It is raining. Suddenly the temperature falls. What can you do? Likely you put on a sweater. Another day you are hungry. You walk into the kitchen and unknowingly you touch a hot plate. Could you think, “What should I do?” Likely you automatically pull back your hand. In both scenarios, your nervous system is at play. ***The ability of an organism to detect and respond to the change in the environment is known as sensitivity.***

Sensitivity is an essential characteristic of living things. The nervous system is responsible for bringing about a fast response to environmental changes. The response can be **voluntary** like the first scenario or **involuntarily** like the second scenario.

How different are voluntary responses from voluntary responses ?

Read through this passage to help you understand

> *Imagine you are in the kitchen. You accidentally touch a **hot stove**. **Immediately**, without even thinking, you pull your hand away. You didn’t decide to move your hand—it just happened! This is an example of an **involuntary response** (a reflex). Your body reacted automatically to protect you from getting burned.*
>
> 💡 **Why?** This is an **involuntary response**. **Involuntary responses are controlled by the spinal cord or brainstem, are much faster, and occur without conscious thought.** Your the threat is processed quickly **without conscious control** and makes you move instantly to protect yourself.
>
> *Now, imagine you see a bowl of your favorite **ice cream** in front of you. You think about how delicious it looks, then you decide to pick up the spoon and take a bite. This is a **voluntary response** because you **chose** to act based on what you wanted.*
>
> 💡 **Why?** This is a **voluntary response** because you **consciously choose** how to react. **Voluntary responses are controlled by the brain's cerebral cortex, take longer, and involve conscious thought.** You decide whether to pick up the spoon and take a bite.

NERVOUS SYSTEM

The nervous system coordinates the organism’s voluntary and involuntary actions through electrical impulses.

It gathers the information of the stimulus through the sense organ, integrates them, decides the needed action and sends an appropriate response to the effector.

An electrical impulse also called a nerve impulse, is simply the flow of information in the nerve cell.

A stimulus is a detectable change in the external or internal environment that elicits a response in an organism.

A response is the reaction of an organism to the stimulus.

A sense organ is an organ that gathers stimulus. Sense organs contain specialised cells called receptor cells that pick up a change in the environment and change a physical stimulus to an electrical impulse.

Humans have five sense organs

i. Skin: pick up information about touch, pain, pressure and change in temperature.
ii. Eyes: pick up information about light.
iii. Tongue: pick up information about taste.
iv. Nose: pick up information about the smell.
v. Ears: pick up information about sound.

An effector is a cell or organ that carries out a response to the stimulus. For example, muscles shiver when it's too cold. Therefore, muscles are effectors carrying a response to coldness.

DIVISION OF THE NERVOUS SYSTEM

1. Central nervous system (CNS): consists of the brain and spinal cord.

2. Peripheral nervous system (PNS): consists of nerves outside the central nervous system.

Central Nervous system

It consists of the **spinal cord** and **the brain**

The spinal cord and the brain receive information from the receptors or sense organs all over the body**.**

They sends response instructions to various effectors in the body **i.e.** the muscles and glands

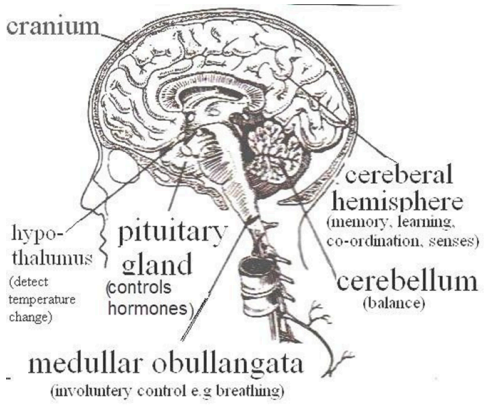
THE BRAIN

The main regions of the brain are the **cerebrum**, **cerebellum** and **medullar** oblongata.

The largest part of the brain is the cerebrum.

The cerebellum is much smaller and is situated below and behind the cerebrum The medullar oblongata forms the bottom part .of the brain stem and is a continuation of the spinal cord

Structure of the human brain



General functions of the brain

1. To coordinate the various activities of the body.

2. Is the seat of higher mental functions such as intelligence, learning, reasoning and memory.

3. It controls and coordinates voluntary movements and balance.

FUNCTIONS OF THE BRAIN

a) Cerebrum

The seat of voluntary actions

Has the centres of vision, hearing, taste, touch and speech

Is the seat of higher mental functions such as intelligence, learning, reasoning, memory and judgement

b) Hypothalamus

Is the reflex control centre of mechanisms such as temperature, blood pressure, appetite, sleep, thirst and emotions

c) Cerebellum

Part of the vertebrate *brain concerned with the coordination and regulation of muscle activity and the maintenance of muscle tone and balance

Contains the centres which control balance and equilibrium

d) Medulla oblongata

Controls vitally important reflexes eg breathing and heart beat

Acts as a transmitter of impulses to and from the brain

e) pituitary gland

Produces certain hormones, eg ADH which assists in maintaining water balance

Is the control centre for homeostasis

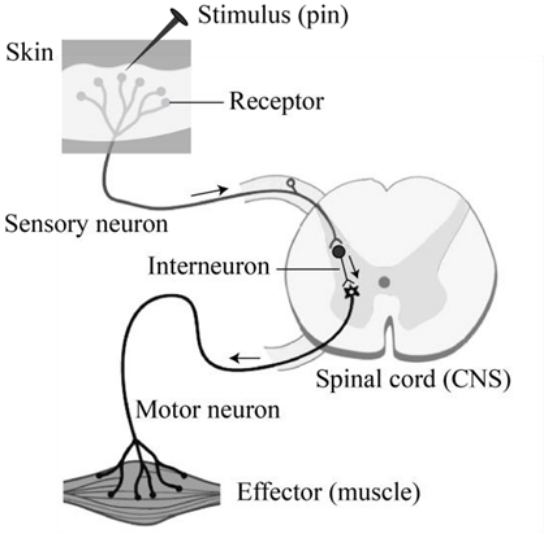
THE SPINAL CORD

Runs in the vertebral canal
extends from the medulla oblongata of the brain to the second lumbar vertebra
is surrounded and protected by membranes and the bones of the vertebral column
is about 45cm long

General functions of the spinal cord

Serves as a pathway for impulses
plays an important role in reflex actions such as blinking and coughing

REFLEX ARC



Reflex arc is the path by which an impulses is transmitted from a receptor to an effector to bring about a response to the stimulus.
Reflex arcs provide the basis for **reflex actions**

- A reflex action is a rapid, predictable and involuntary response to the stimulus.
- The response to the stimulus is automatic. The organism has no control over how to respond.
- The stimulus is picked up by receptor cells of the sense organ that send nerve impulses through the

sensory neuron to the CNS.

- The interneuron in the CNS sends the nerve impulse through the motor neuron to the effector.
- The effector produces an automatic response.
- **For example**, when you prick your finger with a needle receptor cells of the affected area changes pain to nerve impulses which are transmitted through the sensory neuron to the spinal cord. The interneuron in the spinal cord sends the nerve impulse through the motor neuron to the muscles of the arm. Muscles automatically and involuntarily contract to withdraw your finger from the needle.

NB; reflex action is a instinctive action and it does not involve the brain
Examples are blinking, yawning, coughing, sneezing, heartbeat, peristalsis, dilation and constriction of the pupil, **knee jerk (research more about the knee jerk)**

Trial question under coordination in humans

Drug use and abuse

Substance or drug use refers to the correct consumption of legal substances or drug for medical. When used correctly and responsibly, drugs serve beneficial purposes, such as pain relief or disease treatment.

However, **drug abuse** occurs when substances are used inappropriately, excessively, or for non-medical reasons, leading to harm. Abuse often leads to addiction, health complications, and negative social consequences.

Common examples of drug use and drug abuse in uganda

- A person using prescribed painkillers after surgery is engaging in substance use.
- A student taking excessive caffeine pills to stay awake for exams or consuming alcohol excessively is engaging in substance abuse.
- A boda-boda rider chewing khat (mairungi) excessively to stay alert is engaging in drug abuse which may develop dependency, leading to poor decision-making and accidents.

Commonly Abused Substances and Their Effects in Uganda

Uganda faces increasing challenges with substance abuse among different age groups, particularly the youth. The commonly abused substances include:

1. Alcohol

- Local brews such as Waragi, Malwa, and beer are commonly abused
- **Effects:** Liver damage, risky behaviors, domestic violence, and economic hardship due to excessive spending on alcohol.

2. Tobacco and Marijuana (Bangi)

- Some people smoke cigarettes or marijuana for relaxation or peer pressure.
- **Effects:** Lung diseases, mental health disorders, poor concentration, and increased crime rates.

3. Khat (Mairungi)

- Chewed to stay awake, commonly used by boda-boda riders and students cramming for exams.
- **Effects:** Anxiety, insomnia, high blood pressure, and dependency.

4. Prescription Drug Abuse

- Includes overuse of painkillers like Tramadol, Codeine, and sleeping pills.
- **Effects:** Addiction, drowsiness, organ failure, and death in severe cases.

5. Cocaine and Heroin

- Less common but present in urban centers.
- **Effects:** Severe addiction, financial ruin, crime involvement, and health deterioration.

Physiological, Social, and Economic Effects of Substance Abuse (K, U)

1. Physiological (Health) Effects

- Damage to the brain, heart, liver, and lungs.
- Increased risk of diseases such as HIV/AIDS due to risky behavior.
- Poor mental health, including depression and psychosis.

2. Social Effects

- Family breakdown due to neglect and domestic violence.
- Increased crime rates, including theft and sexual violence.
- Poor academic performance among students due to addiction.

3. Economic Effects

- Loss of productivity in workplaces due to absenteeism.
- Increased government spending on rehabilitation and healthcare.
- Poverty due to spending income on drugs instead of necessities.

Prevention, Control, and Avoidance of Substance and Drug Abuse

1. Prevention Strategies

- **Education and Awareness:** Schools and communities should educate youth on the dangers of drug abuse.
- **Parental Guidance:** Parents should monitor their children's behavior and educate them on responsible choices.
- **Law Enforcement:** Strengthening policies against drug trafficking and underage drinking.

2. Control Strategies

- **Rehabilitation Centers:** Provide treatment for addiction, such as Butabika Hospital.
- **Community Support Groups:** Encourage recovering addicts to stay sober and reintegrate into society.
- **Regulation of Substance Sale:** Stricter control on alcohol sale to minors and unregulated drug sales.

3. Avoidance Strategies

- **Resisting Peer Pressure:** Learning to say no when offered drugs.
- **Engaging in Positive Activities:** Involvement in sports, music, and community service.
- **Seeking Counseling:** Talking to a trusted adult or professional when facing stress or emotional challenges.

Real life example

Lisa was preparing to step onto the stage for a public speech when she suddenly felt overwhelmed with anxiety. Her palms became sweaty, her heartbeat raced, and her breathing quickened. A friend suggested that she take an anti-anxiety pill to calm down. Desperate to feel better, Lisa took the pill without a prescription. However, instead of just relaxing her nerves, the medication made her drowsy and unfocused. When it was time to speak, she struggled to articulate her words and completely froze on stage, missing her opportunity.

Question:

a) Using Lisa's experience, analyze how the use of a substance led to substance abuse in this situation.
b) Discuss the physiological, social, and economic consequences of such behavior.
c) Which hormone do you think was responsible for Lisa's initial reaction before stepping onto the stage. Discuss how it prepares a person to handle stressful situations.
d) Additionally, propose alternative coping strategies Lisa could have used to manage her anxiety before the speech.