

VCE Unit 3 and 4 Psychology

Unit Three Area of Study One: Nervous System Functioning

Key Knowledge Point One:

- the roles of different subdivisions of the central and peripheral nervous systems in responding to, and processing and coordinating with, sensory stimuli received by the body to enable conscious and unconscious responses, including spinal reflexes

PART ONE: THE HUMAN NERVOUS SYSTEM

Human Nervous System: A communication system comprised of a network of neurons responsible for the processing, integration, and transmission of information between the external and internal environment.

Function of the Human Nervous System:

Reception	The nervous system initially receives information from the external environment, in the form of raw energy. <ul style="list-style-type: none">● Light = Light Waves● Sound = Sound Waves● Smell = Chemical Energy● Taste = Chemical Energy● Touch = Kinetic Energy (e.g. Pressure, Pain)
Processing	The raw energy received is converted into electrochemical energy, an energy form that can be understood by the nervous system.
Transmission	Sensory neurons carry the information as electrochemical energy to the central nervous system.
Organisation/ Integration	The brain interprets the meaning/ significance of this information, and organises an appropriate response to the sensory information.
Transmission	Motor neurons carry the motor information organised by the brain, to the body's glands, organs, and muscles, to produce a response.
Response	The body's glands, organs, and muscles produce the response.

Worked Example:

- Reception:** The sound of a phone alarm (as a jingle) is heard by a university student, which is received in the form of sound waves, as detected by the sensory receptors in the sensory neurons of the ears.
- Processing:** This raw sound energy is converted into electrochemical energy, for the nervous system to make sense of.
- Transmission:** Sensory neurons in the ears carry this information through the spinal cord, towards the brain.
- Organisation/ Integration:** Due to the familiar jingle of the alarm, the brain is reminded that this sound indicates that the student must wake up, to attend their university class.
- Transmission:** Motor neurons carry this information through the spinal cord, to the body's organs (such as the heart), and muscles.
- Response:** This causes an increase in heart rate and blood pressure to support their body now that it is upright, and arm and leg muscles, to manoeuvre themselves up, and out of their bed.

PART TWO: THE CENTRAL NERVOUS SYSTEM

Central Nervous System: A division of the human nervous system consisting of the brain, and spinal cord.

1. Integration of sensory information.
2. Coordination of responses for conscious, and unconscious activities.

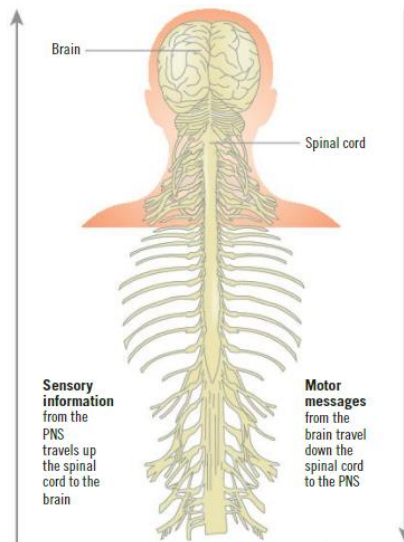


FIGURE 1.5 The CNS – sensory information travels up the spinal cord to the brain; motor messages travel down to the muscles

Brain: The master organ of the nervous system, consisting of a large bundle of nerves responsible for organising responses to internal or external signals, and coordinating conscious and unconscious responses.

1. Receives sensory information transmitted by sensory neurons.
2. Processes and integrates the information, by applying meaning to the information (e.g. using memory, or emotional significance).
3. Organises an appropriate response to the sensory information.
4. Transmits the motor information via motor neurons to the body's glands, organs, and muscles.

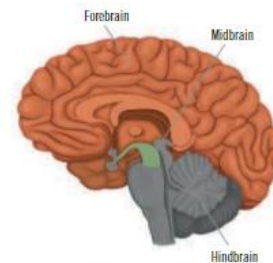


FIGURE 1.6 The three main regions of the brain

Key Characteristics of the Brain:

1. The brain is the size of a large grapefruit, weighing an average of 1.5 kilograms.
2. The brain is comprised of 100 billion neurons, allowing for an infinite number of synaptic connections to be formed.
3. The brain constitutes 90% of the neurons of the central nervous system.
4. The brain is responsible for perception, emotion, feelings, thoughts, reactions, understanding of identity, decision-making, problem-solving, etc.
5. The brain is divided into specialised regions, some of which interact, whilst others do not (meaning certain responses can only be produced if both regions are involved).

Hindbrain: The region of the brain located at the back of the base of the skull.

- **Structures:** Pons, Medulla, and Cerebellum
- **Responsibilities:** Basic involuntary/ automatic survival functions, including control of heart rate, breathing, sleep, arousal, voluntary muscle movements, and reflexive actions (e.g. swallowing).

Midbrain: The region of the brain located at its centre, between the fore- and hindbrain.

- **Structures:** Reticular Formation
- **Responsibilities:** Filtering of information, maintaining alertness and arousal.

Forebrain: The largest and most complex region of the brain, located above the midbrain.

- **Structures:** Cerebrum, Thalamus, Hypothalamus, Pituitary Gland, and Amygdala
- **Responsibilities:** Muscle control, and higher cognitive functions, including problem-solving, decision-making, risk assessment, motivations, sensations, perceptions, learning, memory, reasoning, and the regulation, understanding, and perception of emotions/

Spinal Cord: A column comprised of a network of nerve fibres spanning from the base of the brain, to the lower back, responsible transmitting sensory information to the brain, and motor information from the brain.

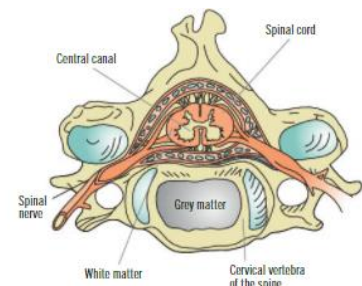


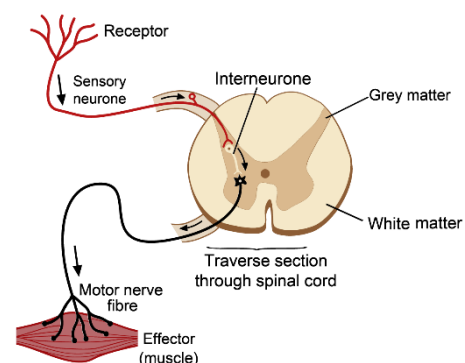
FIGURE 1.7 A spinal cord section (top view). The spinal column

Features of the Spinal Cord:

- **Grey Matter:** Matter comprised of the neuron's somas (bodies), axons, and dendrites, within the centre of the spinal cord (surrounded by white matter).
- **White Matter:** Matter comprised of the white, fatty, insulating myelin that coats axons.
- **Ascending Tracts:** Axon columns of the spinal cord through which sensory information is transmitted from the peripheral nervous system, through to the brain for interpretation.
- **Descending Tracts:** Axon columns of the spinal cord through which motor information is transmitted from the brain, through to the peripheral nervous system.
- **Vertebrae:** Circular rings of bone surrounding the spinal cord, that form the spinal column/backbone.

Function No.1 – Communication of Neural Information:

1. The spinal cord receives sensory information from the peripheral nervous system, from which is transmitted through the **ascending tracts** of the spinal cord.
2. The brain then receives, organises, and interprets the information, to generate an appropriate motor response.
3. The motor information generation by the brain is received by the spinal cord, which is transmitted through the **descending tracts** of the spinal cord.
4. The motor information is then directed through to the body's muscles, glands, and organs, for them to produce a specific response.



Function No.2 – Behaviour: Without a spinal cord, the continuous flow between the peripheral nervous system, and central nervous system would be interrupted, and no response(s) produced (causing a loss of sensation, or inability for voluntary movement to occur).

- **Paraplegia:** Damage occurring to the middle-to-lower section of the spinal cord, causing a loss of sensation and ability for movement in majority of the torso, hips, and legs.
- **Quadriplegia:** Damage occurring to the nerves in the upper section of the spinal cord, causing a loss of sensation and ability for movement from the neck downwards.

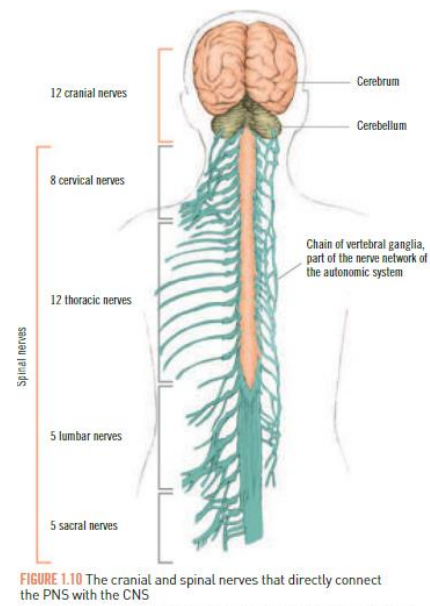
PART THREE: THE PERIPHERAL NERVOUS SYSTEM

Peripheral Nervous System: A sub-system of the human nervous system, which is comprised of all the nerves outside of the central nervous system, connecting the central nervous system to the body.

1. Transmits sensory information from the internal and external environment of the body, through to the central nervous system.
2. Carries motor information from the nervous system, to the body's organs, glands, and muscles.

Types of Nerves Connecting the Peripheral Nervous System and Central Nervous System: The position of the nerves correspond to their role in the body.

- **Spinal Nerves:** Nerves of the peripheral nervous system that connect the central nervous system to the body's muscles, organs, and glands.
- **Cranial Nerves:** Nerves of the peripheral nervous system that connect the central nervous system to the organs within the head (e.g. eyes, ears, nose, etc).



Sensory Nerve Receptors: The receptors (dendrites) of sensory neurons within the peripheral nervous system, that are responsible for receiving different, and specific types of stimuli, to send to the brain.

1. **Thermoreceptors:** Receptors that detect, receive, and respond to changes in temperature.
2. **Photoreceptors:** Receptors that detect, receive, and respond to changes in light.
3. **Chemoreceptors:** Receptors that detect, receive, and respond to changes in chemicals.
4. **Mechanoreceptors:** Receptors that detect, receive, and respond to changes in pressure, touch, and vibration (mechanical stress/ strain).
5. **Nociceptors:** Receptors that detect, receive, and respond to pain.

Pain: A physical stress response that indicates the body to be under stress, damaged, or in danger.

- Pain is necessary to enable the body to respond to the stress appropriately, and thus, treat it.
- Pain is a protection mechanism against the body's external environment.
- Pain is indicative that the body requires assistance of a sort.
- A lack of sensitivity to pain would result in an individual being unable to respond correctly to the source of stress or damage, causing damaging and fatal implications for the body (e.g. inability to recognise pain of hot water, causing significant burns).