

12.1 COORDINATION AND RESPONSE

1. Multicellular organisms need to respond toward environmental changes. This response will be coordinated by organs and organ systems in body.
2. The changes in environment are known as stimuli (sing. Stimulus).
3. External stimuli are changes of external environment such as light, sound, smell, taste, surrounding temperature, pain, pressure and touch.
4. Internal stimuli are changes of internal environment in body such as blood pressure, blood pH, body temperature, osmotic pressure, carbon dioxide partial pressure and blood sugar level.
5. The stimulus can be detected by an organism using receptors
6. Receptors are specialised cells in the sensory organs which detect stimuli and trigger impulse
7. The nerve impulse will send to integration centre via nerve for analysis.
8. After analysis, integration centre will send nerve impulse to effectors for producing appropriate responses toward that stimulus.
9. Effectors consist of muscles (smooth, skeletal and cardiac muscle) and glands (endocrine and exocrine glands)
10. Coordination is the corporation between several organs and organ systems in body in order to function effectively by producing an appropriate response toward a stimulus.
11. Nervous system and endocrine system are the two main organ systems in communicating and integrating towards environment.
12. Coordination and response in humans can be illustrated as below:

stimuli — receptors — intergration centre- effectors - response

Necessity of response

- Adapt to surrounding temperature
- Move to a safe place
- Obtain food sources
- Obtain partners
- Regulate internal environment via homeostasis



12.2 NERVOUS SYSTEM



HUMAN NERVOUS SYSTEM



CENTRAL NERVOUS SYSTEM (CNS)

Brain

Consists of forebrain, midbrain and hindbrain

Spinal cord

Tubule extension from the brain

HUMAN NERVOUS SYSTEM

Cranial nerves

- Branch from the brain
- Connect the brain, sensory organs (eyes, ears and nose) and effectors (muscles and glands) at the head

PERIPHERAL NERVOUS SYSTEM

Spinal nerves

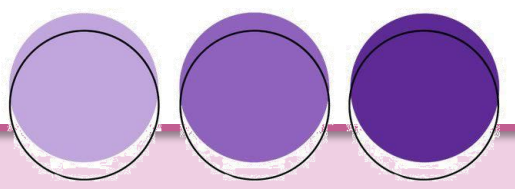
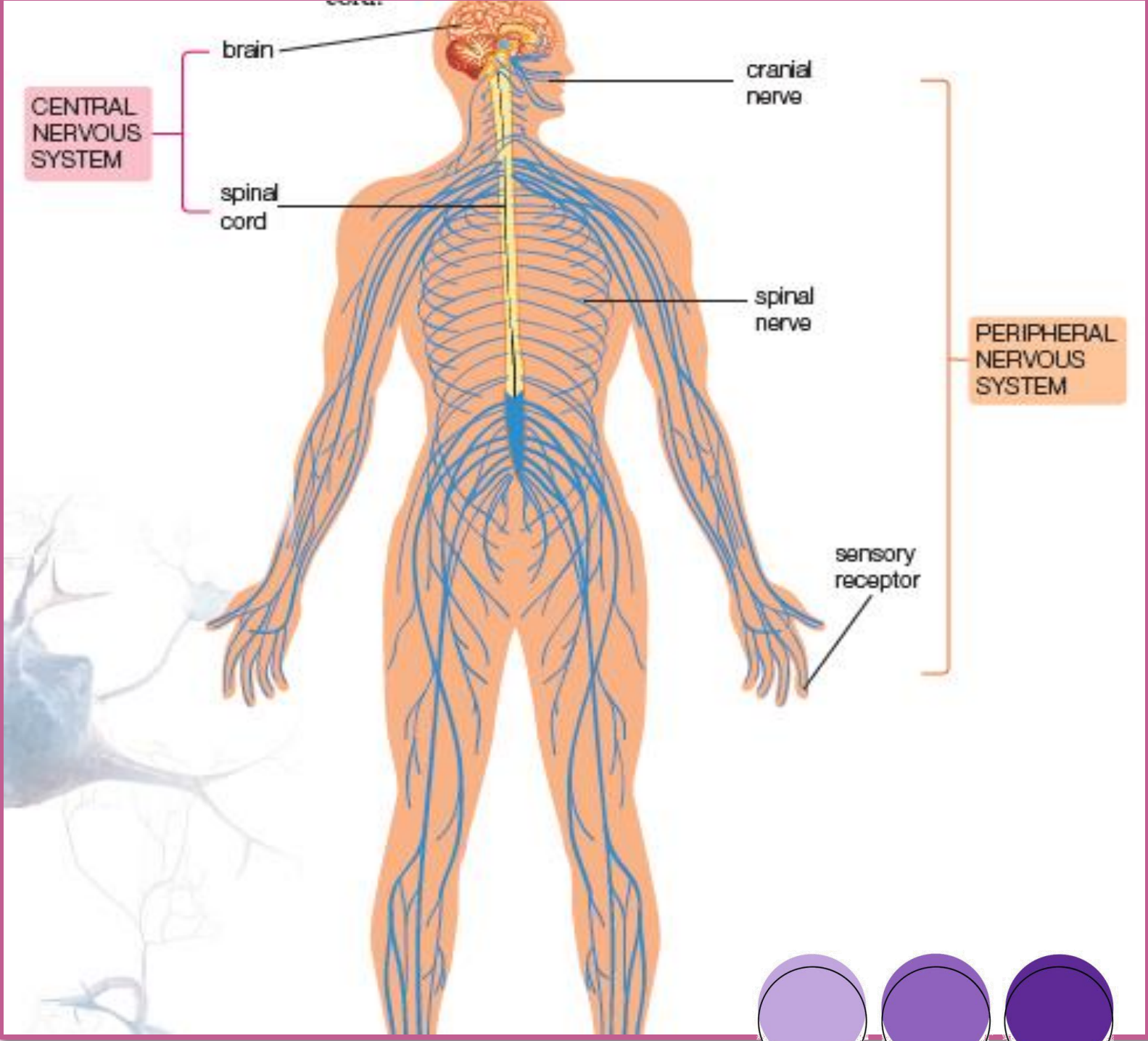
- Branch from the spinal cord
- Connect the spinal cord, sensory organs and effectors at other limbs

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Sensory receptor

Found at the end of cranial and spinal nerves in organs





CENTRAL NERVOUS SYSTEM :



STRUCTURE AND FUNCTIONS OF THE BRAIN

CEREBRUM

- The largest and most complex structure present in the frontal part of the brain.
- The surface is folded to increase the surface area to hold more nerves.
- It is the centre that controls emotions, hearing, sight, personality and controlled actions.
- The cerebrum receives information and stimulus from the receptor.
- This information is analysed, integrated and correlated to produce sensory perception.
- The response is determined and instructions are given to the effectors.
- The cerebrum is also responsible for higher mental abilities such as learning, memorising, linguistic skills and mathematics skills.

HYPOTHALAMUS

- Coordinating homeostasis.
- It is the control centre that regulates body temperature, water balance, blood pressure, and senses hunger, thirst and fatigue.
- The hypothalamus connects the nervous system to the endocrine system through the pituitary gland.
- Controls the secretion of a few types of pituitary gland hormones.

CEREBELLUM

Maintains body balance and coordination of muscle contraction for body movement.

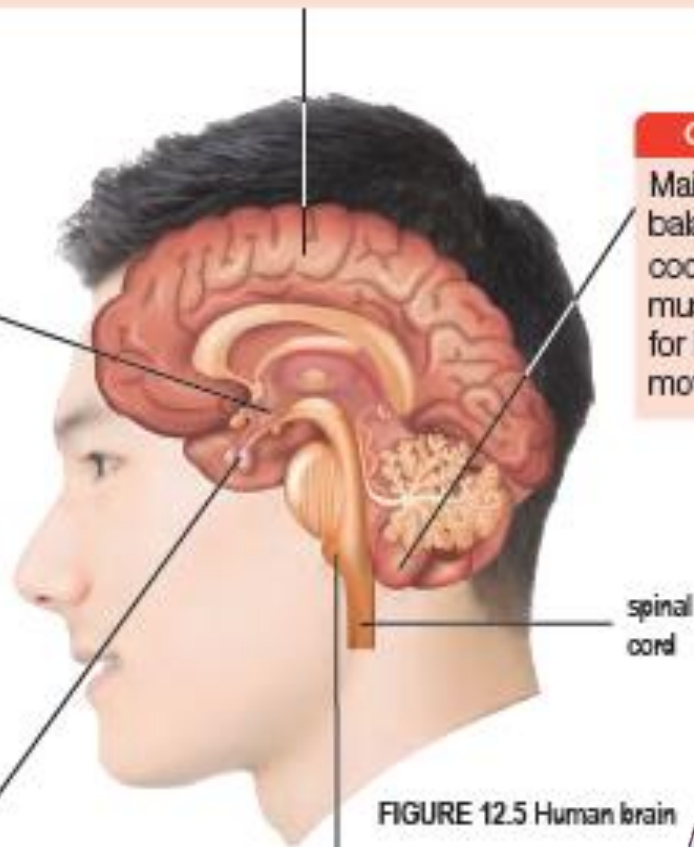


FIGURE 12.5 Human brain



PITUITARY GLAND

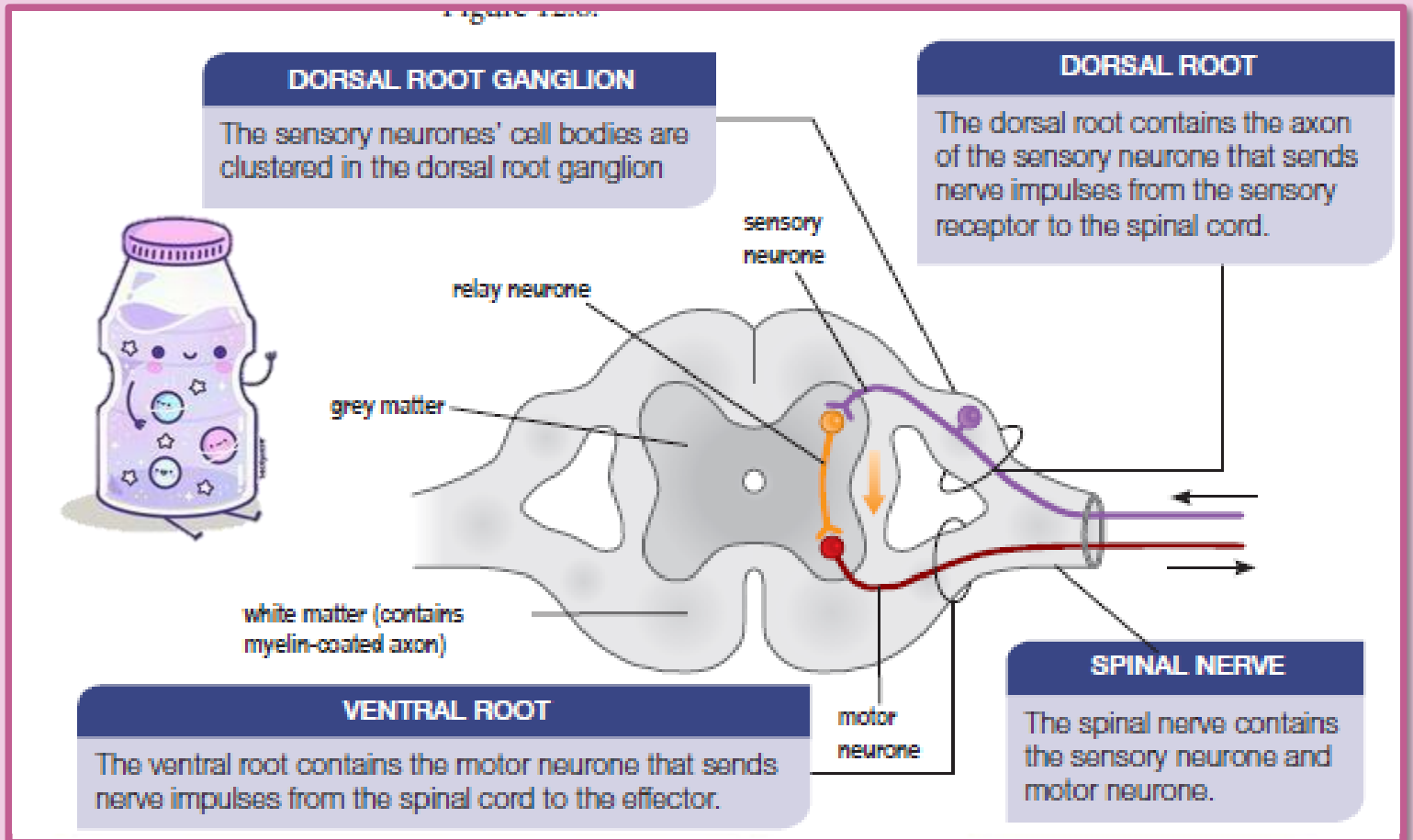
- Located at the base of the hypothalamus.
- The main gland in the endocrine system.
- This gland secretes hormones that control the secretion of hormones by other endocrine glands.

MEDULLA OBLONGATA

- Located at the anterior of the cerebellum.
- Controls involuntary actions such as heartbeat, breathing, food digestion, vasoconstriction, blood pressure, peristalsis, vomiting, coughing, sneezing and swallowing.

STRUCTURE AND FUNCTION OF THE SPINAL CORD

- a) Located within the vertebral column
- b) Function to control reflexes and convey signals from and to the brain
- c) Surrounded by cerebrospinal fluid to provide nutrients and cushion the spinal cord



PERIPHERAL NERVOUS SYSTEM

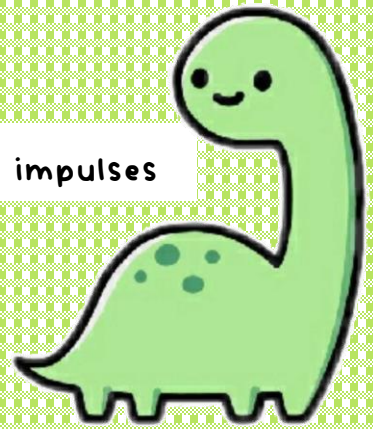
1. Peripheral nerves consist of somatic and autonomic nervous systems.
2. The somatic nervous system controls all voluntary actions.
3. The autonomic nervous system controls involuntary actions such as heartbeat and blood vessel contraction.
4. The function of peripheral nervous system is to connect sensory receptors and effectors to the central nervous system.



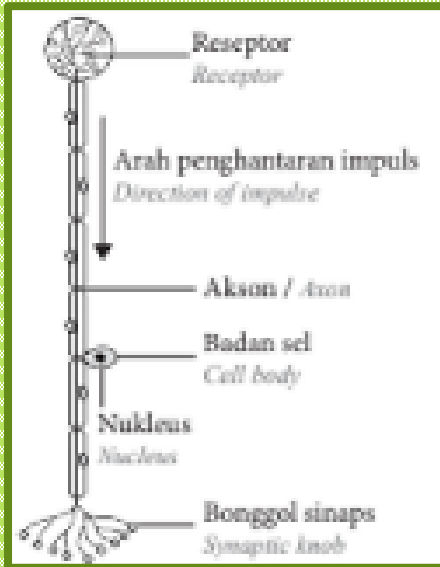
12.3 Neurones and Synapse

Structure of a Neurone

Neurones are cells in the nervous system that transmit nerve impulses



SENSORY NEURONE



- Afferent neurone is also known as sensory neurone

FUNCTION :

- Send nerve impulse from receptor to brain and spinal cord

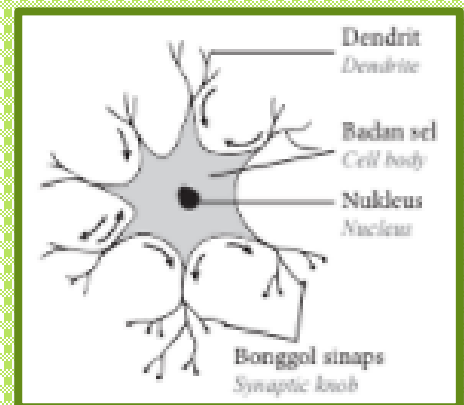
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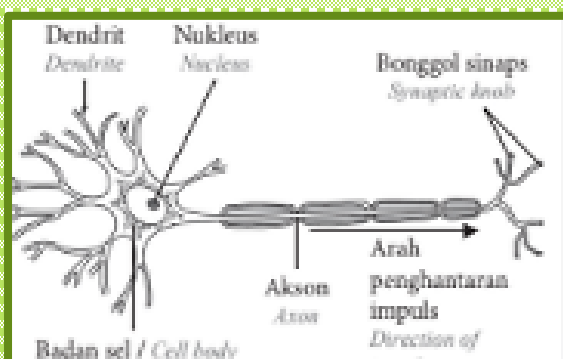
FUNCTIONS :

- Connects sensory neurone to motor Neurone
- Transmit impulse between brain and spinal cord

RELAY NEURONE



MOTOR NEURON



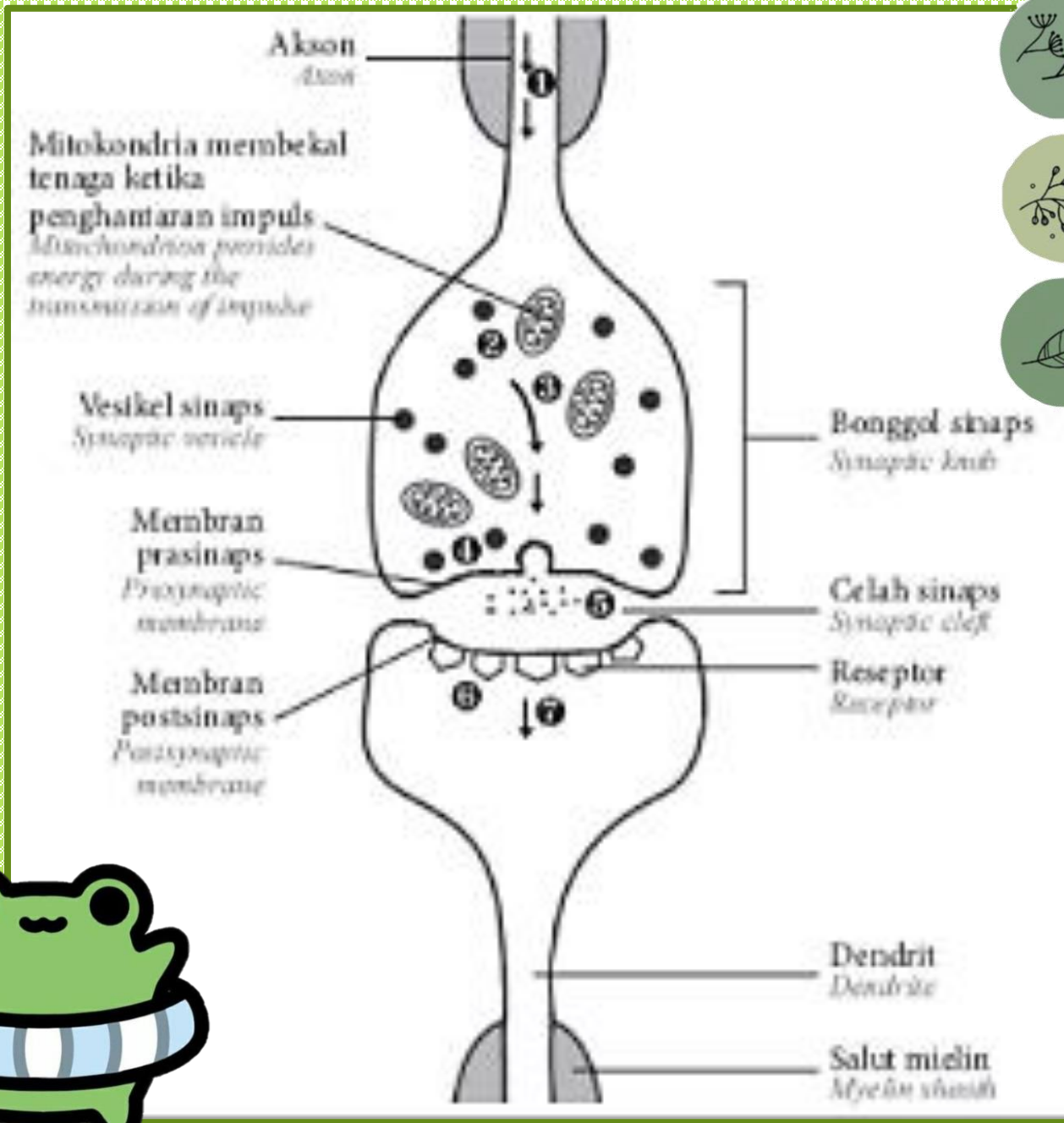
- Efferent neurone is also known as motor neurone

FUNCTION :

- Carry information from the spinal cord or brain to the effectors (muscle or glands cells)



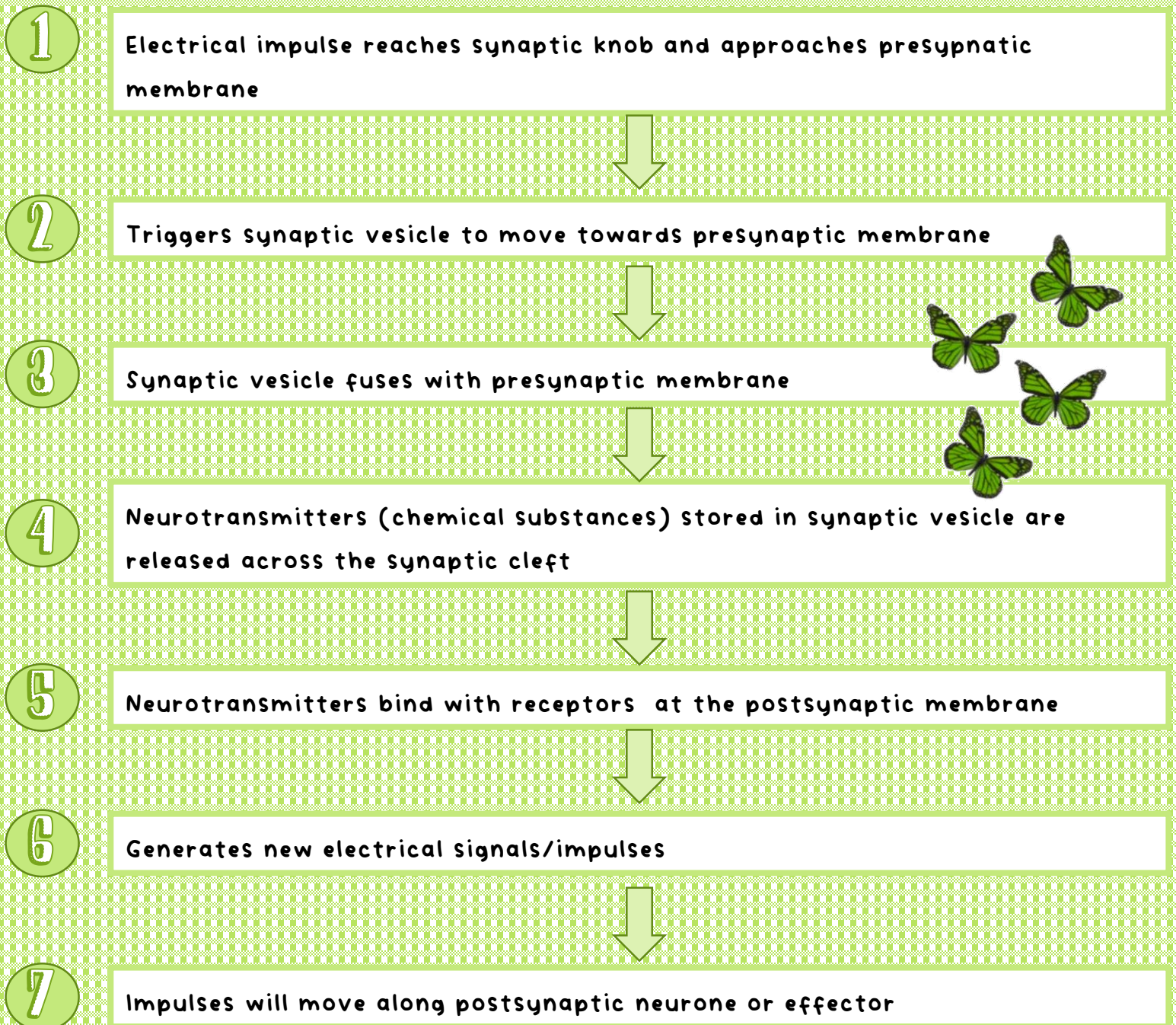
Synapse and transmission of information



SYNAPSE PLAYS IMPORTANT ROLES IN :

- Controlling and integrating nerve impulses that are transmitted by stimulates receptors
- Allow nerve impulses to be transmitted only in one direction because
 - synaptic vesicles only present at the synaptic terminal
 - receptor is only present at the postsynaptic





12.4 VOLUNTARY AND INVOLUNTARY ACTIONS

voluntary action and involuntary action

Voluntary Action

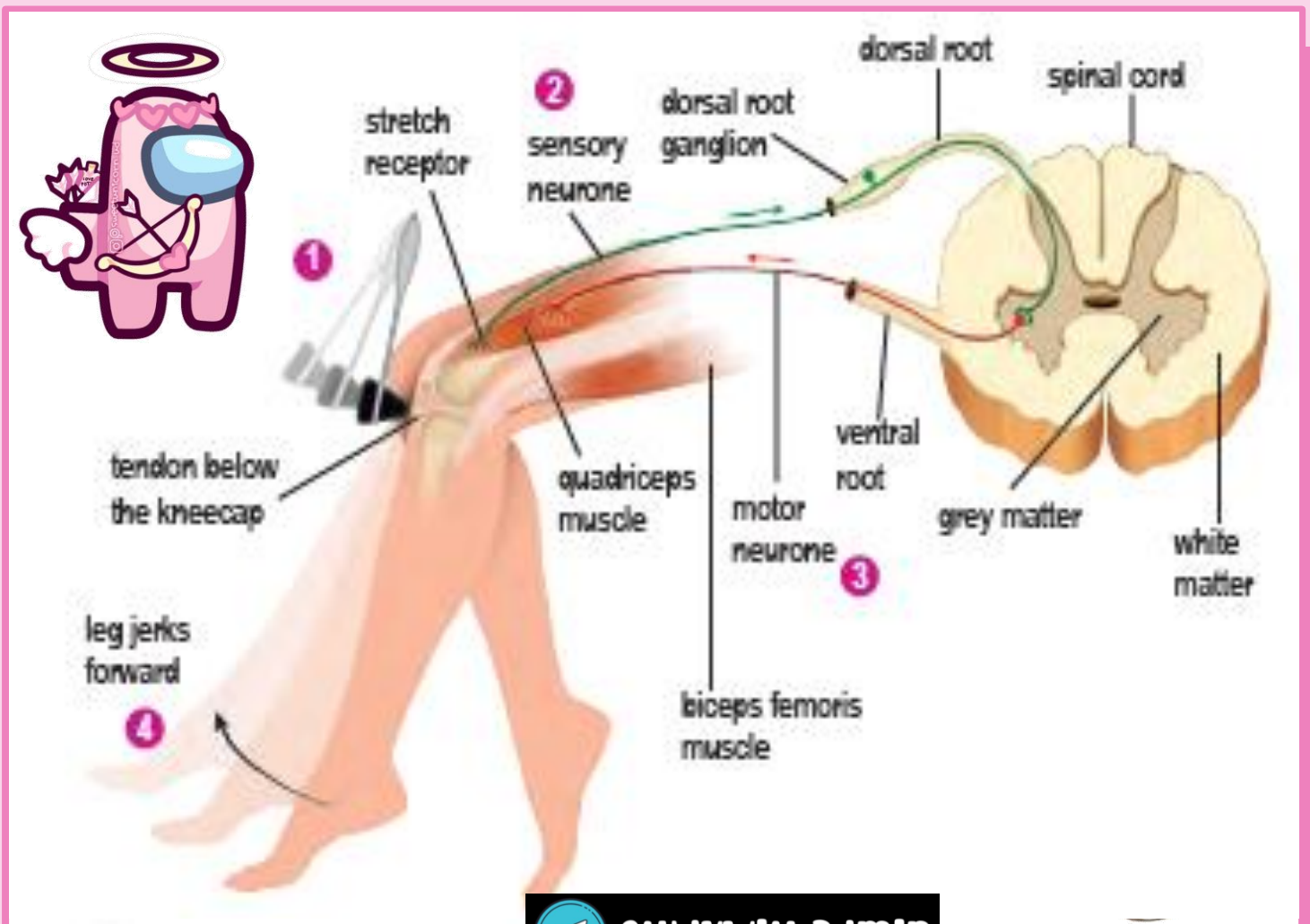
- Effector: skeletal muscle
- Involved by somatic nervous system
- Involve processes of analysis, integration, and interpretation of information
- According to our own will
- Interpretation of information in cerebrum
- Example: Writing, taking books, raising hand to answer a question

Involuntary Action

- Effector: smooth muscle, cardiac muscle, gland
- Do not involve processes of analysis, integration, and interpretation of information
- Involved by autonomic nervous system
- Occurs automatically without notice
- Interpretation of information in medulla oblongata
- Example: Heartbeat, peristalsis, sneezing, blood pressure

1 Spinal reflex action involved skeletal muscle as an effector.

- a) This action is an involuntary action that controlled by spinal cord and responds quickly and spontaneously toward external stimulus.
- b) Nerve impulse is sent from receptor to spinal cord and from spinal cord to effectors
- c) The pathway passed by the nerve impulse in a reflex action is known as reflex arc
- d) Example of the spinal reflex action that involved two neurones is knee jerk



The reflex arc of knee jerk:

1. Stimulus

The tendon below kneecap is knocked

3. Sensory neurone

Sends nerve impulse the spinal cord

5. Effector

Quadriceps muscle contracts

2. Sensory receptor

Stretch out the quadriceps muscle (stretch receptor) and triggers nerve impulse

4. Motor neurone

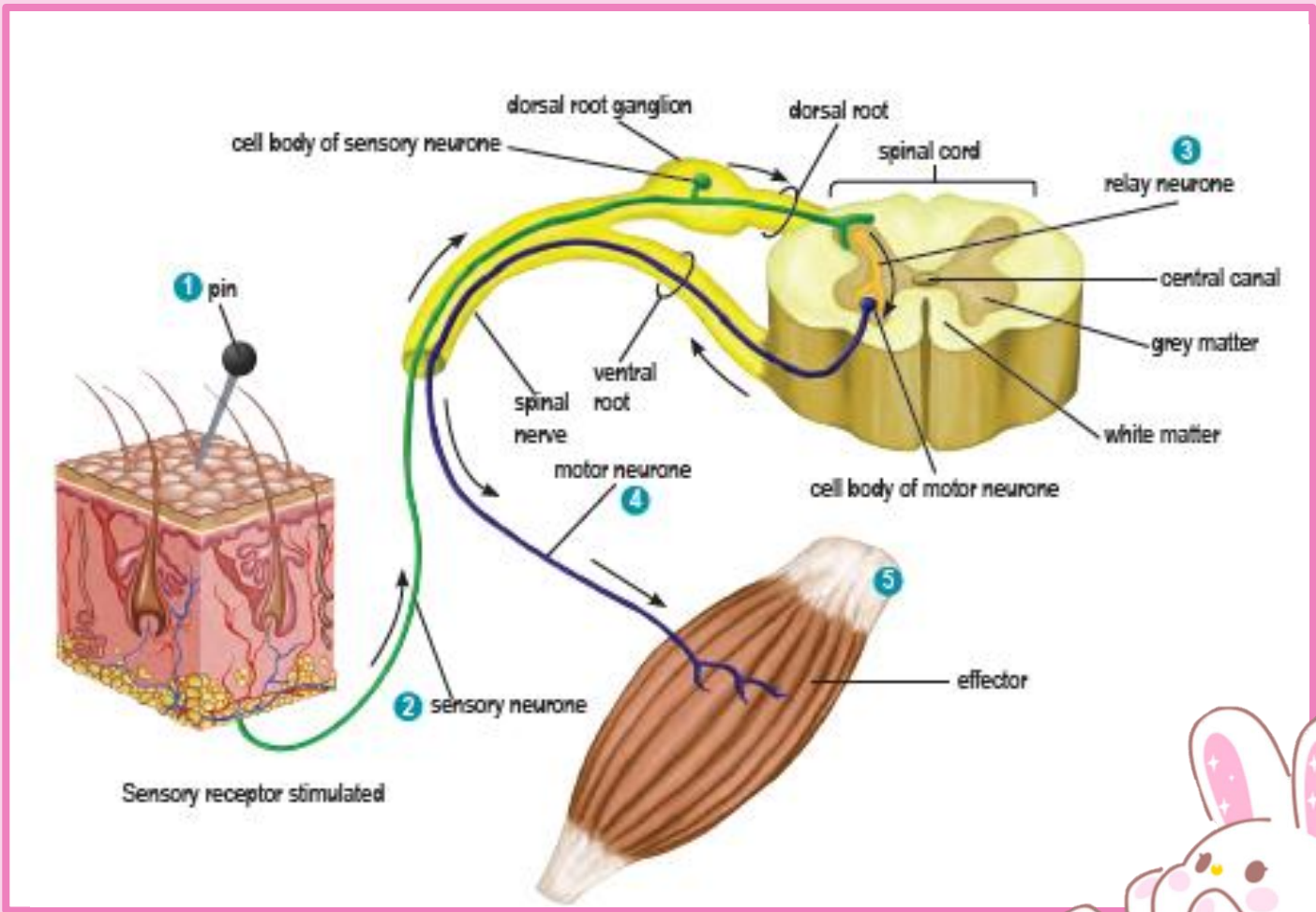
Receives the nerve impulse from sensory neurone and send it to effector

6. Response

Leg kicks forward




e) Example of the spinal reflex action that involved three neurones is hand or foot pull from an object



12.5 HEALTH ISSUES RELATED TO THE NERVOUS SYSTEM



Types of health issues	Factors	Effects
MULTIPLE SCLEROSIS	<ul style="list-style-type: none"> • Body immune system attacking myelin sheath of nerves in central nervous system 	<ul style="list-style-type: none"> • Affects activities of brain and spinal cord • Disturbs coordination between central nervous system and peripheral nervous system
ALZHEIMER 	<ul style="list-style-type: none"> • Brain cells degenerate and die progressively • Usually occur in senior citizen • Individual experienced brain injury • Genetic factor • Lifestyle 	<ul style="list-style-type: none"> • Memory loss • Loss of intellectual and social skills • Unable to take care of themselves
PARKINSON	<ul style="list-style-type: none"> • Less secretion of dopamine • Usually occur in senior citizen progressively • Usually occur in man • Genetic factor 	<ul style="list-style-type: none"> • Shaking (tremor) of body • Movement becomes slow • Muscles become weak • Difficulty in balancing body
LOU GEHRIG AMYOTROPHIC LATERAL SCLEROSIS (ALS)	<ul style="list-style-type: none"> • Motor neurone degenerates and die • Age factor, between 40 – 60 • Genetic factor 	<ul style="list-style-type: none"> • Affects somatic nervous system • Skeletal muscle unable to function progressively • Finally, skeletal muscles for moving, ingesting, speaking and breathing unable to function
ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)	<ul style="list-style-type: none"> • Genetic factor • Premature baby, before 37th week or underweight • Pregnant mother who smokes, alcoholic and drug abuse 	<ul style="list-style-type: none"> • Unable to pay attention, hyperactive and easy to get bored



Effects of drug abuse on human coordination and response



1. STIMULANTS DRUG

- Examples: cocaine, nicotine, amphetamine, metamphetamine, ecstasy pill and caffeine.
- Accelerates nervous system activities
- Effects: affecting the functions of the blood circulatory system (high blood pressure and heart failure), digestive system (loss of appetite), and nervous system (mood changes, vandalism, tendency to commit suicide), kidney failure then causing hallucinations and depression

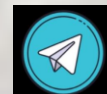


2. DEPRESSANT DRUG

- Examples: barbiturates, tranquiliser, morphine and heroin.
- Delays activities of nervous system.
- Reduces blood pressure, relaxes muscles, relieves anxiety and promotes sleep
- Effects: memory loss, unable to pay attention, respiratory problems, lung cancer, liver and brain damage, muscle cramp, drowsiness, delirium and coma

3. EFFECTS OF ALCOHOL ABUSE ON HUMAN COORDINATION AND RESPONSE

- Influences ability to think and make decision
- Slowing reflex actions, poor muscle coordination, fail to control body balance and difficulty in estimating distance
- Blurred vision, confusion and mental disorders



12.6 The Endocrine System

1. Endocrine gland is a ductless gland that secretes hormone directly into blood. The endocrine gland consists of a mass of cells, tissue or organ.
2. Hormone is a chemical substance made up of protein or steroid which can regulate physiological processes in humans and animals.
3. how hormone works in human endocrine system.

Hormon dirembeskan ke dalam aliran darah
Hormones secreted into the blood stream

Sel sasaran menerima hormon dan mengakibatkan perubahan tertentu
Target cells receive hormones and cause a specific change

Sel-sel dalam kelenjar merembeskan hormon
Cells in the gland secrete hormones

Hormon diangkut di dalam aliran darah ke seluruh bahagian badan
Hormones are transported in the blood to all parts of the body



THE HUMAN ENDOCRINE SYSTEM AND HORMONES SECRETED

LELAKI

PEREMPUAN

KELENJAR ADRENAL

Hormon: Aldosteron

Tisu/organ sasaran: Ginjal

Fungsi: Meningkatkan penyerapan semula garam mineral di ginjal

Hormon: Adrenalina

Tisu/organ sasaran: Tisu otot, hati dan jantung

Fungsi:

- Meningkatkan aras gula dan asid lemak dalam darah
- Meningkatkan kadar pemafasan dan denyutan jantung
- Meningkatkan kadar metabolisme dan mengecutkan salur darah

KELENJAR TIROID

Hormon: Tiroksina

Tisu/organ sasaran: Semua tisu

Fungsi:

- Meningkatkan kadar metabolisme
- Meningkatkan suhu badan
- Mengawal atur pertumbuhan dan perkembangan

PANKREAS

Hormon: Insulin

Tisu/organ sasaran: Hati, otot dan tisu adipos

Fungsi: Mengurangkan aras glukosa darah dan menggalakkan penukaran glukosa berlebihan kepada glikogen

Hormon: Glukagon

Tisu/organ sasaran: Hati, otot dan tisu adipos

Fungsi:

- Meningkatkan aras glukosa darah
- Menggalakkan penukaran glikogen kepada glukosa

TESTIS

Hormon: Testosteron

Tisu/organ sasaran: Gonad, kulit, otot dan tulang

Fungsi: Merangsang perkembangan ciri-ciri seks sekunder lelaki dan spermatogenesis

OVARI

Hormon: Estrogen

Tisu/organ sasaran: Gonad, kulit, otot dan tulang

Fungsi:


- Merangsang perkembangan ciri-ciri seks sekunder perempuan dan kematangan folikel
- Membaiki serta merangsang penebalan dinding uterus

Hormon: Progesteron

Tisu/organ sasaran: Gonad

4 Fungsi hormon yang



Endocrine gland	Hormone	Target tissue / organ	Functions
Hypothalamus	Gonadotropin releasing hormone (GnRH)	Pituitary gland	<ul style="list-style-type: none"> Regulates activities of pituitary gland
Pituitary gland (Anterior lobe) 	Growth hormone (GH)	Bone and muscle	<ul style="list-style-type: none"> Stimulates growth especially in bone and muscle
	Follicle stimulating hormone (FSH)	Testis and ovary	<ul style="list-style-type: none"> Stimulates development of follicle in ovary and sperms in testis
	Luteinising hormone (LH)	Testis and ovary	<ul style="list-style-type: none"> Stimulates testis to produce testosterone in male Stimulates ovulation and formation of corpus luteum in female
	Thyroid stimulating hormone (TSH)	Thyroid gland	<ul style="list-style-type: none"> Stimulates thyroid gland to secrete Thyroxine
	Adrenocorticotrophic hormone (ACTH)	Adrenal gland	<ul style="list-style-type: none"> Stimulates adrenal cortex to produce hormone cortisol
Pituitary gland (Posterior lobe)	Oxytocin	Uterus muscle and milk gland	<ul style="list-style-type: none"> Stimulates muscular contraction in uterus during baby delivery Stimulates milk gland to secrete milk
	Antidiuretic hormone (ADH)	Kidney	<ul style="list-style-type: none"> Stimulates reabsorption of water

Ovary

Oestrogen

Gonad, skin, muscle and bone

- Stimulates growth of uterus wall after menstruation
- Stimulates development of secondary sexual characteristics in female

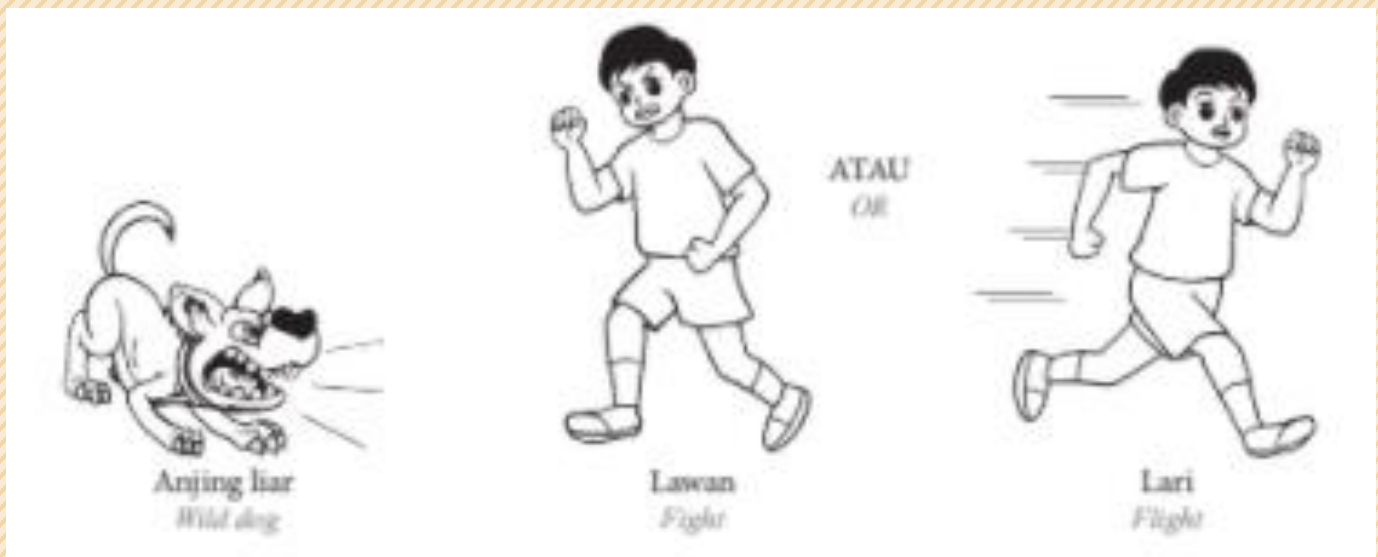
Progesterone

Gonad

- Stimulates development of uterus wall
- Stimulates development of placenta

COORDINATION OF BOTH NERVOUS SYSTEM AND ENDOCRINE SYSTEM IN AN ANXIOUS SITUATION

Example: Chased by a wild dog.



1. Stimulus of fear occurs
2. Nerve impulse sent to the central nerves
3. Central nervous system interprets information
4. Stimulus of fear occurs
5. Heartbeat increases
6. Breathing rate increases
7. Blood pressure increases
8. Metabolic rate increases
9. Blood glucose level increases
10. Energy production increases
11. Skeletal muscles use the energy produced to fight or flight



COMPARISON BETWEEN NERVOUS SYSTEM AND ENDOCRINE SYSTEM

Similarities

- Both systems play important roles in coordination and response of body toward stimulus
- Coordinates all body activities
- Both systems have cell, tissue or organ as target

Nervous system

- Consists of nerve tissue
- Signal is transmitted via nerve impulse and neurotransmitter
- Signal is sent along the neurone
- Transmission of electrical impulse is rapid
- Region of response is small, limited to specific region
- Effect is short-lived and reversible
- Involves voluntary and involuntary actions
- Involves in movement of body



Endocrine system

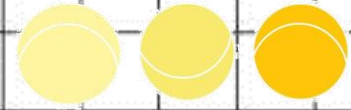
- Comprises of endocrine gland
- Signal is sent via hormone
- Signal is sent by blood circulation
- Delivery of hormone is relatively slow
- Region of response is wider, involved few target organs
- Effect is long lasting and irreversible for certain hormones
- Only involves involuntary actions
- Involves in physiological processes in body



12.7 Health Issues Related to the Endocrine System

1 Hormonal imbalances can occur in humans when endocrine glands secrete hormone in less or more than normal quantity.

2 The effects are as table below:



HORMONAL imbalance and its Related diseases

DEFICIENCY	HORMONE	OVER SECRETION
<ul style="list-style-type: none">• Dwarfism• Pituitary dwarfism	GROWTH HORMONE	<ul style="list-style-type: none">• Gigantism• Acromegaly
<ul style="list-style-type: none">• Goitre• Cretinism• Hypothyroidism• Myxedema	THYROXINE	<ul style="list-style-type: none">• Hyperthyroidism• Graves' disease
<ul style="list-style-type: none">• Diabetes mellitus• Hyperglycaemia	INSULIN	<ul style="list-style-type: none">• Hypoglycaemia
<ul style="list-style-type: none">• Diabetes insipidus	ANTIDIURETIC HORMONE (ADH)	<ul style="list-style-type: none">• Oedema• Hyponatrimia

