

# Edexcel (A) Biology A-level

8.8 to 8.13 + 8.19 -

## Investigating Brain Function

Flashcards

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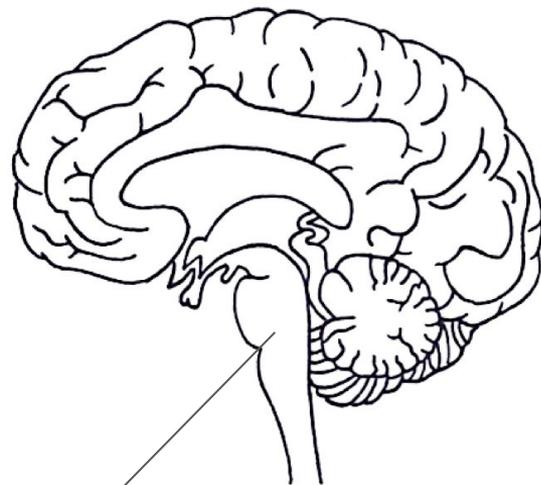


Identify the location and function of the medulla oblongata.



Identify the location and function of the medulla oblongata.

Controls a range of autonomous functions, including breathing and heart rate (location of cardioacceleratory / deceleratory centres).



A

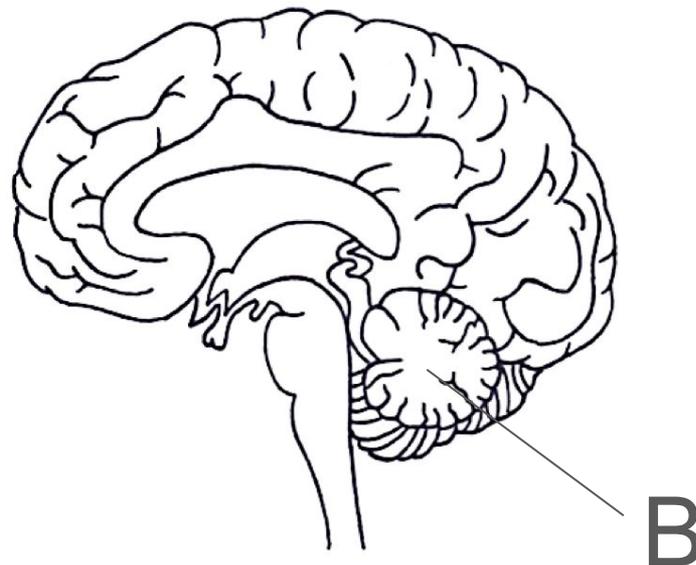


Identify the location and function of the cerebellum.



## Identify the location and function of the cerebellum.

- Controls execution (not initiation) of **movement**  
e.g. timing, balance, coordination, posture.
- Possible role in cognition  
e.g. attention & language.

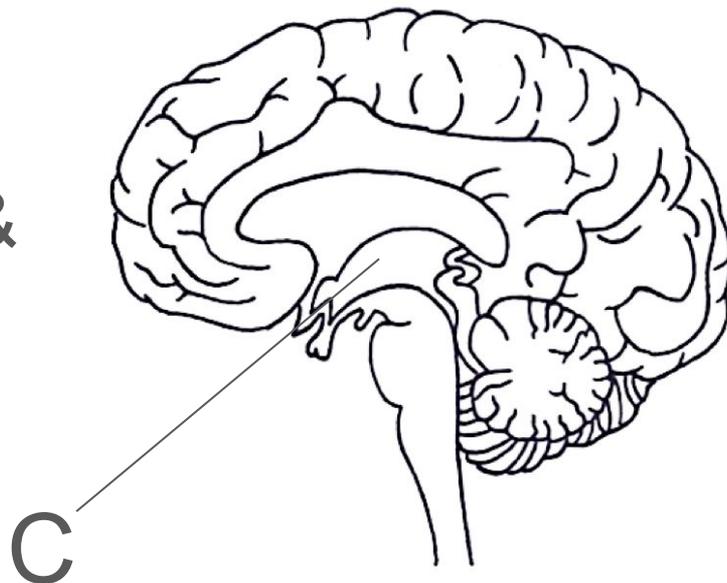


Identify the location and function of the hypothalamus.



## Identify the location and function of the hypothalamus.

- Includes anterior pituitary gland (secretes metabolic & reproductive hormones).
- Involved in thermo & osmoregulation.



# What is the cerebrum?



## What is the cerebrum?

Largest part of the brain. Composed of two halves (cerebral hemispheres) connected by a band of nerve fibres (corpus callosum).

Different lobes have different functions to control advanced mental activity e.g. vision, thought, learning.



Name the main cerebral lobes and state their function.



Name the main cerebral lobes and state their function.

- **Parietal lobe** at the top of the brain: movement, orientation, memory, recognition.
- **Occipital lobe** at the back of the brain: visual cortex processes signals from the eye.
- **Temporal lobe** beneath the temples: processes auditory signals.



Name 4 medical imaging tools used to investigate brain structure and function.



Name 4 medical imaging tools used to investigate brain structure and function.

- Magnetic resonance imaging (MRI).
- Functional magnetic resonance imaging (fMRI).
- Positron emission tomography (PET).
- Computed tomography (CT) scans.



# How does an MRI scan work?



## How does an MRI scan work?

Uses powerful magnetic field to cause protons from hydrogen atoms in water molecules to align.

Radio waves then knock protons out of alignment.

When protons realign after radio waves turn off, they emit radiation to receivers.

Signals are used to produce a cross-sectional image.



# How can an MRI scan be used in diagnostics?



# How can an MRI scan be used in diagnostics?

## For soft tissue, shows:

- Excess fluid
- Diseased structures
- Size & position of tumours



Suggest the advantages and disadvantages of using an MRI scan.



Suggest the advantages and disadvantages of using an MRI scan.

- + High resolution distinguishes between tissues
- + 3D image or cross-section
- + No radiation = comparatively safe
- Image affected by movement
- Does not show bone



# How does an fMRI scan work?



## How does an fMRI scan work?

Uses MRI technology to study brain activity based on blood flow.

Oxyhaemoglobin absorbs high frequency radio signals; deoxyhaemoglobin reflects them.

Shows where most aerobic respiration occurs. Active areas have higher respiratory rate.



# How can an fMRI scan be used in diagnostics?



How can an fMRI scan be used in diagnostics?

Shows abnormal patterns of activity in the brain e.g. related to seizures.



Suggest the advantages and disadvantages of using an fMRI scan.



Suggest the advantages and disadvantages of using an fMRI scan.

- + Can investigate normal functioning of the brain.
- + No radiation = comparatively safe.
- + Suitable for use in real time.
- Difficult to interpret results; one brain region may be responsible for a variety of processes.
- Cannot show action of individual neurons.



# How does a PET scan work?



## How does a PET scan work?

A radioactive isotope e.g. of carbon is injected & used by the body to synthesise molecules.

When isotope decays, it emits gamma radiation to a detector. Active areas show higher radioactivity.



# How can a PET scan be used in diagnostics?



## How can a PET scan be used in diagnostics?

- Shows tumours.
- Shows amyloid plaques associated with Alzheimer's disease.



Suggest the advantages and disadvantages of using a PET scan.



Suggest the advantages and disadvantages of using a PET scan.

- + Can investigate normal functioning of the brain.
- + Suitable for use in real time.
- + Can show how a disease progress over time
- Gamma radiation is harmful.



# How does a CT scan work?



## How does a CT scan work?

Uses X-rays to produce cross-sectional image. Denser structures absorb more radiation and appear lighter on image.



# How can a CT scan be used in diagnostics?



How can a CT scan be used in diagnostics?

Bleeds appear white on image e.g. after a stroke.



Suggest the advantages and disadvantages of using a CT scan.



Suggest the advantages and disadvantages of using a CT scan.

- + Non-invasive.
- X-rays are a mutagenic agent.
- Can only be used to investigate abnormal functioning of brain.



# What is the critical period for visual development?



What is the critical period for visual development?

Developmental stage in which an organism has heightened sensitivity to light stimuli.

Vital for full visual capacity since synaptic connections form & non-overlapping ocular dominance columns develop equally.



# What are ocular dominance columns?



## What are ocular dominance columns?

Bands of neurons in visual cortex which are arranged in columns. Respond preferentially to impulses from left or right eye. Likely to be involved in 3D vision.



Describe the direction of axon growth  
from the eyes.



Describe the direction of axon growth from the eyes.

Ganglionic axons in retina form optic nerve → Hypothalamus → Synapse with neurons in thalamus → Visual cortex



Why are animal models used to investigate the structure and function of the human brain?



## Why are animal models used to investigate the structure and function of the human brain?

- Different species have similar principles of brain function.
- Animals show simpler patterns of brain activity that can be applied to humans.
- Cross-species comparisons mean multiple variables can be investigated.



What did Hubel and Wiesel's experiments on monkeys and kittens show?



## What did Hubel and Wiesel's experiments on monkeys and kittens show?

Monocular deprivation of animals with a similar visual cortex to humans during critical period caused permanent visual impairment. Retinal neurons still functioned, but ocular dominance columns did not.

Evidence that critical period is vital.



What are the 2 ethical standpoints surrounding the use of animals in medical research?



What are the 2 ethical standpoints surrounding the use of animals in medical research.

**Absolutist:** use of animals is always unacceptable.

**Relativist:** use of animals is justified in certain circumstances.



Suggest the ethical justifications of using animals in medical research.



Suggest the ethical justifications of using animals in medical research.

- No other options for studying whole-body processes.
- Strict guidelines prevent undue harm.
- Enables medical breakthroughs that can save many lives (some argue that humans have a greater right to life).



Suggest the ethical objections to using animals in medical research.



Suggest the ethical objections to using animals in medical research.

- Can use cell cultures & computerised models.
- Distress & possible death (some argue that animals have an equal right to life).
- Even animal models cannot predict exact effect on humans.



# 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 the neural response that causes habituation.



Describe the neural response that causes habituation.

$\text{Ca}^{2+}$  channels on presynaptic neuron respond less to stimulus. Less  $\text{Ca}^{2+}$  diffuses into presynaptic neuron, so less neurotransmitter released by exocytosis.

Impulses at postsynaptic neuron do not reach threshold for depolarisation. No action potential.



Name 5 methods of investigating the effect of nature and nurture on brain development.



Name 5 methods of investigating the effect of nature and nurture on brain development.

- Use twin studies (compare genetically identical with non-identical).
- Use animal models.
- Record the abilities of newborns.
- Use cross-cultural studies.
- Study the effects of brain damage.

