
Locomotion and Movement - Part 1

Objectives

After going through this lesson, the learners will be able to understand the following:

- The concept of Locomotion and Movement
- The difference between Locomotion and Movement
- Locomotor movements
- Types of Movement
- Movement in unicellular and multicellular organisms
- Movement in Vertebrates
- Movement in Plants

Content Outline

- Introduction
- What is Locomotion?
- What is movement?
- Difference between Locomotion and Movement
- What are Fundamental body movements?
- Types of Locomotion
- Types of Movement
- Movement in Plants
- Summary

Introduction

Change is inevitable. We all need change in our life in one form or the other. Like, one can even get bored of sitting idle in a place, and want some change in posture. He/She needs to move. Now, this movement can be moving from one place to another but not always. It can even mean stretching your back, legs, hands, neck, etc. It also means yawning, blinking your eyes, scratching your head, touching your face with your hands and much more. All these gestures have one thing in common, and that is movement. The only difference is when you are displaced from your place it is called locomotion and when you are moving your body parts, it is called movement.

For example, if someone says - Move on... It can mean, move from the place and sit or stand somewhere else. But not always. Sometimes you can even move your hand and say - I have moved my hand, so I have moved on. All this comes in the category of the interrelated concept of locomotion and movement. This module is all about the interrelation between the two.

All living organisms show a characteristic phenomenon of either moving their whole body from one place to another place or only a part of the body while the whole body remains fixed to a place. The locomotion helps the organism to shift its entire body from one place to another, i.e. change of location. Various acts of the body like walking, running, crawling, jumping, flying, swimming etc. are known as locomotory movements. Locomotory structures need not be different from those affecting other types of movements. For example - in paramecium, cilia helps in the movement of food through cut-pharynx and in locomotion as well. Hydra can use its tentacles for capturing its prey and locomotion as well. They use limbs for changes in body posture and locomotion as well.

This clearly indicates that locomotion and movement go hand in hand. They are inseparable and cannot be studied separately. Thus, in this module we would be discussing both the concepts one by one, with their comparisons and examples. One thing you should always remember for Locomotion and Movement is that all locomotions are movements but all movements are not locomotion.

What is Locomotion?

Locomotion is derived from the Latin word “locus” which means place and “movere” which means move. Locomotion refers to the ability to move. Locomotion in biology pertains to the various movements of organisms, single-celled or multicellular organisms, to propel themselves from one place to another. In multicellular animals, these movements include walking, running, jumping, crawling, climbing, swimming, flying, galloping, slithering, and so on.

The movement of an organism from one place to another, often with the action of appendages such as flagella, limbs, or wings. In some animals, such as fish, locomotion results from a

wavelike series of muscle contractions. Locomotion in animals and man, a variety of movement, described by an active shift of the body in space, that includes swimming, flying, and various kinds of movement on the ground (including man's walking and running). Locomotion plays an enormously important role in the life of animals. Animals move through, or on, four types of environment: aquatic (in or on water), terrestrial (on ground or other surface, including arboreal, or tree-dwelling), fossorial (underground), and aerial (in the air).

Generally, the animals show locomotory movements in search of food, mate and shelter. It also helps the animals to run from the adverse environmental conditions, and to move away from the predators. Methods of locomotion performed by animals vary with their habitats and the demand of the situation. However, locomotion is generally for search of food, shelter, mate, suitable breeding ground, favourable climatic conditions or to escape from enemies or predators.

Locomotion and movement in vertebrates including man are brought about by skeleton, joints and muscles. Fundamental movement skills are movement patterns that involve various body parts and provide the basis of physical literacy. Fundamental movement skills are the foundational movements, or precursor patterns, to the more specialised and complex skills used in play, games and specific sports.

Also the ability to move is to get from one place to the next. The locomotive system permits locomotion and consists of bones that are the framework of the skeleton, joints that hold the bones together and make movement possible, and muscles that contract and relax and make for movement. Humans have developed many other ways of locomotion through technological advances in transportation such as aircrafts, boats, or ground vehicles.

What is movement?

Movement is one of the things that differentiates a living thing from a non-living thing. Movement is an act of moving, change of place or posture, transference, by any means, from one situation to another, natural or appropriate motion, progress or advancement. as the movement of an army in marching or manoeuvring; the movement of a wheel or a machine, the party of movement.

Movement expresses a general idea of not being at rest. Movement is used to express a definite, regulated motion. Movement is when the living organism moves a body part or parts to bring without a change in the position of the organisms. Locomotion is when the movement of a part of the body leads to change in the position and location of the organism. Both of these are brought about by the joint efforts of the skeletal and muscular systems. Movement is seen in both vertebrates and invertebrates.

Movements of limbs, appendages, head and trunk serve to change the posture of the body and maintain equilibrium against the gravity. For example, taking in food involves the movements of tongue, jaws, snout, limbs in humans. Movements of the external ear and eyeballs help to perceive the information from the outside environments. Movements of the alimentary canal help to pass the food down. Movements of the heart circulate the blood in the body; lungs are ventilated by the movements of thoracic muscles and diaphragm etc.

Most of the multicellular animals have muscle fibers for locomotion, limb movements as well as movements of internal organs. In all higher animals i.e., vertebrates, there are mainly two systems that bring about movement and locomotion of the body. These two systems are the skeletal system and muscular system that work in coordination with each other. The force generated by muscle contraction is utilised to move bones of the skeleton like levers. This results in movements of limbs and appendages. So, the muscles working with the skeletal system are called skeletal muscles.

Fundamental Movement Patterns are patterns that allow the body to be coordinated in those simple, basic movement patterns of lateral motion, weight transfer, forward motion, up and down motion, and coordinating upper and lower body movements.

Difference between Locomotion and Movement

While discussing Locomotion and Movement separately above, we are now very well aware of the two concepts. Still, at times when we speak about locomotion and movement, we often use one for the other. But, it is important to understand the difference between the two in relation to living things.

Just for a short revision - Movement is the temporary or permanent displacement of a body or its parts from its original position. Living beings and parts thereof move in response to stimulus from outside or from within the body. Locomotion, on the other hand, is the displacement of the entire body from one place to another.

While both locomotion and movement sound similar in their meaning, there are a few interesting differences between the two:

- Locomotion takes place at organism level while movement can take place at any biological level from cellular to organisms.
- Locomotion is usually voluntary while movement could be either voluntary or involuntary.
- Movement essentially requires energy, but locomotion does not essentially require energy when the free-floating organisms are considered.

Usually plants do not move from place to place, but there are various types of movements that take place inside plants.

Both movement and locomotion are necessary for an organism to survive. Locomotion allows an organism to escape from predators, avoid harsh weather conditions, find food, and others. Movement, on the other hand, allows an organism to perform necessary functions, such as breathing, digestion, pumping of blood to the different parts of the body, and others.

Basic Body Movements

There are seven basic movements the human body can perform and all other exercises are merely variations of these seven: Pull, Push, Squat, Lunge, Hinge, Rotation and Gait. When performing all of these movements, you will be able to stimulate all of the major muscle groups in your body.

Pull

First, we have the pulling motion which consists of pulling a weight toward your body or your body towards your hands. This can be a vertical or horizontal pull, such as a pull up or

barbell row, respectively. The main muscles being worked in these set of movements are the mid and upper back, biceps, forearms and rear shoulders.

Push

The second motion is pushing, which is the opposite of the pull. This movement involves pushing a weight away from your body or your body away from an object. This group is also divided into a vertical and horizontal component as well. Exercises in this group include push ups and dumbbell shoulder presses. The muscles targeted are the chest, triceps and front shoulders.

Squat

Next, we have the squat — considered to be the most complex movement the human body is capable of. Variations of the squat include goblet squats, sumo squats, front squats and much more. The squat targets the glutes, core, quadriceps and to a slight degree, the hamstring muscles.

Lunge

Another lower body movement is the lunge, which involves your body in a less stable position of one foot further forward than the other. Since your body is at a disadvantaged stance, this movement set demands greater flexibility, stability and balance. Some exercises in this section are step ups, side lunges and Bulgarian split squats (despite its name, it is still considered a lunge). The lunge hits the glutes, quadriceps, core and hamstrings like in squats; however, it stimulates all three of the glute muscles to a greater degree because of the split stance.

Hip Hinge

hip hinge exercises, which are executed by kicking your butt back and leaning your torso forward while maintaining a neutral spine — like when picking up something off the floor. The most crucial exercises in this group are deadlifts, with varying forms such as sumo deadlifts, Romanian deadlifts, kettlebell deadlifts, etc. These exercises build the posterior chain, which comprises the hamstrings, glutes and lower back.

Rotation

The sixth movement, rotation, is unique from the other six movements because of the plane that it works in. The other exercises involve moving forward and backward or side to side, yet rotation involves twisting at the core. This motion is underrated despite being essential for success in sports. Rotation is seen while throwing a ball, kicking a ball, changing directions while running and many other actions. The core (specifically the obliques) are the main contributor to this set of movements. Exercises that fall under this group are Pull of presses, Russian twist and wood chops.

Gait

Lastly, we have gait, which is the technique of walking. This might seem trivial, but walking is a fundamental movement. Gait is a combination of multiple movements (involving lunging, rotating and pulling with the hamstrings). Exercises that could be done in this group include jogging, jumping and farmer's walk.

Fundamental Body Movements

Fundamental movement skills are movement patterns that involve various body parts and provide the basis of physical literacy. Fundamental movement skills are the foundational movements, or precursor patterns, to the more specialised and complex skills used in play, games and specific sports. Fundamental body movements are the building blocks necessary for more complex physical activities. Playing sports, exercising and dancing are some of the simple fundamental body movements. Students should master these movements in early childhood. If students master these fundamental body movements at an early age, they are more likely to remain active. Otherwise, students are not able to participate in such activities at a later age.

There are three main categories of fundamental body movements:

Locomotor movement

Locomotion involves locomotory organs that help the body to move from one place to another. Locomotion always occurs at the organism level and is always voluntary. These are movements where the body travels through space from one location to another. Locomotor movements primarily use the feet for support however, the body can travel on other parts such as the hands and feet.

Movements that occur over some distance is known as Locomotor Movement. Locomotor movements are the foundations of human movement. Walking, running, hopping, skipping, jumping, galloping, leaping and sliding are the eight locomotor movements.

Non-locomotor movement or Axial Movement

Non-locomotor movement or Axial movement is a movement that a person performs while remaining stationary. For example: Bending or flexing, Stretching or extending, lifting or raising, twisting, rotating or encircling, swinging, swaying, pulling, pushing, etc. Non-locomotor skills are fundamental body movements that do not incorporate traveling. They are stability skills that include movements of limbs or body parts, and sometimes even the whole body.

Manipulative movement

Manipulative movements involve both the body and an object. They are the movements most associated with games and sports. Manipulative skills involve moving or using an object with the hands or feet to achieve a goal or complete a task. For fine motor skills, that object might be a pencil or button. For gross motor skills, the object might be sporting equipment or toys such as bats, balls, racquets, or jump ropes.

Types of Locomotion

Locomotion in animals can fall under the following broad types:

Aerial = flying

Arboreal = living in and moving through trees

Aquatic = moving on water

Cursorial = running

Fossorial = digging and living underground

Saltatorial = jumping or hopping

The natural means of locomotion in other animals such as microorganisms or coelenterates are highly interesting. Hydra, the coelenterate, shows different types of locomotion; somersaults, walking with upside down body, climbing with tentacles, walking with bent and straightened body, gliding, and floating upside down beneath the water surface. Flagella in

Chlamydomonas and cilia in Paramecium could be considered as some classic examples for basic structures of locomotion. However, the adjustment of the body to create temporary locomotion structures is another primitive adaptation for the function, which is depicted in pseudopodia of Amoeba. However, there are organisms (plankton and other microorganisms) without specialised structures developed to accomplish locomotion, yet they move from place to place. The use of water or wind currents happens to be the aid of their locomotion, and they do not spend energy for that.

Types of Movement

Movement, on the other hand, implies the following basic mechanisms:

Amoeboid Movement

Amoeboid movement is brought about by pseudopodia which are appendages which move with movement of protoplasm within a cell. For example - In amoeba and certain cells in other organisms, such as the movement of leukocytes in the blood of humans.

Ciliary Movement

Ciliary movement is brought about by appendages called as cilia which are hair-like extensions of the epithelium. In ciliated protozoans, both these kinds of movements are seen with cells of the lymphatic system.

Flagellar Movement

A flagellum is a long, whip-like structure. While cilia cover the entire surface, flagellum is mostly present singly or in a small number at one end of a cell. Flagella occur in flagellate protozoan like Euglena or an alga like Chlamydomonas and in animal sperms. A flagellum beats symmetrically in a snake-like manner and propels the water parallel to the long axis of the flagellum.

Muscular Movement

Muscular movement is a more complex movement which is brought about by the musculoskeletal system. This type of movement is seen in the higher vertebrates. There are also many invertebrates like jellyfish, earthworm and leech, which are devoid of skeletons but possess muscles for their movements.

Movements in Hydra

Hydra lacks a well-developed muscular system. They have two types of contractile cells on its body wall, viz. epitheliomuscular cells in the outer layer of the body wall and the nutritive muscular cells in the inner layer. Contractions and relaxations of these cells, respectively, shorten and elongate their processes. Various types of movements seen in Hydra are looping, somersaulting, climbing, shortening and elongation etc.

Movements in Annelids

Earthworms and leeches have muscle fibers of the body wall that help these animals to crawl on land. These muscle fibers are of two types – longitudinal muscle fibers; and circular muscle fibers. In earthworms, the locomotion of the body is brought about by alternate contraction of circular and longitudinal muscles, causing waves of thinning and thickening to pass backwards. It involves partly a pushing of the anterior end and partly of the posterior end. The coelomic fluid gives turgidity as it acts as a hydraulic skeleton making the body wall tough. The worm moves at the rate of about 25 cm per minute.

Movements in Starfish

Starfishes have got a water vascular system that helps them in their locomotion. Each arm of the starfish has two rows of tube feet underneath. Water enters into these tube feet by the muscular contractions and this moves the animal over the surface of the substratum in water. Starfishes are bottom dwellers found in sea waters only.

Movements in higher vertebrates

In higher animals, movements and locomotion depend on the association of skeletal muscles with the skeletal system. The skeletal system consists of a specialised rigid connective tissue called bones. This skeletal system consists of many parts, each made of one or more bones.

Movement in Plants

Plants are rooted to the soil, so they don't possess the ability to move from one place to another. Thus, they do not exhibit locomotion. However, different types of movements can occur inside plants. Plants can also demonstrate movement in response to stimuli, like light, water, gravity, called tropic movements. In tropic movements, plants are fixed but their parts e.g., a branch or a flower move in the direction of stimulus.

When a plant part, such as the root or stem, moves towards the source of stimulus, it is termed positively tropic e.g., shoot moves and grows towards sunlight, it is positively phototropic. Root moves away from light, it is negatively phototropic. Similarly, there are other movements as well in response to stimuli. This includes hydrotropism i.e., movement towards water, geotropism i.e., movement towards gravity, thigmotropism i.e., movement towards Touch/Contact, etc.

Turgor movements are due to differences in water potential in different parts of the plant.

For example:

Leaf closes in the insectivorous Venus fly trap when an insect enters.

Mimosa pudica called 'chhui mui' in Hindi, droops when touched.

Guard cells cause opening and closing of stomata due to changes in turgor pressure.

Nastic movements are induced by certain stimuli like contact, change in day length, temperature etc. Unlike tropic movements in nastic movements the plant parts do not move in the direction of stimulus e.g. flowers of Portulaca, bloom in the day. But when light fails at sunset, the petals close in response to darkness and lowered temperature. In other words, the direction of movement of an organ is fixed but the stimulus may come from any direction.

Summary

Movement is a characteristic of living beings. It means a temporary or permanent displacement of the body or its parts. Locomotion is the displacement of the entire body from one place to another.

Cilia and flagella are organelles which help in movement. Ciliary protozoa advance with the help of cilia. Human sperms, certain algae like Chlamydomonas move from one place to another with the help of flagella. Cilia are many and move together causing a wavy motion. Flagella may be one or two and with whip-like strokes help in Locomotion. Most animals carry out Locomotion with the help of muscles.

All the organisms encounter movement at different levels including cellular, tissue, organ, or entire organism. Movements are the most visible means of the expenditure of energy that have been stored in organisms. When the animals walk, the muscles designed for walking are

contracted and relaxed accordingly. Similarly, all the movements are incorporated with a muscle or a set of muscles so that the required movement is accomplished through muscle contraction and relaxation. Movements in organisms could be classified into two major groups known as voluntary and involuntary.

Voluntary movements can be willingly controlled for an organism. Walking, running, speaking, writing, and an umpteen number of movements can be understood as voluntary movements. On the other hand, involuntary movements cannot be willingly controlled. Beating of the heart is a classic example for the involuntary movements. The movements incorporated with the digestion of food in the digestive system are mostly involuntary while the chewing and swallowing of food at the oral cavity are voluntary. It would be interesting to know that breathing can be controlled willingly as well as it takes place involuntarily. In addition, it would be important to state that there are an infinite number of cellular movements incorporated in all biological processes.