is considered as an innate behaviour because it is characteristic of all baby gulls.

Ex 2: Nest building behaviour of tailor birds. Tailor bird builds nests by punching holes in the margins of two large leaves and sewing them with bits of string or spider webs. The tailor bird has not seen nest building by older birds and it has no previous experiences, but on its first try its nest is built.

Ex 3: Construction of spider web.

C. REFLEXES:

Reflex behaviour is the simplest form of reaction to stimulus. **It describes the rapid autonomic response of the body or part of the body to a simple stimulus.** Reflexes are normally autonomic, involuntary and stereotyped. They usually

involve the movement of a part of the body. Reflexes are the outcome of the neural mechanisms and a reflex action is directly proportional to the stimulus strength. Reflexes can be grouped into two;

1. **TONIC REFLEXES:** These are slow and long-lasting response. They are involved in maintenance of the muscular tone, posture and equilibrium adjustments.
2. **PHASIC REFLEXES:** These are fast and short-lived responses. They occur during flexion response of the body. Ex: Knee jerk reaction, withdrawal of hand from a hot object, bathing of eyelids when an object comes close.

REFLEX ARC AND ITS COMPONENTS:

The nerve path traced by a reflex is known as reflex arc. A reflex arc includes 5 neural components, they are;

- a. A cell or group of cells acting as sensory receptor.
- b. An afferent neuron carrying impulses from sensory cells.
- c. An efferent neuron carrying impulses to the effector cells.
- d. An interneuron connecting sensory and motor neurons.
- e. Effector organ or muscle or gland.

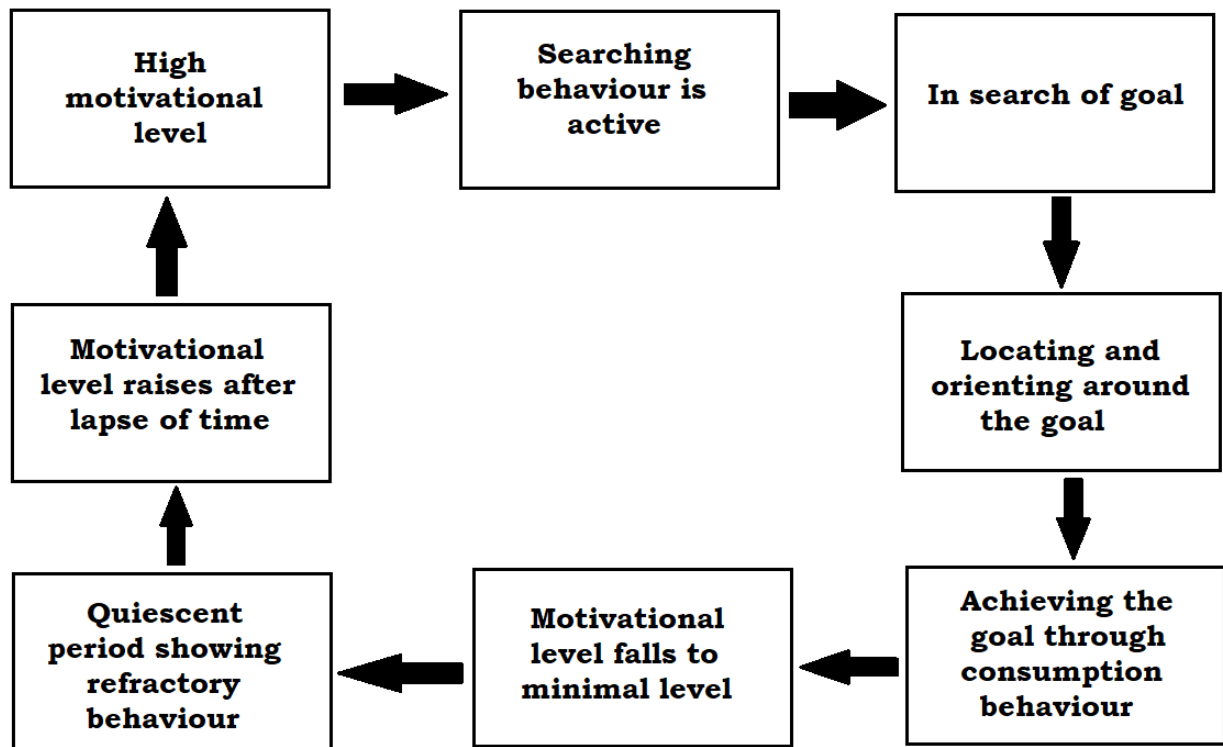
Many patterns of animal behaviour are actually the complex combinations of simple reflexes. Reflex response is one of the major forms of adaptation in animal kingdom. In course of evolution, reflexes became less prominent features of behaviour because they became more variable due to influence of neural mechanisms.

D. MOTIVATION:

Motivation is a type of stereotyped behaviour where motives are internal stimuli such as hunger, thirst, urge for sex etc.

Each instinctive behaviour has a motivational level at all times and this value declines when the act is performed, then rises again. At different times, the animals respond in different ways to the same stimuli.

Ex: A hungry dog would get up and sniff around looking for food. At this point, motivational levels or urge for eating is at its peak. When it finds goal (FOOD), it feeds on it and post feeding (full meal), the motivational level falls down to the minimal level. The dog then does not feed for next few hours, the motivational level rises gradually and the sniffing and searching behaviour is activated. The process goes on. Schematic representation of this is show below;



Thus, the dog responds differently to food when hungry or full. This is true not just with food, but almost all instinctive behaviours are regulated by motivation.

Motivation has been divided into 3 phases, namely;

1. Searching phase,
2. Achieving phase (Orientation around the goal and achieving the goal),
3. Quiescent period/phase (refractory behaviour).

ACQUIRED BEHAVIOUR (LEARNED BEHAVIOUR):

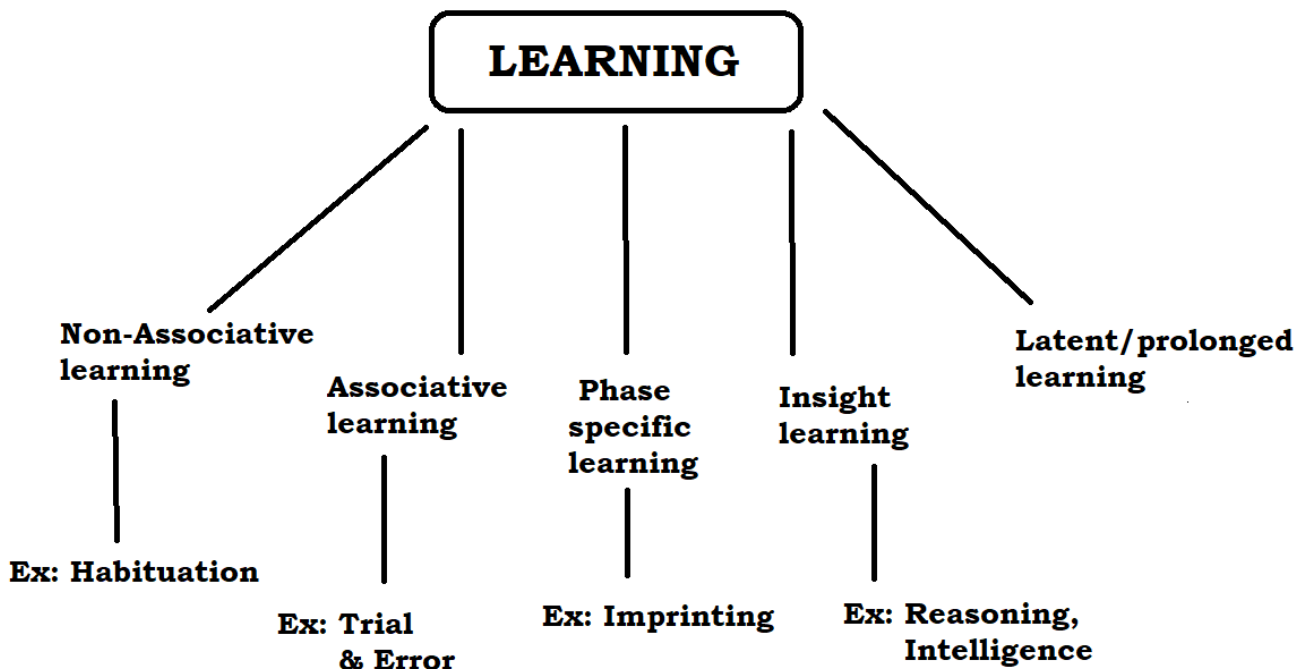
Learning can be defined as a process which brings about certain adaptive changes in the behaviour of an individual as a result of experience.

The ability to learn is a striking feature seen in most of the living organisms. It is the modification of stereotyped behaviour based upon past experiences.

Two criteria are used to distinguish learning from other stereotyped behaviour, they are;

1. Learning must be permanent and not result of fatigue,
2. Learning must not be a simple permanent change in behaviour resulting from maturation.

LEARNING CAN BE CLASSIFIED INTO FIVE MAJOR CATEGORIES:



I. HABITUATION:

Habituation is the simplest kind of learning. It is a form of non-associative learning. **Habituation is a process in which an animal learns to inhibit a response** and is considered to be the most primitive and wide spread form of learning. It is the general suppression of a stereotyped behaviour pattern as a result of a repeated stimulus that is not followed by an adverse effect. **In simple terms, it is a learning to ignore stimuli in the environment and not associated with any reward or punishment.** Ex: If a garden snail is allowed to crawl across a surface and the surface is tapped sharply, the snail will rapidly withdraw into its shell. After a few moments, it will come out again and starts crawling. Tapping the surface again will cause it to stop, withdraw, wait and re-emerge. This response will continue for a while but gradually the time taken to re-emerge diminishes and ultimately the snail will not respond to tapping at all.

To sum up, repeated application of stimulus often results in decrease response. This phenomenon is called habituation. **Habituation is regarded as a method of adjusting to the pressure of the environment** and is found in complex animals as humans as well as in ones with a simple nervous system.

II. IMPRINTING:

Imprinting is a specialized form of learning that is seen clearly in many kinds of birds during their early period of life. When the early period is over, the birds are unable to learn. Ex: Young ducks will normally follow their mother soon after they hatch. This following behaviour is the result of hatching. Imprinting occurs for a short period of time after hatching. If imprinting is prevented from occurring by hatching the egg in an incubator, and not exposing the young birds to an adult bird for some days, it never gets imprinted.

Experiments have been performed with ducks and other birds hatched in incubators. In case of many, the first large moving object seen by the newly hatched birds will be the stimulus for imprinting. If the first such object seen is a man, the young birds follow the man about. In simple form, if the young ducklings are hatched artificially and then exposed early to some moving object other than their true mother, they will behave towards the object as they normally would do their mother duck.

Imprinting, besides birds, is also been reported in **insects and man**. It is a limited and **restricted type of learning which unlike other learning is not possible at all times of the life, but occurs only during early stage of life.**

III. TRIAL AND ERROR:

It is also called as selective learning. This learning is generally associated with a reward or punishment. The animal learns either to get a reward or to avoid a punishment. Various types of mazes (i.e. problem apparatus) as well as other multiple-choice situations have been developed to measure learning ability in various animals.

Ex: A hungry cat is placed in a box. The box has two chambers which are separated by glass door. Food is kept in another chamber. The cat can see the food but cannot reach it. The door has many levers. The desperate cat presses all the levers and when it presses the correct lever, the door opens and it reaches the food. After repeated trials, the cat learns how to get the food and as soon as it is placed in the box, presses the correct lever and takes the food.

Most experiments on learning in animals involve mazes or problem apparatus. A maze is a series of pathways with many blind ends. The animal must choose the correct way to get out of the maze. If it makes a wrong choice, the animal touches a blind end and will be punished (Ex: Electric shock). After repeated trials, the animal learns to avoid blind ends and chooses the right path.