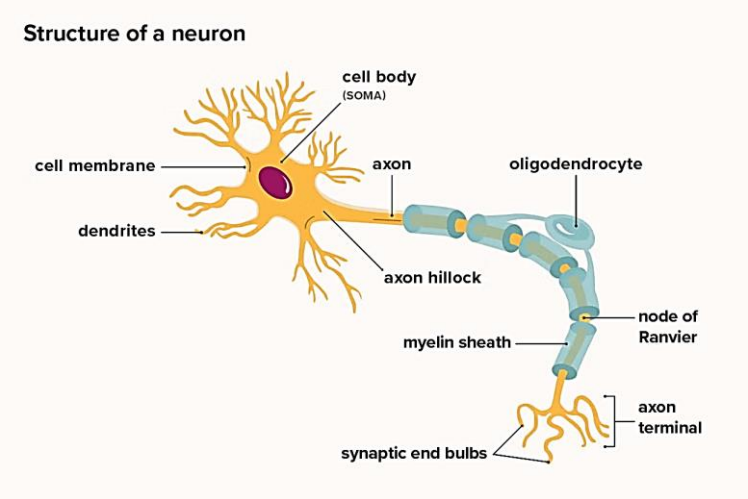
- Movement: "A characteristic of living organisms involving a change in the position of the whole organism or of a part of the organism in response to internal or external stimuli."
- Living organisms move to: Obtain food. Escape predators or danger, find shelter, Reproduce, Respond to environmental changes.
- Movement hhelps organisms to adapt and survive.
- Control and Coordination help organisms detect changes and respond properly for survival and functioning.
- In animals, coordination is done by: Nervous tissue and Muscular tissue Example: Pulling hand away from hot object.
- All information from our environment is detected by the specialized tips of some nerve cells.
- Receptors: Detect stimuli (environmental changes). Located in sense organs: Tongue – Gustatory receptors (taste), Nose – Olfactory receptors (smell), Eyes, ears, skin, etc.

Neuron:
A neuron is the structural and functional unit of the nervous system.
It is a specialized cell designed to transmit information through electrical and chemical signals.

STRUCTURE OF A NEURON: A typical neuron has three main parts:

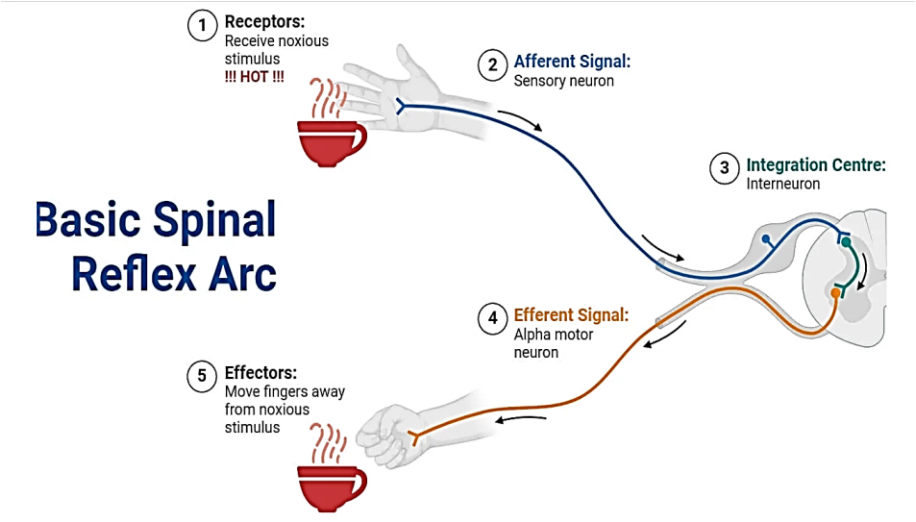
1. Cell Body (Soma/Cyton):
   - Contains the nucleus, cytoplasm, and organelles (like mitochondria, ribosomes, Golgi apparatus).
   - Responsible for the metabolic activities of the neuron.
2. Dendrites:
   - Short, branched projections from the cell body.
   - They receive signals (stimuli) from adjacent neurons or receptors.
   - Carry impulses towards the cell body.
3. Axon:
   - A long, thin extension from the cell body.
   - Transmits impulses away from the cell body to other neurons, muscles, or glands.
   - Axon terminal or synaptic knob at the end releases neurotransmitters.



Parts	Functions
Cell Body	Maintain the neuron's metabolism
Dendrites	Receive Signals
Axon	Transmits Signals
Synapse	Gaps between two neurons where impulse is passed via chemical signals
Myelin Sheath	Insulates axon, speed conduction
Nodes of Ranvier	Facilitate rapid signal transduction
Axon Terminal	Release Neurotransmitters

Reflex Action and Reflex Arcs:

- A reflex action is an automatic, immediate, and involuntary response to a stimulus that does not require conscious thinking.
- Examples: Pulling hand away from a hot object etc.
- Why Do Reflex Actions Occur? Some situations (like touching a flame) require an immediate response to prevent injury or harm. If we wait to think and process the danger in the brain, the delay may cause damage (e.g., getting burnt). So, the body uses a shortcut pathway called the reflex arc to react quickly.
- A reflex arc is the pathway followed by nerve impulses during a reflex action.
- Reflex Arc Components:
  - ✓ Receptor: Detects the stimulus (e.g., heat).
  - ✓ Sensory neuron: Carries the signal to the spinal cord.
  - ✓ Interneuron (in spinal cord): Connects sensory to motor neuron.
  - ✓ Motor neuron: Carries response signal to the muscle.
  - ✓ Effector (muscle): Performs the action (e.g., pulls hand away).
- Reflex arcs are formed in the spinal cord, not the brain.

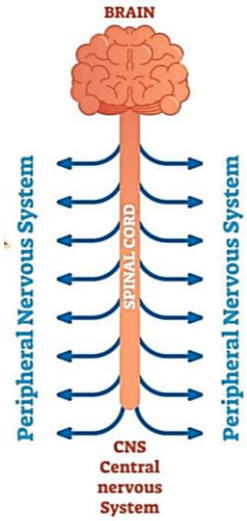


Nervous System: The organ system in animals that controls and coordinates body activities by transmitting signals between different parts of the body through nerve cells (neurons)**.** There are two types of Nervous System:

1. Central Nervous System (CNS):
   - Brain and spinal cord
2. Peripheral Nervous System (PNS):
   - Cranial nerves: Arise from brain.
   - Spinal nerves: Arise from spinal cord.

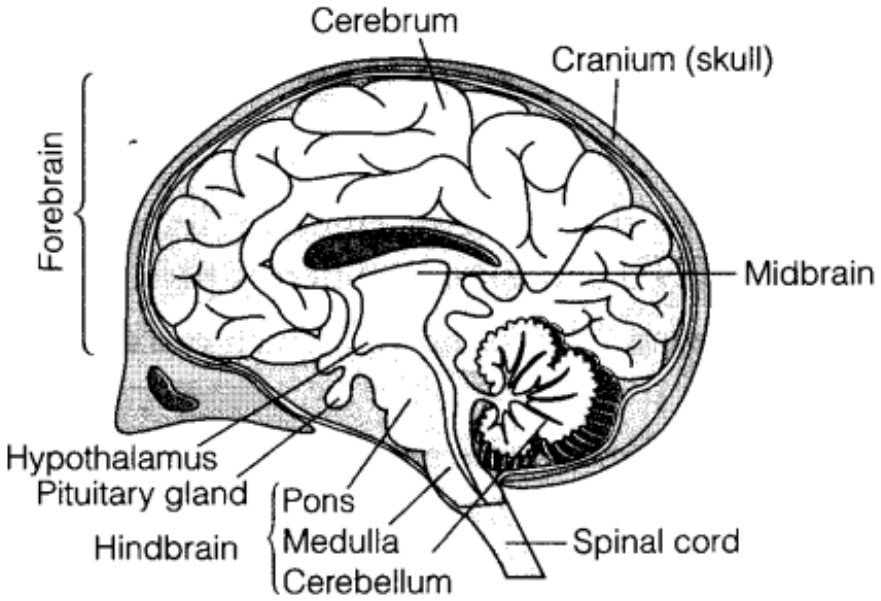
Human Brain:

- Brain is the main coordinating center of the body.
- It:
  - ✓ Receives signals from all body parts.
  - ✓ Processes and interprets them.
  - ✓ Sends out responses through muscles or glands.
- Examples: Walking, writing, speaking, clapping.
- Brain decides the action and sends signals via nerves to muscles.



The brain is divided into three main parts:

1. Forebrain (Cerebrum):
   - Main thinking part.
   - Receives and processes sensory input: Sight, hearing, smell, taste, touch
   - Has association areas: Compare current input with stored memories.
   - Sends signals to motor areas to cause voluntary muscle movement.
   - Controls emotions, learning, memory, intelligence, hunger.
2. Midbrain:
   - Controls involuntary reflexes of eyes and ears.
   - Coordinates messages between forebrain and hindbrain.
3. Hindbrain:
   - Medulla oblongata: Controls involuntary actions like heartbeat, breathing, blood pressure, vomiting, etc.
   - Cerebellum: Maintains balance, posture, and coordination of voluntary movements (e.g., riding a bicycle, walking in a line).



Human brain

- **Cerebrum:** Control Decision making, problem-solving, planning, voluntary movement, speech, Sensory perception (touch, temperature, pain), Hearing, memory, understanding language, Visual processing, connects the left and right cerebral hemispheres and allows communication between them.
- **Hypothalamus:** Maintains homeostasis: Regulates hunger, thirst, temperature, circadian rhythms, emotions.
- **Midbrain:** Controls reflexes of the eyes and ears (like turning your head when you hear a sound)
- **Cerebellum:** Helps in smooth and coordinated movements (e.g., walking, dancing).
- **Pons:** Helps in breathing control.
- **Medulla Oblongata:** Controls involuntary actions like: Breathing, Heartbeat, Digestion, Sneezing, vomiting.

Protection:

- The brain and spinal cord are very delicate and vital organs.
- They control coordination, movement, sensation, thinking, and many involuntary functions.
- Any damage can cause serious health issues or loss of body control.

Protection of the Brain:

- The brain is enclosed in a bony box called the cranium (part of the skull).
- Inside the cranium, the brain is surrounded by a fluid-filled balloon: This fluid is called Cerebrospinal Fluid (CSF).

Protection of the Spinal Cord:

- The spinal cord is protected by the vertebral column (also known as the backbone).
- The vertebral column is made up of a series of interconnected bones (vertebrae).

From Nerve to Muscle – The Action Pathway

1. Stimulus → Brain or spinal cord detects the need to move.
2. Nerve impulse → Message travels along a motor neuron to the muscle.
3. Neuromuscular junction → Nerve ending releases a chemical (neurotransmitter – acetylcholine).
4. Muscle cell activation → Chemical makes the muscle fiber generate its own electrical signal.
5. Calcium release → Signal causes calcium to be released inside the muscle fiber.
6. Actin–Myosin interaction → Muscle proteins slide over each other, shortening the muscle.
7. Movement → The muscle contracts, pulling the bone via tendons.

Why Muscle Cells Move & Change Shape:

- Movement happens because muscle fibers shorten when actin and myosin filaments slide past each other.
- Shape change occurs as contraction makes the muscle shorter and thicker, and relaxation makes it longer and thinner.
- Actin – A thin protein filament in muscle fibers.
- Myosin – A thick protein filament in muscle fibers.
- They slide past each other during contraction, making the muscle shorten and cause movement.

Steps:

Step 1: Myosin gets ready

- Myosin is like a tiny hand.
- It uses energy from ATP to get charged and ready to pull.
- ATP is broken into ADP + P (this gives energy).

Step 2: Myosin grabs Actin

- Myosin (the hand) grabs the actin (a rope).
- This grabbing is called forming a crossbridge.

Step 3: Power Stroke

- Myosin pulls the actin rope towards the center.
- This pulling action makes the muscle shorten (contract).
- During the pull, ADP is released.

Step 4: Letting go

- A new ATP comes and tells myosin to let go of the actin.
- So myosin releases the actin.

Step 5: Ready for next pull

- Myosin uses the new ATP to get ready again (energized and reoriented).
- If more calcium and ATP are still present, the cycle keeps repeating.

Type of Muscle	Controlled By	Examples	Voluntary/Involuntary
Skeletal Muscles	Brain (via motor nerves)	Limbs, face, neck	Voluntary
Smooth Muscles	Autonomic Nervous System	Intestine, blood vessels	Involuntary
Cardiac Muscles	Autonomic Nervous System	Heart	Involuntary

Coordination in Plants:

- Plants do not have: Nervous system and Muscles. Yet, they respond to stimuli, such as: Touch (e.g., *Chhui-mui* plant), Light, Gravity, Water, Chemicals.

- **Types of Movements in Plants:**

A. Tropic Movements – Directional, toward or away from a stimulus.

- Phototropism – Growth toward light (e.g., stem bending toward sunlight).
- Geotropism **–** Growth in response to gravity (e.g., roots grow downwards).
- Hydrotropism – Growth toward water (e.g., roots toward water source).
- Thigmotropism – Response to touch (e.g., tendrils coiling around support).
- Chemotropism **–** Response to chemicals (e.g., pollen tube growth toward ovule).

B. **Nastic Movements** – Non-directional, caused by change in turgor pressure in cells.

- Seismonasty **–** Sudden leaf folding in *Mimosa pudica* (touch-me-not plant).
- Photonasty – Flower opening and closing in response to light.

Plant Hormones (Phytohormones)

- **Auxins** – Promote cell elongation, phototropism, and root initiation.
- **Gibberellins** – Promote stem elongation, seed germination, flowering.
- **Cytokinins** – Promote cell division, delay ageing of leaves.
- **Abscisic Acid (ABA)** – Inhibits growth, causes stomatal closure during stress.
- **Ethylene** – Promotes fruit ripening, leaf fall.

Hormones in Animals:

Definition – Chemical messengers secreted by endocrine glands into the blood, controlling and coordinating various body functions.
Nature – Act in **very small amounts**, but have powerful effects.
Transport – Carried by blood to target organs.

Hormone	**Gland**	**Function**
Adrenaline	Adrenal glands	Prepares body for emergencies ("fight-or-flight" response).
Thyroxin	Thyroid gland	Regulates metabolism of carbohydrates, proteins, and fats for growth.
Growth Hormone	Pituitary gland	Controls growth & development; deficiency → dwarfism; excess → gigantism
Testosterone	Testes	Male sexual development at puberty
Oestrogen	Ovaries	Female sexual development, menstrual cycle regulation
Insulin	Pancreas	Regulates blood sugar levels

Insulin and Diabetes:

- Insulin lowers blood sugar by helping cells take in glucose.
- If insulin production is low:
  - ✓ Blood sugar rises → diabetes.
  - ✓ Treatment: Insulin injections.

Feedback Mechanism:

- Hormone levels are regulated by feedback loops.
- Example:
  - ✓ High blood sugar → pancreas releases more insulin.
  - ✓ Blood sugar falls → pancreas reduces insulin secretion.

Question and Answers:

Question 1: What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?
Answer: Receptors are special cells that detect stimuli (changes) from the environment and send information to the nervous system.
If receptors don't work – Eyes (light receptors) damaged → blindness, Ears (sound receptors) damaged → deafness, Skin (touch receptors) damaged → inability to feel pain, heat, or cold etc.

Question 2: Which signals will get disrupted in case of a spinal cord injury?
Answer: Signals disrupted in spinal cord injury: Reflex actions below the injury, Messages between brain and affected body parts, Voluntary movement and sensations below the injury site.

Question 3: What is the need for a system of control and coordination in an organism?
Answer: Need for a system of control and coordination:

- To detect changes in the environment.
- To process information and respond correctly.
- To control and regulate body activities efficiently.

Question 4: How are involuntary actions and reflex actions different from each other?
Answer:

Involuntary Actions	Reflex Actions
Not under conscious control (e.g., heartbeat, digestion)	Automatic, quick response to a stimulus (e.g., pulling hand from hot object)
Controlled by brain	Controlled mainly by spinal cord
Slower	Faster

Question 5: Compare and contrast nervous and hormonal mechanisms for control and coordination in animals.

Nervous Control	Hormonal Control
Uses electrical impulses	Uses chemical messengers (hormones)
Very fast	Usually slower
Effects last for short time	Effects last longer
Acts on specific target cells	Can affect multiple organs

Question 6: How does chemical coordination take place in animals?
Answer:

- Through hormones secreted by endocrine glands into the blood.
- Hormones travel to target organs and control activities like growth, metabolism, reproduction, and responses to stimuli.

Question 7: Why is the use of iodised salt advisable?
Answer:

- Iodine is needed by the thyroid gland to produce thyroxine.
- Lack of iodine causes goitre (swelling of the neck), so iodised salt prevents it.

Question 8: Why are some patients of diabetes treated by giving injections of insulin?
Answer:

- In diabetes (type 1), the pancreas does not produce enough insulin.
- Insulin injections help regulate blood sugar levels and prevent harmful effects of high blood glucose.

Question 9: How do auxins promote the growth of a tendril around a support?
Answer:

- When a tendril touches a support, auxin moves to the opposite side of contact.
- The cells on that side elongate more, causing the tendril to bend and wrap around the support.

Question 10: Experiment to demonstrate hydrotropism.
Answer:
Aim: To show root growth towards water.
Materials: Two glass troughs, moist soil, porous pot with water, germinating seeds.
Procedure:

1. Fill a trough with moist soil.
2. Place a porous pot filled with water on one side.
3. Plant germinating seeds in the soil at some distance from the pot.
4. Leave it for a few days.
   Observation: Roots grow towards the side of the porous pot containing water.
   Conclusion: Roots show positive hydrotropism.