Hammad Ahmad

GSA

Test-2

Q No. 1

(a)

Functions of the Forebrain and Hindbrain

1. Introduction

The Central Nervous System (CNS) is a complex network responsible for controlling and coordinating the body's activities. The brain, the leading part of the CNS, is divided into three main regions: the forebrain, midbrain and hindbrain. Each of these regions has specialized functions that contribute to our survival, cognition and interaction with the environment.

2. Forebrain

The forebrain is the most advanced and largest part of the brain, associated with higher cognitive and emotional processes.

Major Structures and functions

I. Cerebrum

It is divided into two hemispheres (left and right) and further subdivided into lobes (frontal, parietal, temporal, occipital).

Functions

It is responsible for processing sensory information, voluntary movement, decision-making, problem-solving, memory and emotional responses. The frontal lobe plays a key role in planning, reasoning and controlling voluntary movements. The parietal lobe processes sensory information such as touch and spatial awareness. The temporal lobe is involved in hearing, memory and understanding language.

The occipital lobe primarily processes visual information.

II. Thalamus

The thalamus acts as the brain's relay station, directing sensory signals from the body to the appropriate areas of the cerebrum except for smell. It is also involved in regulating sleep, consciousness and alertness.

III. Hypothalamus

The hypothalamus is crucial for maintaining homeostasis in the body, controlling functions such as temperature regulation, hunger, thirst and circadian rhythms. It also controls the endocrine system by regulating the release of hormones through the pituitary gland.

IV. Limbic System

The limbic system, which includes the amygdala and hippocampus

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play a critical role in emotional responses and memory formation. The amygdala is responsible for processing emotions like fear and pleasure. The hippocampus is essential for the formation and retrieval of long-term memories.

3- Hindbrain

The hindbrain is located at the base of the brain and is primarily responsible for basic life functions and motor coordination.

Functions of hindbrain

I. Cerebellum

The cerebellum is responsible for coordinating voluntary movements and ensuring they are smooth and precise. It maintains balance and posture, helping the body adjust to changes in positions. It is also involved in motor learning such as learning to ride a bike or play an instrument.

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II. Pons

The pons serves as a communication bridge between the cerebrum, cerebellum and spinal cord. It is involved in regulating sleep patterns and controlling respiration. The pons also play a role in processing sensory information such as hearing and balance.

III. Medulla Oblongata

The medulla oblongata controls essential autonomic functions such as regulating the heart rate, breathing, blood pressure and digestion. It also governs reflex actions like swallowing, coughing and sneezing which are vital for protection and survival.

4- Conclusion

The forebrain and hindbrain have distinct yet complementary functions. The forebrain is responsible for complex processes such as thinking

memory and emotional regulation, while the hindbrain ensures the body's survival by controlling autonomic functions and motor coordination. Together, they maintain the body's overall functioning and adaptability.

Q No. 1
(b)
Enzymes

Definition

Enzymes are biological catalysts that speed up chemical reactions in living organisms. They are typically proteins though some RNA molecules also exhibit catalytic activity. Enzymes work by lowering the activation energy required for a chemical reaction to occur, making proceses more efficient and faster.

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Mechanism of Action

Enzymes facilitate reactions by binding to specific molecules called substrates and converting them into products. The mechanism involves several key steps:

I. Substrate Binding

Enzymes have a specific region called the active site where substrates bind. The active site has a unique shape and chemical environment that allows it to recognize and bind specific substrates. This interaction forms the enzyme-substrate complex. The lock and key model suggest that the enzyme's active site has a specific shape for each substrate, while the induced fit model proposes that the active site adjusts to fit the substrate upon binding.

II. Catalysis

Once the substrate is bound, the enzyme catalyzes the conversion

of the substrate into products by facilitating the breaking and forming of chemical bonds. This may involve the enzyme stressing certain bonds within the substrate or providing a favorable environment. Enzymes may stabilize the transition state of the reaction lowering the activitation energy.

III. Product Release

After the reaction, the product is released from the enzyme's active site. The enzyme is unchanged and can catalyze further reactions, making enzymes reusable.

3- Characteristics of Enzymes

I. Specificity

Enzymes are highly specific to their substrates. Each enzyme typically catalyzes only one specific reaction or a group of related reactions. This specificity is due to the

enzyme's unique active site structure.

II. Catalytic Efficiency

Enzymes are incredibly efficient, accelerating reactions by a factor of millions or more. A single enzymes molecule can catalyze thousands to millions of reactions per second.

III. Temperature and pH sensitivity

Enzymes function optimally within a specific temperature and pH range. Excessively high or low temperatures or pH can denature enzymes altering their shape and rendering them inactive.

IV. Co-factors and co-enzymes

Some enzymes require non-protein molecules called co-factors or co-enzymes to function properly. These molecules often assist in the catalyst process by helping stabilize the enzyme-substrate complex or participating directly in the reaction.

V. Saturation Point

At high substrate concentrations the rate of reaction may reach a saturation point where all enzymes active sites are occupied. Beyond this point, increasing substrate concentration no longer increases the reaction rate.

4- Conclusion

Enzymes are essential biological catalysts that speed up chemical reactions by lowering activation energy. Their specificity, efficiency, and ability to be regulated allow them to play critical roles in biological processes such as digestion, metabolism DNA replication and signal transduction.

Q No.1

(C)

1. Introduction

Transitioning to renewable energy systems is crucial for addressing environmental challenges particularly those associated with the high costs of fossil fuel dependency. Renewable energy resources such as solar, wind, hydro and geothermal power play a central role in mitigating the environmental issues caused by traditional energy generation.

2- Renewable Energy can help in reducing environmental costs

I. Reduction of greenhouse Gas Emissions

One of the most significant environmental costs of fossil fuel use is the emission of greenhouse gases such as CO_2, CH_4 and N_2O

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which contribute to climate change. Fossil fuel combustion for energy production is the largest source of global GHG emissions. Renewable energy resources, on the other hand, produce little to no GHG emissions during operation.

II. Air and water pollution reduction

Fossil fuel power plants contribute to significant air and water pollution. While wind and solar energy produce zero air pollutants and require minimal water use compared to coal or nuclear power plants which need substantial water for cooling. Hydropower, while involving some environmental trade-offs still significantly reduces the reliance on polluting sources by generating electricity cleanly.

III. Energy Independence and local economic development

Renewable energy projects can create jobs in manufacturing installation and maintenance thus

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stimulating local economies. Countries investing in renewable energy infrastructure are less vulnerable to fluctating global fuel prices, leading to greater energy security and more stable economic conditions.

IV. Long-term environmental Sustainability

Wind and solar power generate energy without diminishing the earth's resources, unlike fossil fuels which contribute to their exhaustion. The ability to reuse materials such as solar panel recycling or the use of organic waste for bioenergy further enhances sustainability.

Conclusion

Renewable energy resources play a pivotal role in reducing environmental costs by significantly decreasing greenhouse gas emissions, air and water pollution resource depletion and habitat destruction.

They offer sustainable, cost-effective and scabe solutions to mitigate climate change foster energy independence and project the environment.

Q No. 1

(d)

Remote Sensing

Definition

Remote sensing refers to the acquistion of data about an object or phenomenon without direct physical contact. It involves detecting and measuring the reflected or emitted radiation from the Earth's surface, typically through satellite or air borne sensors.

Principles of Remote Sensing

I. Energy Source

Remote sensing requires

an energy source such as sun or artificial lights to illuminate the Earth's surface.

II. Emission and Reflection

Objects reflects or emits energy which is then captured by sensors. The energy can be reflected or emitted.

III. Sensor Detection

Sensors on satellites or aircraft detect the energy reflected or emitted from the surface and the data is processed into images or maps.

IV. Data Interpretation

The captured data is analyzed to understand surface characteristics such as land cover, vegetation water bodies and urban areas.

Environmental Applications of remote sensing

I. Deforestation monitoring

Remote sensing helps track forest cover changes identify

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illegal logging and assess deforestation rates.

II. Water resource management

It assists in monitoring water quality, assessing water availability and mapping wetlands or groundwater levels.

III. Agriculture and crop monitoring

Remote sensing is used for crop health assessment, yield prediction and detecting plant diseases or pests.

IV. Climate change Studies

Satellite data helps in monitoring environmental changes, such as rising sea levels changes in temperature and ice cap melting.

V. Disaster management

Remote sensing provides real-time data for assessing the impact of natural disasters like floods, ~~wildfit~~ wildfires and hurricanes.

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Conclusion

Remote sensing is a powerful tool for monitoring and managing the environment helping make informed decisions about conservation resource management and disaster response.

Q No. 2

(a)

Working of the human eye

Introduction

The human eye is a complex organ responsible for capturing light and converting into electrical signals that are interpreted by the brain as visual images.

Working of an eye

I. Light entry through the Cornea

Light enters the eye through the cornea which is the transparent curved outer layer. The cornea bends the light to direct it towards the center of the eye.

II. Pupil and Iris Regulation

The light passes through the pupil, the black circular opening in the center of the iris. The iris which contains muscles controls the size of the pupil to regulate the amount of light entering the eye. In bright light, the pupil constricts and in low light it dilates.

III. Refraction by the Lens

After passing through the pupil, the light reaches the lens which further focuses the light onto the retina. The lens changes shape to focus on object at different distances

ensuring that the light converges on the retina correctly.

IV. Image formation on the Retina

The light is focused onto the retina, the light-sensitive layer at the back of the eye. The retina contains photoceptor cells called rods and cones. Rods are sensitive to dim light and help with night vision, while cones to detect color and fine detail under bright light. The image formed on the retina is upside down.

V. Transmission of signals to the Brain

The photoreceptor cell convert the light into electrical signals. These signals travel via the optic nerve to visual cortex in the brain where they are processed and intepreted as visual images right-side up and integrates the visual information.

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Conclusion

The human eye works by capturing light, focusing it onto the retina converting it into electrical signals and sending these signals to the brain for interpretation enabling vision.

Q No. 2

(b)

Malaria and Dengue

Malaria

Symptoms:

Malaria is caused by the Plasmodium parasite which is transmitted through the bite of an infected female Anopheles mosquito. The symptoms of malaria usually appear between 10 and 15 days after bite and include:

→ Feves which often occurs in cycles typically alternating

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between chills, high fever and sweating. → Headaches and fatigue → Muscle and joint pain → Nausea and vomiting → Sweating and chills.

Preventive Measures

To prevent malaria several measures can be taken:

1. Mosquito control

→ Use mosquito nets that are treated with insecticide while sleeping.

→ Apply insect repellents containing DEET to skin and clothing.

→ Install mosquito screens on windows and doors to keep mosquitoes out.

2. Avoiding mosquito Bites

→ Wear long-sleeved clothing and long pants, especially during dawn and dusk when mosquitoes are most active.

→ Use mosquito coils

Dengue

Symptoms

Dengue is caused by the dengue virus which is transmitted through the bite of infected Aedes mosquitoes especially Aedes aegypti. Symptoms of dengue typically appear 4 to 10 days after bitten and includes:

- High fever and severe headache
- Painful muscles and joints
- Nausea and vomiting
- Pain in the eyes

Preventive Measures

- To prevent dengue, the following steps should be taken:

1. Mosquito Control

- Eliminate standing water in containers such as flower pots, tires and water storage tanks as these serve as breeding grounds for mosquitoes.
- Use mosquitoes net

2- Personal Protection

➡ Wear protective clothing including long sleeves and pants.

➡ Regularly apply insect repellent containing DEET to exposed skin.

➡ Use mosquito screens in homes and sleeping areas to prevent mosquitoes from entering.

Conclusion

Both malaria and dengue are significant mosquito-borne diseases with serious health impacts particularly in tropical regions. Preventive measures such as controlling mosquito populations using insect repellents wearing protective clothing are key to reducing the risk of infection.

Q No. 2

(c)

Eutrophication

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Introduction

Eutrophication is the process by which a water body becomes enriched with excess nutrients, primarily nitrogen and phosphorus, leading to an overgrowth of algae and other aquatic plants. This excessive growth disrupts the normal balance of the ecosystem and can cause various negative impacts on the water body.

Causes of Eutrophication

I. Agricultural Runoff

The use of chemical fertilizers in agriculture introduces large amounts of nitrogen and phosphorus into nearby water bodies through runoff during rainfall.

II. Wastewater Discharge

Untreated or poorly treated sewage and industrial wastewater which often contain high levels of nutrients can lead to

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eutrophication when they are released into rivers, lakes and oceans.

III. Detergents and Household Chemicals

Many household cleaning products and detergents contain phosphorus which can also contribute to nutrient pollution when washed into water systems.