


Research
Based
Curricula



**Dementia: The Ageing
Brain and the Role of
Participatory Arts**
Key Stage 4 Psychology
Resource 1

2019



Resource One Overview



Topic	The Anatomy of the Functioning Human Brain
GCSE Modules	Biopsychology, memory, neurons, brain function
Objectives	<p>By the end of this resource, you should be able to:</p> <ul style="list-style-type: none">✓ Have a good understanding of the structures and functions of the human brain✓ Locate different structures of the human brain on a diagram✓ Explain the role of neurons and neurotransmitters in the human brain
Instructions	<ol style="list-style-type: none">1. Read the data source2. Complete the activities3. Explore the further reading
Context	<p>The brain is the most complex organ of the body for all vertebrates. The central organ of the nervous system, the human brain is responsible for sending signals to different parts of the body and coordinating our responses to the environment around us. The complexities of the brain are difficult to summarise in a short introduction to biological psychology, but the following resource will outline three elements of brain anatomy: a) the structure of the brain; b) the function of different structures of the brain, and c) the activity of neurons and neurotransmitters of the brains.</p>

Resource One

Data Source



Section A

The Structures and Functions of the Brain



Please read the following material on the organisation of the brain, influenced by Atkinson and Hilgard's 2009 textbook '*An Introduction to Psychology*'.

Understanding the anatomy of the brain can be confusing amongst newbies to psychobiology, particularly because the brain can be defined, organised and divided up into different 'compartments' or sections using different terms. The following bullet-pointed overview offers a brief summary of the main structures or elements of the brain that are useful to know for a psychologist:

- At its most basic, the human brain can be broken down into the cerebrum, cerebellum and brainstem.
- The cerebrum is the largest element of the brain and contains two hemispheres – generally, the left hemisphere controls the right side of the body, while the right hemisphere controls the left-side of the body, though each hemisphere contains many other more complex structures.
- The brainstem is located underneath the cerebrum, while the cerebellum is behind the brainstem.
- The cerebrum has an outer layer called the cerebral cortex which can be divided into four different lobes, as illustrated in figure 1:
 - Frontal lobe – associated with executive functioning, motor skills, reasoning and higher-level cognition. It contains most of the dopamine system linked to reward, attention, planning and motivation.
 - Parietal lobe – responsible for the processing of tactile sensory information and somatosensory information, in addition to some elements connected to language processing.

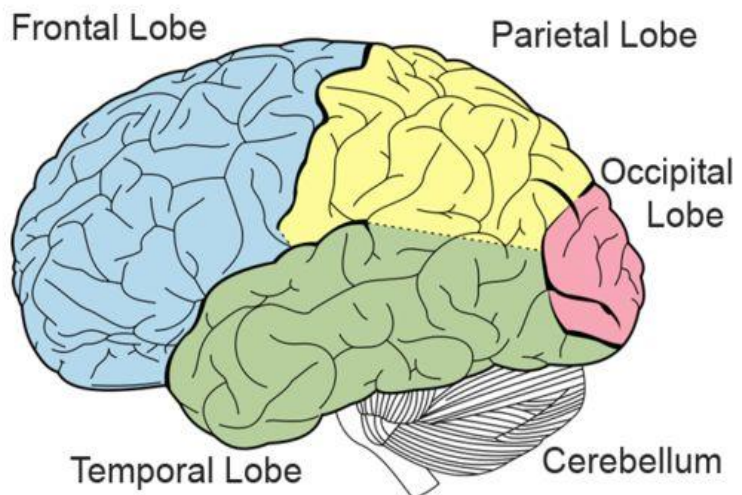
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- Temporal lobe - associated with the formation and storage of memories, as well as auditory and language processing.
- Occipital lobe – responsible for visual stimuli interpretation, including colour identification and motion perception.
- Another common way to divide the brain is into three main regions based on location: the hindbrain, the midbrain, and the forebrain (see above figure). Regardless of how one decides to divide the brain, it is more important to develop an understanding of the brain's intricate anatomy by identifying the smaller structures and their different functions. The following diagram, from Atkinson and Hilgard's 2009 textbook, illustrates some of the main structures in the brain, while the figure on the right offers a more detailed illustration of the limbic system which is not present in the first image. The subsequent table offers you a brief description of the functions of some of the labelled structures.

Figure 1
Lobes of the Brain



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Figure 2

Other structures of the brain

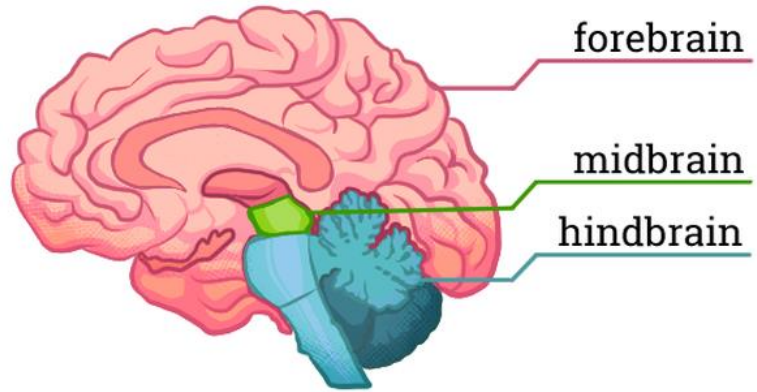
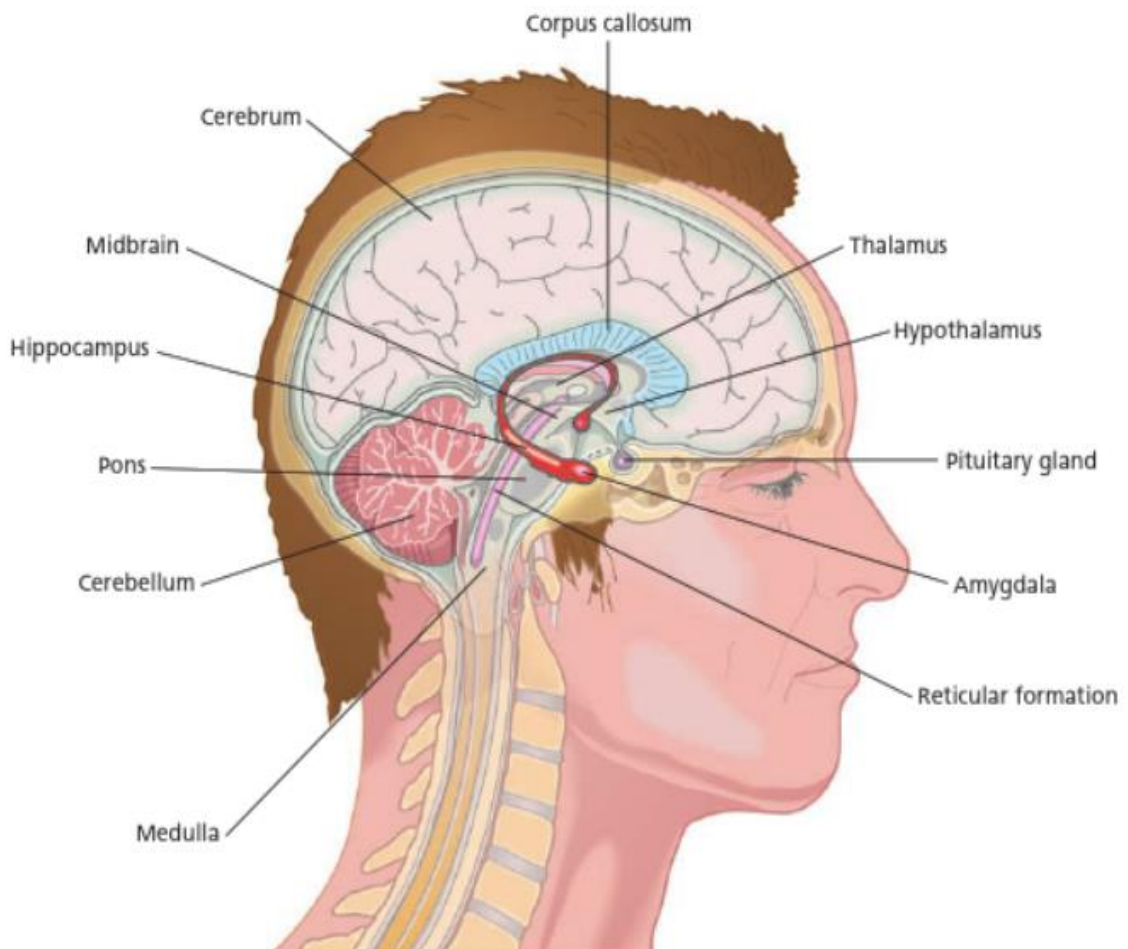


Figure 3

Main Brain Structures



Resource One

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Figure 4
Limbic System
Structures

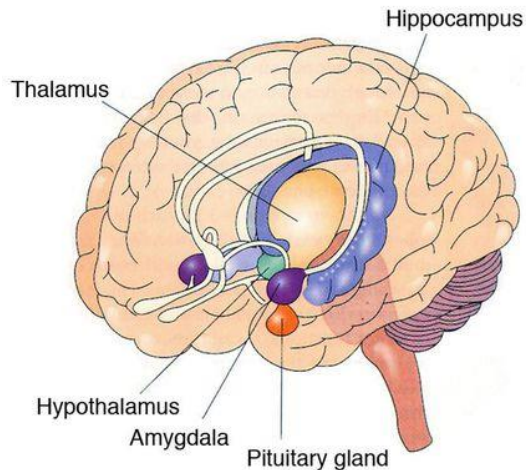


Table 1: The Main Brain
Structures and
Functions

Brain Structure	Brain Function
Cerebrum	Largest part of the brain – responsible for approximately two thirds of brain mass – associated with highest intellectual processes and contains an outer layer called the cerebral cortex, the largest section of neural integration associated with attention, memory, perception, language, consciousness and emotion.
Substantia nigra	Smallest structure of the brain and plays a role in the 'reward-pathway' in relation to dopamine. Also regulates auditory, visual and motor functions.
Thalamus	Part of the gray matter of the brain possessing various functions, including relaying sensory and motor signals to the cerebrum, as well as regulating consciousness and alertness. Part of the limbic system.
Hypothalamus	Small structure with many functions, including regulating sexual behaviour, eating and drinking, while also maintaining homeostasis in the endocrine and autonomic nervous systems by regulating weight, emotions and sleep cycle.
Corpus callosum	Thick structure of white matter connecting the left and right hemispheres of the brain, responsible for physical co-ordination. Also processes complicated thought patterns.
Limbic system	System of interconnected structures (including the hypothalamus, amygdala and hippocampus). Associated with emotional and motor response functions, including fear, pleasure, memory and motivation.
Pituitary gland	Most important part of the endocrine system with links to the limbic system. Produces hormones based on the signals and control shared by the hypothalamus.
Amygdala	A selection of small structures associated with the processing of emotions, in particular the detection of fear and preparation of the stress response i.e. 'fight, flight or freeze'.
Hippocampus	Small uniquely shaped structure with roles in the limbic system. It is responsible for the formation of new memories, storage of long-term memories and memories of locations, objects and people.

Resource One

Data Source



Section B

Neurons and the Brain

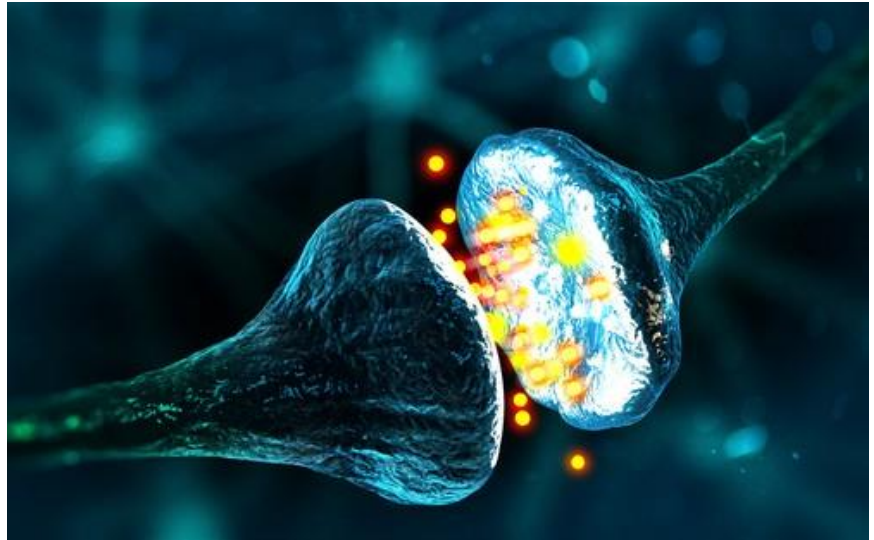
Neurons are what make up the cells in the brain and nervous system of a human being. Also referred to as nerve cells, neurons are found across the whole body and are fundamental to our functioning because they send and receive signals throughout the body and brain. In our brains, there are estimated to be tens of thousands of different types of neurons and they are both complex and hard to distinguish from one another (University of Queensland Australia, 2018). Recent research has estimated that the human brain possesses around 86 billion neurons. In a basic explanation, neurons – or nerve cells – conduct electrical pulses that travel down part of the cell called the axon. These electrical pulses or charges aid in the transmission of information around the brain. These electrical pulses are created by the action potential of neurons – that is, a “phenomenon that is generated through the flow of positively charged ions across the neuronal membrane” (University of Bristol, 2011). Do not worry if you do not understand this – we won’t need to go into any further detail for this pack! All you need to know is that these electrical pulses instigate the release of neurotransmitters which pass through the microscopic gaps between neurons called synapses and are able to pass information from one neuron to the other. Neurotransmitters are like messengers for neurons – they are released and passed across the synapse to the adjacent neuron, where they are received by receptors on the subsequent neuron. There are more than 70 types of neurotransmitters in the brain, including the following:

- Acetylcholine
- Norepinephrine
- Dopamine
- Serotonin
- Gamma-aminobutyric acid (GABA)
- Glutamate

Resource One Data Source



Figure 5
Neurons and
neurotransmitter



This simple journey of a neurotransmitter can take place in a miniscule amount of time, potentially thousands of times per thought.

Imagine how often these chemical reactions take place in your brain every day! This neural network and the normal functioning of neurotransmitters is essential for the health of our brain, body and behaviour.

Resource One

Activities



- Activities**
1. Can you recall the names of the four brain lobes and their general functions?
 2. Sketch the human brain and illustrate where the four brain lobes are located. Use the diagrams in Source 1 to assess your answer when you are finished.
 3. List four types of neurotransmitters that can be found in the human brain.
 4. Match the names of the brain structures with their functions using arrows to connect them.

Brain Structure		Brain Function
Amygdala		System of interconnected structures associated with emotional and motor responses, including fear, pleasure and memory.
Corpus Callosum		Part of the endocrine system that receives information to produce hormones.
Hippocampus		Multifunctional structure that regulates sexual behaviour, eating, temperature and aims to maintain homeostasis in the body and brain.
Limbic System		Uniquely shaped structure in the limbic system that is responsible for memory.
Pituitary glands		Small structures associated with processing emotions and the fight, flight or freeze response.
Hypothalamus		Thick structure of white matter connecting the left and right hemispheres of the brain, responsible for physical co-ordination. Also processes complicated thought patterns.

Resource One Activities



Activities

5. Which structure of the brain is most associated with the storage of memories and why?

6. Re-read the brain structures and their functions from the table in Source 1. Now pick two structures that you think have similar functions to each other. State one similarity and one difference that they have based on the above information.



*Building an
argument*

7. Based on your assumptions about dementia, which structures of the brain would you propose to be affected by dementia and why? Don't worry if you aren't sure about the correct answer – you will cover this material in Resource 2. For now, make an argument based on the basic information you have learned so far.

Resource One Further Reading



Explore



Read

Read Chapter 2 'Biological Foundations of Psychology' from Atkinson and Hilgard's 15th Edition Introduction to Psychology:

<https://www.amazon.co.uk/Atkinson-Hilgards-Introduction-Psychology-Nolen-Hoeksema/dp/1844807282>

Have a look at the American Association of Neurological Surgeons' 'Anatomy of the Brain' online article, which reviews the material of the above resource, as well as including some additional anatomical information:

<https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Anatomy-of-the-Brain>

Listen and Watch

Check out Jam Campus 'Parts of the Brain Song | Science Music Video' on YouTube.

[Jam Campus: Parts of the Brain](#)

Do

Visit 'Sporcle.com' which is "the world's largest trivia quiz website" and find the following quizzes to practice your brain anatomy knowledge and learn new terms: 1) 'Parts of the Brain quiz'; and 2) 'Can you name the parts of the human brain that are pictured here?'

<https://www.sporcle.com/>



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