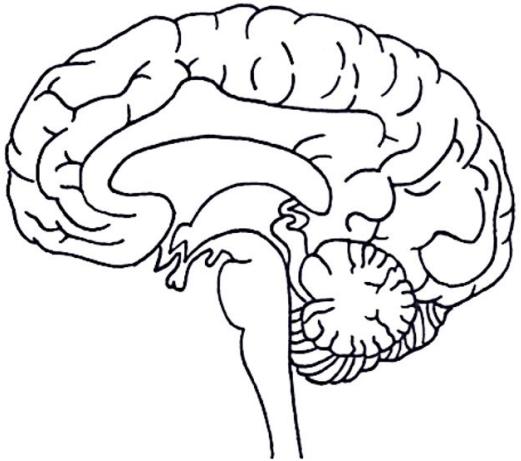
WJEC (Eduqas) Biology A-level

Topic 3.C - Neurobiology and behaviour

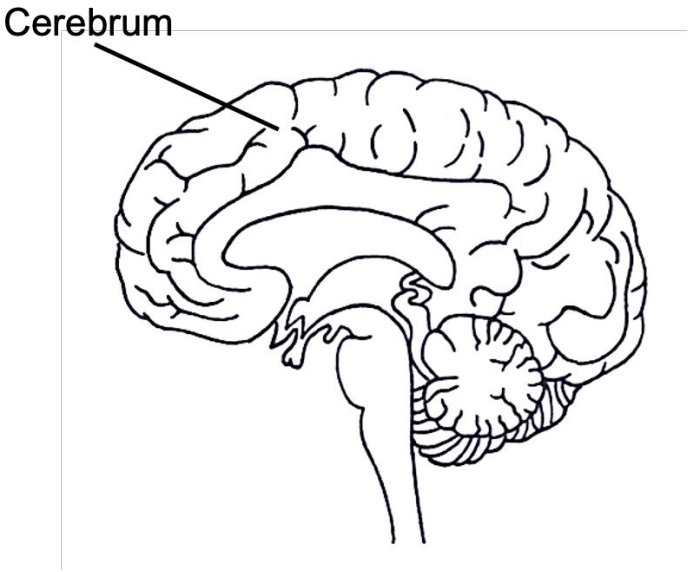
Flashcards

Identify the location and function of the cerebrum.

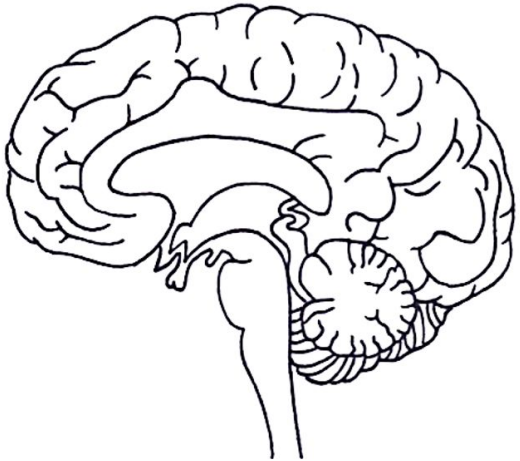


Identify the location and function of the cerebrum.

Responsible for all voluntary behaviour, memory, personality, learning and reasoning.

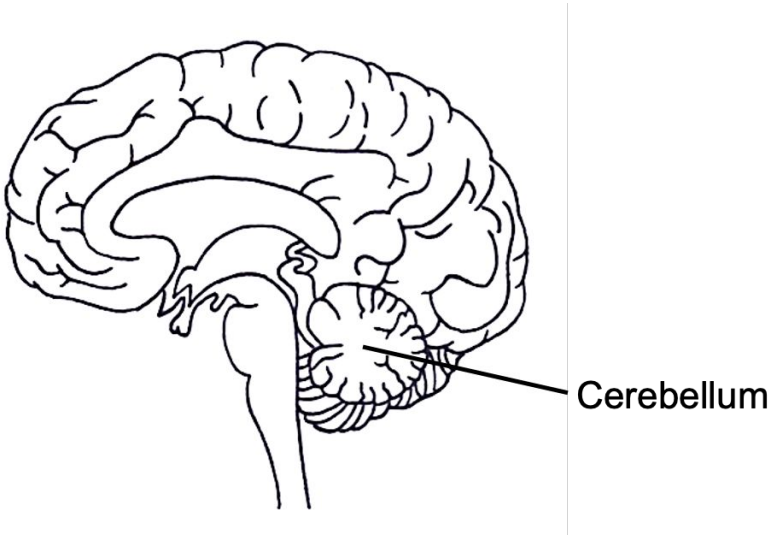


Identify the location and function of the cerebellum.

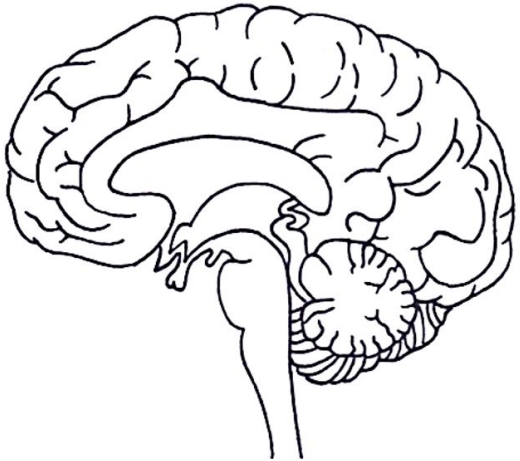


Identify the location and function of the cerebellum.

Controls muscle coordination and non-voluntary movement (e.g. balance, posture).

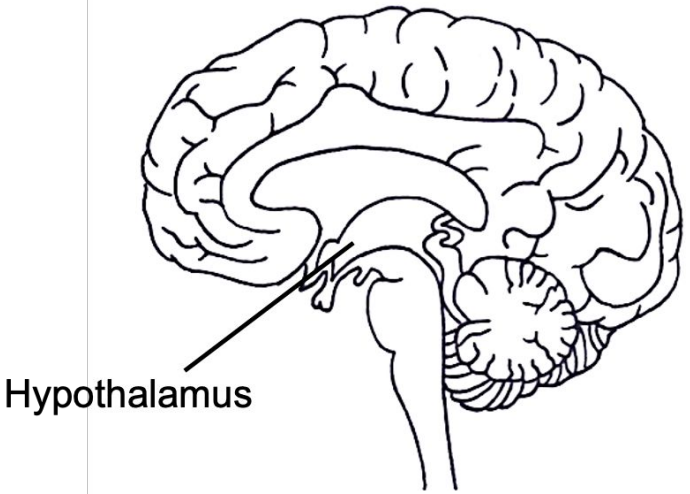


Identify the location and function of the hypothalamus.

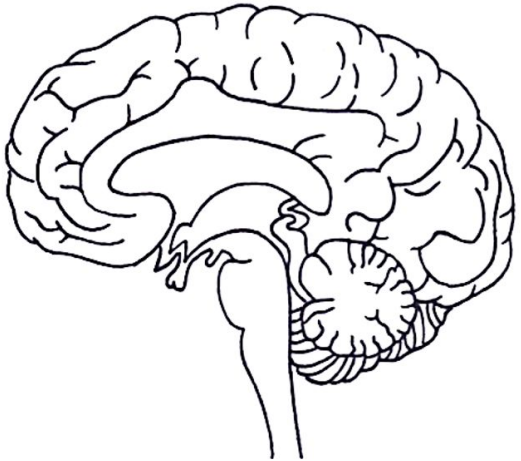


Identify the location and function of the hypothalamus.

- Control centre for autonomic nervous system
- Responsible for hormone production, regulation of the water potential of body fluids and control of behavioural patterns
- Links nervous and endocrine systems

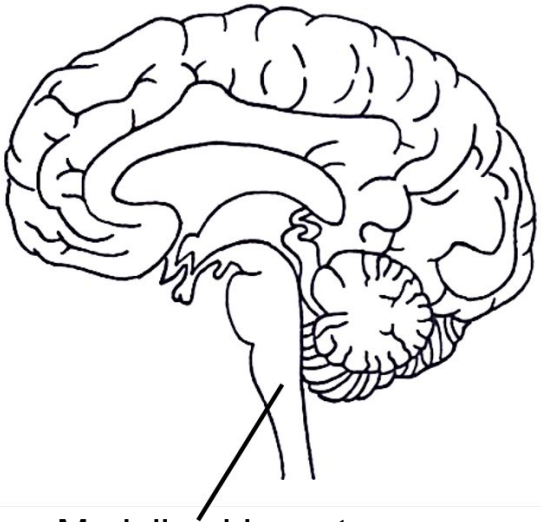


Identify the location and function of the medulla oblongata.



Identify the location and function of the medulla oblongata.

Regulates autonomic activities such as ventilation, heart rate and peristalsis.



What are the meninges?

What are the meninges?

Three membranes that cover the brain and spinal cord.

What is inflammation of the meninges known as?

What is inflammation of the meninges known as?

Meningitis

Name the fluid that fills the four ventricles of the brain. What is its function?

Name the fluid that fills the four ventricles of the brain. What is its function?

- Cerebrospinal fluid
- Supplies oxygen and nutrients to the neurones

Describe the three main regions of the brain.

Describe the three main regions of the brain.

- **Hindbrain** - medulla oblongata and cerebrum
- **Midbrain** - nerve fibres that connect forebrain and midbrain
- **Forebrain** - hypothalamus, thalamus and cerebrum

What is the thalamus?

What is the thalamus?

- Small structure located above the brainstem
- Sends and receives information to and from the cerebral cortex

What is the role of the hippocampus?

What is the role of the hippocampus?

It is involved in learning, memory, reasoning and personality.

What do the thalamus, hypothalamus and hippocampus constitute?

What do the thalamus, hypothalamus and hippocampus constitute?

The limbic system

Name the two main divisions of the autonomic nervous system.

Name the two main divisions of the autonomic nervous system.

- Sympathetic
- Parasympathetic

Act antagonistically to regulate response of effectors, e.g. heart rate.

What is the autonomic nervous system?

What is the autonomic nervous system?

- Branch of the motor nervous system
- Carries nerve impulses to muscles and glands
- Controls involuntary activities

Describe the sympathetic nervous system.

Describe the sympathetic nervous system.

- Usually stimulates effectors (coordinates fight-or-flight response)
- Neurotransmitter noradrenaline
- Ganglia are located near CNS

Describe the parasympathetic nervous system.

Describe the parasympathetic nervous system.

- Usually inhibits effectors (coordinates rest and digest response)
- Neurotransmitter acetylcholine
- Ganglia located far from CNS

Describe the structure of the cerebrum.

Describe the structure of the cerebrum.

- Largest region of the brain, consisting of two hemispheres
- Hemispheres connected by a bundle of nerve fibres, the **corpus callosum**
- Thin outer covering, the **cerebral cortex**

Describe the structure and function of the cerebral cortex.

Describe the structure and function of the cerebral cortex.

- Highly folded layer of nerve cell bodies (grey matter)
- Responsible for most conscious thoughts and actions

Compare grey and white matter.

Compare grey and white matter.

- **Grey matter** - darker tissue of the CNS which lies centrally and consists of relay and motor neurone cell bodies
- **White matter** - lighter tissue of the CNS which surrounds grey matter and consists of myelinated axons

Name the four cerebral lobes and state their function.

Name the four cerebral lobes and state their function.

- **Frontal lobe** - involved in planning, decision making, problem solving, emotions, speech and movement
- **Temporal lobe** - language, learning and memory
- **Occipital lobe** - visual processing centre
- **Parietal lobe** - processes sensory information and is concerned with orientation, movement, sensation and aspects of memory and recognition

State the three divisions of the cerebral cortex.

State the three divisions of the cerebral cortex.

- Sensory areas
- Motor areas
- Association areas

What are sensory areas?

What are sensory areas?

Areas of the brain that receive and process sensory information from receptors in the body.

What are motor areas?

What are motor areas?

- Areas of the brain involved in the control of voluntary movements
- They send nerve impulses to effectors on the opposite side of the body via motor neurones

What are association areas?

What are association areas?

- Regions that receive information from sensory areas and relate this information to previous experiences
- They initiate responses, sending impulses to the appropriate motor areas

Describe the relationship between the the nerve supply of a body part and the size of the corresponding area of the cerebrum.

Describe the relationship between the the nerve supply of a body part and the size of the corresponding area of the cerebrum.

Positive relationship

How can the relationship between the nerve supply of a body part and the size of the relevant area of the cerebrum be represented?

How can the relationship between the nerve supply of a body part and the size of the relevant area of the cerebrum be represented?

Using sensory and motor homunculi.

Describe the sensory homunculus.

Describe the sensory homunculus.

- Represents the primary somatosensory cortex
- Highly innervated areas such as the **tongue**, **lips** and **fingertips** are depicted in an exaggerated fashion

Describe the motor homunculus.

Describe the motor homunculus.

- Represents the primary motor cortex
- Highly innervated areas such as the muscles of the **hands** and **face** are depicted in an exaggerated fashion

Name the two main areas for speech in the brain.

Name the two main areas for speech in the brain.

- Wernicke's area
- Broca's area

What division of the cerebral cortex includes Broca's area?

What division of the cerebral cortex includes Broca's area?

Motor area

What is Broca's area?

What is Broca's area?

The area of the cerebrum that has motor control over speech production.

What division of the cerebral cortex includes Wernicke's area?

What division of the cerebral cortex includes Wernicke's area?

Association area

What is the function of Wernicke's area?

What is the function of Wernicke's area?

Comprehension of written and spoken language.

How are Broca's area and Wernicke's area linked?

How are Broca's area and Wernicke's area linked?

Linked by the nerve fibre bundle **arcuate fasciculus**.

Name 5 brain imaging techniques.

Name 5 brain imaging techniques.

- Magnetic resonance imaging (MRI)
- Functional magnetic resonance imaging (fMRI)
- Positron emission tomography (PET)
- Computerised tomography (CT)
- Electroencephalography (EEG)

How does an MRI scan work?

How does an MRI scan work?

Uses a powerful **magnetic field** to cause protons from hydrogen atoms in water molecules to align. **Radio waves** then knock protons out of alignment. Radio waves turned off. Protons realign and emit radiation to receivers. Signals used to produce a 3D cross-sectional image.

Describe the advantage of using an MRI scan.

Describe the advantage of using an MRI scan.

High resolution distinguishes tissues and provides more detail that ultrasound or CT scans.

How does an fMRI scan work?

How does an fMRI scan work?

- Uses radio waves and a magnetic field to assess brain function through the visualisation of **blood flow** in brain capillaries
- Shows where most aerobic respiration occurs and changes in brain activity

How does a PET scan work?

How does a PET scan work?

- A **radioactive isotope** (e.g. carbon) with a **short half-life** is injected and used by the body to synthesise molecules
- Isotope decays and emits **gamma radiation** to a detector. Active areas show higher radioactivity

What is a CT scan?

What is a CT scan?

A medical imaging technique that uses specialised X-ray equipment and computer software to create detailed images of internal organs.

How does an EEG scan work?

How does an EEG scan work?

- Electrodes attached to scalp detect electrical signals between neurons
- Records changes in the electrical activity of different regions of the brain

What is neuroplasticity?

What is neuroplasticity?

The ability of the brain to form new connections and pathways in response to environmental changes, disease, or injury.

When does neuroplasticity occur?

When does neuroplasticity occur?

Neuroplasticity takes place throughout an organism's life.

What is developmental plasticity?

What is developmental plasticity?

The formation of new connections and pathways in the brain during **development** as a result of environmental changes and sensory stimulation.

What stage of development is known as the critical period?

What stage of development is known as the critical period?

Early childhood

Describe synaptic pruning.

Describe synaptic pruning.

The elimination of unused synapses in the brain during development.

When does mass ‘pruning back’ of synapses usually occur?

When does mass ‘pruning back’ of synapses usually occur?

Adolescence

Describe the importance of the critical period, using language development as an example.

Describe the importance of the critical period, using language development as an example.

- At around 7 months, majority of babies produce speech-like sounds
- Obvious deficits in early vocalisations of congenitally deaf infants
- Evidence that children raised in a completely language deprived environment never learn more than basic communication

Define epigenetics.

Define epigenetics.

The study of changes in gene expression that are not due to alterations in the nucleotide base sequence of DNA.

Describe the link between epigenetics and mental illness.

Describe the link between epigenetics and mental illness.

Altered gene expression in childhood (e.g. due to abuse) may increase the risk of an individual developing a mental illness or addiction later in life.

What is cortisol?

What is cortisol?

A steroid hormone produced by the adrenal glands in response to stress.

Compare the average concentration of cortisol in adults who experienced traumatic childhoods and those who did not.

Compare the average concentration of cortisol in adults who experienced traumatic childhoods and those who did not.

Adults who have experienced traumatic childhoods tend to have higher concentrations of cortisol.

Describe the link between cortisol concentration and mental illness.

Describe the link between cortisol concentration and mental illness.

Higher concentration of cortisol, higher background stress levels, greater vulnerability to mental illness.

What type of mechanism controls the production of cortisol?

What type of mechanism controls the production of cortisol?

Negative feedback mechanism

Name the structure in the brain that controls the production of cortisol.

Name the structure in the brain that controls the production of cortisol.

Hippocampus

Describe the process by which cortisol is secreted.

Describe the process by which cortisol is secreted.

- Hippocampus sends impulses to hypothalamus in response to stress
- Hypothalamus secretes **corticotrophin-releasing hormone** and **arginine vasopressin**
- Hormones stimulate pituitary gland to secrete **adrenocorticotrophin** into the blood
- Adrenal glands take up hormone and secrete cortisol

Describe the negative feedback mechanism by which overproduction of cortisol is inhibited.

Describe the negative feedback mechanism by which overproduction of cortisol is inhibited.

- Cortisol binds to **glucocorticoid receptors** on the hippocampus
- Hippocampus sends nerve impulses to the hypothalamus, inhibiting the secretion of **corticotrophin-releasing hormone** and **arginine vasopressin**
- This prevents further release of cortisol

Why is the negative feedback system by which cortisol is produced important?

Why is the negative feedback system by which cortisol is produced important?

It prevents chronic stress.

What is an innate behaviour?

What is an innate behaviour?

A behaviour that is inherent in an organism.

Give some examples of innate behaviours.

Give some examples of innate behaviours.

- Reflex
- Kinesis
- Taxis

Define reflex.

Define reflex.

- Rapid, automatic response to a sensory stimulus by the body
- Serves as a protective mechanism

What is a kinesis?

What is a kinesis?

A **non-directional** movement response to a stimulus in which the whole organism moves faster and changes direction, e.g. in response to a dry environment, woodlice move faster and change direction more often.

What is a taxis?

What is a taxis?

A directional movement response to a stimulus, e.g. woodlice move away from a light source.

What is a learned behaviour?

What is a learned behaviour?

A permanent change in an organism's behaviour as a result of experience.

What is habituation?

What is habituation?

- Type of learned behaviour
- Repetition of a non-harmful/non-beneficial stimulus desensitises an organism by reducing the release of neurotransmitter
- The organism no longer responds

Describe imprinting.

Describe imprinting.

- Type of learned behaviour that occurs during early development
- Young animal attaches to the first large moving object it sees/hears/smells/touches
- Reinforced by subsequent rewards such as food, warmth and protection

What are associative behaviours?

What are associative behaviours?

Behaviours in which an organism associates a specific stimulus with a certain action or response.

State the two types of associative behaviours.

State the two types of associative behaviours.

- Classical conditioning
- Operant conditioning

Describe classical and operant conditioning.

Describe classical and operant conditioning.

- **Classical conditioning** - the association of a natural stimulus with an artificial stimulus to induce the same response
- **Operant conditioning** - the association of a behaviour with a reward or punishment

What is latent learning?

What is latent learning?

A type of learning that occurs in the absence of external reinforcement, e.g. learning information during the exploration of new surroundings.

What is insight learning?

What is insight learning?

A type of learning that occurs suddenly through the understanding of relationships between previously learned information.

Describe imitation.

Describe imitation.

- Form of learning in which an animal copies the behaviour of another animal
- Enables knowledge and behavioural traits to be passed down from generation to generation

Give an example of an imitation behaviour.

Give an example of an imitation behaviour.

Some populations of chimpanzees use sticks to crack nuts whereas other populations use stones.

What do social behaviours rely on?

What do social behaviours rely on?

Communication between animals.

What is a fixed action pattern (FAP)?

What is a fixed action pattern (FAP)?

An instinctive behavioural sequence in response to a sign stimulus.

Give an example of a fixed action pattern (FAP).

Give an example of a fixed action pattern (FAP).

Begging in gull chicks in response to the sight of the red spot on its parents' beak.

What does the response of an individual to a sign stimulus depend on?

What does the response of an individual to a sign stimulus depend on?

Its motivational state.

Give some examples of organisms that live in colonies.

Give some examples of organisms that live in colonies.

Social insects such as bees, ants and termites.

What is a caste?

What is a caste?

A group of closely-related individuals within a social insect colony with a specific role, e.g. finding food or defending the colony.

Give some examples of castes in a honeybee colony.

Give some examples of castes in a honeybee colony.

- Queen - single fertile female
- Workers - thousands of sterile females
- Drones - hundreds of fertile males

How do individuals within a colony communicate?

How do individuals within a colony communicate?

- Touch
- Pheromones
- Visual displays (such as dances)

Describe how worker bees communicate the position of a nectar source.

Describe how worker bees communicate the position of a nectar source.

Perform dances in the hive:

- Source less than 70 m from the hive, **round dance**, doesn't indicate direction
- Source more than 70 m from the hive, **waggle dance**, indicates distance and direction

What is a dominance hierarchy?

What is a dominance hierarchy?

A type of social hierarchy in which higher-ranking members dominate over lower-ranking individuals.

What types of species do dominance hierarchies exist in?

What types of species do dominance hierarchies exist in?

Vertebrates that can recognise one another and have the ability to learn, e.g. hens, red deer.

What is an advantage of a dominance hierarchy?

What is an advantage of a dominance hierarchy?

- Reduces individual aggression related to feeding, selecting mates and choosing breeding sites
- Distribution of resources ensure that the fittest individuals survive

What is courtship?

What is courtship?

A set of innate behaviours exhibited by an animal to attract mates.

Many species exhibit sexual dimorphism. What does this mean?

Many species exhibit sexual dimorphism. What does this mean?

There are differences in appearance between two sexes of the same species.

What is sexual selection?

What is sexual selection?

- Mode of natural selection that arises through the preference of one gender for particular characteristics in the other gender
- Leads to more conspicuous characteristics

Describe the two theories for the mechanism behind sexual selection.

Describe the two theories for the mechanism behind sexual selection.

- **Intra-sexual selection** - females choose between male mates
- **Inter-sexual selection** - males compete for sexual access to females