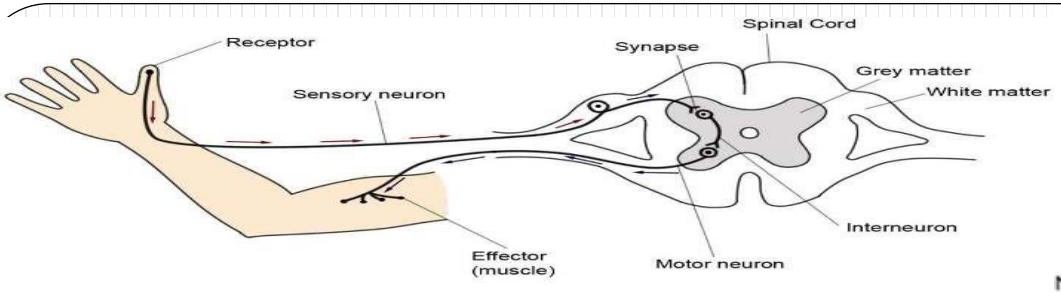
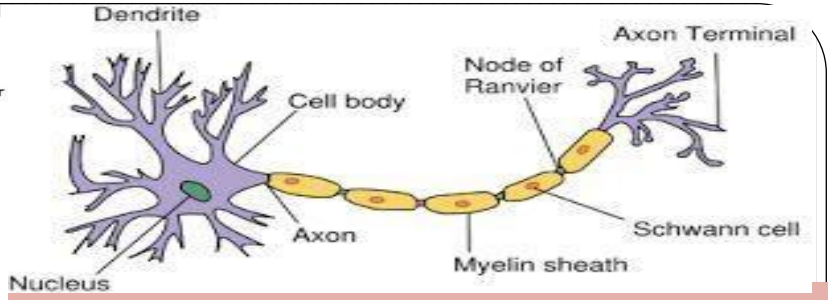
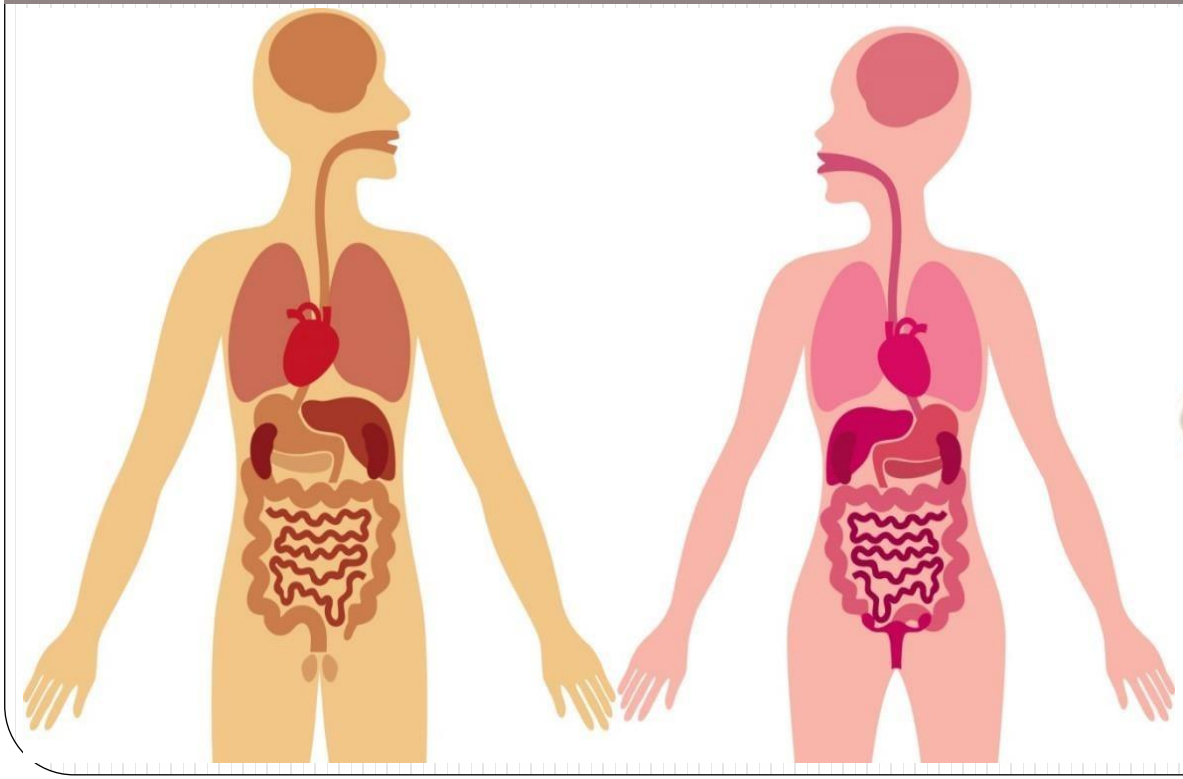
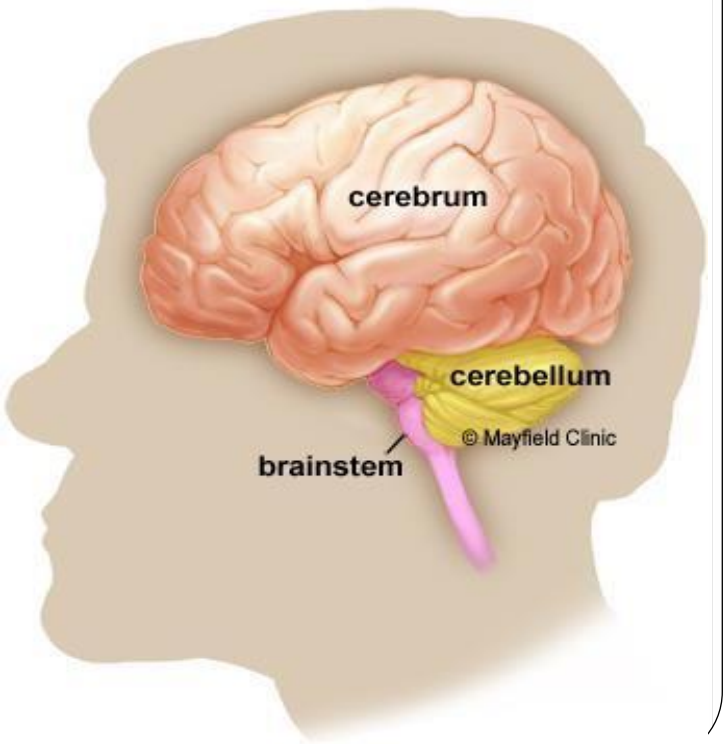




UNIT 5
HUMAN BODY SYSTEM





Body Coordination

- There are two main important forms of body coordination in animals as a whole. These are nervous and hormonal coordination.
- **The nervous system**
  - Uses nerve cells to pass electrical impulses along their length.
  - They stimulate their target cells by secreting **neurotransmitters** directly on to them.
- **The endocrine system**
  - Produces hormones that are transported in the blood plasma to their target cells.
  - The target cells have specific receptors on their cell-surface membranes and the change in the concentration of hormones stimulates them.

Table 1. Comparison of nervous system versus endocrine system

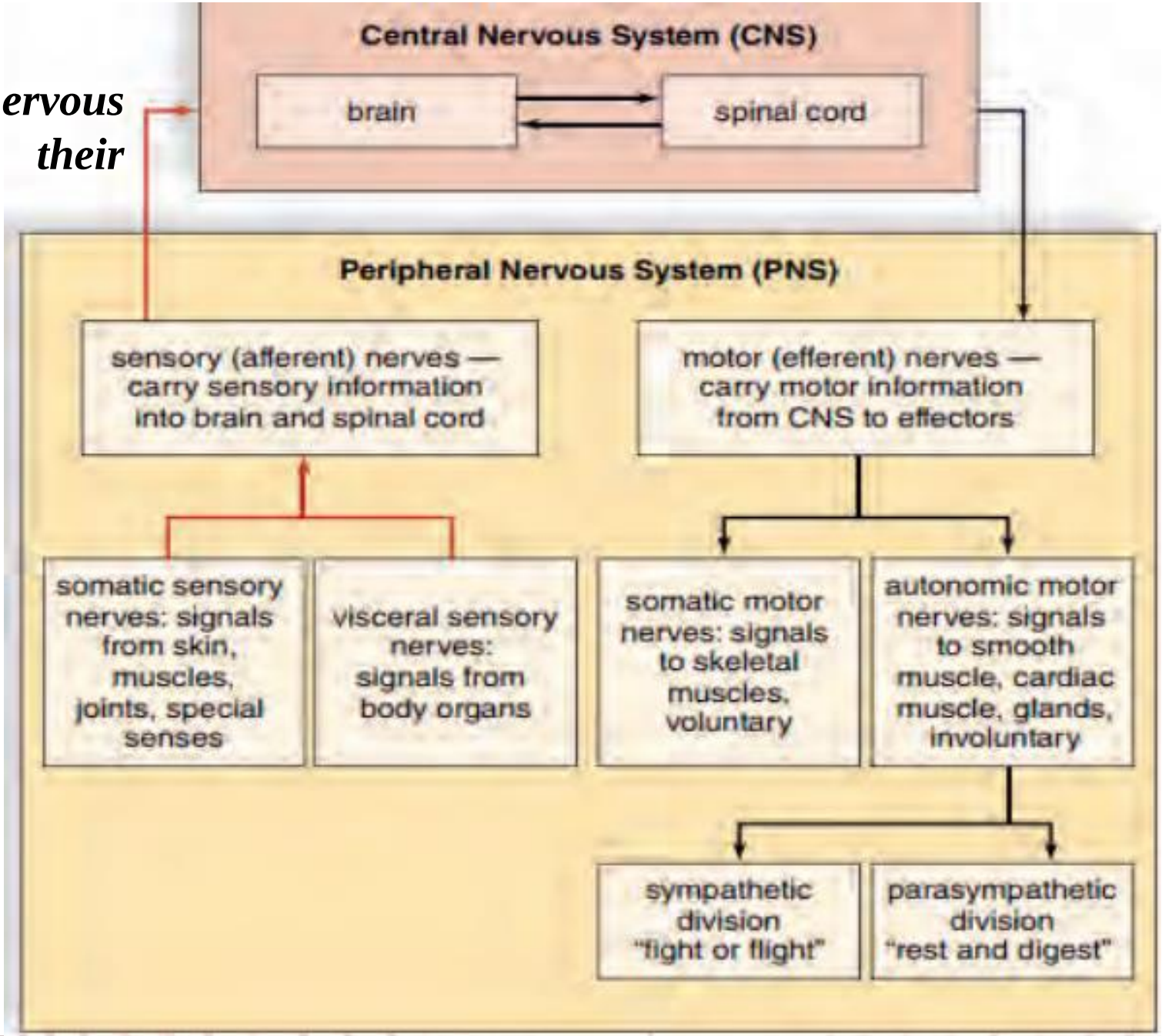
	Nervous system	**Endocrine system**
Speed of action	Seconds	Minutes to hours (even days)
Duration of action	Seconds to minutes	Minutes to days
Method of transmitting messages	Electrical	Chemical
Transport method	Neurons	Hormones

5.1 The Nervous System

- The nervous system is responsible for the reception and processing of sensory information from both the external and internal environments.
- ***The nervous system has two major divisions:***
  1. **The Central Nervous System (CNS)** consists of the brain and spinal cord.
  2. **The Peripheral Nervous System (PNS)** consists of nerves outside the CNS.
- ***The nervous system has three specific functions:***

1. The nervous system receives sensory input from sensory receptors in the sense organs respond to stimuli by generating nerve signals that travel by way of the PNS to the CNS.
2. The CNS performs information processing and integration, summing up the input it receives from all over the body.
3. The CNS generates motor output. Nerve signals from the CNS go by way of the PNS to the effectors (muscles, glands, and organs).

Figure 1: nervous system with their function



5.1.1 Neurons and their Functions

- The nervous system is composed of only two principal types of cells; **Neurons** and **Supporting cells (glial cells)**

Neurons (Neuron)

- Are the basic structural and functional units of the nervous system.
- **Nerve cell** is the basic unit of communication in the nervous system.
- They are specialized to respond to physical and chemical stimuli, conduct electrochemical impulses, and release chemical regulators.
- Through these activities, neurons enable the perception of sensory stimuli, learning, memory, and the control of muscles and glands.

Supporting Cells

- Aid the functions of neurons
- They are about five times more abundant than neurons
- In the CNS, supporting cells are collectively called **neuroglia**, or glial cells (from Greek glia = glue).
- Neuroglia serves as providing support and nourishment to the neurons.

- ***All neurons consist of:***
  - **Cell body**
  - **Dendrites and**
  - **Axon**

Cell body (also known as Soma):

- It is the neuron's core.
- The cell body consists of nucleus and other organelles that carries genetic information, maintains the neuron's structure, and provides energy to drive activities.
- Most of the neuron cell bodies are located inside the CNS and form the **grey matter**.
- The cell bodies that are located in the PNS are called **ganglia**.

Axon:

- Each neuron has only one axon that conducts information away from the cell body.
- It has branch at its terminal into many axon terminals.
- It delivers the impulse to another neuron or a gland or a muscle.

- Individual axons are termed as nerve fibers, and collectively they form a nerve.
- Many axons are insulated with **myelin sheath**.

Dendrites:

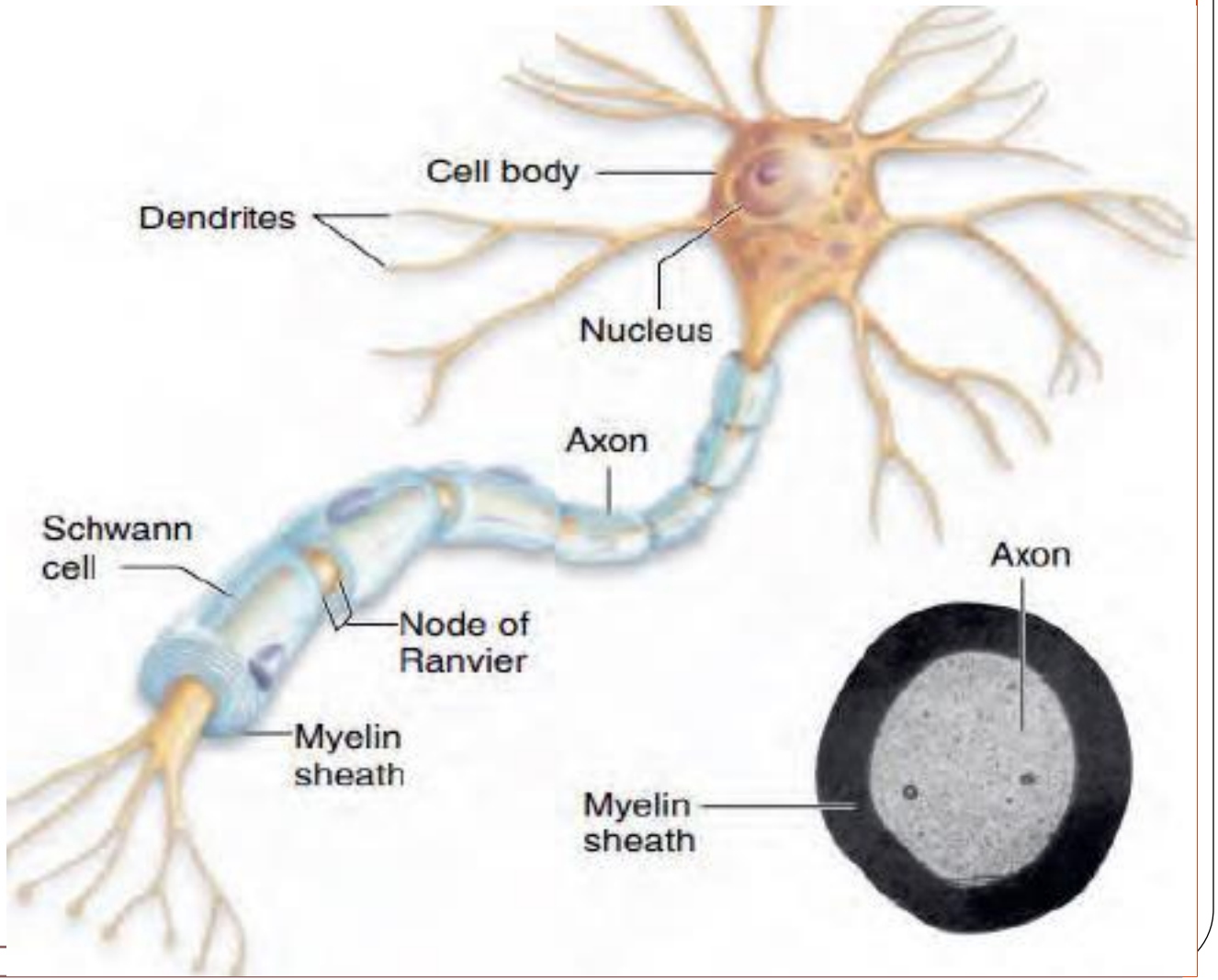
- Dendrites are short extensions that receive signals from sensory receptors or other neurons.
- Incoming signals from dendrites can result in nerve signals that are then conducted by an axon.
  - Neurons can have more than one set of dendrites, known as **dendritic trees**.
  - The number of dendritic tree neurons have depends on their role.

Myelin sheath:

- Myelin is a fatty substance whose purpose is to protect the neuron and to electrically insulate it, speeding up impulse transmission.
  - Within the PNS Schwann cells wrapped in layers around the neuron form the myelin sheath.

- The gaps where there is no myelin sheath are called **nodes of Ranvier**.
  - Some nerve fibres are unmyelinated, and this makes nerve impulse transmission significantly slower.

Figure 2: parts of neurons



Types of Neurons

- Neurons vary in structure and function.
- ***In terms of function, scientists classify neurons into three broad types:***
  - **Sensory**
  - **Motor and**
  - **Interneurons**

1. Sensory (Affector/ Afferent) Neurons:

- Sensory neurons carry messages from sensory receptors to the central nervous system.
- They have a long dendrite and short axon.
- They are triggered by the physical and chemical stimuli such as sound, touch, heat, and light.

2. Motor (Effector/ Efferent) Neurons:

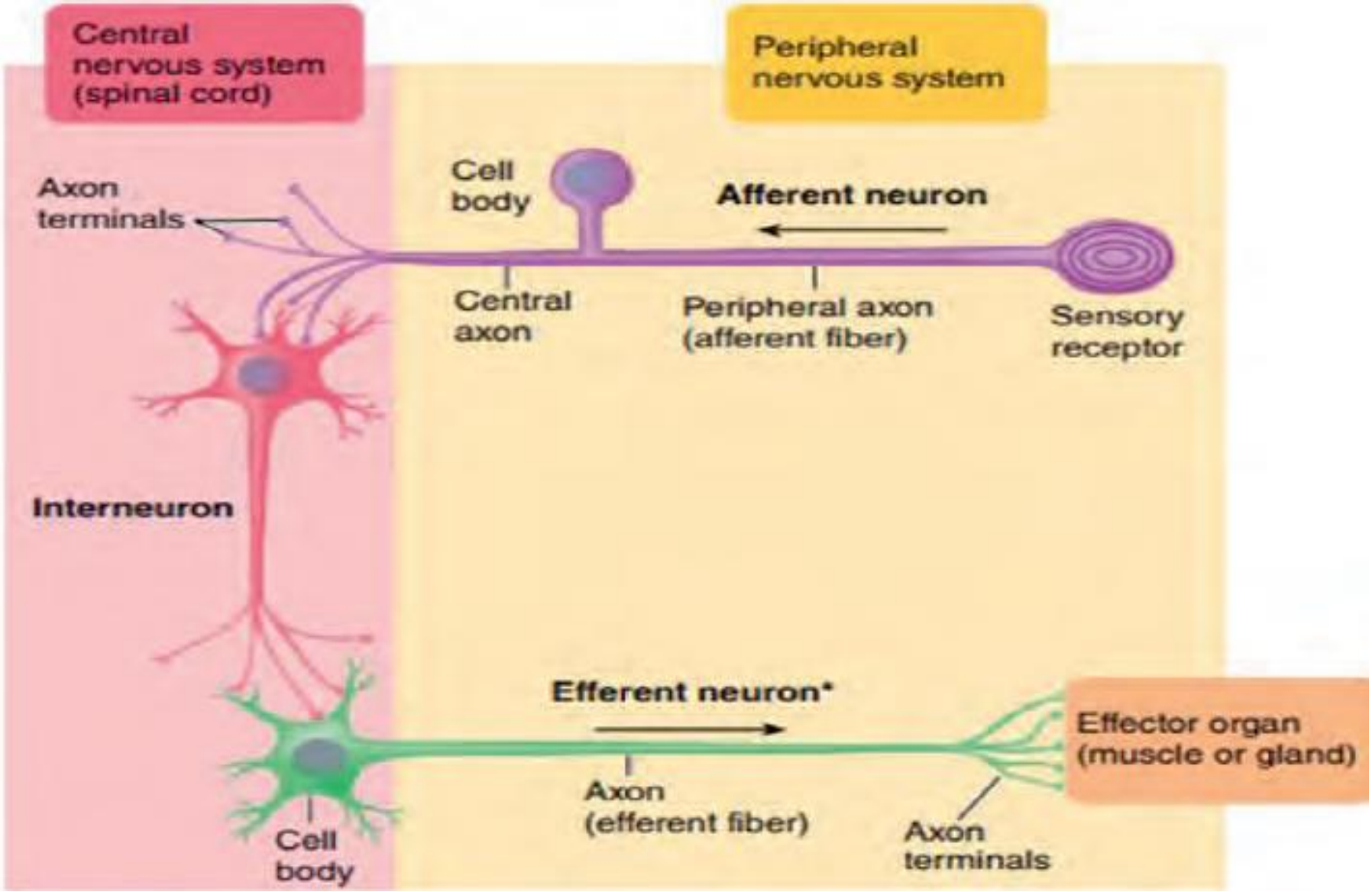
- Transmit messages from the CNS to effectors (muscles or glands).
- They have a long axon and short dendrites.
- They play a role in voluntary and involuntary movements.
- They allow the brain and spinal cord to communicate with effectors (muscles, organs, and glands) all over the body.

3. Interneurons (Association Neurons):

- Interneurons are found entirely within the CNS.
- They pass signals from sensory to motor neurons, or to integrate these functions.

- **Summary of information flows through the nervous system in the following sequence:**
- Stimulus → Reception by sensory receptor → transmission by afferent neuron → integration by interneurons in CNS → transmission by efferent neuron → action by effectors

Figure 3: Types of neurons



Nerves and Nerve Tracts

- **A nerve** is a group of neurons (bundles of neurons) with blood vessels and connective tissue.
- **Sensory (afferent) nerves** are made only of sensory neurons. Example,
  - **Optic nerves** for vision and
  - **Olfactory nerves** for smell
- **Motor (efferent) nerves** are made only of motor neurons.
  - Example, Autonomic nerves.
- **A mixed nerve** contains both sensory and motor neurons.
  - Most of our peripheral nerves, such as the **sciatic nerves** in the legs, are mixed nerves.
- The term **nerve tract** refers to groups of neurons within the central nervous system.
  - These tracts are often referred to as **white matter**; the myelin sheaths of the neurons give them a white color.

5.1.2. The Nerve Impulse and Transmission

- The nervous system relies on nerve impulses travelling along a neuron.
  - Each nerve impulse is a minute electrical event that works as a result of charge differences across the axon membrane.
- The wave of positive charge inside the axon when the neuron is stimulated is known as the **action potential**.
- When the axon is not conducting an impulse, the voltmeter records a membrane potential equal to about -65 mV (millivolts),
  - Indicating that the inside of the neuron is more negative than the outside.
  - This is called the **resting potential** because the axon is not conducting an impulse.
- When a neuron is stimulated, the potential across the cell membrane changes, it open the channels to let ions go through the membrane.

- When a **sodium channel** is open, Na+ ions will flow through the membrane into the cell for two reasons:

1. The resting potential keeps the inside of the cell negatively charged, so positive ions are attracted in.
2. There is an attracting concentration gradient for sodium, because there are many more Na+ ions outside the cell than inside it.

- The resulting influx of positive ions makes the inside of the cell less negative, reducing the resting potential. This is called **depolarizing** the cell.
- If the cell is **depolarized** from its resting potential of around -70 millivolts to its **threshold potential** of about -55 millivolts, an abrupt change occurs. This is called an **action potential**.
- During action potential,
  - The inside of an axon becomes positive compared to the outside (this is called **depolarization**) and then
  - The inside becomes negative again (this is called **repolarization**).

- Action potential requires two types of channels in the membrane:
  - One channel allow Na ions to pass through the membrane, and
  - The other allow K ions to pass through the membrane.
- During **depolarization**, Na ions move to the inside of the axon, and during **repolarization**, K ions move to the outside.

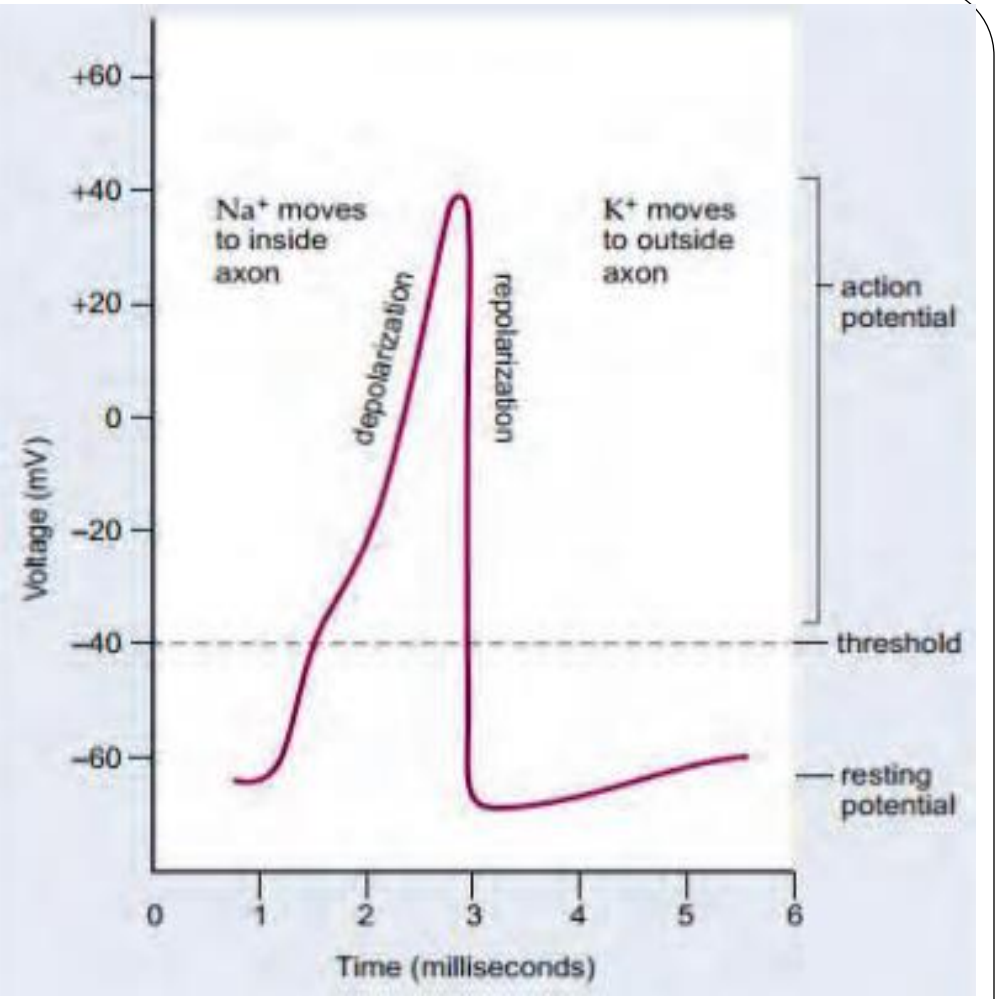
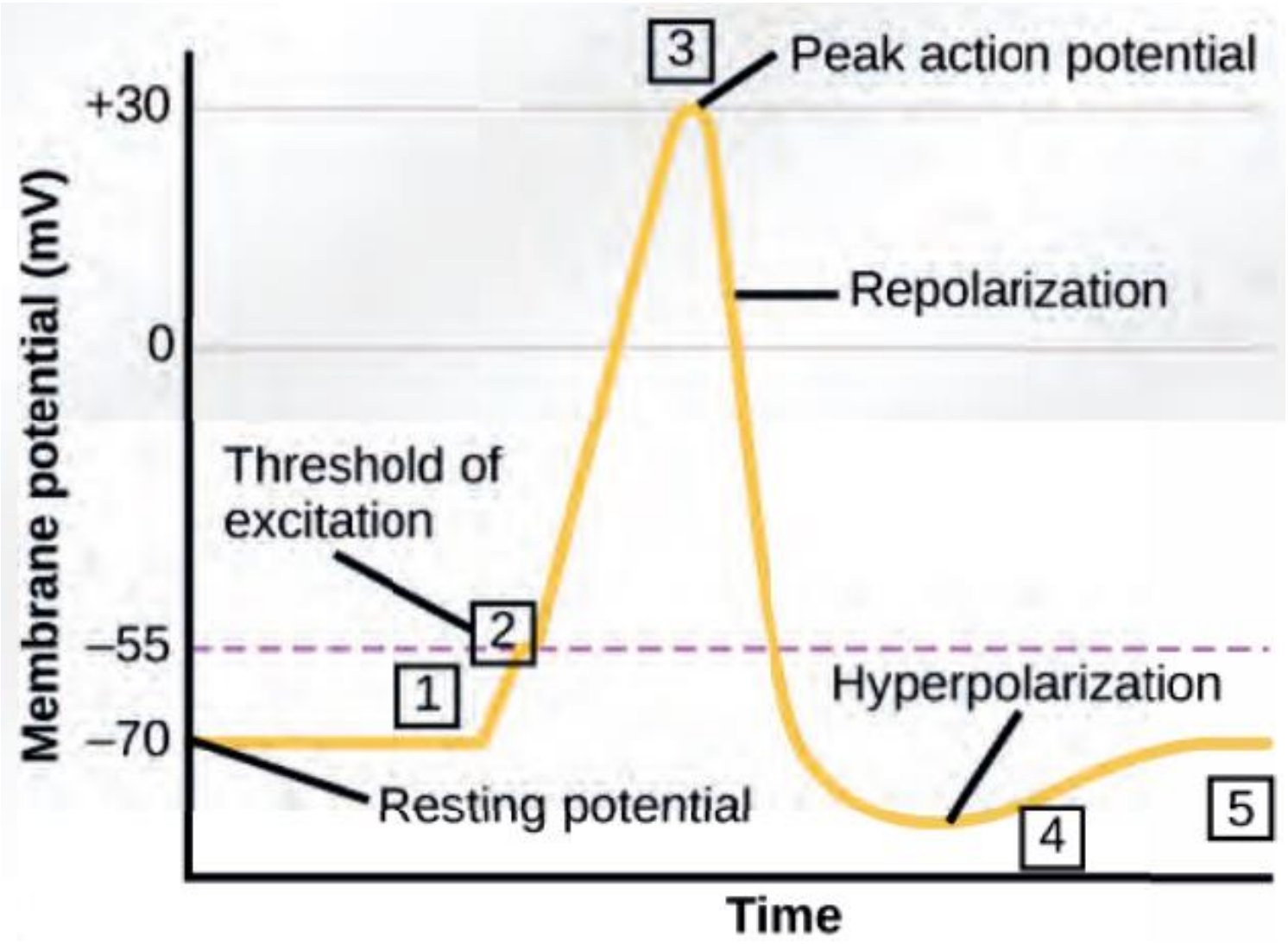


Figure 4: Action potential graph

- Consequently, the inside becomes positive relative to the outside.
- The normal direction of polarization is rapidly restored once the stimulation stops.
- In fact, the neuron becomes **hyperpolarized** for a few milliseconds, which means that its inside becomes even more negatively charged than usual.
- During the **refractory period,** the hyperpolarized neuron is less readily able to respond to further input.
- So a single, relatively small, stimulation pulse can produce a radical change in the neuron's electrical state.
  - **Threshold potential** the voltage at which depolarization of a cell leads to generation of an action potential.
  - **Hyperpolarization** increasing neuronal membrane potential to more than its usual resting potential (making it harder to induce the cell to produce an action potential)
  - **Refractory period** a brief period following the generation of an action potential, during which a neuron is hard to re-excite.

Figure 5: the action potential is the basis of all the electrical signals in the nervous system of the body.



Synapse

- Whenever one neuron ends and another begins there is a gap known as a **synapse**.
  - **Neuron-neuron synapses** involve a connection between the axon of one neuron and the dendrites, cell body, or axon of a second neuron.
- The electrical impulses that travel along the neurons cannot leap the gap (synapse).
  - Therefore, when an impulse arrives at the end of a neuron, chemicals are released.
- These chemical transmitters (**neurotransmitters**) cross the synapse and are picked up by special receptor cells in the end of the next neuron.
- In turn this starts up an electrical impulse, which then travels along the next neuron. This is how impulses pass from one neuron to another.

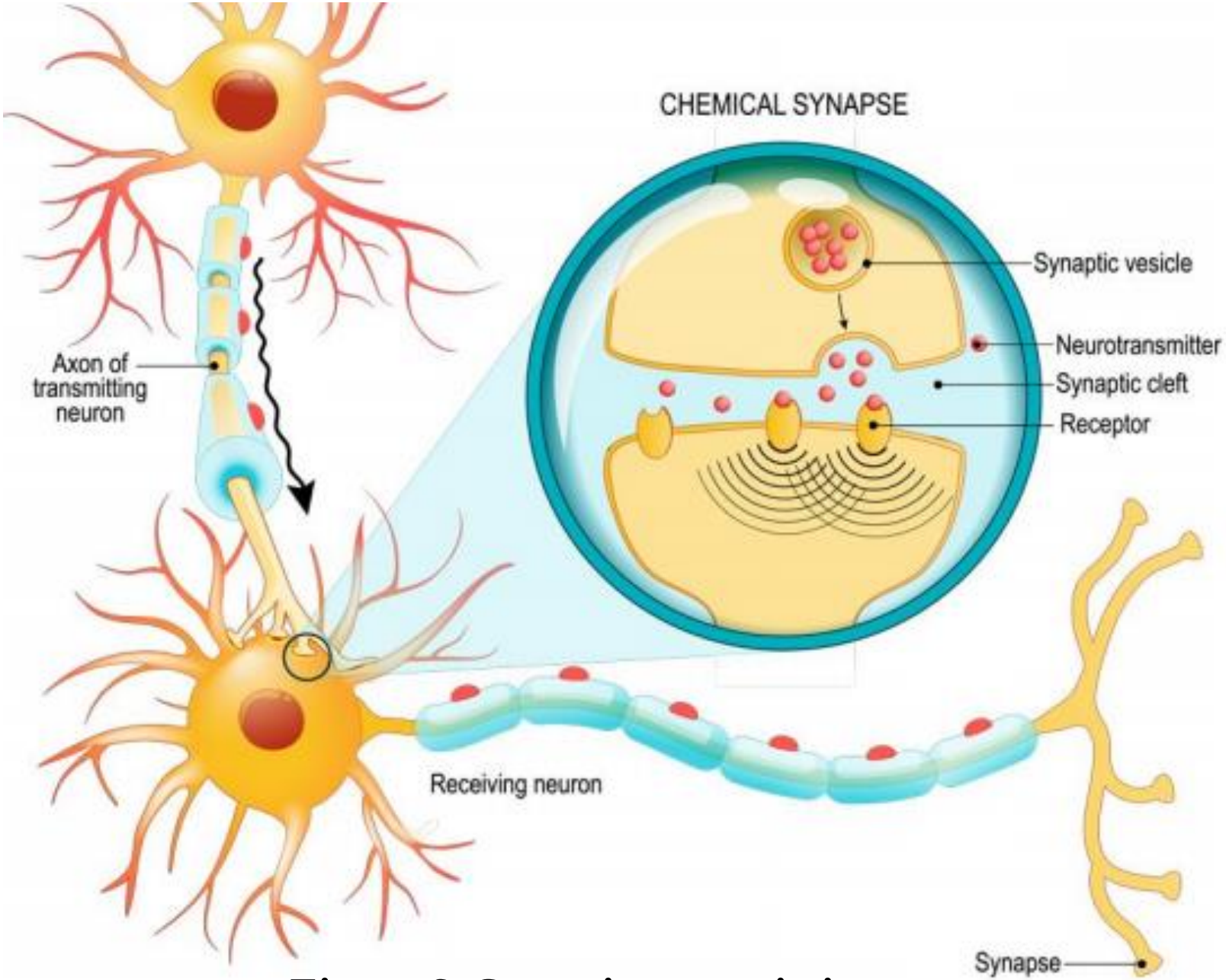


Figure 6: Synaptic transmission

5.1.3 Neurotransmitters

- Neurotransmitters are often referred to as **the body's chemical messengers**.
- They are used by the nervous system to transmit messages between neurons, or from neurons to muscles.
- **Acetylcholine (ACh)** is an abundant neurotransmitter in the human body. It is found in both the CNS and the PNS.
  - **Excitatory transmitter** promotes the generation of an action potential in the receiving neuron, whereas
  - **Inhibitory transmitter** prevents it.
- Whether a neurotransmitter is excitatory or inhibitory depends on the receptor it binds to.

5.1.4. Types of the Nervous System

- The human nervous system has two main parts. These are:
  - **The Central Nervous System (CNS)** and
  - **The Peripheral Nervous System (PNS)**

The Central Nervous System

- The **CNS** is the main coordinator of any of the affector (sensory) inputs comes from the sense organs.
- The **CNS** is made up of **brain** and **spinal cord**.
- **Brain** is a delicate mass of nervous tissue.
  - It is enclosed in membranes and protected by the bones of your **skull** in a space known as the **cranium**.
- The **spinal cord** runs out from your brain down your body.
  - It is encased and protected by the **vertebrae** making up spine.
- . The CNS contain two types of nerve. These are,
  - **Cranial nerves** and **Spinal nerves**

- **Cranial nerves** are 12 pairs of nerves that come out of the brain.
  - They go mainly to structures in your head and neck, like your eyes, tongue and jaws.
- **Spinal nerves** are majority of the nerves in the CNS that come out of the spinal cord.
  - They stretch to the arms, legs, trunk and to the rest of the body.
- Central nervous tissue is delicate; and as a damaged neurons cannot be replaced, this fragile, irreplaceable tissue must be well protected.
- ***Four major features help protect the CNS from injury:***

1. It is enclosed by hard, bony structures.
   - The **cranium (skull)** encases the brain and
   - The **vertebral column** surrounds the spinal cord
2. Three protective and nourishing membranes, the **meninges**, lie between the bony covering and the nervous tissue.

- ***The meninges consist of three connective tissue layers:***

I. **Dura mater:** this layer lies closest to the bone of the skull and is a double layer of tough, fibrous, connective tissue.
   - The outer layer is called the **periosteal layer** (absent in spinal cord) and the meningeal layer lies closest to the brain.

II. **Arachnoid mater:** is a delicate serous membrane.
   - Between the dura mater and the arachnoid mater, there is a space called the **subdural space**.
   - **Subarachnoid space** is below the arachnoid mater and above the pia mater.
     - It contains CSF and contains some of the larger blood vessels serving the brain.

III. **Pia mater**
   - Is a delicate connective tissue layer that clings tightly to the brain.
   - It contains many tiny blood vessels that serve the brain.

The Brain

- Human brain is a very complex structure that carries out an amazing variety of functions.
- The brain "floats" in a special cushioning fluid, the cerebrospinal fluid (CSF).
- **CSF** is a thin fluid similar to plasma and has several important functions:
  - It acts as a cushion, supporting the weight of the brain and protecting it from damage.
  - It helps to maintain a uniform pressure around the brain and spinal cord.
  - There is a limited exchange of nutrients and waste products between neurons and CSF.
- Protected within the skull, the brain is composed of:
  - **Cerebrum, Cerebellum** and **Brainstem (Medulla)**

Cerebrum

- Cerebrum (also called the **Telencephalon**) is the largest part of the human brain.
- It composed of right and left hemispheres.
- It performs higher functions like:
  - Interpreting touch, vision and hearing
  - Speech, reasoning, emotions, learning, and fine control of movement.

Hypothalamus

- Is found under the **Thalamus**.
- Is the center for **homeostatic** control of the internal environment.
  - It receives signals about the state of the body and regulates thirst, appetite, and body temperature.
- It controls **sex drive** and is an **endocrine gland** that interacts with the adjacent **pituitary** gland.

Thalamus

- Is superior to the hypothalamus and inferior to the cerebrum. The **third ventricle** is a narrow cavity that passes through both the thalamus and hypothalamus.
- Many of the functions of thalamus are concerned with **sensation**.

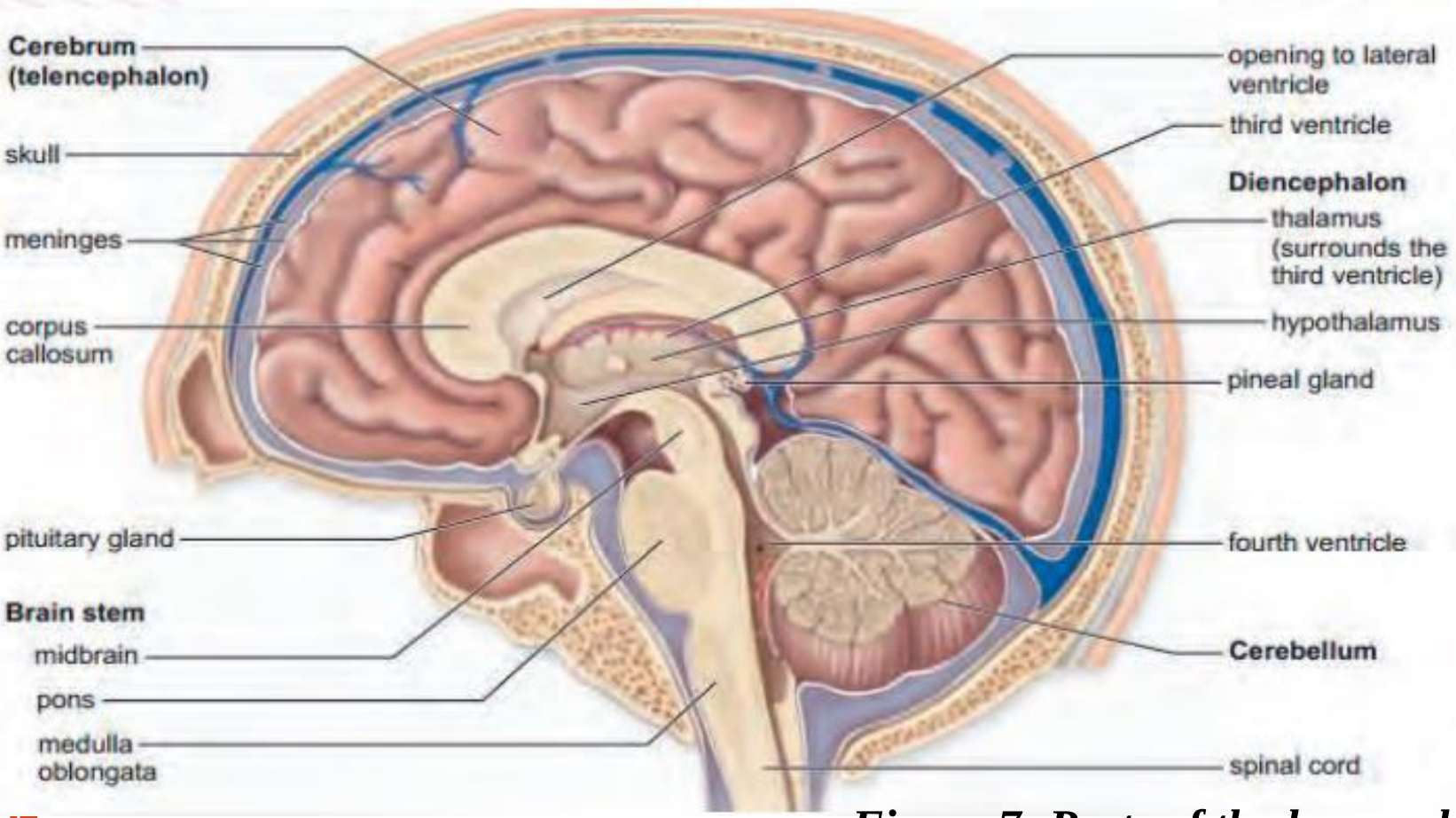


Figure 7: Parts of the human brain

Cerebellum

- Is the largest part of the hindbrain.
- It lies under the **occipital lobe** of the cerebrum.
- It is separated from the **brain stem** by the **fourth ventricle**.
- The cerebellum receives:
  - **Sensory input** from the eyes, ears, joints, and muscles about the present position of body parts; and **motor output** from the cerebral cortex about where these parts should be located.
- After integrating this information, the cerebellum sends motor impulses by way of the brain stem to the skeletal muscles. In this way, the cerebellum maintains **posture** and **balance**.
  - It also ensures that all of the muscles work together to produce smooth, coordinated voluntary movements.
  - It assists the learning of new motor skills such as playing the piano or hitting a baseball.
  - New evidence indicates that the cerebellum is important in judging the passage of time.

Medulla (Brainstem)

- The brainstem connects the spinal cord to the remainder of the brain
- The brain stem also has **reflex centers** for visual, auditory, and tactile responses.
- The **medulla oblongata, pons,** and **midbrain** constitute the **brainstem**.
- **Pons:** (means **bridge** in Latin) contains bundles of axons traveling between the cerebellum and the rest of the CNS.
  - The pons functions with the medulla oblongata to regulate breathing rate.
  - It has reflex centers concerned with head movements in response to visual and auditory stimuli.
- **The Medulla Oblongata:** contains reflex center:
  - For regulating heartbeat, breathing, and blood pressure.
  - For vomiting, coughing, sneezing, hiccuping, and swallowing.

- **The Midbrain** acts as a relay station for tracts passing between the cerebrum and the spinal cord or cerebellum.
- The tracts cross in the brain stem so that:
  - The right side of the body is controlled by the left portion of the brain, and
  - The left side of the body is controlled by the right portion of the brain.

White and Gray Matter

- The brain and spinal cord contain gray matter and white matter.
  - **Gray matter** is primarily made up of neuron cell bodies.
  - **White matter** consists of bundled axons.
- In the **spinal cord**, white matter forms the outer layer, reflecting its role in linking the CNS to sensory and motor neurons of the PNS.
- In the **brain**, white matter is predominantly in the interior, where signaling between neurons functions in learning, feeling emotions, processing sensory information, and generating commands.

The Spinal Cord

- The spinal cord has a much simpler structure than the brain.
- It is a tubular structure composed of the nervous tissue that extends from the brainstem and continues distally before tapering at the lower thoracic/upper lumbar region as the conus medullaris (the terminal end of the spinal cord).
- The spinal cord runs out from the brain down the body.
  - It is encased and protected by the **vertebrae** making up the spine.

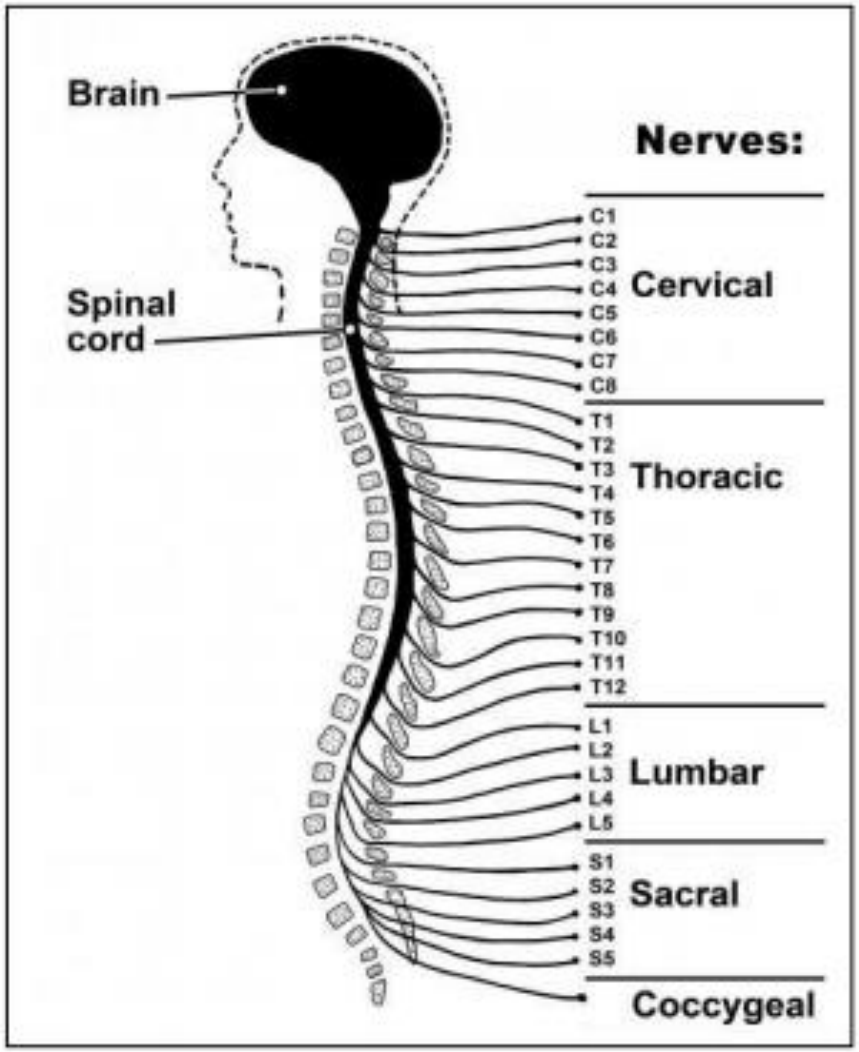


Figure 8: Spinal cord and spinal nerves

- ***In the spinal cord:***
  - The **grey matter** is located in the middle whereas
  - The **white matter** is found on the outside
- At regular intervals along the spinal cord there are:
  - Entrance points for **affector** nerves that bring information into the CNS and
  - Exit points for **effector** nerves carrying instructions from the CNS.
- **Dura mater:**
  - Is the thick outermost covering (meninges) of the brain and spinal cord.
  - It is the layers of connective tissue that make up the meninges of the brain (dura, arachnoid, and pia).
  - It is the outermost layer of the three meninges that surround and protect the brain and spinal cord

- **Pia mater:**
  - Is the innermost covering of the spinal cord.
  - Intimately adhered to its surface, the pia mater stabilizes the spinal cord through lateral extensions of the pia called the **denticulate ligaments**, extending between the ventral and dorsal roots unto the dura mater.

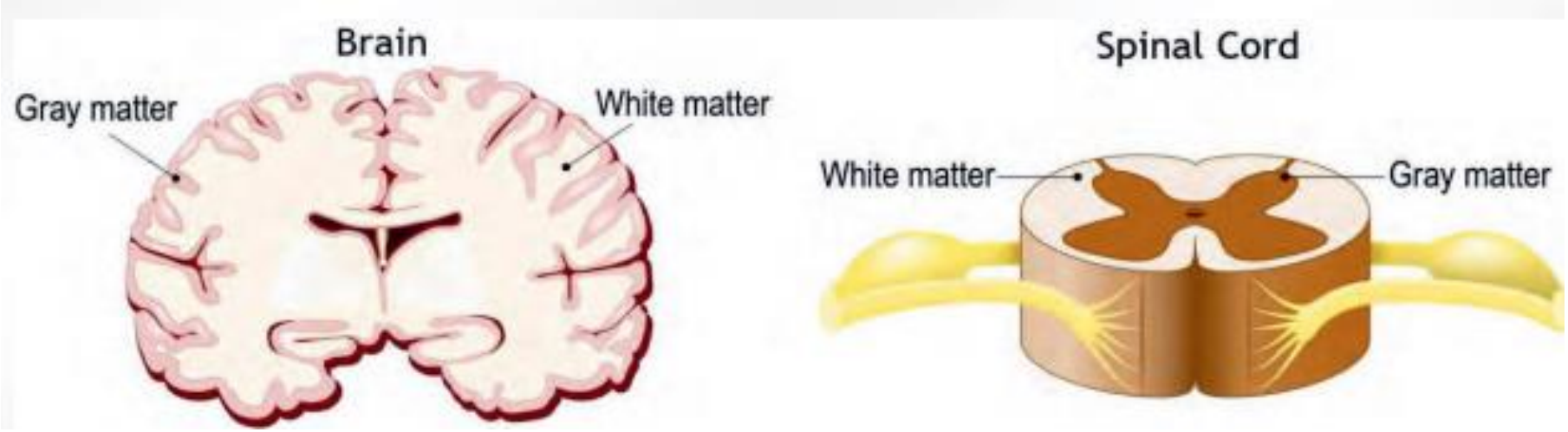


Figure 9: The cross section of the CNS showing position of grey and white matter

The Peripheral Nervous System

- The Peripheral Nervous System (PNS) is the division of the nervous system that contain all the nerves that lie outside of the CNS.
- The PNS is subdivided into:
  - The afferent division and
  - The efferent division

Afferent Division

- **The afferent division** of the PNS carries signals to the CNS and includes all the neurons that transmit sensory information from their receptors.

Efferent Division

- **The efferent division** of the PNS carries signals from the CNS to the muscles and glands, which act as effectors to bring about the desired response.

- In mammals,
  - 31 pairs of spinal nerves carry signals between the spinal cord and the body trunk and limbs and
  - 12 pairs of cranial nerves connect the brain directly to the head, neck, and body trunk.
- The efferent division of the PNS is further subdivided into:
  - The somatic nervous system and
  - The autonomic nervous system

The Somatic Nervous System

- The somatic system is the part of the PNS that is responsible for carrying out sensory and motor information to and from the CNS.
- The somatic system is responsible for transmitting sensory information as well as for voluntary movement.

The Autonomic Nervous System

- The autonomic system is part of your PNS that is responsible for regulating involuntary body functions, such as blood flow, heartbeat, digestion, and breathing.
  - In other words, it is the autonomic system that controls aspects of the body that are usually not under voluntary control.
  - This system allows these functions to take place without the need to consciously think about what is happening.
- ***The autonomic system is further divided into two branches:***

Sympathetic system:

- By regulating the 'flight-or-fight' response, the sympathetic system prepares the body to expend energy to respond to environmental threats.
- When action is needed, the sympathetic system triggers a response by accelerating heart rate and increasing breathing rate, boosting the blood flow to muscles, activating sweat secretion, and dilating the pupils.

Parasympathetic System:

- This helps maintain the normal body functions and conserve physical resources.
- Once a threat is recognized, this system will slow the heart rate, slow breathing, reduce blood flow to muscles, and constrict the pupils.
- This allows us to return our bodies to a normal resting state.

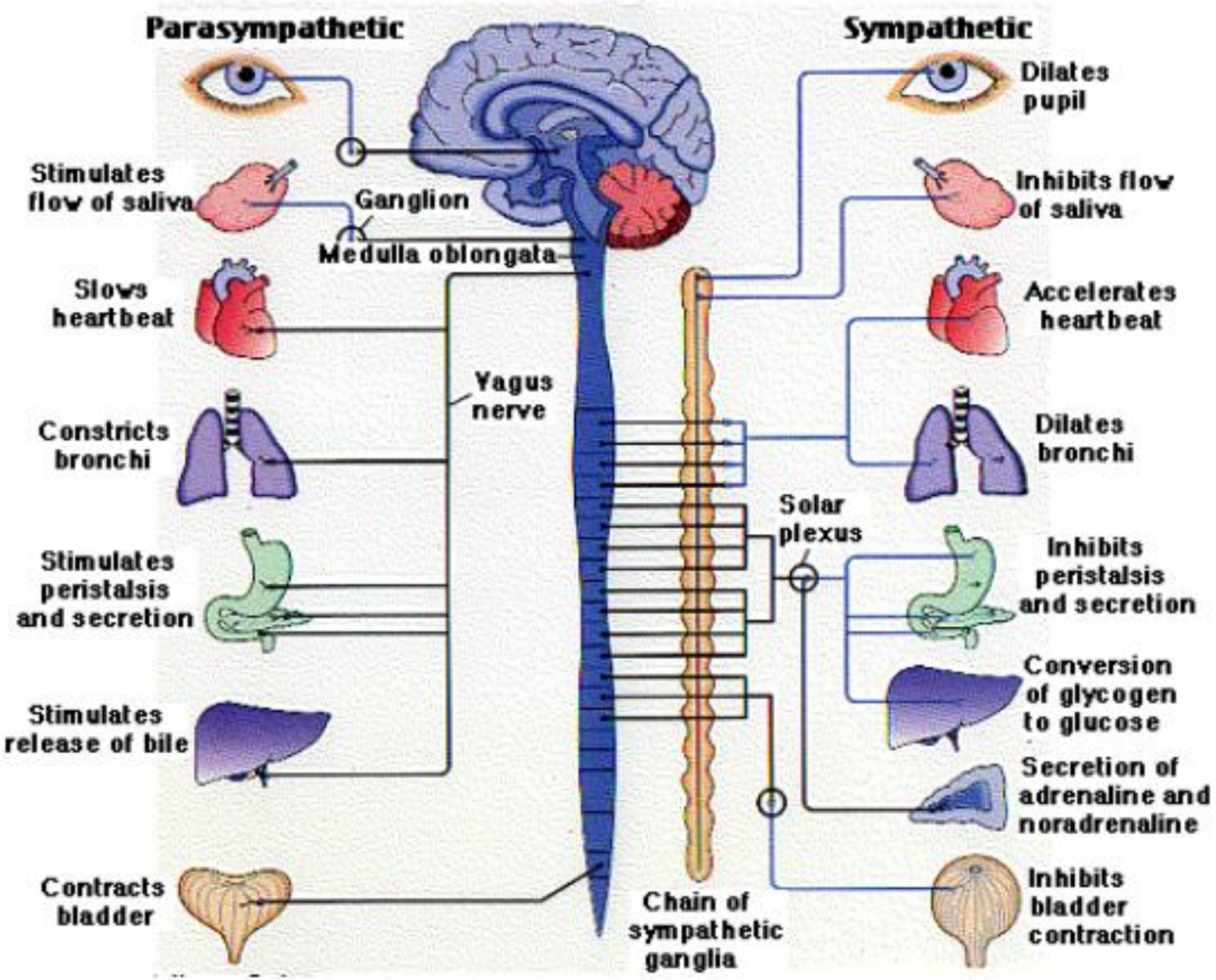


Figure 10: Parasympathetic and Sympathetic nervous system

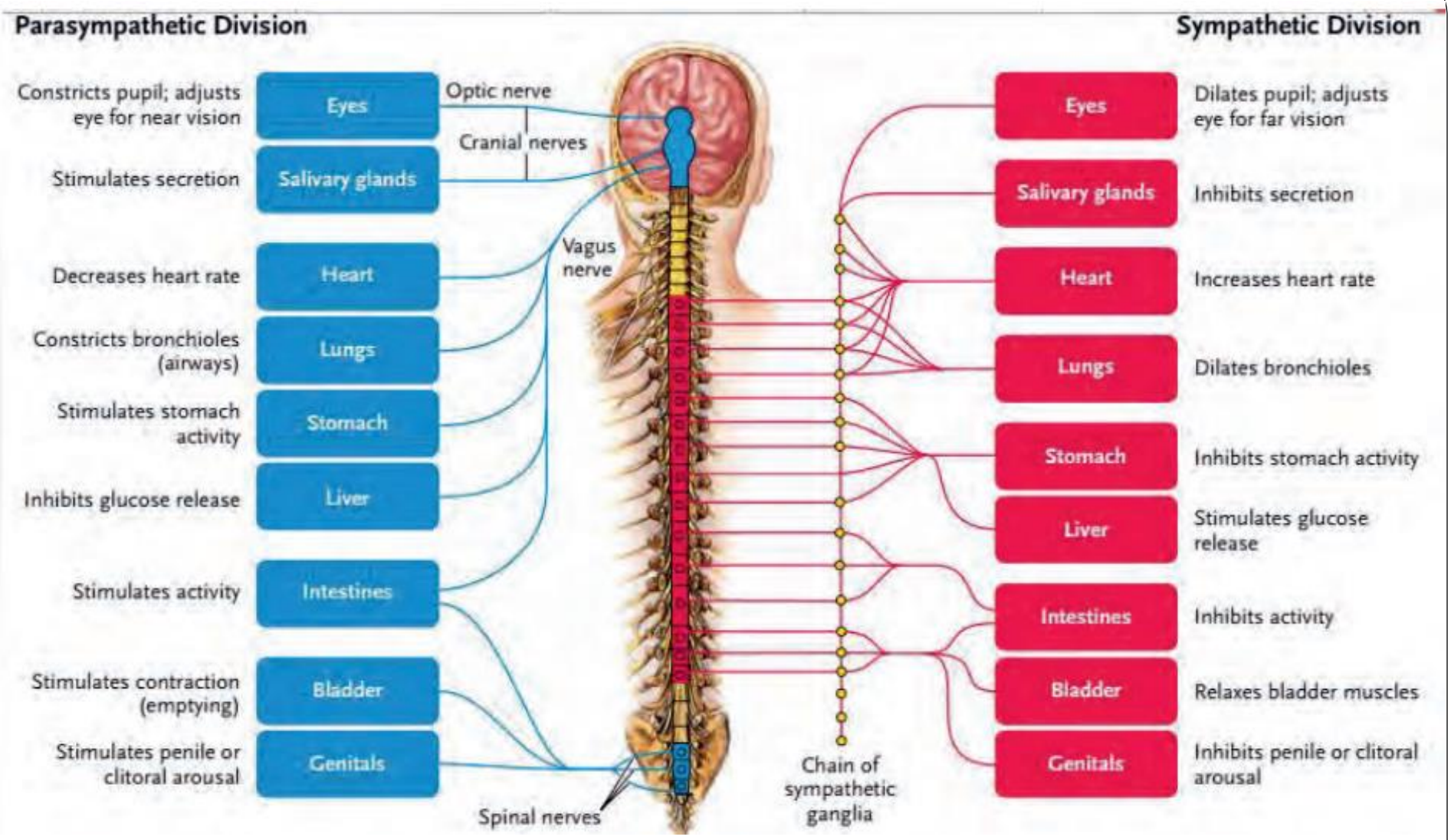


Figure 11: The autonomic nervous system

5.1.6 Reflex Action

- A **reflex action** is a sudden, automatic and uncontrolled response of parts of the body or the whole body to the external stimuli.
  - They are usually involved in helping us to avoid danger or damage.
  - When the body is in danger, it can respond to the situation, without conscious, thought.
  - This causes a faster response, preventing or minimizing damage to the body. This is known as **reflex action**.

Reflex Arc

- The pathway of neurons involved in a reflex action is known as **reflex arc**.
- The **receptors**, **neurons** and **effectors** involved are referred to as a reflex arc.
- Most reflexes follow the same steps between the stimuli and the response. One of the simplest situations where impulses cross synapses to produce action is in the reflex arc.

- A reflex arc is the pathway that nerve impulses travel when a reflex is elicited, and there are **five essential parts**:

1. **Receptors**: detect a change (the stimulus) and generate impulses.
2. **Sensory neurons**: transmit impulses from receptors to the CNS.
3. **Central nervous system**: contains one or more synapses (interneurons may be part of the pathway).
4. **Motor neurons**: transmit impulses from the CNS to the effector.
5. **Effector**: performs its characteristic action.

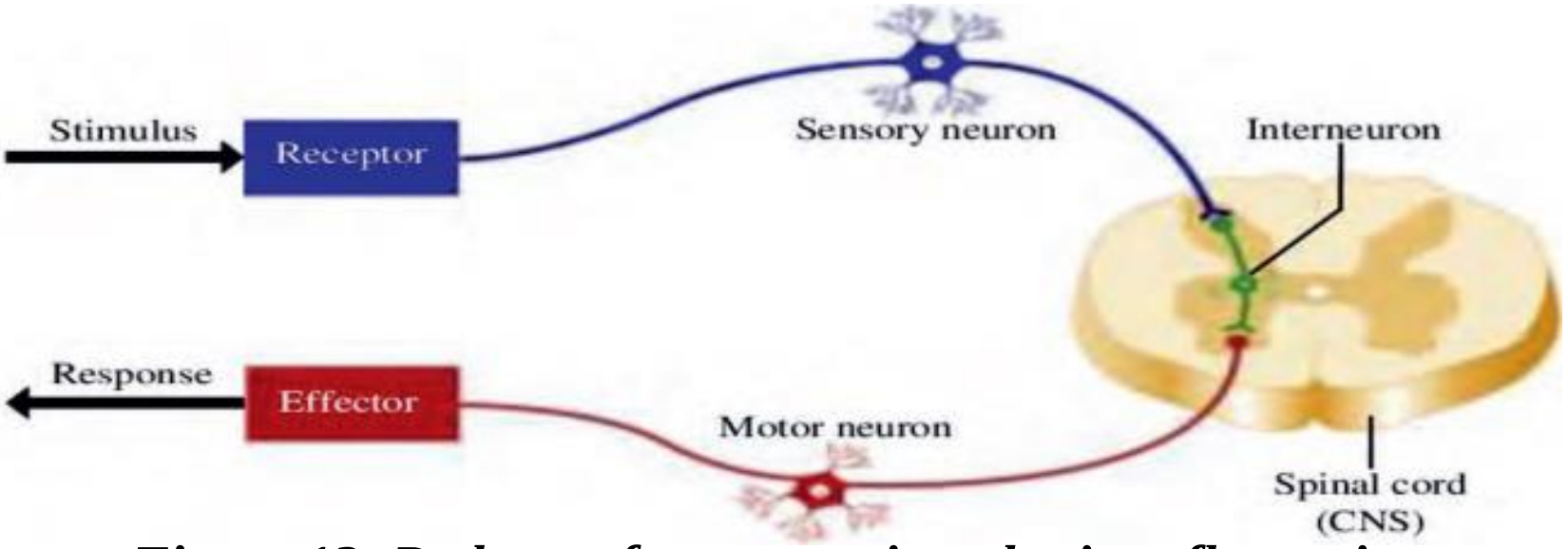


Figure 12: Path way for a nerve impulse in reflex action

- Let us now look at the reflex arc of a specific reflex,
  - The patellar (or knee-jerk) reflex, with which you are probably familiar.
- In this reflex,
  - A tap on the patellar tendon just below the kneecap causes extension of the lower leg.
  - This is a **stretch reflex**, which means that a muscle that is stretched will automatically contract.
- As shown in the Figure 13:
  - Impulses from a sensory receptor in the skin pass along an affector neuron to the CNS (the spinal cord).
  - The neuron enters the spinal cord through the **dorsal root**.
  - When an impulse from the affector neuron arrives in the synapse with a short relay neuron a transmitter is released, which causes an impulse to be sent along the relay neuron.

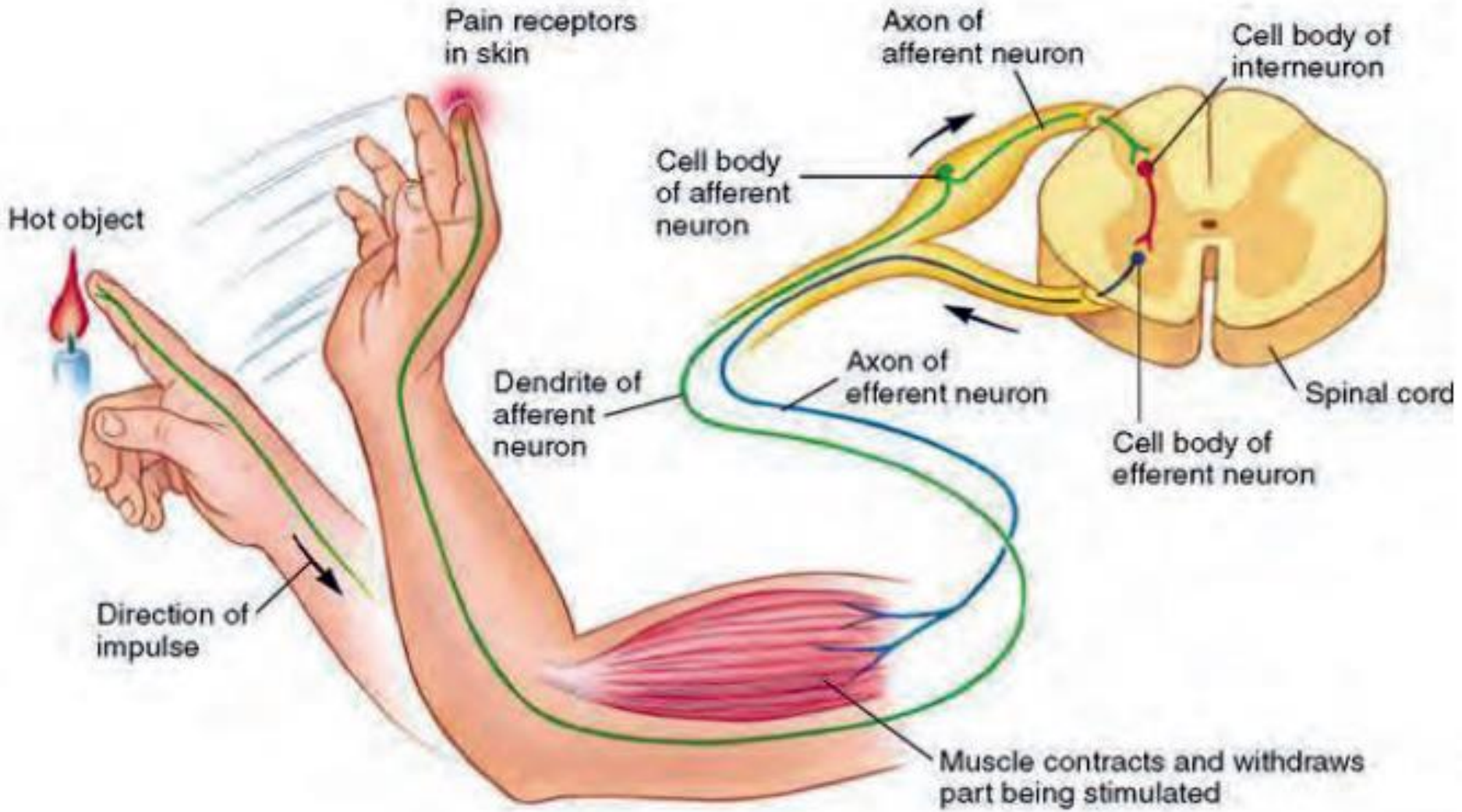


Figure 13: The reflex action

- When the impulse reaches the synapse between the relay neuron and an effector neuron returning to the arm again another transmitter chemical is released.
- This starts impulses travelling along the effector neuron to the effector, which brings about change.
- The effector neuron leaves the spinal cord by the **ventral root**.

- In this example the impulses arrive in the muscles of the upper arm, causing them to contract and move your hand upwards sharp.
- Some reflexes are important for avoiding injury, but the knee-jerk and ankle-jerk reflexes are important for normal physiological functions.
- For example,
  - The knee-jerk reflex helps a person stand erect.
  - If the knee begins to bend slightly when a person stands still, the quadriceps femoris is stretched, and the leg straightens.

- The key point about a reflex action is that the messages do not reach a **conscious area** of your brain before instructions are sent out to take action.
- Many reflexes involve the spinal cord, whereas others involve the brain.
- ***They involve three types of neuron:***
  - **Affector neurons**
  - **Relay neurons and**
  - **Effector neurons**
- Relay neurons (interneurons with short axons) connect the affector and effector neurons directly in the CNS, without input from other areas.
- The brain and spinal cord act together as **coordinators** that process the information coming from sensory receptors and neurons and instruct effector neurons and effectors to react.

5.17 Drug Abuse

- **Drugs** are substances that change a person's mental or physical state. They can affect the way the brain works, how you feel and behave, your understandings and your senses.
- Some **drugs** are used for **medicine** while, others are **used for pleasure**.
- Most drugs tend to be habit-forming, if not physically addictive.
- Some of the substances (drug) are socially **acceptable** (**legal**) and others are **illegal**.
  - **Legal drugs** are used for the mild pleasure they bring, to be sociable and because using them becomes a habit.
- **Drug abuse** is the excessive and wrong use of drugs.
  - Taking an excess of a drug cause a risk serious side effects and even death.
- **Drug dependence** is the use of a drug again and again and become addicted.

- Drugs change the chemical processes in your body so you can become addicted to them (dependent on them). This means, you cannot manage or function properly without the drug.
  - This may be psychological; the need to keep using it becomes a craving or compulsion or a physical dependence where your body no longer works properly without the drug.

Dependence Vs. Addiction

- **Dependence** is exhibited by physical symptoms.
- **Addiction** manifests as a combination of physical, mental and behavioral symptoms .
  - A person who is addicted is also dependent. However, a person who is dependent on a drug may not be addicted to it.
- **Substance use disorder (SUD**) or drug addiction is a disease that negatively affects a person's brain and behavior.
- **Drug abuse and dependence** can hurt the individual user, their family and the entire community.

- **Withdrawal symptoms:** a set of unpleasant effects upon the body caused by a sudden stopping of using a drug. Such as:
  - Feel very unwell, Pains, Shaking, Sweating and Headaches
  - Cravings for the drug and even fevers
- Alcohol, tobacco (nicotine), khat (cathinone), coffee (caffeine), cannabis (marijuana) and Solvents like gasoline are the most widely used substances in Ethiopia.
  - Alcohol, khat, tobacco and coffee (caffeine) are the most commonly used legal recreational drugs in Ethiopia but cannabis (marijuana) is illegal drug. Solvents like gasoline are legal.
- ***All commonly used recreational drugs in Ethiopia have the following features in common:***
  - They are addictive.
  - They affect brain function and alter behavior.
  - They damage health, resulting in lower productivity and absence from school/work.
  - They adversely affect the individual, families, community and country.

- ***Illegal drugs rarely used in Ethiopia are:***
  - Prescription Sédatives
  - Cocaïne
  - LSD **(lysergic acid diethylamide)**
  - Ecstasy and heroin.
- ***Illegal drugs affect the health, in two quite different ways.***
  1. They cause changes in the body and can damage vital systems.
  2. Turn to crime or prostitution to raise the money.
- They take part in risky activities such as sharing needles, which increases the risk of becoming infected with HIV/AIDS or hepatitis.

Cigarette Smoke

- **Smoking** is not as common in Ethiopia as it is in many parts of the world. Cigarette smoke contains is a complex mixture of chemicals.
- ***Some of the smoke components include:***
- **Gases components:**
  - Carbon monoxide, Hydrogen cyanide and Nitrogen oxides.
- **Solid particles that are suspended in cigarette smoke:**
  - Nicotine, Phenol, Tar, Polyaromatic hydrocarbons (PAHs), and
  - Certain tobacco-specific nitrosamines (TSNAs)
- **Volatile chemicals componets:**
  - Formaldehyde, Acrolein, Benzene and certain N-nitrosamines
- The addictive drug in cigarette smoke is **nicotine**.
  - It affects the brain and produces a sensation of calm well-being and being able to cope. It is very physically addictive.
  - It is the major psychoactive component of smoke, causes powerful changes in heart rate and blood circulation.
  - Nicotine appears to cause injury to the arterial lining.

- ***How does Nicotine use Lead to Addiction?***
  - Nicotine releases a chemical called dopamine in the same regions of the brain as other addictive drugs. It causes mood-altering changes that make the person temporarily feel good.
  - Inhaled smoke delivers nicotine to the brain within 20 seconds, which makes it very addictive.

What is Dopamine?

- **Dopamine** is a chemical released in the brain that makes you feel good.
- The right amount of dopamine is important both for body and brain.
  - Dopamine helps nerve cells to send messages to each other.
  - It's produced by a group of nerve cells in the middle of the brain and sends out messages to other parts of the brain.
  - Within seconds of inhaling cigarette smoke, nicotine causes the release of dopamine in the brain, which gives people a good feeling.

- Over time, the brain begins to crave that feeling from nicotine and people need to use more and more tobacco to get that same good feeling.

- ***Major Health Effects of Cigarette Smoking:***
  - Coronary Heart Disease
  - Strokes
  - Lung Disease
  - Cancers (lip, mouth, esophagus, larynx, throat, pancreas, bladder and kidney)-many of the chemicals in cigarette smoke are carcinogenic.
  - toxicity to the human reproductive system.

Alcohol /Depressant drug/

- **Alcohol** is one of the drugs most commonly used in Ethiopia but we still drink far less than many other countries.
- For many people alcohol is part of their social life.
- Alcohol, like other drugs, has a powerful effect on the brain, producing pleasurable feelings and blunting negative feelings.
- In small amounts, alcohol makes people:
  - Feel relaxed and cheerful; it makes you less inhibited. So shy people can feel more confident when they've had an alcoholic drink.
  - These feelings can motivate some people to drink alcohol again and again.
- Alcohol use is one of the world's leading health risks that results in 2.5 million death each year.

The effect of alcohol on human body

- **Alcohol use disorder (AUD)** is a condition characterized by an impaired ability to stop or control alcohol use despite adverse social, occupational, or health consequences.
- Alcohol has a powerful effect on human body.
  - It is very addictive and poisonous.
  - Liver can usually break it down.
  - It gets rid of the alcohol before it causes permanent damage and death.
- Alcohol acts quickly because it is readily absorbed into the bloodstream from the stomach.
- Alcoholic drink → Wall of gut → Bloodstream → Nearly every tissue s body.

- ***Regular use of alcohol may eventually cause:***
  - Depression
  - Poor memory and brain damage
  - Lose your self-control, as a result you make dangerous decisions.
  - Poor muscular co-ordination, resulting in slurred speech and a lack of balance.
  - Research has shown that young people who drink alcohol are; more likely to have unprotected sex, to become pregnant and to become infected with HIV/AIDS.
  - Difficulty getting an excretion, results in dehydration
  - Increases hunger, High blood pressure and heart disease
  - Cancer and Liver diseases /**cirrhosis of the liver/**
- **Cirrhosis of the liver** (end stage liver disease): a serious disease of the liver that can be caused by drinking too much alcohol.
  - This disease destroys liver tissue.
  - They can also get liver cancer, which spreads quickly and can be fatal.

Catha edulis (Khat)

- ***Catha edulis* (Khat)** is a plant grown commonly in the horn of Africa. The leaves are chewed by people for it is **stimulant**.
- Khat leaves contain **cathinone** drug which affects the brain.
  - **Cathinone** drug is absorbed into the bloodstream through the membranes lining the mouth and the stomach as the leaves are chewed.
  - It acts quickly, within 30 minutes of starting to chew, before it is broken down and removed by the liver.
  - It is a mild stimulant, makes people feel happy.
  - It is often used in social situations.
- The negative effects of the drug may be damaging the economy even more.
  - People spend hours chewing and dreaming when they could be working.
  - Affects the health of the population directly and indirectly by the behaviour it causes.

The effect of khat:

- ***Using khat makes people:***
  - More likely to be injured in accidents and involved in crime.
  - Less likely to have a job and reduces appetite.
  - Mood changes, changes in sex drive- inability to get erection
  - Excessive talkativeness, unprotected sex, risk of pregnancy and HIV/AIDS infection
  - Hyperactivity, enlarged liver and Reduce sleeping (insomnia).
  - Increase heart rate, body temperature and breathing rate, inflammation esophagus, heart attack, change in white blood cells.

Cannabis (Marijuana)

- **Cannabis** is a plant that contains 400 known chemicals, 60 of which are the cannabinoids, unique to the plant.
  - The most potent is **delta-9-tetrahydrocannabinoid (THC).**
  - **THC** is known to affect the brain cells that are responsible for memory, emotion and motivation.

- Cannabis is usually smoked but it can also be eaten, when it has a much stronger effect because your liver converts it into a much more powerful drug.
  - It can make you feel a great sense of wellbeing and relaxation, happy and euphoric and this is why people use it.
  - It is a mild hallucinogenic drug.
- **Hallucinogens** are drugs that produce vivid waking dreams, where the user sees or hears things that are not really there, or has a distorted view of the world.
- However, many people find the effect of the drug a very unpleasant and disturbing experience.
- The effect of cannabis is very variable.
  - It affects different people in different ways, and even the same person can react very differently depending on how it is used.
- Cannabis is illegal in Ethiopia.