

Chapter - 2
Control and coordination

Control and coordination

≠ Coordination is the working together of the various organs in a systematic manner so as to produce reaction to the stimulus.

⇒ all living organisms respond and react to changes in the environment around them.

⇒ The changes in the environment to which the organism respond and react are called Stimuli, such as light, heat, cold, sound, smell, touch.

Both plants and animals respond to stimuli but in a different manner.

Ex. withdrawal of hand on touching a hot object.

≠ The response which a living being makes in relation to external stimuli is called

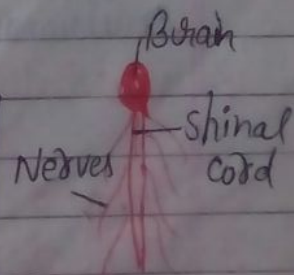
Control and coordination

In is Nervous system which is mainly responsible for control and coordination in human and complex animals

Nervous system.

≠ nervous system is mainly composed of brain, spinal cord, nerves.

↓ one or more bundles of nerve fibers forming part of system that convey impulse of sensation



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Though 5 sense organs (Nose, eyes, ears, tongue, skin) are also a part of nervous system and play a very important role in nervous system.

Function of Nervous System.

- Receive the information from environment by sense organ.
- Transportation of information to brain through spinal cord and nerves.
- After analyzing the information, it reacts accordingly through muscles and glands.
Ex when we touch a hot object. our skin helps us to sense the heat, the nerves carry the impulse to the brain through spinal cord and then the brain sends impulse to the muscles to contract and take off the hands.

Receptors - are group of cell present in sense organs which are sensitive to change in environment.

There are 5 type of receptors which are responsible for sensing the change in environment.

1. **Gustatory Receptors** - Responsible for taste detection
2. **Phono** " - hearing
3. **Olfactory** " - Smell detection
4. **Photo** " - detecting light
5. **Thermo** " - feeling the touch of external stimuli

Table 2.6 A comparative account of stimulus, type of receptors and respective location

S.No.	Stimulus	Name of receptors	Location
1.	Heat	Thermoreceptors	Skin
2.	Touch	Tangoreceptors	Skin
3.	Sound	Phonoreceptors	Ears
4.	Smell	Olfactoreceptors	Nose
5.	Taste	Gustatoreceptors	Tongue
6.	Light	Photoreceptors	Eyes

Neuron

Neurons are specialized cells which are combined to form nerves of the nervous system. As nerves are emerged from brain and spinal cord and branch out to almost all parts of the body, so neuron is called unit of nervous system.

The neuron consists of the following parts-

1. Cell body - The main part of the cell, such as the nucleus, endoplasmic reticulum, ribosome, mitochondria if the cell body dies the neuron dies.
2. Axon This is a long cable like projection of the cell along the length of the cell. it ends in several hair like structure, called axon terminals axon endings. The axon terminals relay nerve impulses.
3. Dendrites - These small branch-like projections of the cell make connections to other neuron and receive the nerve impulses.
4. Synapse - The point of contact between the terminal branch or axon of one neuron with the dendrites of other neuron is called "Synapse". (The junction of an axon and dendrite is)

Neuron

1. <u>Dendrite</u> information is acquired	2. <u>Cell body / Axon</u> information travels as an electrical impulse	3. <u>Synapse</u> Part where electrical signal is converted into chemical message for onward transmission to next neuron by release of neurotransmitters
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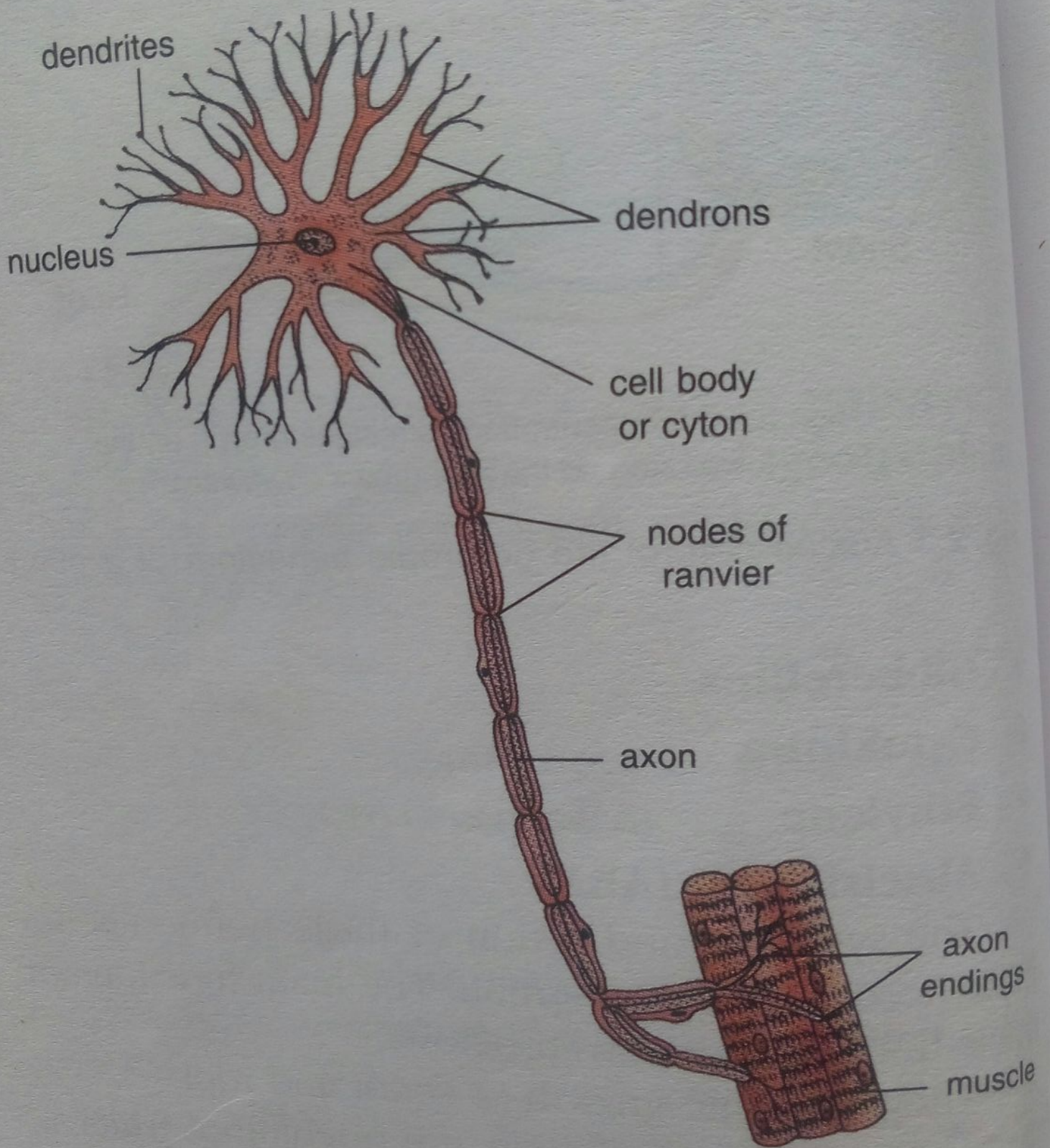


Fig. 2.5 A nerve cell or neuron

❖ **Neurolemma** (the outermost layer)
The axolemma

Working of neuron

Neuron are responsible for transmitting message from brain to body parts and vice versa. When receptors sense anything, a chemical reaction is triggered. This chemical reaction cause an electrical impulse in dendrites. This impulse travels through the body of neuron to axon endings. Tiny amount of chemical is released in synapse by axon endings when impulse reaches there. This chemical crosses the synapse and reach to tip of dendrites where it again produce electrical impulse. And then this impulse travels along neuron.

Types of Neuron

1. Sensory - These neuron transmit message from body parts to central nervous system (which is composed of the brain and spinal cord)
2. Motor neuron - These neuron transmit message from central nervous system to body parts.
3. Relay - These neuron relay the signals within the central nervous system

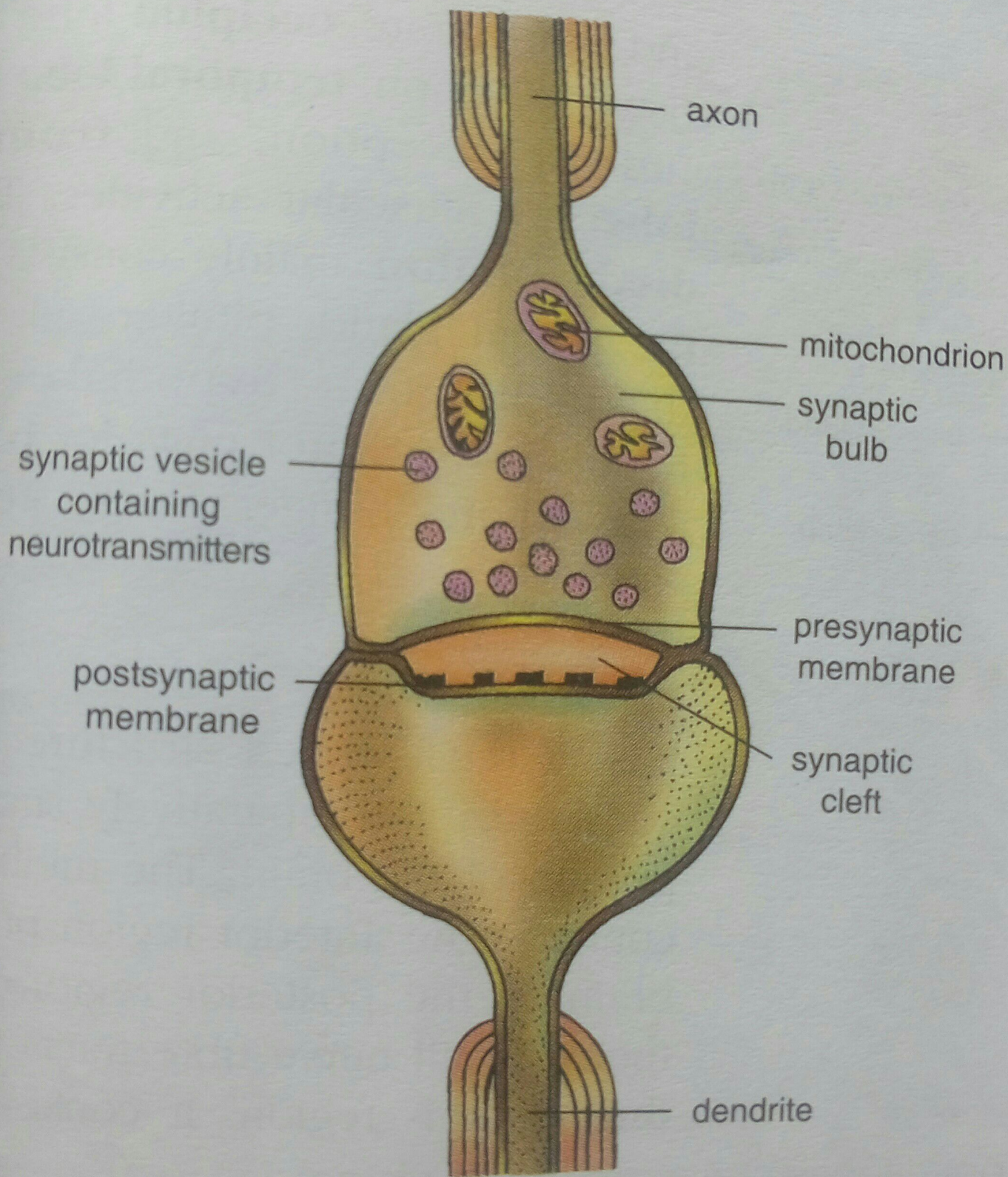


Fig. 2.6 Structure of the synapse

Nervous System in Humans

Peripheral

Central

1. Peripheral Nervous System (PNS)

PNS is composed of Cranial nerve, spinal cord (nerve) and visceral nerve.

⇒ Cranial nerve -: There are 12 pairs of Cranial nerve. The cranial nerves come out of the brain and go to the sense organs and muscles in the head region.

⇒ Spinal nerve - There are 31 pairs of Spinal nerve. The spinal nerve come out of the spinal cord and go to sense organ and muscles which are below the head region. These nerves carry message to brain through spinal cord.

⇒ Visceral Nerve - The visceral nerve come out of the brain and spinal cord and go to the internal organs (like heart, kidney etc.)

● ⇒ Voluntary Action - are action which we do in conscious control of brain - for ex. writing, speaking, walking, lifting an object etc.

NERVOUS SYSTEM IN HUMANS

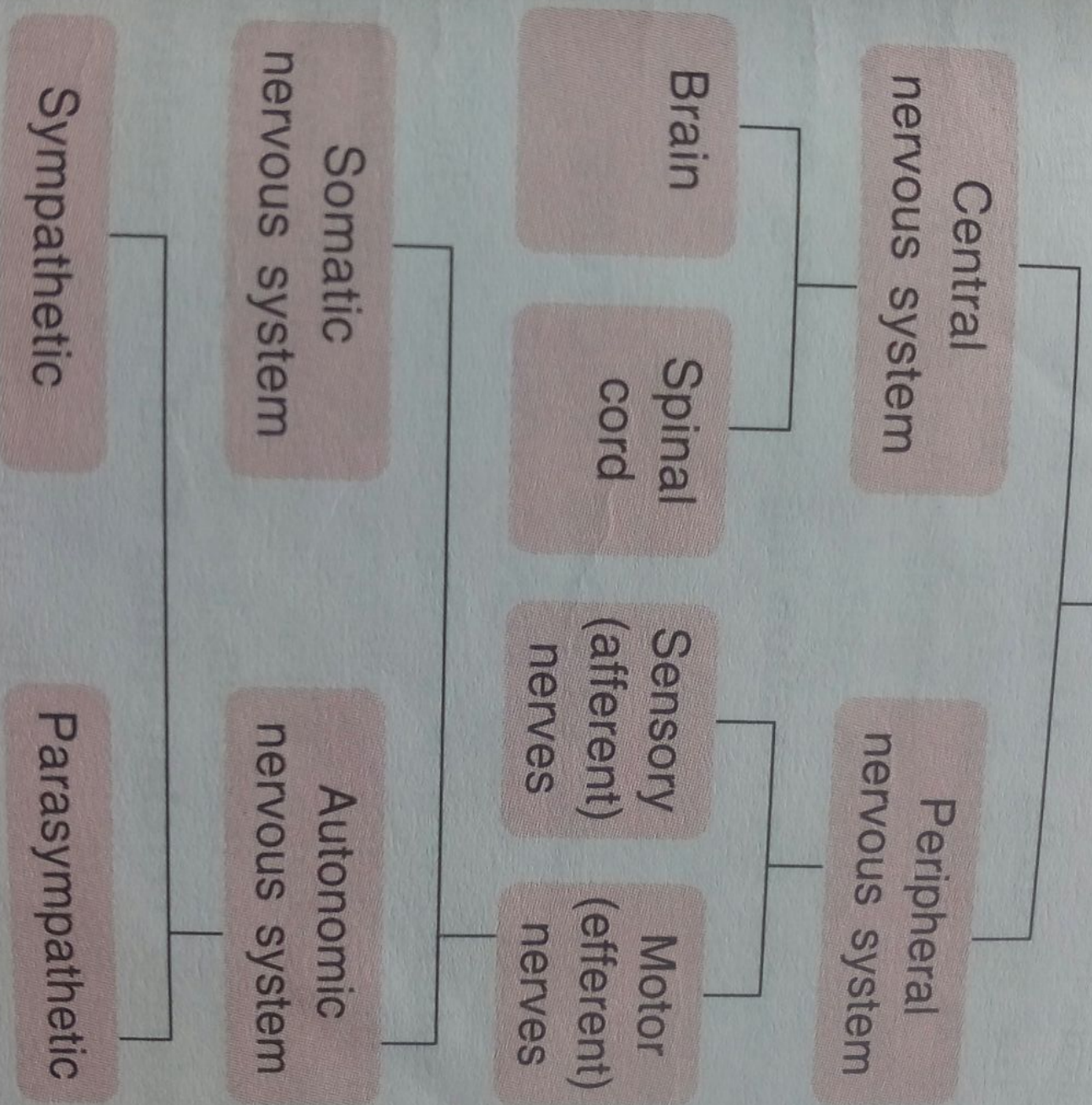


Fig. 2.7 Organisation of the nervous system in humans

• Involuntary Actions - are those which occur without the conscious control of organisms of we can say they are not under the control of will.

Ex. beating of heart, breathing, sweating, working of kidney, digestion of food.

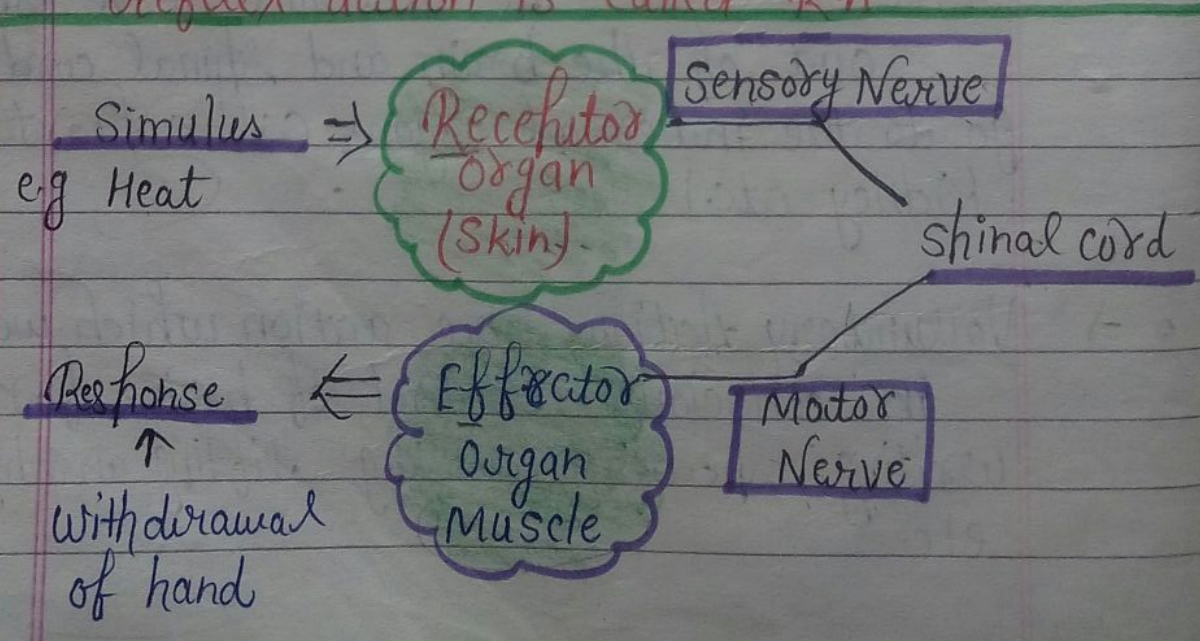
• are controlled by specific centres located mid and hind brain. Reflex Action and Arc.

Reflex action - It is a quick, automatic response to the change in environment (stimuli) that involves only spinal cord. reflex actions occur within fractions of seconds.

Ex. withdrawal of hand, knee jerk etc. on touching a hot plate.

Reflex Arc - it is a pathway through which reflex action occurs.

The pathway taken by nerve impulse in a reflex action is called R.A.



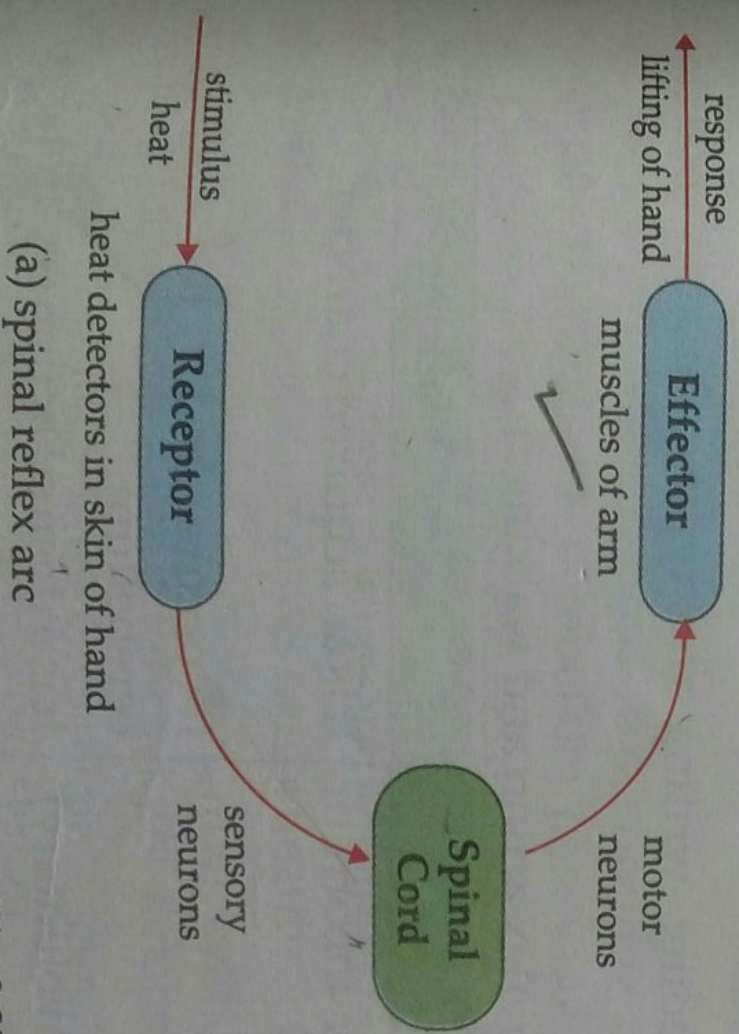
2.7.1 Reflex Arc

When we touch fire or hot object. This is an example of reflex action.

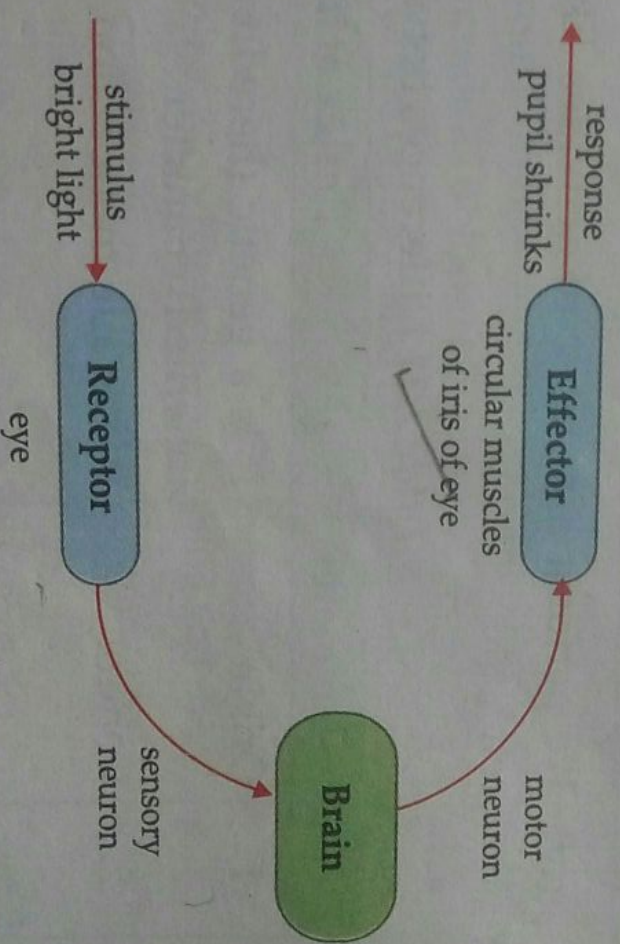
A reflex action involves coordination between receptor organ, sensory neurons, a part of CNS (brain or spinal cord), motor neurons and effector organ. The path taken by nerve impulse in a reflex action is called reflex arc. The entire impulse circuit of a reflex response is as follows:

Stimulus → Receptor → Sensory neurons → CNS → Motor neurons → Effector

This route or sequence by which a nerve impulse acts to be effective is known as reflex arc. The nerve fibres carry the impulses to their cell bodies (cyton) located in the dorsal root ganglion of the nerve. Axons of these neurons then carry the impulses into the grey matter of the spinal cord.



(a) spinal reflex arc



(b) cerebral reflex arc

Fig. 2.35 Reflex arc

Type of Reflexes

1. Cerebral Reflex: is one that is controlled by one of the cranial nerve and tends to take place the facial or head area.
ex. change in size of pupil in bright light
2. Spinal Reflex: is a reflex that involves only the spinal nerves and spinal cord and is not processed by brain. forex Take off the hand on touching a hot object

Mechanism of Reflex Action.

A reflex action mechanism involves a receptor organ, an effector organ, and some type of communication network. When a sensory receptor is stimulated, signals pass from it along a sensory neuron to the spinal cord. The message travels out of the spinal cord along a motor neuron to the effector organ (e.g. a muscle or gland) which shows the response. Such pathway is called Reflex Arc.

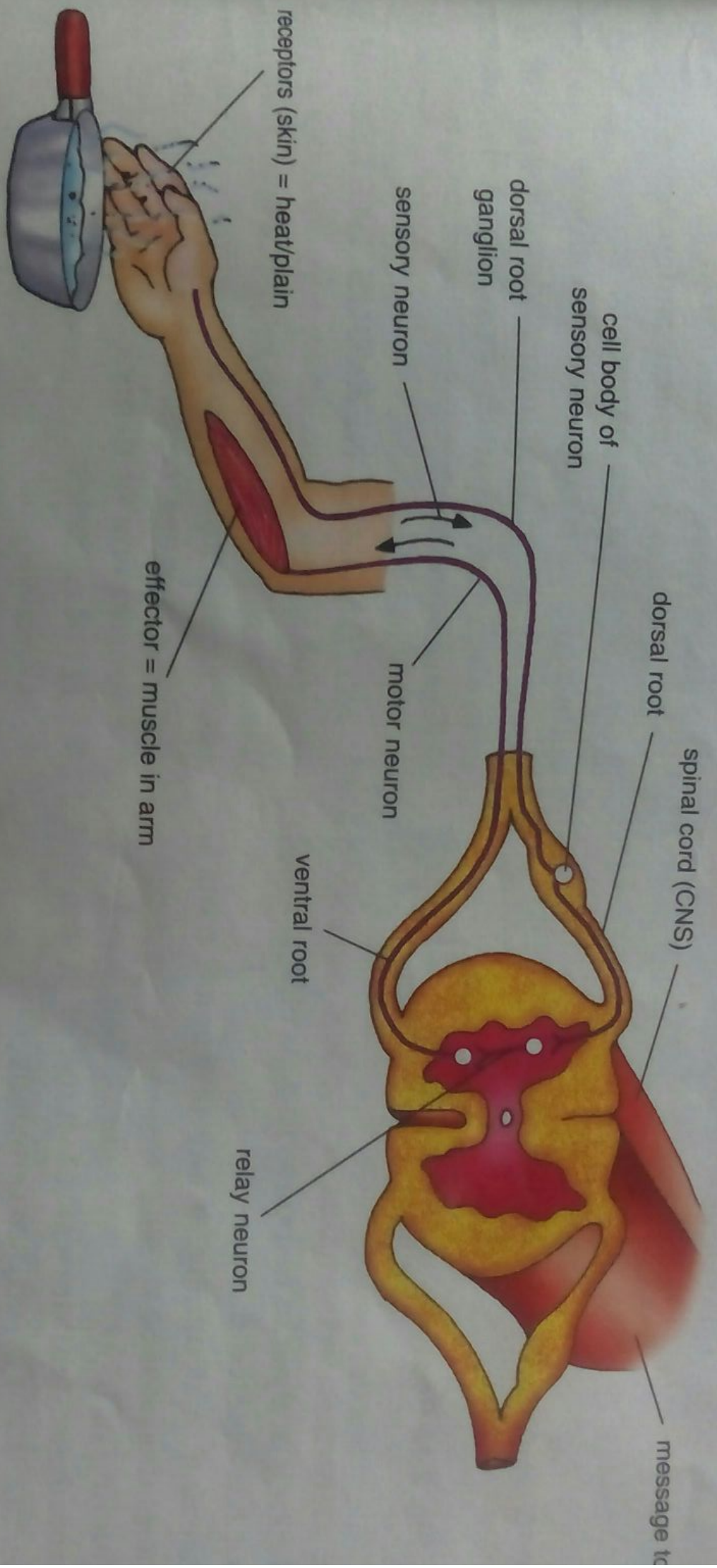
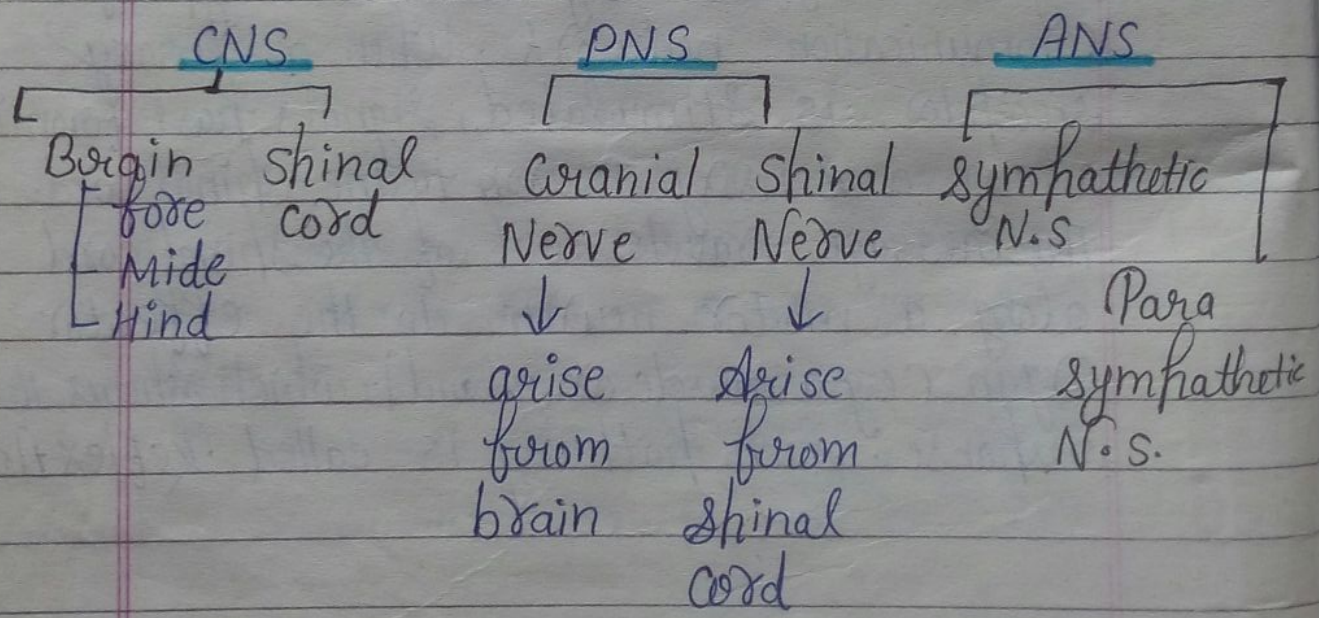
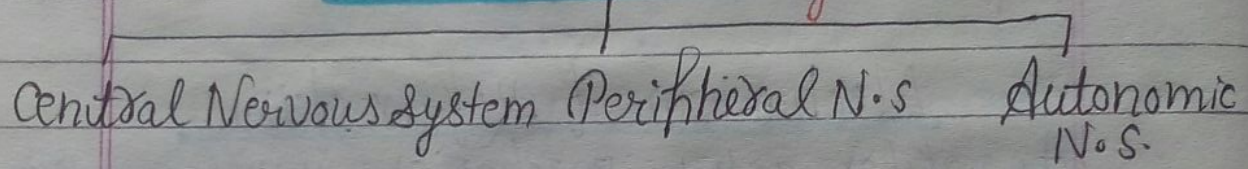


Fig. 2.11 Reflex arc

How muscles (effectors) cause movement?
 Muscles are made up of muscle cells which have special proteins. These proteins can change their arrangement on receiving message from brain. When they do so, shape of muscle change. They can contract or expand. This contraction and expansion can cause movement in body parts.

Human

Human Nervous System



Human brain → it is enclosed in cranium (brain box) and protected by cerebrospinal fluid which acts as a shock absorber.

1. Fore brain (Cerebrum)

most complex / specialized part of the brain is cerebrum of the fore brain

Functions

- Thinking part of brain.
- Control the Voluntary actions
- Store information (memory)
- Centre associated with hunger
- Receives sensory impulse from various body parts and integrates it.

2. Mid brain

it connects the fore brain with the hind brain. It is the location of the central nervous system associated with vision, hearing, motor control, sleep / wake, arousal (alertness) and temperature regulation

3. Hind-Brain

- (i) Cerebellum; (ii) maintains posture and balance of the body.
- (iii) Control body movement

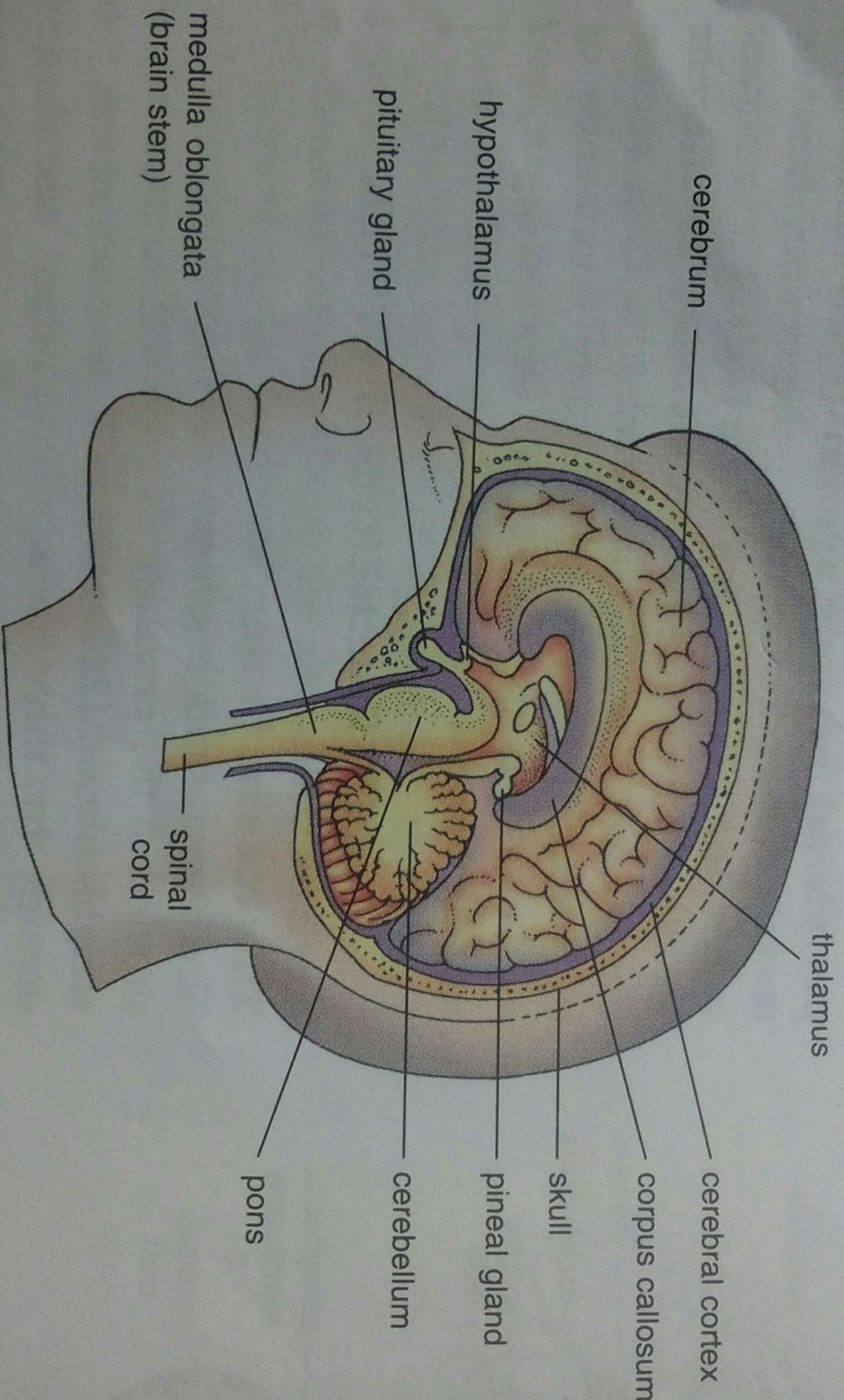


Fig. 2.8 Parts of the human brain

2. Medulla - 1. Controls involuntary actions
e.g. blood pressure, Salivation, Vomiting

3. Pons - Involuntary action, regulation of respiration.

- The human brain is the ^{center} command for the human nervous system. It receives input from the sensory organs and sends output to muscles.

The human brain has the same basic structure as other mammal brains, but is larger in relation to body size than any other brains.

- Brain is protected by a fluid Cerebro-spinal fluid which acts as shock absorber.

It has several layers called Meninges

Spinal cord.

Spinal cord is situated at medulla (hind brain) and extends downwards. It is enclosed by a body structure called vertebral column at back centre of body.

Function. It carries message between brain and nerves.
It controls spinal reflexes.

Endocrine System


endocrine system is composed of several endocrine glands.

Glands - Glands are organs in our body which excrete a liquid substance having some different chemical. This liquid is called secretion of the gland.

Type

Exocrine - Glands that have ducts are called exocrine glands. The secretions of exocrine glands reach their target by traveling through a duct (tube). Some ex. of exocrine glands are sweat and salivary glands.

Endocrine - glands do not have tube (duct) to carry their product to a surface. They are called endocrine glands.

 Hormones are the chemical substances produced by endocrine glands. These glands secrete their hormones directly into their blood vessels. Blood carries the secretion to different parts.

Hormones are chemical substances secreted by the endocrine glands and transmitted by the blood to tissues on which it has a specific effect.

Endocrine gland

Hormones

Pineal Gland

Melatonin

Location

close to centre of brain

Function

Regulates sleep cycle

Hypothalamus

Secrete many hormones
ex. Growth X

Below mid brain

controls pituitary gland
control secretion of many other gland

Pituitary (Master gland)

Secrete many hormone
growth, thyroid stimulating hormones

Below hypothalamus in brain

Growth hormones stimulate growth of muscles, bones.
Regulates secretion of many other glands

Thyroid

Thyroxine Iodine is necessary for secretion of thyroxine

Around wind pipe's neck

Metabolism Regulates Carbohydrate fat, proteins

Parathyroid

Parathyroid

on thyroid gland

Regulates the level of calcium and Phosphate in body

Thymus

Thymosins

in upper part of chest between lungs

Play important role in development of immune system.

Adrenal

Adrenaline

on top of kidneys

Regulation increasing of blood pressure heart beat, carbohydrate metabolism causing emergency!

Pancreas

Insuline

below

stomach

Regulate amount of sugar in blood
sperm production of sex organs during puberty
egg production, development of sex organ during puberty.

Gonads Testes (Male)

Testosterone

Ovary (Female)

estrogen progesterone

≠ Iodine salt is necessary because thyroid gland need iodine to make thyroxine, which helps in regulating the metabolism of carbohydrates, fats, proteins.

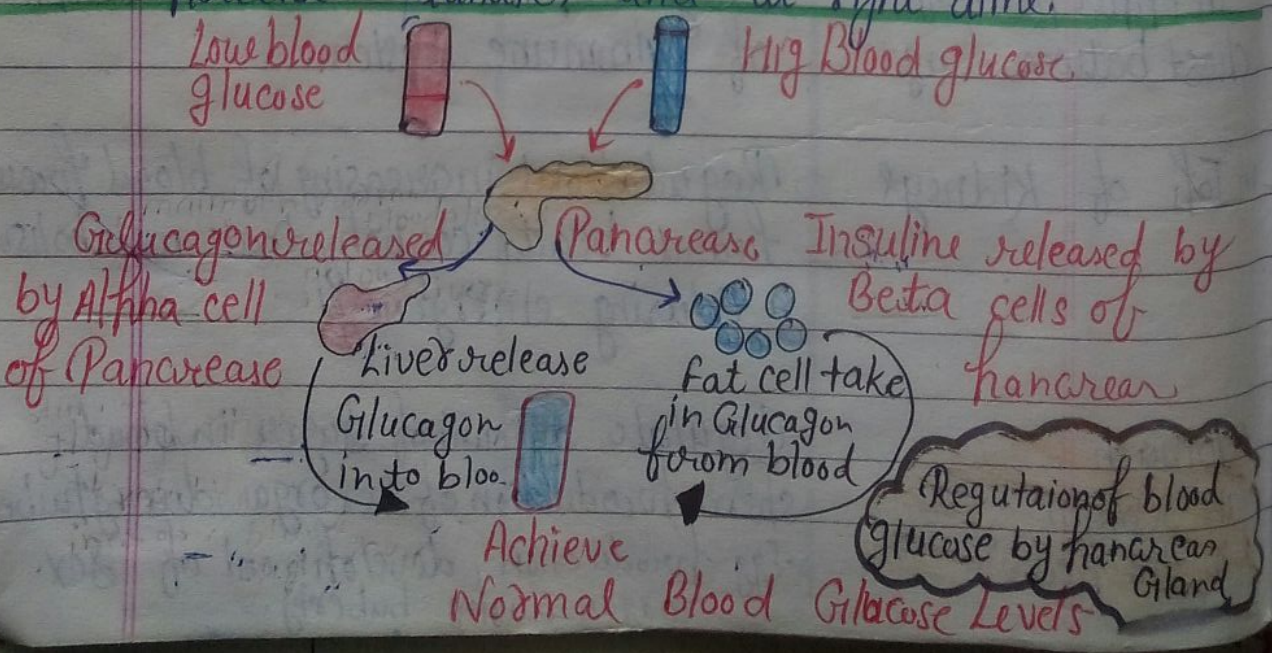
Deficiency of iodine cause disease called goitre.

≠ Diabetes it is due to deficiency of insulin hormone secreted by pancreas that is responsible to lower/control the blood sugar levels.

Common diabetes is controlled by medicine but in severe cases, injections of insulin hormone are given to the patients.

Feed back Mechanism

The excess or deficiency of hormones has a harmful effect on our body. Feed back m. makes sure that hormones are secreted in precise quantities and at right time.



Feedback Mechanism takes care that right amount of hormones are secreted by glands

Nervous

- Messages are in form of impulses
- Messager travel fast
- Message have short term effect

Endocrine System

- Messages are in form of chemicals
- Slow
- have long term effect

Control and Coordination in plants

Movement in Plants

Movement dependant on growth

Movement independent of growth

Tropic Movement

direct movement in response to stimulus

immediate response to stimulus

e.g. drooping of leaves of Touch-me-not plant on touching it

Thigmotaxis

Phototropism

Movement towards light

Geotropism

Movement towards gravity

Chemotropism

towards chemical / growth of Pollen tube towards ovule)

Hydrotropism

movement towards water

≠ hormones are chemical compounds which help to coordinate growth, development and response to the environment.

Plant Hormones.

1. Auxin - it controls growth of stem, fruits and roots, cell elongation promotes
2. Gibberellins - it controls growth of stem, breaking dormancy of buds and seeds and growth of fruits
3. Cytokinin - controls growth of plants by cell division, functioning of stomata, breaking dormancy of seeds. These type of hormones present more in seeds and fruits
4. Abscissic Acid (ABA) it controls growth, controls shedding of leaves, functioning of stomata and promote dormancy of seeds. Inhibits growth, causing wilting of leaves (Stress hormone).

Movement in Plants.

1. Tropic/Tropism:- is the movement of plants in which direction of movement is guided by the direction of external stimulus causing the movement.

2. Nastic - is the movement of plant in which direction of movement is not guided by the direction of any stimulus causing the movement.

1. Tropic - movement happens as a result of growth of a part in a particular direction.

1. Phototropism is growth movement of parts of plant is response to light. Growth towards a source of light is called positive phototropism (stem show)
- Growth away from the source of light is termed negative phototropism root usually show N.P. movement

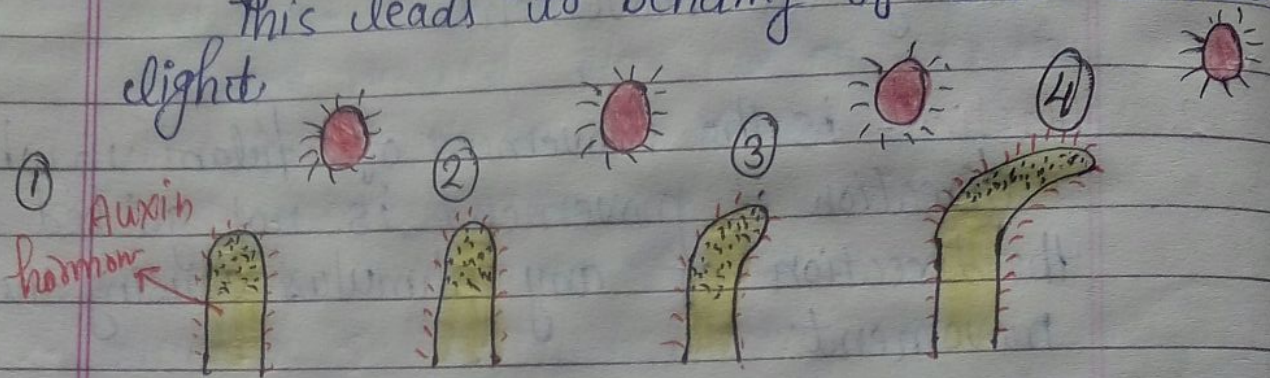
Mechanism

Auxin hormone cause growth in part of stem where it is present in more amount. But it prefers to accumulate more in regions of stem getting less light. When light come from top, at sides of stem get same light. Thus auxin is uniformly

Table 2.2 Differences between tropic and nastic movements

S.No.	Parameter	Tropic movements	Nastic movements
1.	Direction	These are directional movements, i.e., they occur in the direction of stimulus or away from it.	These are non - directional movements.
2.	Cause	These are caused by unilateral growth which occurs due to faster growth on one side of organ than other, i.e., produce curvature.	These are also curvature movements but occur due to turgor changes.
3.	Organs Examples	Generally cylindrical bending of stem towards light, downward growth of roots in response to gravity	Flat or asymmetric organs folding and drooping of leaves of <i>Mimosa</i> plant

distributed in stem grows straight But when light comes only from one side auxin hormones gather on the other side and causing more growth on that side. This leads to bending of stem towards light.



Geotropism when stems and roots of plants move against and along the direction of gravity is called Geotropism.

Stem show negative geotropic movement to get light and air.

Roots show positive geotropic mov. towards the direction of the gravity to get water and nutrients from soil.

Hydrotropism, movement of root towards water called hydrotropism. This shows a positive hydrotropic movement. Growth hormones in roots are responsible for bending of roots towards the direction of water.

Thigmotropism, it is the growth movement of stem of some plants over a surface influenced

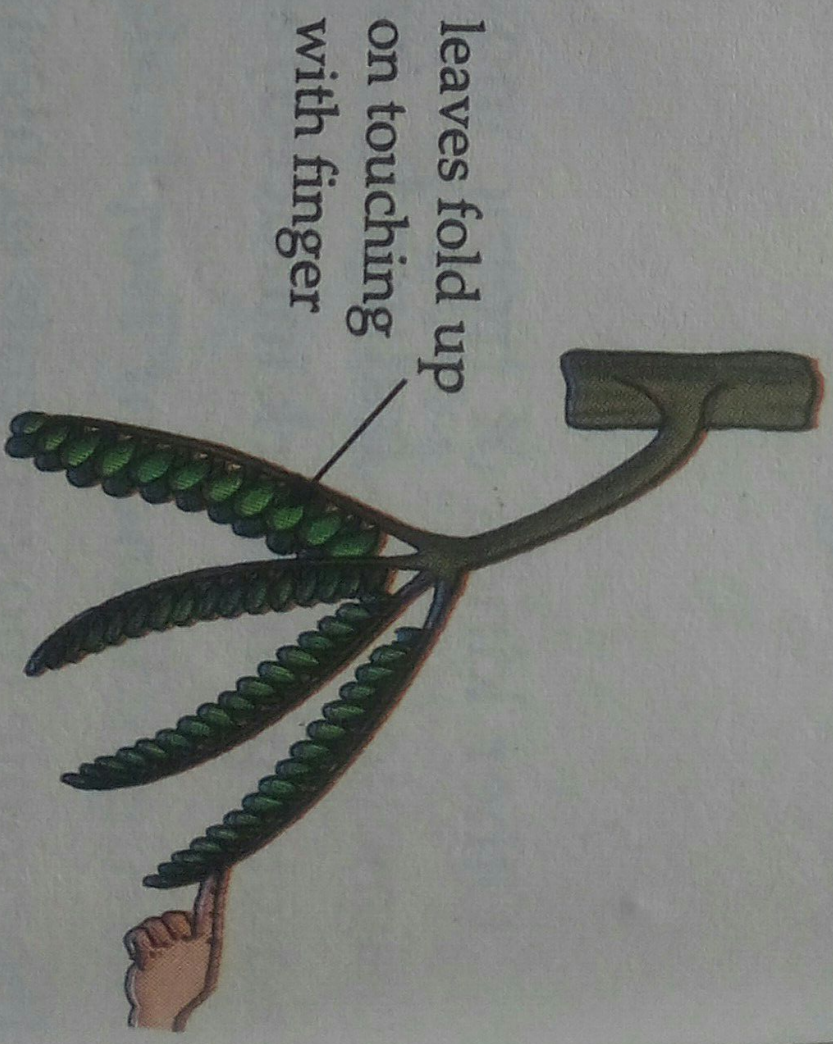
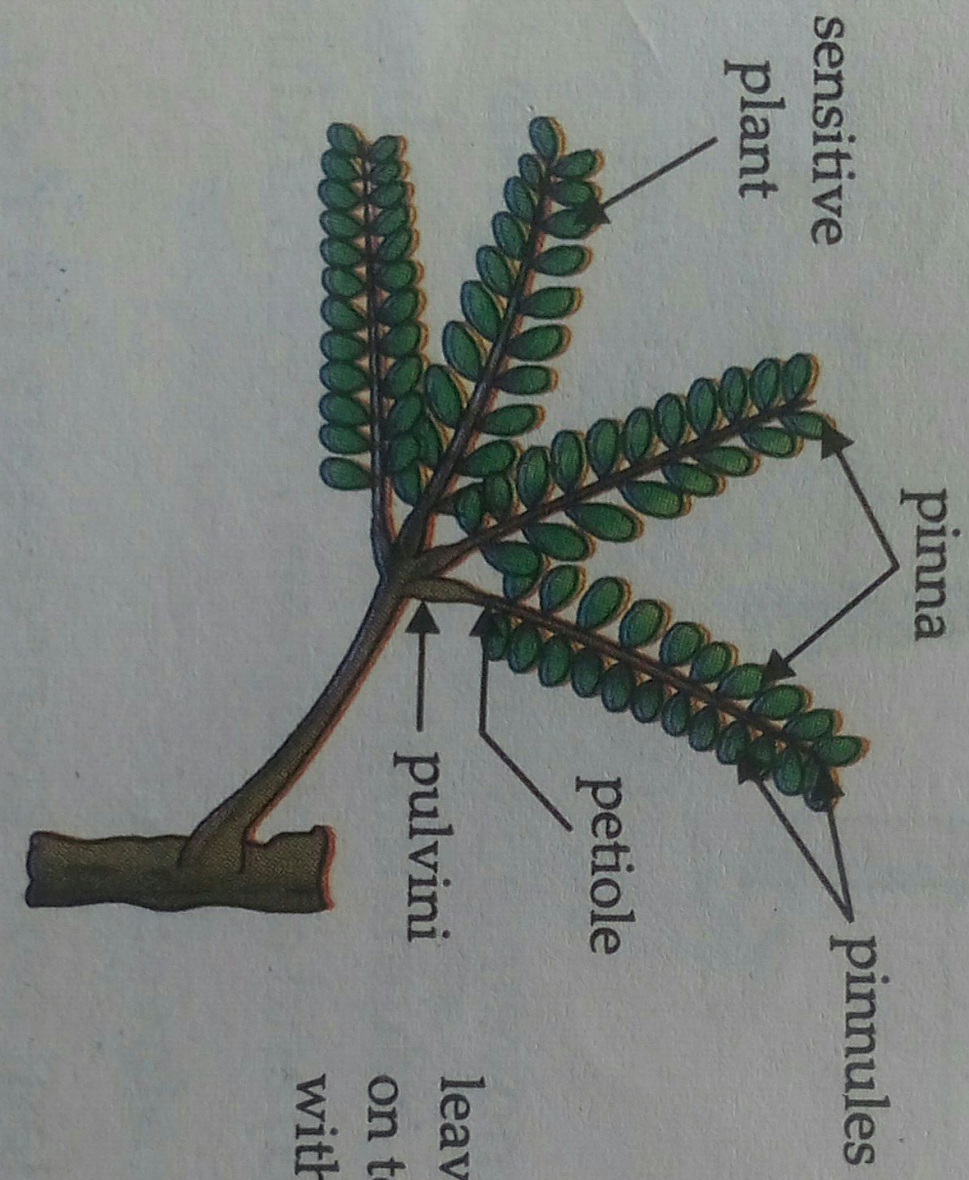


Fig. 2.14 *Mimosa pudica* leaves exhibit nastic movement.

...leaves are swollen areas consisting of large number of...

... and *Cucurbita* show this type of movement. ... bitter melon, bottle gourd, ...

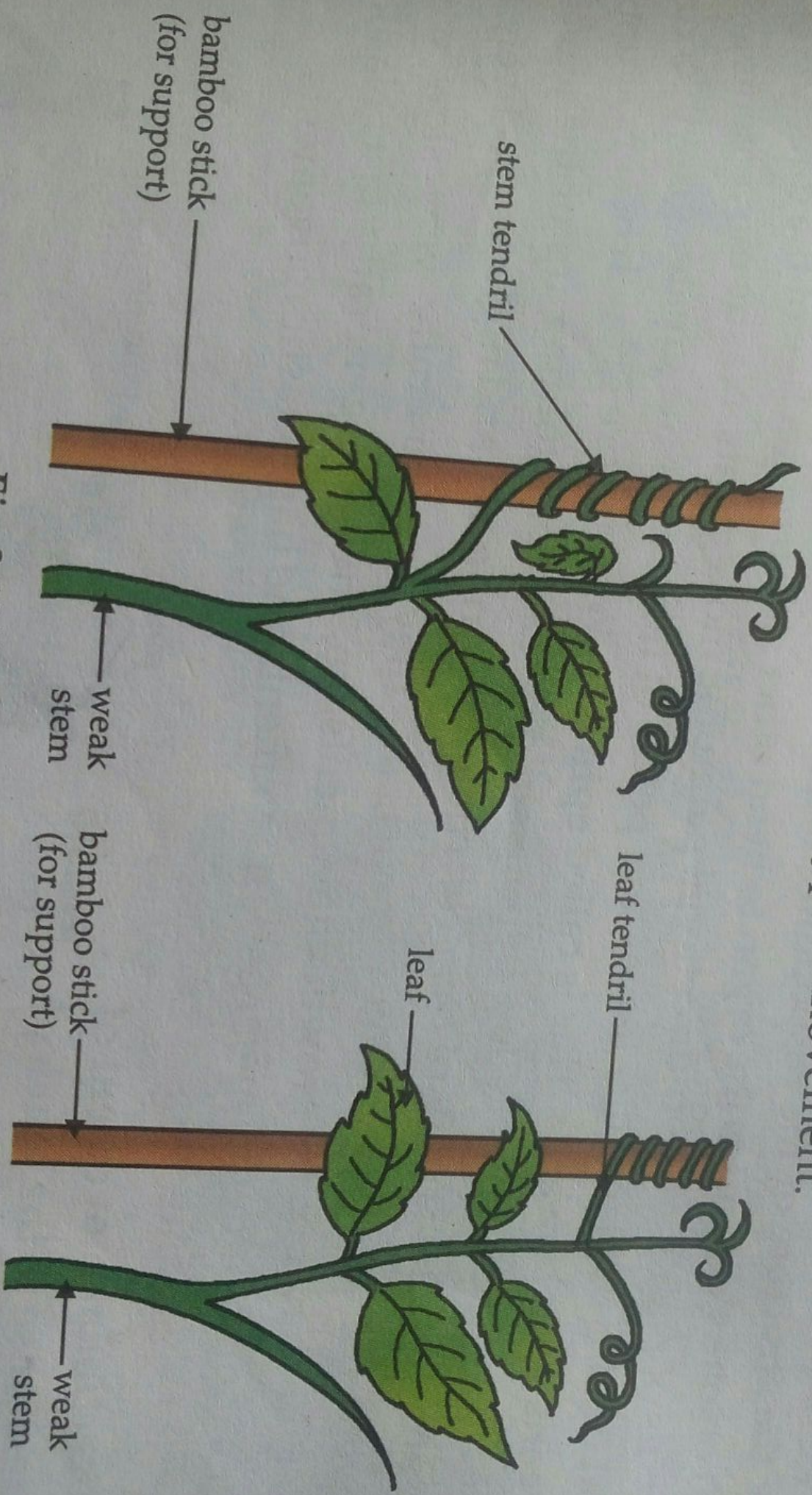


Fig. 2.12 Tendrils wrap around a support.

... kinds of tropic movements ...

by touch. The filant grows in a way so as it can coil around a support.

Such movement are seen in Creeper for Money Plant.

the amount of auxin reduces in the portion of stem touching the stick. More auxin is present on the other side of stem which results in more growth on the side. this leads in the bending of stem around the contact surface.

chemotrophism - Movement of plant or parts of plant in response to chemical stimulus is called chemotrophism. in positive chemotrophism movement is ^{away} from the chemical.

Growth of pollen tube from pollen to ovary under the influence of chemical released by ovary is an ex. of chemotrophism.

Nastic Movement Nasty

≠ Nastic movement are the movement in which direction of the response is not dependent on the direction of the stimulus.

ex. when we touch the leaves of mimosa pudica touch me not plant. its leaves fold inside and droop. The drooping is independent of the directions from which the leaves are touched.