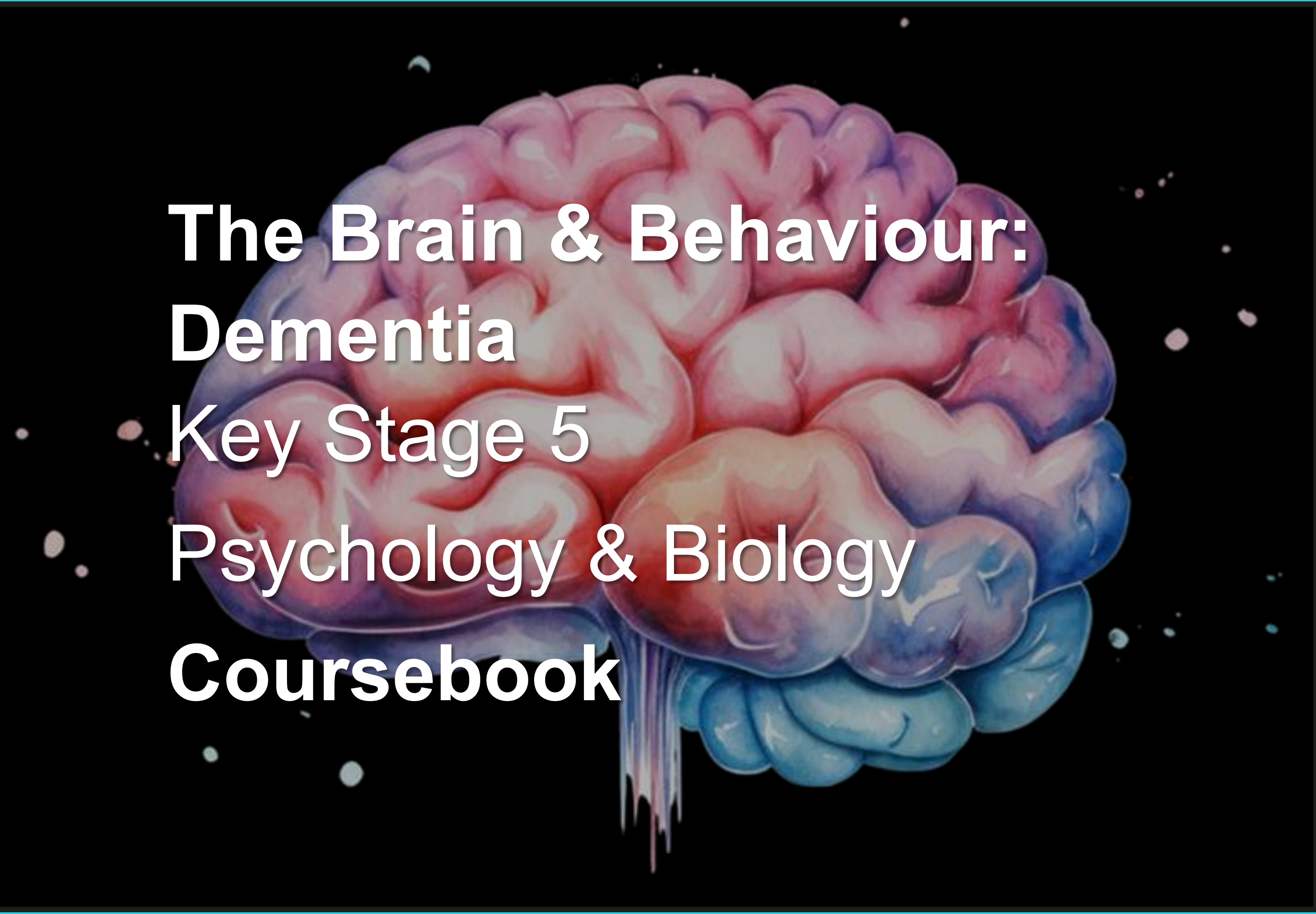
Research-Based Curricula



The Brain & Behaviour: Dementia

Key Stage 5

Psychology & Biology

Coursebook

2026

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Building global university access programmes accessed

Contents

Getting Started

Subject Learning

Study Skills, Tips and Guidance

About this Pack

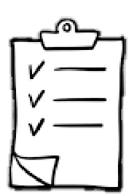
Who is this pack for?

- This pack was created for all students, regardless of whether this is your best or worst subject.
- It's not graded or marked by your teacher. It's a chance to explore the subject and learn in a new way that's different to the classroom.
- Each pack is written by a student at the University of Cambridge researching this topic and has special knowledge on the subject. When they were your age, they knew nothing about it either!
- By completing their mini-course, you will find out why it's interesting, and you will build the skills that help you improve at school.

So… why complete this pack?

- Learn new cool areas of a subject that you won't cover in the classroom
- Sharpen your academic skills, like short essay writing and interpreting data
- Experience what it's like to explore a subject freely
- Better understand what you enjoy and don't – it will help you make decisions about your future studies and career choices!

What's in this booklet?



Your RBC booklet is a pack of resources containing:

✓ More about how and why study this subject

✓ Four 'resources' each as a lesson with activities

✓ A final assignment to gauge learning

✓ Extra guidance throughout about the university skills you are building

✓ End notes on extra resources and where to find more information

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Meet the Author

Name Emily Todd

Area of Study and Degree Neuroimaging in FTLD; PhD in Clinical Medicine

University University of Cambridge

My Background

I studied for a BSc in Psychology at the University of Birmingham, where I specialised in neuroimaging in patients with ischemic stroke. I then moved to University College London (UCL), studying for an MRes in Brain Sciences, specialising in neuroimaging techniques specifically in gene carriers with frontotemporal dementia (FTD). I worked as a researcher at UCL for 4 years as the neuroimaging coordinator for an international study of genetic FTD called GENFI. Following this, I moved to the University of Cambridge to coordinate several studies, including a drug trial, investigating neuroimaging correlates in patients with frontotemporal lobar degeneration (FTLD).

My Research

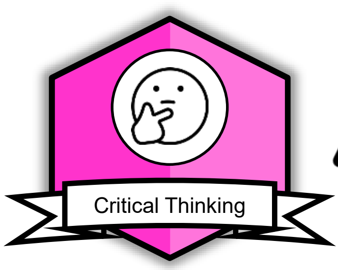
My PhD involves a drug trial and positron emission tomography (PET) brain imaging to investigate GABAergic and synaptic alterations in patients with FTLD. I am specifically interested in the symptoms of apathy and disinhibition.

I think my subject is awesome because…

I have been interested in brain anatomy and function for many years. I am so lucky to have the opportunity to work with patients and do my part toward a cure for dementia.

Building Your Skills

Research-Based Curricula packs challenge you to build your skills in this subject and be used across any of your schoolwork.

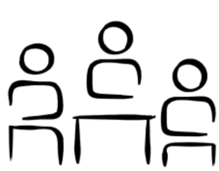


Any time you see a badge, look out for a skill you'll be building!

These skills are the type of skills that teachers and universities look for as you progress, so see how many you know below.

Skills you may see and use in this pack.

Research	*your ability to work on your own and find answers online or in other books*
Creativity	*your ability to create something original and express your ideas*
Problem solving	*your ability to apply what you know to new problems*
Source analysis	*your ability to evaluate sources (e.g. for bias, origin, purpose)*
Data analysis	*your ability to discuss the implications of what the numbers show*
Active reading	*your ability to engage with what you are reading by highlighting and annotating*
Critical thinking	*your ability to think logically to build an argument clearly*

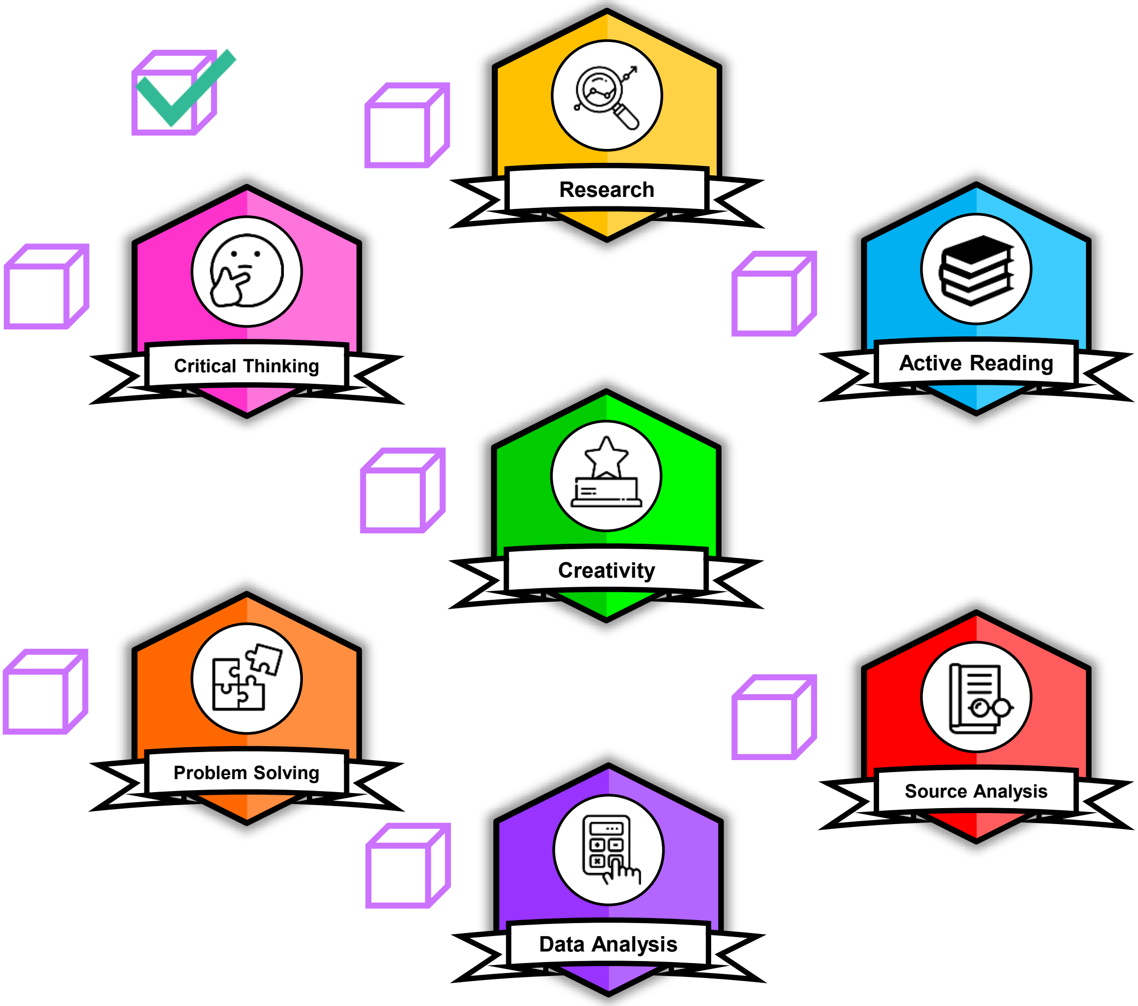


Psst! You can learn more about these skills in the Academic Study Skills section.

Your Skills Badges

As you work through this booklet, you'll have the chance to build the skills you have read on the previous page.

Make sure to revisit this page once you have mastered each skill. Tick off each skills badge below once completed!



Look out for these badges in the Data Source, Activities and Further Reading sections of each Resource. If you complete a skill more than once, write the number of times you completed it next to the badge.

When you've earned all seven skills badges, you can discuss with your teacher how to further build your skills!

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Vocabulary

Be sure to use this section as you go through your booklet. If you see an emboldened word, you can find the definition here. If you are still unsure about the meaning or use of the word, we encourage you to use a dictionary or ask a teacher.

Term	Definition
Action Potential	A rapid electrical signal that travels along a neuron's axon, enabling communication between neurons.
Aggregates	Clumps of misfolded proteins or other molecules found in neurodegenerative diseases.
Alzheimer's Disease	A progressive neurodegenerative disorder characterised by memory loss, cognitive decline, and brain atrophy.
Apathy	A lack of interest, motivation, or emotion, which is often observed in neurological disorders.
Atrophy	Brain cell death/brain shrinkage linked to neurodegeneration.
Behaviour	Observable actions or responses of an organism, influenced by brain function and environment.
Biomarkers	Biological indicators (e.g., proteins, imaging findings) used to diagnose or monitor diseases.
BOLD Signal	Blood Oxygen Level Dependent signal used in fMRI to detect brain activity based on blood flow changes.
Central Nervous System (CNS)	The brain and spinal cord, which is responsible for processing and responding to sensory information.
Cerebrospinal Fluid (CSF)	A clear fluid surrounding the brain and spinal cord, providing cushioning and nutrient transport.

Vocabulary

Term	Definition
Clinical Neurology	A medical field focused on diagnosing and treating disorders of the nervous system.
Cognitive Function	Mental abilities such as memory, attention, language, and problem-solving.
Computational	Refers to using computer models and simulations to understand brain function or process data.
Connectivity	The way different brain regions are structurally or functionally linked.
Cytoplasm	The internal fluid of a cell (excluding the nucleus), where most cellular activities occur.
Depolarised	A change in a neuron's membrane potential, making it less negative and moving toward triggering an action potential.
Deoxygenated Haemoglobin	Haemoglobin that has released its oxygen, which plays a role in the BOLD signal in fMRI.
Dementia	A general term for a decline in memory and cognitive ability severe enough to interfere with daily life.
Depression	A mood disorder marked by persistent sadness, loss of interest, and cognitive or physical symptoms.
Diffusion Weighted Imaging (DWI)	An MRI technique that maps the diffusion of water molecules in tissue, useful for mapping white matter in the brain.
Disinhibition	A reduction in restraint or control over behaviour, often due to brain damage or dysfunction, particularly in neurodegeneration.

Vocabulary

Term	Definition
DNA	Deoxyribonucleic acid, which is the molecule carrying genetic instructions for development and function.
Dorsolateral (Prefrontal Cortex)	Dorsolateral means located toward the upper and outer side of a structure (for example, think of the dorsal fin on a fish, or lateral as in on the side), but in the brain, dorsolateral means the upper outer side of the brain or brain structure.
Executive Dysfunction	Impaired ability to plan, organise, or regulate behaviour, often due to frontal lobe damage.
Excitatory	Describes neurotransmitters or inputs that increase the likelihood of a neuron firing an action potential.
Exocytosis	The process by which cells release substances (e.g., neurotransmitters) by merging vesicles with the cell membrane.
functional MRI (fMRI)	A type of brain scan that measures brain activity by detecting changes in blood flow (BOLD signal).
Frontotemporal Dementia (FTD)	A group of disorders caused by progressive damage to the frontal and/or temporal lobes, affecting personality, behaviour, and language.
Gamma	A high-frequency brainwave (>30 Hz) associated with attention, memory, and information processing.
Gene	A segment of DNA that codes for a specific protein or function in the body.
Glucose Metabolism	The process by which the brain uses glucose for energy, measured in PET scans to assess brain activity.
Glycoprotein	A protein with carbohydrate chains attached, often involved in cell signalling and immune function.

Vocabulary

Term	Definition
Haemodynamic Response	The change in blood flow and oxygenation in the brain in response to neural activity, forming the basis of fMRI signals.
Hydrogen Atoms	Atoms with one proton and one electron; their magnetic properties are exploited in MRI scanning.
Hyperphosphorylated	A state where a protein (e.g., tau) has too many phosphate groups, often leading to dysfunction and aggregation in neurodegeneration.
Hyperpolarised	When the inside of a neuron becomes more negative than the resting membrane potential, making it less likely to fire.
Hypertension	High blood pressure, a major risk factor for stroke, dementia, and other neurological conditions.
Impulsivity	A tendency to act without forethought or consideration of consequences; linked to frontal lobe dysfunction.
Insight	A person's awareness and understanding of their own cognitive, behavioural, and emotional changes caused by the disease, and the impact these changes have on their daily functioning and on others
In Vivo	Latin for "in the living"; refers to processes or experiments conducted in living organisms. For example, we say that an MRI scan looks at the brain in vivo, i.e., in a living person.
Inclusion	Abnormal intracellular structures often made of aggregated proteins, characteristic of neurodegenerative diseases.
Inhibitory	Refers to inputs or neurotransmitters that decrease the likelihood of a neuron firing an action potential.
Isotope	A variant of a chemical element with a different number of neutrons; used in medical imaging (e.g., PET scans).

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Vocabulary

Term	Definition
Lesions	Areas of damaged tissue in the brain due to injury, disease, or surgery.
Ligand	A molecule that binds to a receptor, often to trigger a biological response (e.g., neurotransmitters, drugs). Often used in PET neuroimaging.
Limitation	A restriction or weakness of a method, model, or study design; important in interpreting scientific findings.
Localisation	The theory or concept that specific mental functions are tied to specific areas of the brain.
Low-and Middle-Income Countries (LMICs)	Nations with lower gross national income per capita.
Lumbar Puncture	A procedure in which cerebrospinal fluid is withdrawn from the lower spine to diagnose neurological diseases.
Macroscopically	Visible to the naked eye; used to describe large-scale structures or changes in the brain.
Magnetic Field	A field created by magnets or electrical currents; used in MRI to align hydrogen atoms in the body.
Membrane Potential	The voltage difference across a cell's membrane, crucial for generating action potentials.
Metabolically	Refers to the chemical processes involved in maintaining life, such as energy use in brain cells.
Microstructure	The microscopic structure of tissues, such as axons or synapses, often assessed using advanced imaging techniques.

Vocabulary

Term	Definition
Microtubule	A structural component of the cell's cytoskeleton involved in intracellular transport and stability; abnormal in tauopathies.
Microscopically	At the level visible only with a microscope; describes fine structural changes in brain tissue.
Misfolded	Refers to proteins that have not folded into their correct three-dimensional shape, often leading to aggregation and toxicity.
Motor Neuron	A type of neuron that carries signals from the brain or spinal cord to muscles to cause movement.
MRI (Magnetic Resonance Imaging)	A non-invasive imaging technique that uses magnetic fields and radio waves to visualise structures in the body, especially the brain.
Myelin	A fatty, insulating layer that surrounds axons, increasing the speed of electrical signal transmission in neurons.
Network	A system of functionally or structurally connected brain regions that work together to perform complex tasks.
Neuroanatomical	Pertaining to the structure of the nervous system, particularly the brain and spinal cord.
Neurodegeneration	The progressive loss of structure or function of neurons, including their death, often leading to disorders like Alzheimer’s or Frontotemporal lobar degeneration.
Neuron	The basic unit of the nervous system; a cell that receives, processes, and transmits information via electrical and chemical signals.
Neuroscience	The scientific study of the nervous system, including its structure, function, development, and pathology.

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Vocabulary

Term	Definition
Neurotransmitters	Chemical messengers released by neurons to transmit signals across synapses to other cells.
Nucleus	In cell biology, the membrane-bound structure that contains genetic material (DNA); in neuroanatomy, a cluster of neurons in the brain.
Oligodendrocytes	A type of glial cell in the central nervous system responsible for producing and maintaining myelin.
Pathology	The study of disease processes, including structural and functional changes in tissues and organs.
Peripheral Nervous System	The part of the nervous system outside the brain and spinal cord, including nerves and sensory receptors.
Photon	A particle of light; in PET scans, photons are detected after radioactive decay to produce images of brain activity.
Phrenology	An outdated and discredited theory that linked bumps on the skull to personality traits and mental abilities.
Plaques	Deposits of beta-amyloid protein found between neurons in Alzheimer's disease, contributing to neurodegeneration.
Positron Emission Tomography (PET)	An imaging technique that uses radioactive tracers to visualise brain activity and metabolism.
Post-Mortem	Refers to examination of a body or brain after death to study disease pathology.
Postsynaptic Membrane	The membrane on the receiving side of a synapse, containing receptors for neurotransmitters.

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Vocabulary

Term	Definition
Presynaptic Neuron	The neuron that releases neurotransmitters into the synaptic cleft to communicate with the next cell.
Protein	A large, complex molecule made of amino acids that performs many functions in cells, including signalling and structure.
Proteinopathies	Diseases caused by abnormal accumulation or misfolding of specific proteins, such as tau or alpha-synuclein.
Proton	A positively charged subatomic particle found in the nucleus of atoms; their behaviour in magnetic fields is key to MRI.
Purkinje Cell	Inhibitory neuron, found in the cerebral cortex, involved in motor coordination and balance.
Pyramidal Neuron	A type of excitatory neuron found in the cerebral cortex with a characteristic pyramid-shaped cell body.
Radiative Decay	The process by which an unstable atomic nucleus loses energy by emitting radiation; key to PET imaging.
Radioactive Tracer	A substance labelled with a radioactive isotope used in imaging (e.g., PET) to track biological processes. Also called a ligand.
Radiotracer	Another term for a radioactive tracer used to visualize processes like glucose metabolism in the brain.
Repolarisation	The return of a neuron's membrane potential to its resting state after depolarisation, restoring electrical balance.
Resolution	The level of detail an imaging technique can detect; in MRI, higher resolution means clearer, finer structural images.

Vocabulary

Term	Definition
Respite Care	Temporary care provided to give relief to primary caregivers of people with chronic conditions.
Resting State	A condition where the brain is not focused on a task, often used in fMRI studies to examine baseline brain connectivity.
RNA	Ribonucleic acid; a molecule involved in coding, decoding, and regulating gene expression from DNA.
Saltatory Conduction	The rapid transmission of action potentials along myelinated axons, where the impulse "jumps" between nodes of Ranvier.
Sedentary Lifestyle	A way of living with little physical activity; a known risk factor for cognitive decline and other health issues.
Serotonin	A neurotransmitter involved in mood regulation, sleep, and cognition; imbalances are linked to depression and anxiety.
Subcortical	Refers to brain structures located beneath the cerebral cortex, such as the basal ganglia and thalamus.
Support Groups	Peer-led or professionally facilitated groups where individuals with similar conditions (e.g., dementia) can share experiences and resources.
Syndrome	A group of symptoms that consistently occur together and characterise a particular condition or disease.
Tangles	Twisted fibres inside neurons composed of hyperphosphorylated tau protein, commonly found in neurodegenerative disease.
Tesla	The unit of measurement for magnetic field strength used in MRI scanners (e.g., 1.5T, 3T, 7T).

Vocabulary

Term	Definition
Thalamus	A subcortical brain structure that acts as a relay station for sensory and motor signals to the cerebral cortex.
Tissue	Groups of cells in the body that perform specific functions; brain tissue includes neurons and glial cells.
Toxically	Refers to harmful effects caused by toxic substances, such as misfolded proteins damaging neurons.
Tractography	A neuroimaging technique that visualizes white matter tracts in the brain using diffusion MRI data.
Tracts	Bundles of nerve fibres (axons) that connect different parts of the nervous system.
Vesicles	Small sacs in neurons that store neurotransmitters, releasing them into the synaptic cleft during synaptic transmission.
Voxel	A volume element representing a value in three-dimensional space, used in imaging data like MRI or PET scans.
Ventromedial (Prefrontal Cortex)	Ventro refers to the bottom or underside of the brain, medial refers to the middle, or inner part of the brain or brain structure.

When you find words that you don't recognise in a resource, look up their definition.

Introduction to Subject
The Brain & Behaviour

The topics within this pack will include:

Resource 1	The Healthy Brain: Brain Localisation and Function
Resource 2	The Healthy Brain: Neurons and Synapses
Resource 3	Visualising the Brain: Brain Imaging Methods
Resource 4	The Unhealthy Brain: A Brief Introduction to Neurodegeneration
Resource 5	The Unhealthy Brain: A Brief Introduction to Dementia
Resource 6	Diagnosis, Support and Real-life Impact of Dementia

Background to the coursebook:

Our brains shape who we are and how we interact with the world, from polite conversations with strangers to agitated, emotional reactions to unprecedented news, to safety when crossing the road, and even what we choose to eat. This coursebook will begin to unpick the neural underpinnings of behaviour, exploring the key brain centres that shape our behaviour, how our brain cells interact, and how things change when things go wrong, with a particular focus on neurodegeneration.

We will also examine how we can view the brain, the importance of dementia research, and what the future of dementia diagnosis, care, and treatment might look like. By the end of this coursebook, you will better understand how our brain shapes our behaviour, and what happens in some neurodegenerative diseases. This coursebook will bring together knowledge from a variety of disciplines, including psychology, biology, physics, and sociology, to provide a comprehensive starting guide to the neuroscience of behaviour and neurodegeneration.

Resource One Overview

Topic — The Healthy Brain: Brain Localisation and Function

Key Stage 4 or 5 Subject Area

GCSE Psychology: 3.2.3 Brain and neuropsychology
GCSE Biology: 4.5.2.2 The human nervous system: The Brain (biology only)
A-Level Psychology: 4.2.2 Biopsychology

Objectives

By completing this resource, you will be able to:

✓ Identify and label gross brain regions and structures.

✓ Describe the key brain regions involved in behaviour.

✓ Explain how current research in healthy people has forwarded our understanding of the PFC and behaviour.

Instructions

1. Read the data source
2. Complete the activities
3. Explore the further reading
4. Move on to Resource Two

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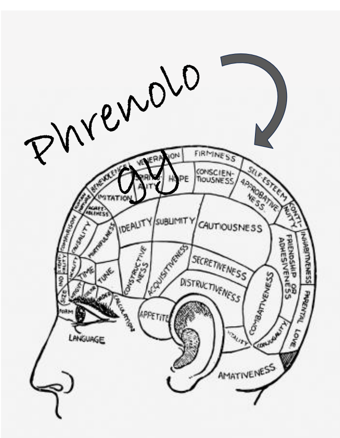
Resource One
Data Source

Section A

Localisation of Cognitive Function & Behaviour

It is well established in **neuroscience** that brain activity is related to our behaviour, specifically our emotions, thoughts, and **cognitive function**. Specific brain regions have been linked to distinct roles in human behaviour and processing, and this is the modern concept of "**localisation**".

Franz Joseph Gall helped develop the concept of localisation in the 18th Century, proposing that specific mental faculties were located in specific **neuroanatomical** brain regions. Although his work on **phrenology** and personality has since been debunked, his ideas formed the basis for the modern-day concept of localisation. Historical case studies of brain injuries, clinical evidence from stroke and tumour patients, electrical stimulation studies during brain surgeries and scientific neuroimaging studies in healthy and ill people have since helped to establish the concept of localisation of cognitive function.



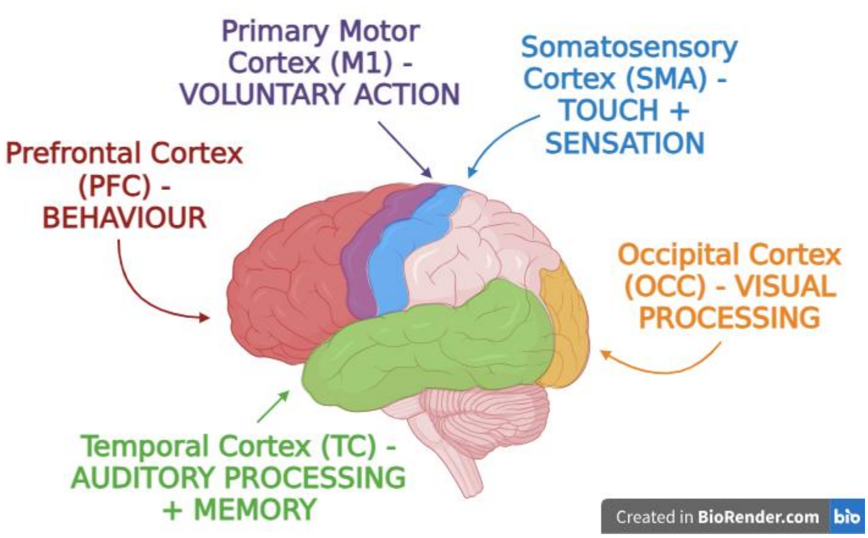


Figure 1:

Labelled diagram of the brain & some of its localised functions

Resource One Data Source

Section B

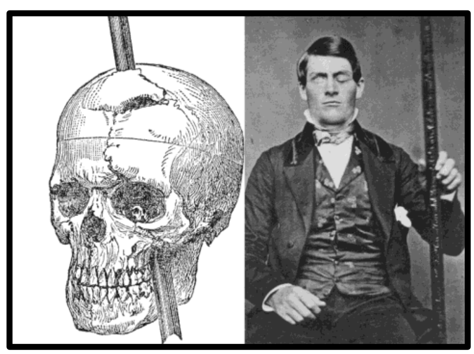
History of the Prefrontal Cortex & Behaviour

Active Reading

The **Prefrontal Cortex** (PFC) is located at the front of the brain just behind your forehead (figure 1). For many years, the PFC's specific function was not fully understood. However, in 1848, a very famous case of severe brain injury in a man called **Phineas Gage** was reported, which provided evidence in support of its associated role. Phineas Gage was a railroad worker who miraculously survived a near-fatal brain injury after an explosion shunted an iron rod through his skull and left frontal lobe. Astoundingly, he survived, but it was reported after this injury that Phineas' personality and behaviours changed markedly, becoming more inappropriate, impulsive and aggressive. This was some of the first evidence that the frontal lobe of the brain played an essential role in determining human personality and behaviours.

Figure 2:

Images of Phineas Gage



Research

In the 1870s, David Ferrier and colleagues explored this relationship and demonstrated a similar finding in animal experiments. They showed that damage or injury to specific frontal brain areas elicited behavioural changes, such as reduced motivation and initiative, as well as difficulties adapting to environmental changes. Although Ferrier's methods would be considered highly **unethical** by today's standards, due to the invasive procedures on animals, his work helped create early, detailed brain maps that informed lifesaving human neurosurgical procedures for conditions such as epilepsy and brain tumours.

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Resource One
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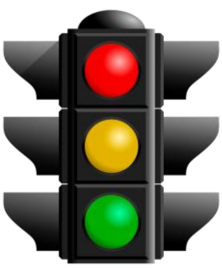
Section C

What is Behaviour?



Psychologists and neuroscientists define behaviour differently. For this resource, we will focus on the neuroscientific definition of behaviour, whereby "*motor, physiological and cognitive processes result from the coordinated activity of the **central nervous system (CNS)**, to adapt to external stimuli in the environment*" (Kandel et al 2013). Essentially, this means that our brains, peripheral nerves, and muscles coordinate in response to stimuli to elicit outward actions or dispositions. For example, when we drive a car, we pay great attention to traffic lights. If the light is red, we know we have to stop, so we press the brake as the light turns amber, and then we press the accelerator when it turns green. When we do this, this would be an example of behaviour elicited by external stimuli in the environment.

Behaviour is a general term that includes impulsivity, eating, aggression, emotional and apathetic processes and many more.

Figure 3 lists some measurable behaviours and some examples of the tools and tasks we use to quantify them in neuroscience.

For individual definitions of behaviours, please see the glossary.

Figure 3:

Examples of how we measure behaviour in neuroscience

Behaviour	Questionnaires	Cognitive test	Behavioural task	Clinician/ Caregiver Rating	Physiological
Apathy	✓ • Apathy Evaluation Scale		✓ • Goal Priors Precision Task	✓ • Neuropsychiatric Inventory – Apathy Subscale	
Impulsivity/ Disinhibition	✓ • Barratt Impulsiveness Scale	✓ • INECO Frontal Screening	✓ • Stop NoGo Task • Stop Signal Task	✓ • Cambridge Behavioural Inventory - R	✓ • EEG P300 amplitude latency
Aggression/ Irritability	✓ • Buss-Perry Aggression Questionnaire		✓ • Taylor Aggression Paradigm	✓ • Frontal Systems Behaviour Scale	✓ • Heart Rate • Testosterone/ Cortisol levels
Emotional blunting	✓ • Dimensional Apathy Scale		✓ • Emotion Recognition task – Ekman Faces	✓ • Scale for Emotional Blunting	✓ • Emotion-Modulated startle paradigm
Compulsive/ Repetitive behaviours	✓ • Cambridge Behavioural Inventory - R			✓ • DAPHNE scale	
Eating habit changes	✓ • Cambridge Behavioural Inventory - R			✓ • DAPHNE scale • Cambridge Behavioural Inventory - R	
Social appropriateness	✓ • Social Norms questionnaire	✓ • Social Faux Pas Recognition Task	✓ • Reading the Mind in the Eyes test	✓ • Frontal Systems Behaviour Scale	

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Resource One
Data Source

Section D

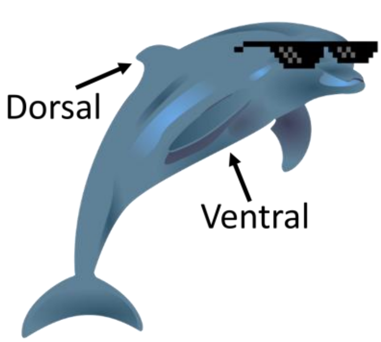
Evidence: The Healthy Brain

Over the last 40 years, technology has advanced significantly, allowing us to investigate brain structure and function, as well as behaviour, in healthy, living people. Specific brain imaging techniques will be covered in more detail in resource three. New MRI machines with very strong magnets have helped us sub-classify certain areas of the brain and localise functions to even smaller, more specific regions within the PFC.

One such region is the **orbitofrontal cortex (OFC)**. Research using structural MRI has shown a clear link between OFC grey matter volume and impulsivity (Lim et al. 2021), OFC brain activation and aggression (Beyer et al. 2015), and eating behaviour (Suzuki et al. 2017).

The **anterior cingulate cortex (ACC)** has also been shown to be involved with apathy and motivation (Le Heron et al 2017), impulsivity and aggression (Gorka et al 2015), with lower ACC grey matter brain volumes being associated with increased levels of apathy (Le Heron et al 2017), and higher rates of aggression (Boes et al 2008).

Finally, the **dorsolateral PFC (dlPFC)** and **ventromedial PFC (vmPFC)** have also been linked to aggressive behaviour (Choy et al. 2018; 2023), apathy (Fazio et al. 2016), and impulsivity (Lim et al. 2021).



Fun fact: *In Latin, dorsal means "back", and ventral means "belly", which is why a dorsal fin on a dolphin is named as such. Over time, scientists have used dorsal and ventral to more accurately describe areas of the brain rather than just up/down and front/back.*

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Resource One
Data Source

Section D

Evidence: The Healthy Brain *(continued)*

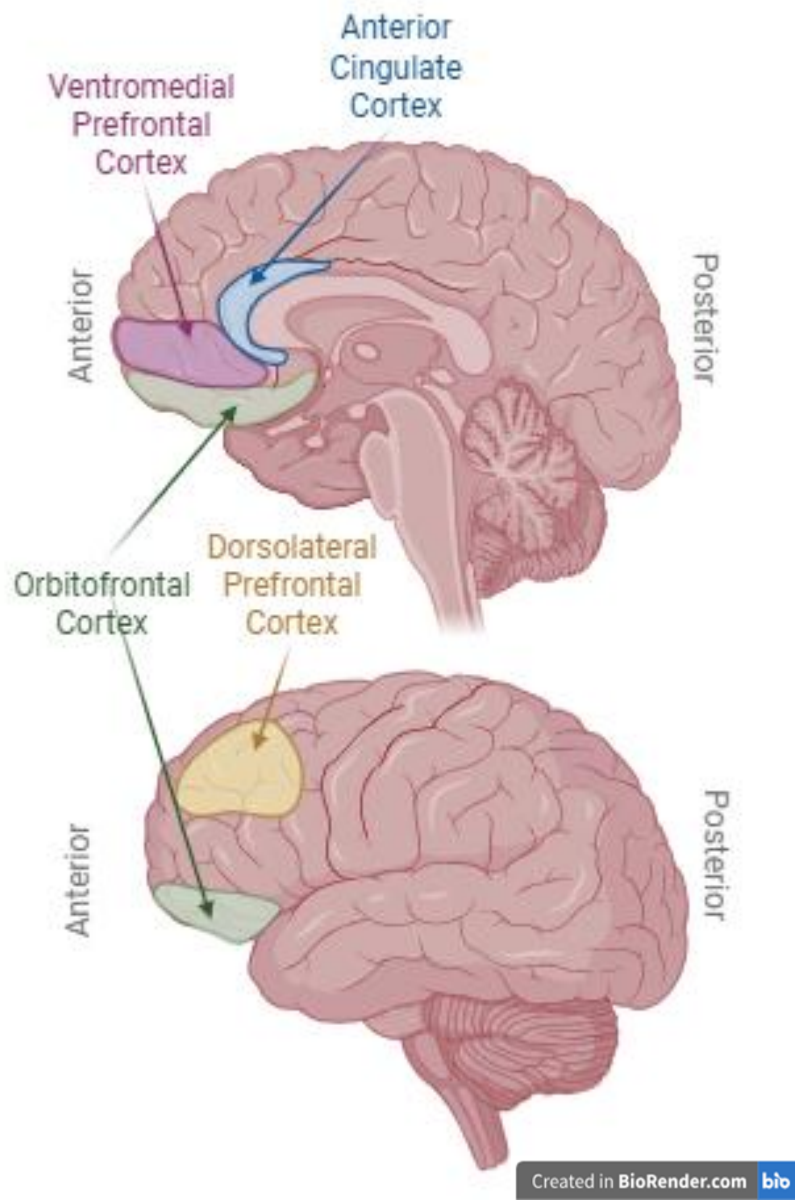
Active Reading

Figure 4 indicates regions implicated in behavioural control and in the functions of impulsivity, apathy, eating behaviour, and aggression.

Figure 4:

Key PFC brain regions involved in coordinating behaviour

Source Analysis



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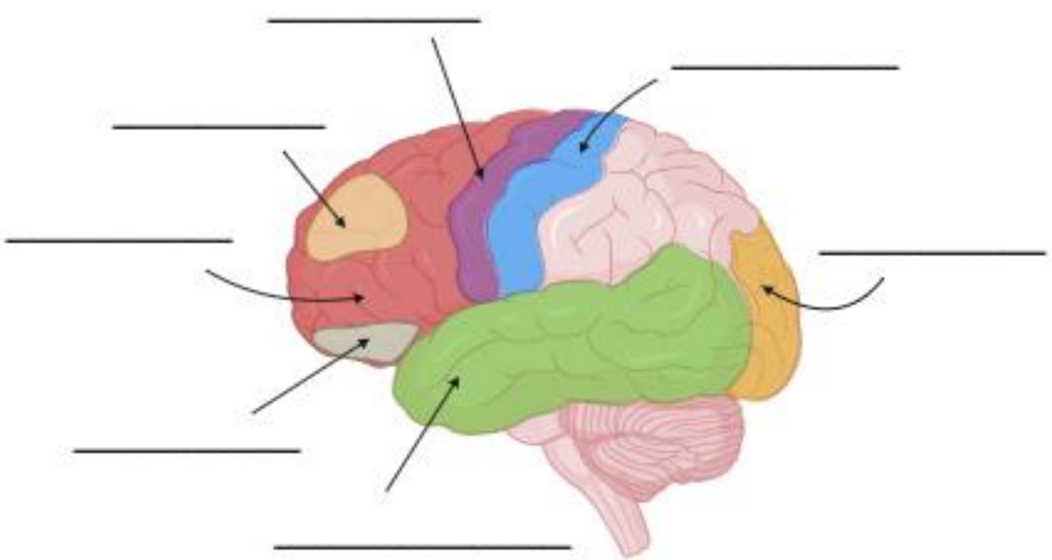
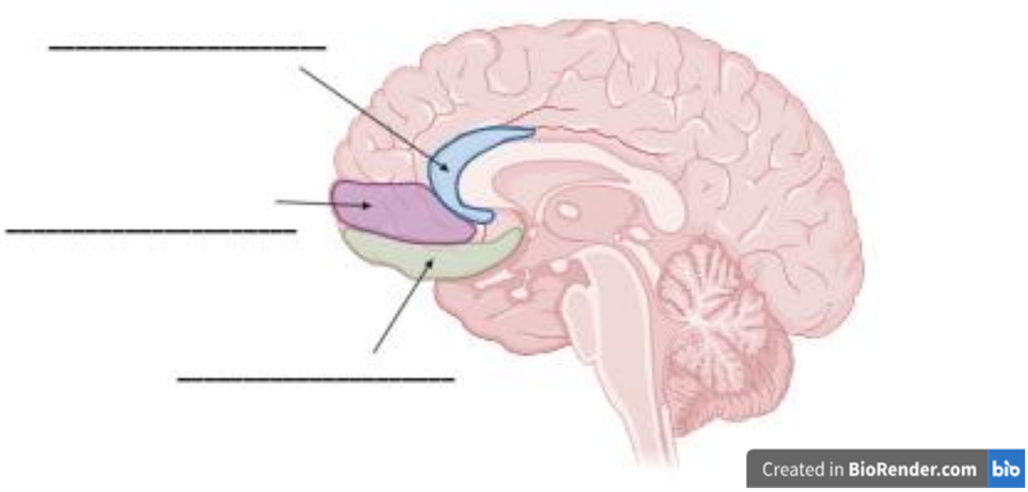
Resource One Activities

Activities

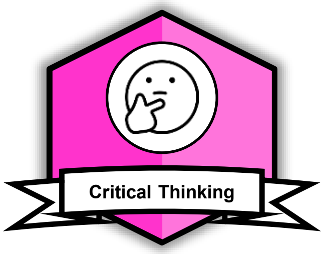
1. Label the diagram of the brain:





Resource One
Activities

Activities
(continued)



2. Using the diagram from (1), briefly describe the main functions of the labelled regions.
3. Explain how recent research in healthy people has revealed the role of the PFC in human eating behaviour
4. Watch this clip about the condition Frontotemporal dementia (this will be covered in more detail in Resource 5), particularly timestamp 0.40 – 1.25: Frontotemporal Dementia - Mayo Clinic. Using your knowledge of the testing materials to assess behaviour in research, write a short paragraph describing your choice of assessment for the eating behaviour symptoms mentioned in this clip and why you selected this measure.
5. Design a poster about the PFC. Include evidence that has aided in our understanding of its function.

Resource One
Further Reading

Explore

1. Anatomy of human brain, specifically PFC: https://youtube.com/shorts/R1VRQIVVTbM?si=zkhEyLDyc2d6RmIy
2. PFC: https://youtu.be/v4Y7MoGpPSU?si=Oil2pw92fEw5u7BU

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Resource One
Further Reading

References *(continued)*

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Resource One
Further Reading

Image Sources

1. Page 17 image: Image by rawpixel.com – Open Source.
2. Cover image: Image by rawpixel.com – Open source.
3. Page 19: Phrenology Image by rawpixel.com – Open Source.
4. Page 19, figure 1 created in https://BioRender.comX.
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6. Page 21: Traffic light Image by rawpixel.com – Open Source.
7. Page 22: Image adapted from rawpixel.com – Open Source.
8. Page 23, figure 4 Created in https://BioRender.comX.

Resource Two Overview

Topic

The Healthy Brain: Neurons and Synapses

Key Stage 4 or 5 Subject Area

GCSE Psychology: 3.2.3 Brain and neuropsychology
A-Level Biology: 3.6.2.2 Synaptic transmission (A-level only)
A-Level Psychology: 4.2.2 Biopsychology

Objectives

By completing this resource, you will be able to:

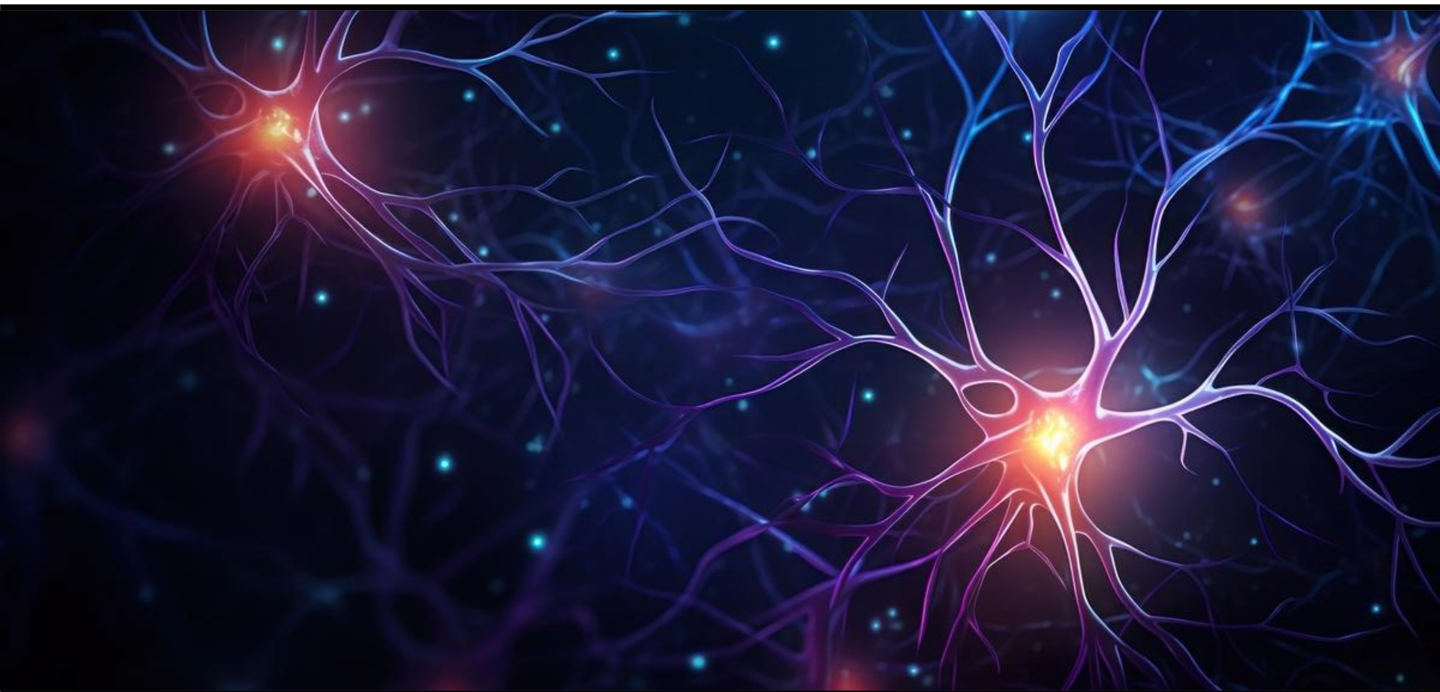
✓ Identify the main components of a neuron and synapse.

✓ Describe salutatory conduction and synaptic transmission.

✓ Explain the role of the synapse relating to neurotransmission, synaptic transmission and brain region communication.

Instructions

1. **Read the data source**
2. **Complete the activities**
3. **Explore the further reading**
4. **Move on to Resource Three**



Resource Two Data Source

Section A

Brain Cells & Their Functions

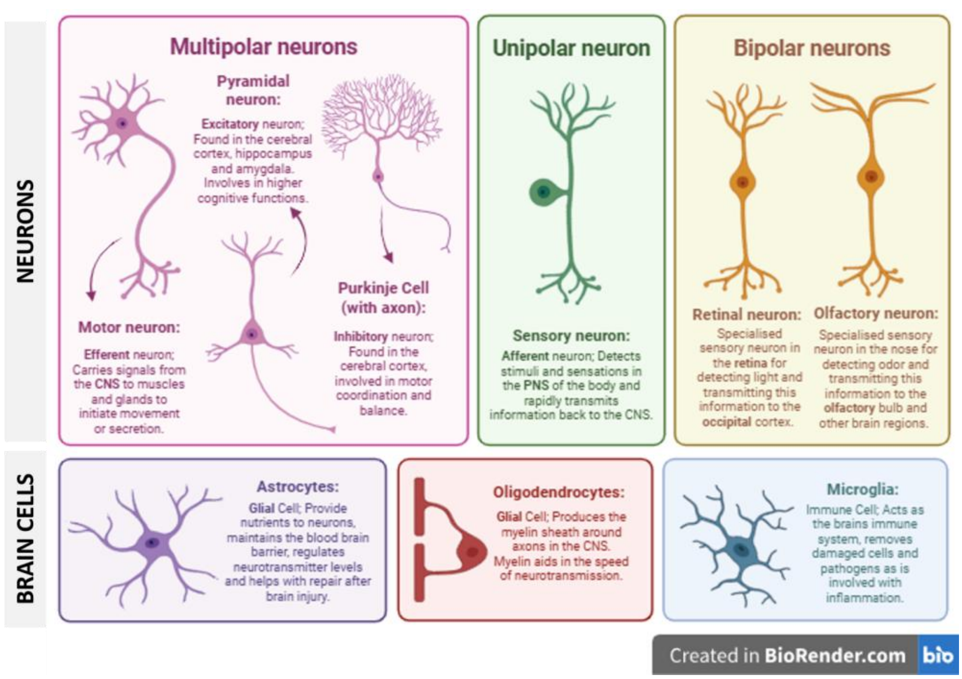
Active Reading

The brain consists of many different cells, each performing a different function. **Neurons** are specialised nerve cells, responsible for receiving signals, processing information and transmitting chemical and electrical signals in the brain and throughout the body. There are three main structural categories of neurons: multipolar, bipolar, and unipolar. Multipolar neurons have one axon and many dendrites and are the most common type of neuron in the CNS. Multipolar neurons can be differentiated into specific types of neurons with specialised functions, such as **motor** and **pyramidal** neurons and **Purkinje** cells. Bipolar neurons contain one axon and a single dendrite and are most often found in sensory organs such as the eye, ear, or nose. Unipolar neurons contain a single extension which bypasses an external cell body and are typically found in the **peripheral nervous system (PNS)**.

The brain also contains other non-neuronal cells, such as immune cells and structural support cells.

Figure 5:

Neurons & brain cells



Resource Two Data Source

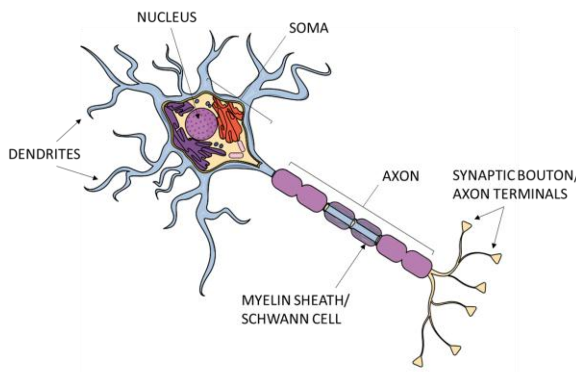
Section B

Neuronal Anatomy

Each neuron contains specialised anatomical elements which coordinate its functionality.

Figure 6:

Basic neuronal anatomy (with an oligodendrocyte)



Watch the following clips, which describe the structure and function of the neuron: https://youtu.be/QBs0g55VKP0?si=jndVtVjDBi6b6JFq.

Section C

Action Potentials & Saltatory Conduction

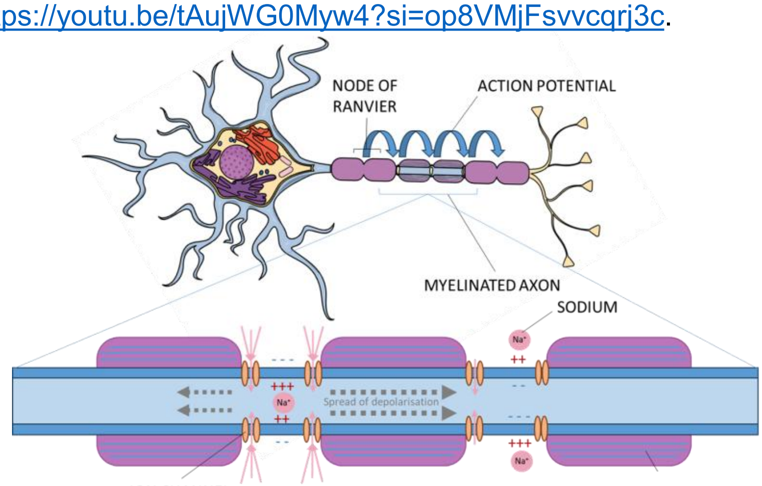
An action potential is a rapid electrical signal that travels along a neuron's axon, enabling communication between neurons. Watch this video about action potentials: https://youtu.be/Nq4XKXFIHqQ?si=GdJGYQqrurF2cRnC.

Saltatory conduction is the process by which a signal moves along an axon of a neuron in a "jumping pattern", at exposed gaps between the myelin sheath, called the Nodes of Ranvier.

Watch this video, which describes the process of saltatory conduction: https://youtu.be/tAujWG0Myw4?si=op8VMjFsvvcqrj3c.

Figure 7:

Basic neuronal anatomy with saltatory conduction



Source Analysis

Resource Two
Data Source

Section D

Brain Cell Organisation

The brain is comprised of “grey” and “white” matter, and this can be observed on structural MRI scans (see resource 3). Evidence from **postmortem** studies has helped to explain the differences between these brain tissue types. Grey matter typically contains the cell bodies of neurons, dendrites, some unmyelinated axons, glial cells, and many synapses. Grey matter is found in the cerebral cortex and deep subcortical brain structures such as the **basal ganglia**.

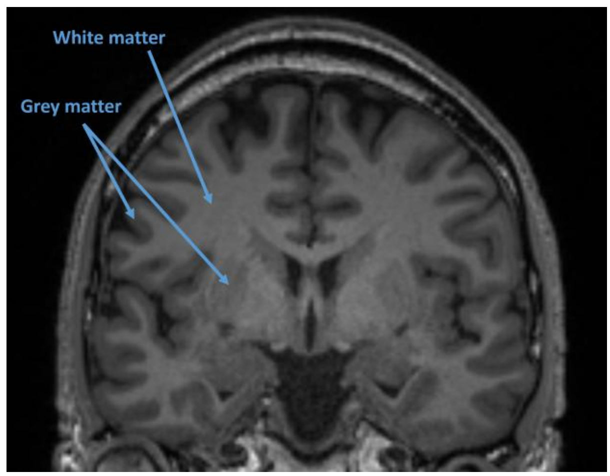
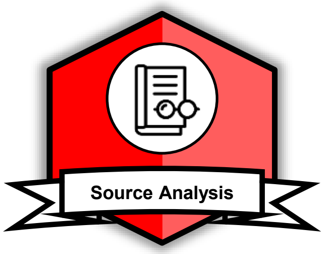


Figure 8:

MRI scan showing Grey vs White matter



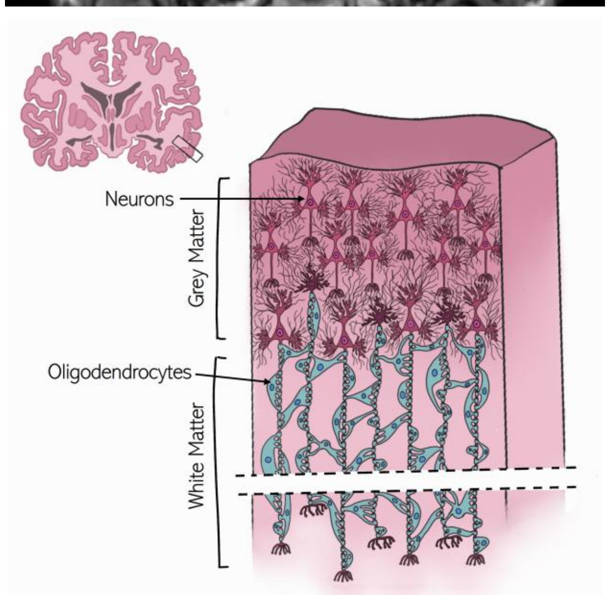


Figure 9:

The organisation of brain cells in grey & white matter

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Resource Two
Data Source

Section D

Brain Cell Organisation *(continued)*

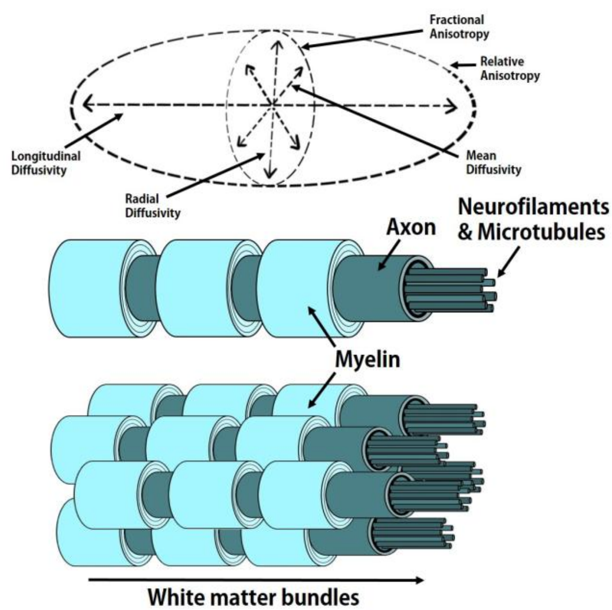
Active Reading

White matter contains many myelinated axons and the oligodendrocytes that produce myelin. The fatty myelin sheath creates the appearance of a paler colour of the tissue, hence the term "white matter". White matter is found below the grey matter layer of the cerebral cortex. It is generally thought to be organised into "**tracts**", where the myelinated axons bundle together to form connections between regions. This enables fast, efficient signal transmission for long-distance communication and **connectivity**. They also enable "**network**" integration, as some cognitive processes, such as memory and decision-making, require certain brain areas to function as a network to process information concurrently and reciprocally.

Figure 10:

White matter bundles

Source Analysis



Specialised MRI scans can be used to estimate and visualise the white matter tracts in the brain, using a type of scan called a **Diffusion Weighted Image**. These images can then be processed and analysed to produce **tractography** images, which indicate the direction and connectivity of tracts between different brain regions.

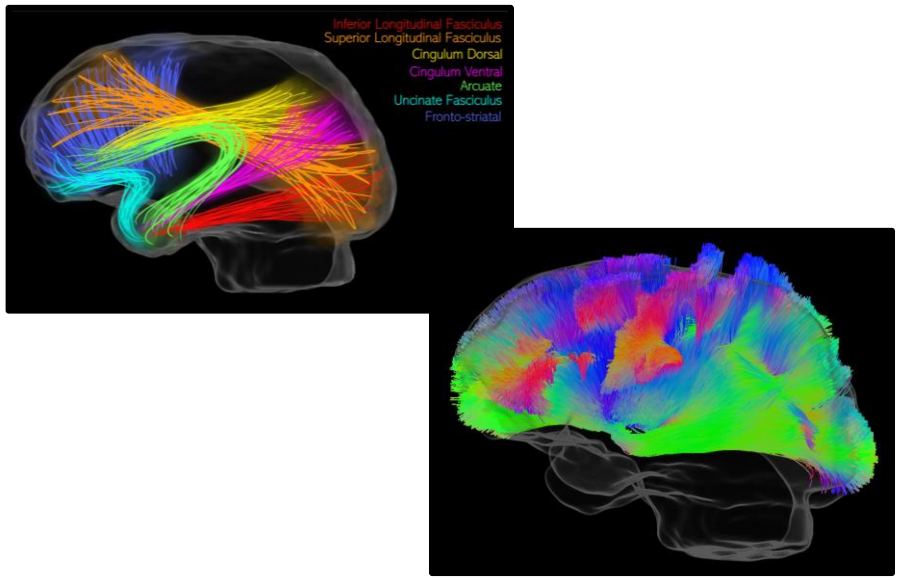
Resource Two Data Source

Section D

Brain Cell Organisation *(continued)*

Figure 11:

White matter organisation as shown by Tractography



Section E

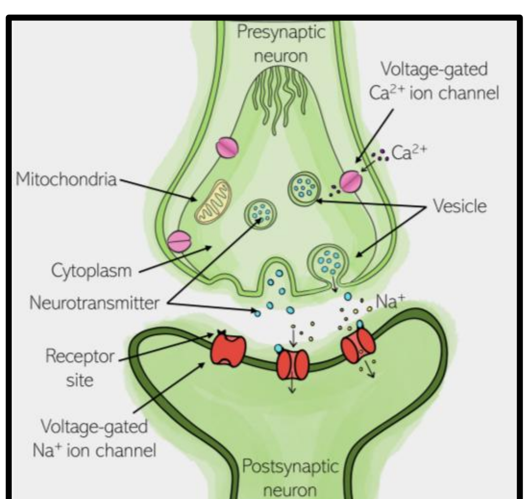
Synapses

Connectivity can also be measured using functional MRI and other brain imaging techniques, which will be covered in Resource 3.

A synapse is a small gap between two neurons, where a signal is passed from one neuron to the other. It is the key area where an electrical signal/stimulus that has travelled along an axon is converted to a chemical signal for transmission across the **synaptic cleft** to initiate an impulse in the next neuron.

Figure 12:

Synaptic transmission



Resource Two
Data Source

Section E

Synapses *(continued)*

Synaptic transmission can be simplified into the following steps:

1. An action potential arrives at the axon terminal (synaptic bouton) on the **presynaptic neuron**.
2. Depolarisation at the synaptic bouton opens voltage-gated calcium ion (Ca^{2+}) channels, and Ca^{2+} ions enter the axon terminal.
3. **Vesicles** containing **neurotransmitters** then fuse to the presynaptic membrane and are released into the synaptic cleft via **exocytosis**.
4. Neurotransmitters **diffuse** across the synaptic cleft and bind to specific **receptors** on the **postsynaptic** membrane of the postsynaptic neuron.
5. This causes ion channels to open in the postsynaptic neuron and cause either a depolarisation or hyperpolarisation of the postsynaptic neuron, depending on the type of neurotransmitter and receptor.
   - A depolarisation will elicit an **excitatory** postsynaptic potential (EPSP)
   - A hyperpolarisation will elicit an **inhibitory** postsynaptic potential (IPSP)

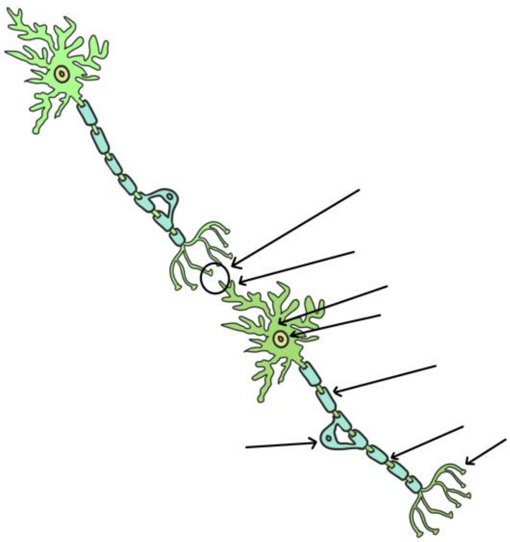
   If the signal is strong enough, it may trigger a new action potential in the postsynaptic neuron.
6. The synapse is reset:
   - Reuptake: Neurotransmitters are reabsorbed into the presynaptic neuron
   - Degradation: Enzymes break down the neurotransmitters
   - Diffusion: some neurotransmitters diffuse out of the synaptic cleft

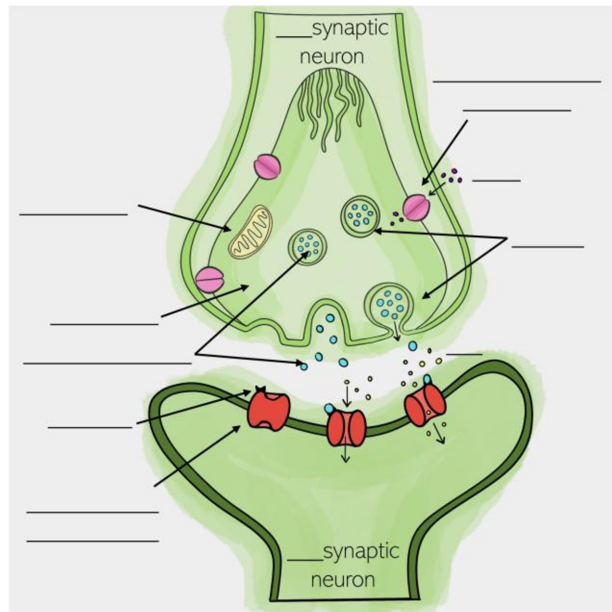
Watch this video about **Long Term Potentiation and Long Term Depression** https://youtu.be/B7ig6sIwIC8?si=0V4PtIizkq-JuGpH.

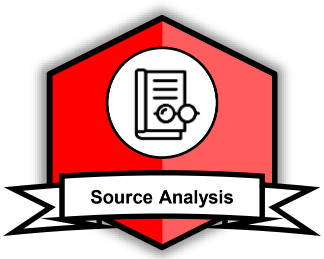
Resource Two Activities

Activities

1. Label this diagram (diagram of neurons, synapses).







2. Using the diagram above, describe the process of neurotransmission.
3. Explain the difference between a Purkinje cell, a pyramidal neuron, and a motor neuron.
4. Using the terms *tracts*, *myelination*, *connectivity* and *network*, explain why the organisation of grey and white matter enables brain function.
5. After watching this clip: https://youtu.be/B1ygYzcWqFY?si=Vc90De_yOKg4_bGH, describe the process of synaptic transmission and explain its importance for brain plasticity.

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Resource Two
Further Reading

Explore

1. Neuroscientifically Challenged, 2023. *10-Minute Neuroscience: Synapses* [video online]. YouTube. Available at: https://youtu.be/k5RafiYXieo [Accessed 30 January 2026].
2. Human Connectome Project, 2026. *Human Connectome Project | Gallery*. [online] Available at: https://www.humanconnectomeproject.org/gallery/ [Accessed 30 January 2026].
3. Diffusion-based tractography in neurological disorders: concepts, applications, and future developments. Ciccarelli, Olga et al. The Lancet Neurology, Volume 7, Issue 8, 715 – 727.
4. Armando Hasudungan, 2013. *Neurology – Glial Cells, White Matter and Gray Matter* [video online]. YouTube. Available at: https://www.youtube.com/watch?v=kR_jWUhmN2A [Accessed 30 January 2026].

References

1. Ward, J., 2015. The Student's Guide to Cognitive Neuroscience. 3rd ed. London & New York: Psychology Press (Taylor & Francis).

Image Sources

1. Cover image: **Image** by **rawpixel.com**.
2. Page 30, Figure 5 created in https://BioRender.comX.
3. Page 31, Figure 6 "Neuron" Adapted image. Original image: Open Design. (n.d.) *Open Design License*. Available at: https://opendesign.fyi/license/ (Accessed: 22 October 2025).
4. Page 31, Figure 7 "Neuron" Adapted image. Original image: Open Design. (n.d.) *Open Design License*. Available at: https://opendesign.fyi/license/ (Accessed: 22 October 2025).

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Resource Two
Further Reading

Image Sources *(continued)*

5. Page 32, Figure 8, Grey and White matter boundary T1 brain scan image courtesy of Dr Timothy Rittman and Tatjana Schmidt, University of Cambridge.
6. Page 32, Figure 9, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. *Procreate* [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
7. Page 33, Figure 10, Original illustration by Emily Todd made using Microsoft PowerPoint.
8. Page 34, Figure 11a Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. *Procreate* [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
9. Page 34, Figure 11b Tractography image courtesy of Dr Timothy Rittman and Tatjana Schmidt, University of Cambridge.
10. Page 34, Figure 12, Synapse: Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. *Procreate* [computer software]. Version [5.4.8]. Available at: https://procreate.art/.

Resource Three Overview

Topic

Visualising the Brain: Brain Imaging Methods

Key Stage 4 or 5 Subject Area

GCSE Psychology: 3.2.3 Brain and neuropsychology
GCSE Physics: 4.2.5.2 Electric fields
GCSE Physics: 4.4 Atomic structure
A-Level Psychology: 4.2.2 Biopsychology
A-Level Physics: 3.2.1 Particles
A-Level Physics: 3.2.2 Electromagnetic radiation and quantum phenomena

Objectives

By completing this resource, you will be able to:

✓ Identify key brain imaging techniques used in clinical practise and research.

✓ Describe the differences between these methods.

✓ Debate the practicality, usefulness and disadvantages of these imaging techniques.

Instructions

1. **Read the data source**
2. **Complete the activities**
3. **Explore the further reading**
4. **Move on to Resource Four**

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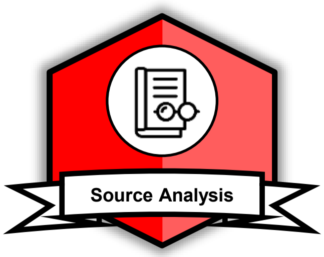
Resource Three
Data Source

Section A

Structural MRI

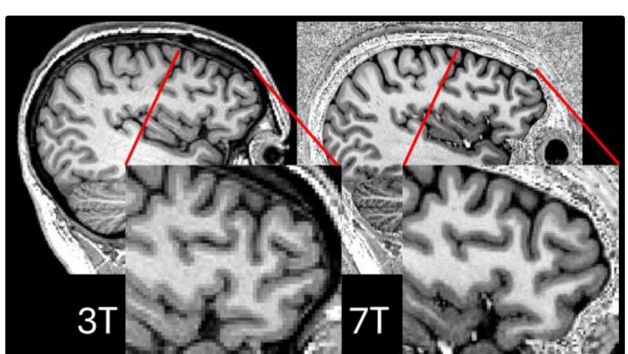


Structural brain imaging

Magnetic resonance imaging (MRI) is a medical imaging technique used to create images of the brain in a living person (**in vivo**). Different types of MRI can be used to see different brain processes, including structural or functional MRI. Structural MRI is used to produce 3D images of the boundaries between grey and white matter in the brain. Structural MRI is most commonly used in clinical **neurology**, for example, to aid in the primary diagnoses of **neurodegenerative diseases** and **dementias** such as **Alzheimer's disease (AD)** or **frontotemporal dementia (FTD)** or other neurological conditions and illnesses such as brain tumours, strokes or traumatic brain injuries. In the context of dementia and neurodegeneration, it allows a **clinician** to assess how much brain tissue loss, also called "**atrophy**" or brain shrinkage, is observable over time, and whether particular areas of the brain are more atrophied than others. Structural MRI scans can also be used in research to assess changes in brain volume loss between participants or longitudinally (over time) by quantifying the 3D image pixels, which are called "**voxels**". It is also used to analyse other neuroimaging techniques, such as Positron Emission Tomography (PET), to provide an individual brain "template" for each participant, thereby improving the accuracy and reliability of interpreting other neuroimaging results.

Figure 13:

Image of an 3T vs 7T MRI scanner



***Fun fact**: A 7T MRI scanner uses a much stronger magnet than a 3T scanner, which means it can produce a sharper image.*

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Resource **Three**
Data Source

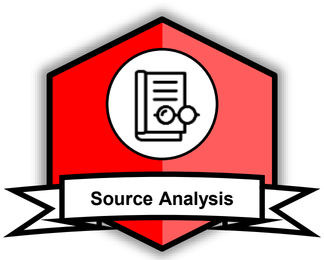
Section A

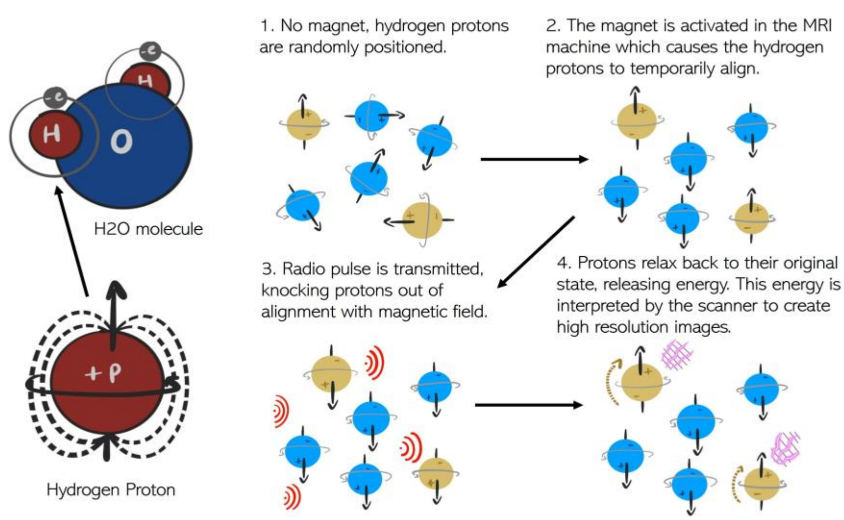
Structural MRI *(continued)*

Structural MRI works by harnessing the **magnetic field** of **hydrogen atoms** from water (H_2O) molecules in different brain cells and tissues. In simple terms, your body and brain contain a lot of water, which is H2O molecules that include hydrogen atoms. Each hydrogen atom has a **proton** at its centre, which acts like a tiny magnet. An MRI machine is made up of a very strong magnet, and when a person lies in the machine, the magnet temporarily aligns the hydrogen protons with the strong magnetic field or against it. The MRI machine then transmits a radio wave pulse through the brain, knocking protons out of alignment with the field. When this radio frequency stops, the protons relax back to their original state, which releases energy. The MRI scanner measures this energy, and, through a complex process, a computer can convert these measured signals into high-resolution images. Different types of tissue produce distinct signals, allowing us to visualise tissue differences on structural MRI.

Figure 14:

Physics of structural MRI image acquisition





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Resource Three
Data Source

Section A

Structural MRI *(continued)*

Active Reading

MRI scanners can use different magnet strengths to produce images of varying quality, and these images might be preferable in different settings. For example, in **clinical neurology**, a 1.5 **Tesla(T)** or 3T MRI is more cost-effective and produces a clear enough image for clinical diagnosis, whilst a 7T MRI is more preferable for research, as it produces an image of very high **resolution** (Figure 1). However, the stronger the magnet, the more expensive the scan, meaning research funding often limits the number of scans that can be undertaken in a study. 7T MRI scans also have more safety exclusion criteria and generally take longer to acquire than a 3T MRI, which can make them unsuitable for studying patients in a research setting. These are important considerations when designing a research study.

Section B

Positron Emission Tomography (PET) – Synaptic PET

Positron Emission Tomography (PET) is a specialised neuroimaging technique that uses radioactive tracers (radiotracers) to measure biological processes in the brain. Some radiotracers are used in clinical PET scans to identify underlying brain **pathology** for diagnosis, whilst others have only been validated for research use. Although a PET scan doesn't produce a structural image, certain types of PET scans can indicate underlying brain structural pathology that is not visible on a structural MRI.

Radioactive tracers and PET scans use radioactive decay, in which an unstable atomic nucleus loses energy by emitting radiation. In short, the radioactive **isotope** eg $[^{11}\text{C}]$, which is on the injected radioactive **ligand**, undergoes positron emission, whereby a proton changes to a neutron, releasing a positron and electron neutrino. The positron is released at high speed and eventually collides with an electron, annihilating them. This produces two gamma photons, which fly in opposite directions.

Resource Three
Data Source

Section B

Positron Emission Tomography (PET) – Synaptic PET *(continued)*

The PET scanner has detectors around the head. When it detects these gamma-ray pairs, it measures the time and location at which they hit the detectors and calculates the origin point, indicating the original **binding** site. After complex computational processing, a binding map is produced to visualise where binding occurred and how much binding occurred.

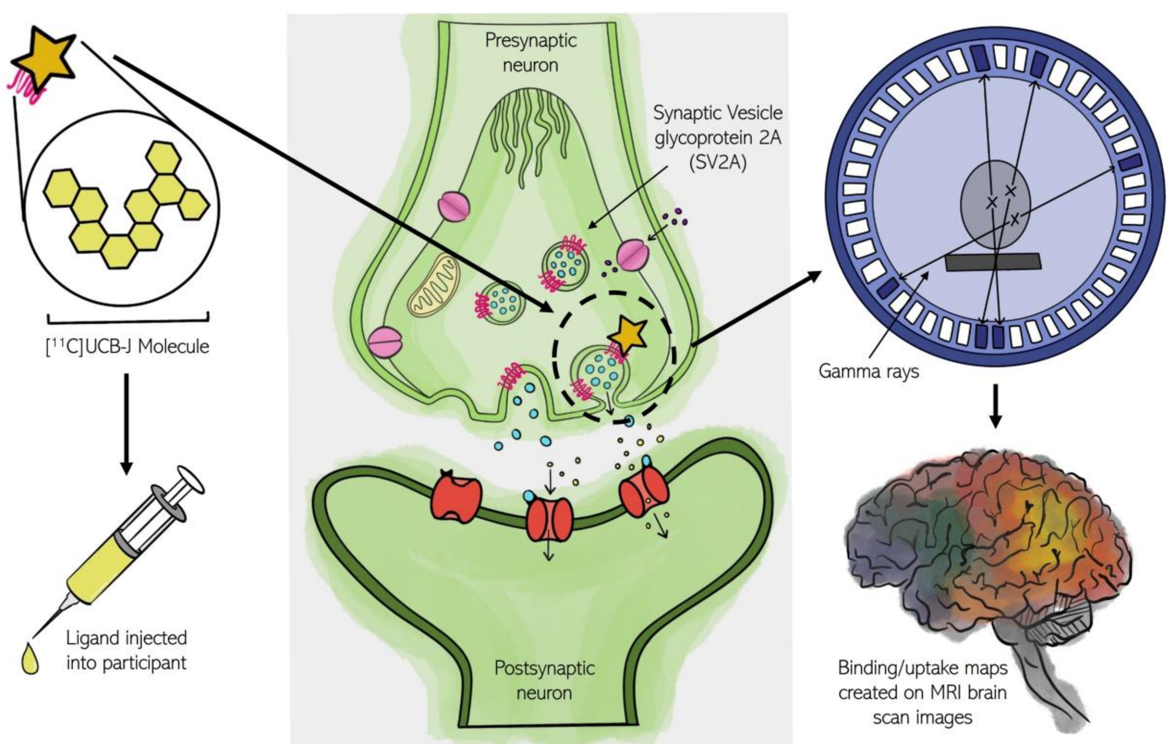


Figure 15: ***UCBJ PET binding***

For example, one new tracer used exclusively in research to indicate viable synapses in the brain is [^{11}C]UCB-J. This tracer was specifically designed to bind to a protein called Synaptic Vesicle **glycoprotein** 2A (SV2A), which is abundantly found in vesicles in the presynaptic terminal of most neurons. This protein is used in the exocytosis of neurotransmitters into the synapse. It is therefore a good general indicator of synaptic health and density in the brain.

Research

access ed

Resource Three
Data Source

Section B

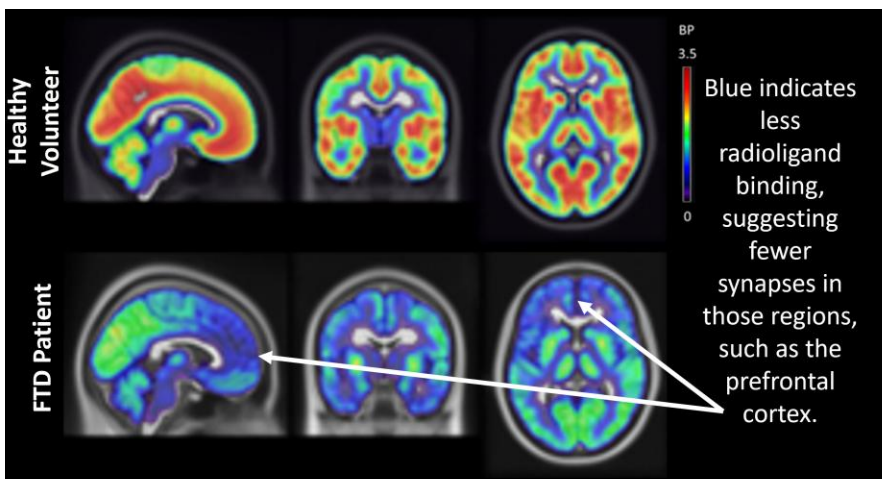
Positron Emission Tomography (PET) – Synaptic PET *(continued)*

***Fun fact**: The word tomography comes from the Greek word "tomos" meaning "cut".*

[11C]UCB-J contains a radioactive isotope called carbon-11 ([11C]), which emits radiation. During a PET scan, after a radiotracer is injected into the bloodstream, the scanner detects the radioactive signal produced by the tracer as it binds to SV2A proteins on presynaptic neurons, and the radiation decays. A computer then creates a 3D image showing where in the brain there was greater tracer binding. More binding is indicative of more viable, working synapses (higher synaptic density), whereas less binding is thought to indicate synaptic loss.

Figure 16:

Differences in UCBJ binding in a healthy vs FTD patient



Section C

Positron Emission Tomography (PET) – Metabolism PET

Functional brain imaging

PET imaging can also be used in clinical practice to assess brain function. PET scans using radiotracers such as [^{18}F]FDG image glucose metabolism in brain tissue by measuring where and how much glucose is being used as an indicator of brain function. FDG-PET is expensive but incredibly useful in the clinical diagnosis of neurodegenerative diseases, as it can detect regional brain abnormalities years before structural changes are visible on an MRI. It can also be used in research studies. It works in a very similar way to other PET tracers. The radio ligand mimics glucose and is taken up by **metabolically** active cells in the brain, where it accumulates.

Resource Three
Data Source

Section C

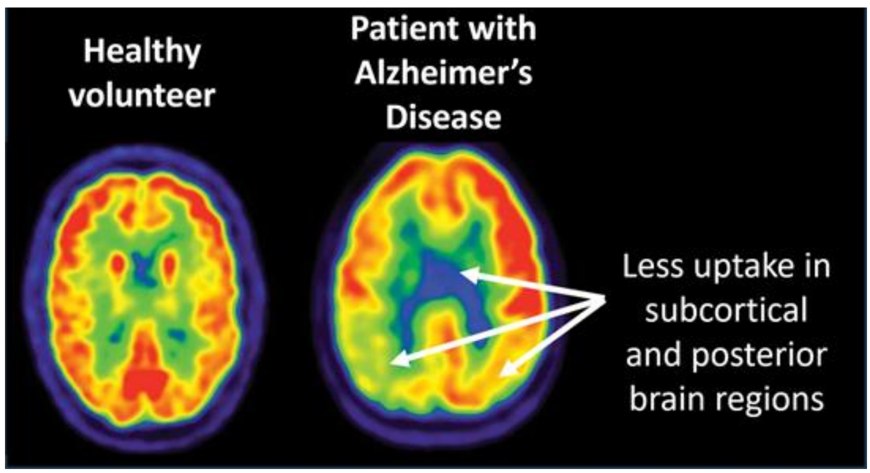
Positron Emission Tomography (PET) – Metabolism PET *(continued)*

The accumulated radioactive isotope then decays, and the PET scan detects the emitted positron emission signal and determines the origin of the tracer accumulation. Higher FDG uptake indicates tissue with higher metabolic activity (healthier tissue), whilst low uptake indicates reduced activity (unhealthy tissue).

Figure 17:

Differences in FDG binding in a healthy vs AD patient

Source Analysis



Section D

Functional MRI

Active Reading

Functional MRI (fMRI) uses blood flow as a measure of regional brain activity. It can be used in both clinical and research contexts to investigate brain activity in a "resting state" or during task performance. fMRI is based on the principle that active brain cells require more oxygen to function, and, as such, there is increased blood flow to a region to deliver more oxygen (neurovascular coupling). An fMRI scan measures the **BOLD** signal, which stands for Blood Oxygen Level Dependent signal. **Oxyhaemoglobin** (highly oxygenated blood) has different magnetic properties from **deoxygenated haemoglobin**, and the MRI machine can detect these subtle changes. Therefore, an fMRI scan does not measure neuronal activity directly, but instead measures the **hemodynamic response** as an indicator of neuronal activity.

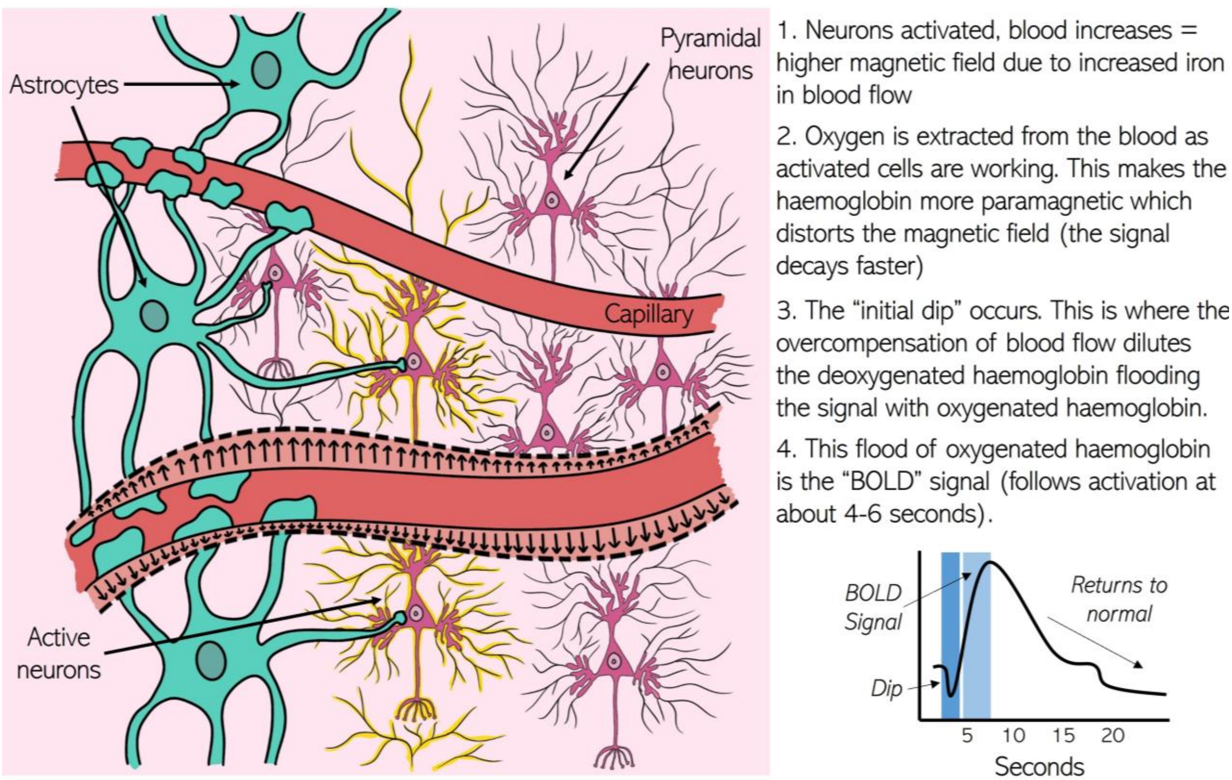
access ed

Resource **Three**
Data Source

Section D

Functional MRI *(continued)*

In research, fMRI can be used to explore brain connectivity and networks, whilst it is used less in neurodegenerative clinical diagnosis. Like structural MRI, it is much cheaper than a PET scan but has limitations in its utility and specificity for diagnosing neurodegenerative diseases.



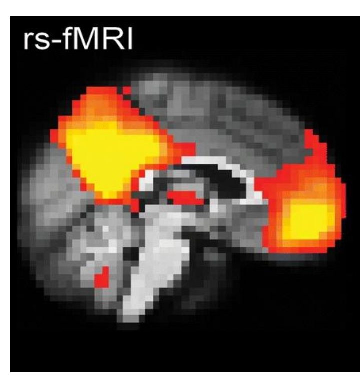


Figure 18:

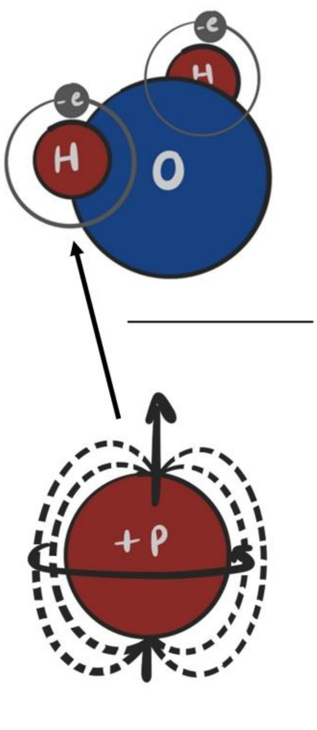
BOLD signal & brain scan output in FTD

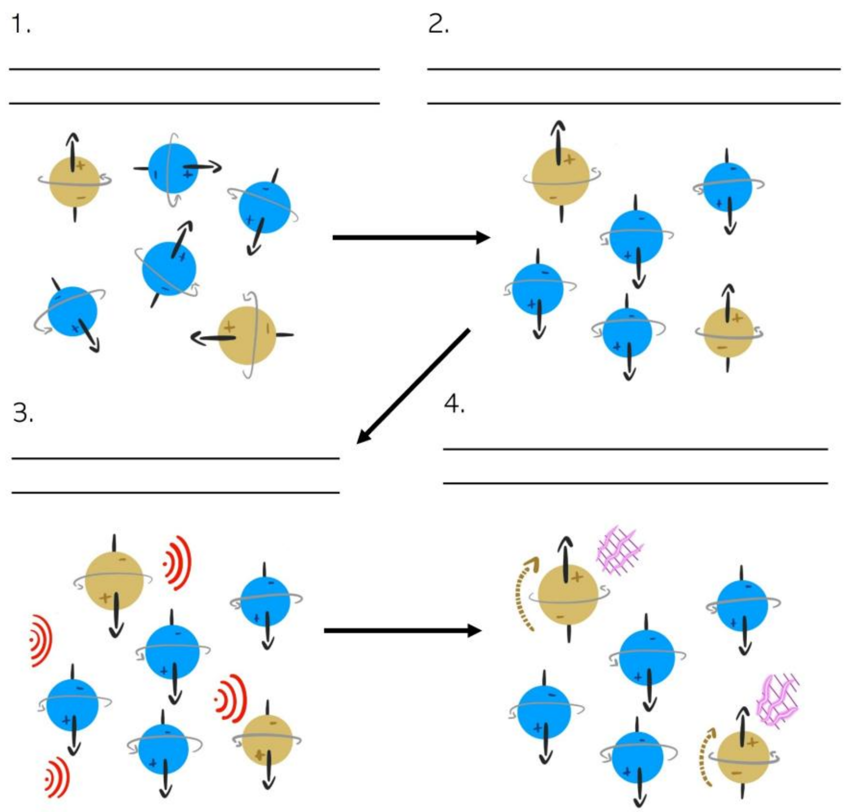
Source Analysis

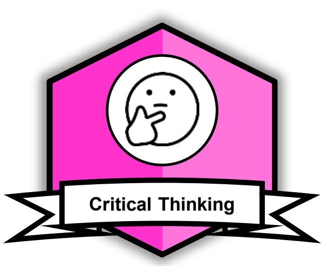
Resource Three Activities

Activities

1. Label the image below that describes how a structural MRI scan works:







2. Using the images in (1), describe how a structural MRI scan produces an image on screen.

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Resource **Three** Activities

Activities *(continued)*

3. Fill in the table identifying the advantages and disadvantages of each type of scan. *(hint this video might help https://youtu.be/tGIaR7ErA3g?si=naVJcWvPmo2tujxM)*

Scan type	Advantages	Disadvantages
Magnetic Resonance Imaging (MRI)	• ____ • ____ • ____ • ____ • ____	• ____ • ____ • ____ • ____ • ____
Positron Emission Tomography (PET)	• ____ • ____ • ____ • ____ • ____	• ____ • ____ • ____ • ____ • ____

3. Using the table from (3), create a poster about brain imaging, focusing on the advantages and disadvantages of each brain imaging technique

4. Using your poster created in (4) and your own self led research, in groups debate why some brain imaging techniques are used in clinical practice as opposed to research. Why are not all brain imaging techniques equal? *(Hint.. Maybe think about the following things.. Cost, scan times, type of data acquired, how many scans would be needed..)*

Resource Three
Further Reading

Explore

1. Ten Kate, M., Ingala, S., Schwarz, A.J. *et al.* Secondary prevention of Alzheimer's dementia: neuroimaging contributions. *Alz Res Therapy* **10**, 112 (2018). https://doi.org/10.1186/s13195-018-0438-z.
2. Students Guide to Cognitive Neuroscience, 2021. Basics of fMRI [video online]. YouTube. Available at: https://www.youtube.com/watch?v=-C84RFgyzuE . [Accessed 30 January 2026].
3. fMRI and the BOLD Signal, 2018. fMRI and the BOLD Signal [video online]. YouTube. Available at: https://www.youtube.com/watch?v=drP8Nk67I1s [Accessed 30 January 2026].

References

1. YouTube. 2013. How does an MRI scan work? [video online] Available at: https://www.youtube.com/watch?v=1CGzk-nV06g&t=1s [Accessed 24 October 2025].
2. YouTube, 2016. How does a PET scan work? [video online] Available at: https://www.youtube.com/watch?v=yrTy03O0gWw [Accessed 24 October 2025].
3. Li J, Zou R, Varrone A, Nag S, Halldin C, Ågren H. Exploring the Interactions between two Ligands, UCB-J and UCB-F, and Synaptic Vesicle Glycoprotein 2 Isoforms. ACS Chem Neurosci. 2024 May 15;15(10):2018-2027. doi: 10.1021/acschemneuro.4c00029. Epub 2024 May 3. PMID: 38701380; PMCID: PMC11099911.

Image Sources

1. Cover image: Image by Dmitriy Kievskiy from Pixabay.com – Open Source.

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Resource Three
Further Reading

Image Sources *(continued)*

2. Page 40, MRI scanner Image by Mohamed Hassan from Pixabay.com – Open Source.
3. Page 40, Figure 13: 3T/7T Images courtesy of Professor James Rowe, Dr Thomas Cope and Simon Jones, University of Cambridge.
4. Page 41, Magnet Image by rawpixel.com. – Open Source.
5. Page 41, Figure 14, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
6. Page 43, Figure 15: Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/ with knowledge of UCB-J Chemical makeup from Li J, Zou R, Varrone A, Nag S, Halldin C, Ågren H. Exploring the Interactions between two Ligands, UCB-J and UCB-F, and Synaptic Vesicle Glycoprotein 2 Isoforms. ACS Chem Neurosci. 2024 May 15;15(10):2018-2027. doi: 10.1021/acschemneuro.4c00029. Epub 2024 May 3. PMID: 38701380; PMCID: PMC11099911.
7. Page 44, UCBJ binding image - adapted from Malpetti, M., Jones, P. S., Cope, T. E., Holland, N., Naessens, M., Rouse, M. A., Rittman, T., Savulich, G., Whiteside, D. J., Street, D., Fryer, T. D., Hong, Y. T., Milicevic Sephton, S., Aigbirhio, F. I., O'Brien, J. T. and Rowe, J. B. (2023) Synaptic loss in frontotemporal dementia revealed by [11C]UCB-J positron emission tomography. Annals of Neurology, 93(1), pp. 142–154. doi: 10.1002/ana.26543. (Open access under CC BY 4.0). Changes: image cropped.

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Resource Three Further Reading

Image Sources *(continued)*

8. Page 45, Figure 17, FDG PET binding image – adapted from Ten Kate, M., Ingala, S., Schwarz, A. J., *et al.* (2018). *Secondary prevention of Alzheimer's dementia: neuroimaging contributions*. **Alzheimer's Research & Therapy, 10**, 112. https://doi.org/10.1186/s13195-018-0438-z. Licensed under **Creative Commons Attribution 4.0 International (CC BY 4.0)**. Changes: image cropped.

9. Page 46, Figure 18a, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/ with knowledge from Principles of fMRI (2015) Principles of fMRI Part 1, Module 8: fMRI Signal & BOLD Physiology [online video], 24 August. YouTube. Available at: https://www.youtube.com/watch?v=jG2WQpgpnMs (Accessed: 19/01/26).

10. Page 46, Figure 18b, FMRI image - *Adapted from:* Ten Kate, M., Ingala, S., Schwarz, A. J., *et al.* (2018). **Secondary prevention of Alzheimer's dementia: neuroimaging contributions**, *Alzheimer's Research & Therapy, 10*, 112. https://doi.org/10.1186/s13195-018-0438-z. Licensed under **CC BY 4.0**. *Changes: image cropped.*

Resource Four Overview

Topic
The Unhealthy Brain: A Brief Introduction to Neurodegeneration

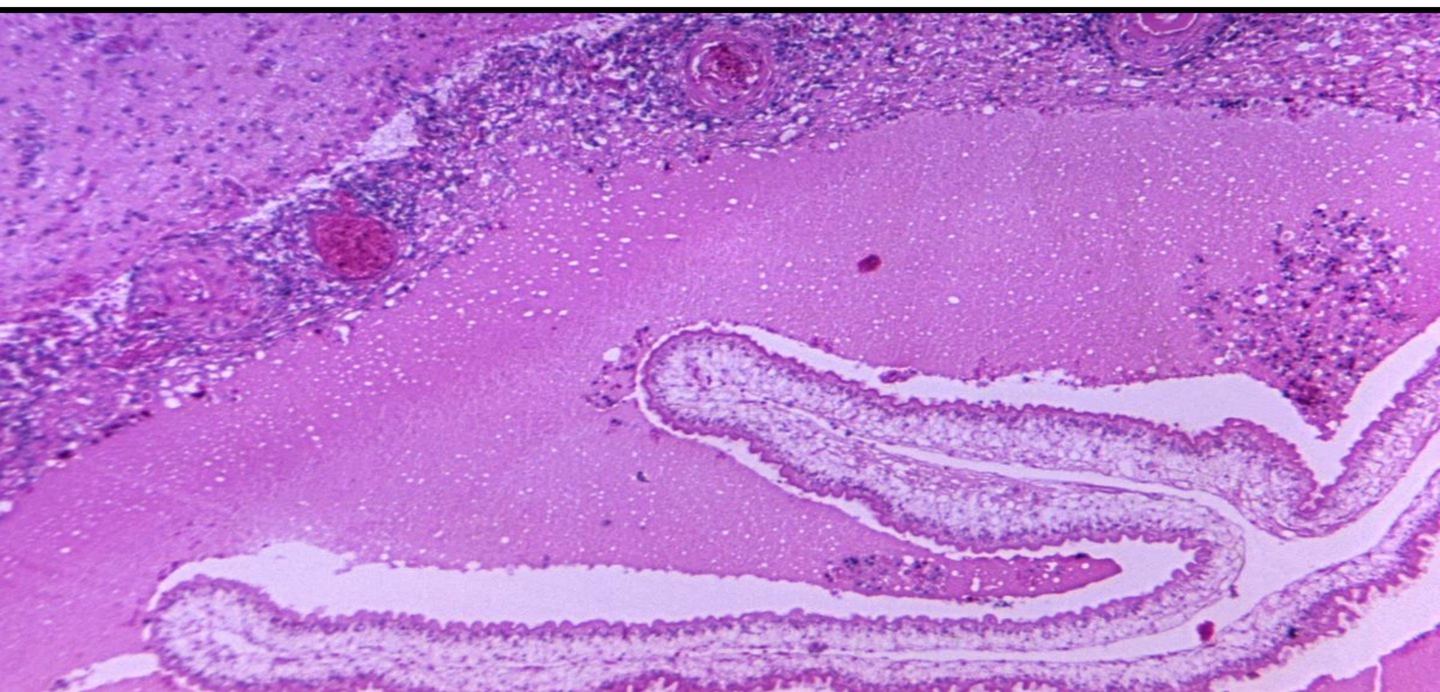
Key Stage 4 or 5 Subject Area
A-Level Biology: 3.1 Biological molecules
A-Level Biology: 3.2 Cells
A-Level Biology: 3.6 Nervous coordination
A-Level Biology: 3.8 The control of gene expression
A-Level psychology: 4.2.2 Biopsychology

Objectives
By completing this resource, you will be able to:

- ✓ Describe neurodegeneration.
- ✓ Explain the difference between different neurodegenerative diseases.
- ✓ Describe different pathologies underlying FTLD.

Instructions

1. **Read the data source**
2. **Complete the activities**
3. **Explore the further reading**
4. **Move on to Resource Five**



Resource Four
Data Source

Section A

What is Neurodegeneration & Dementia?

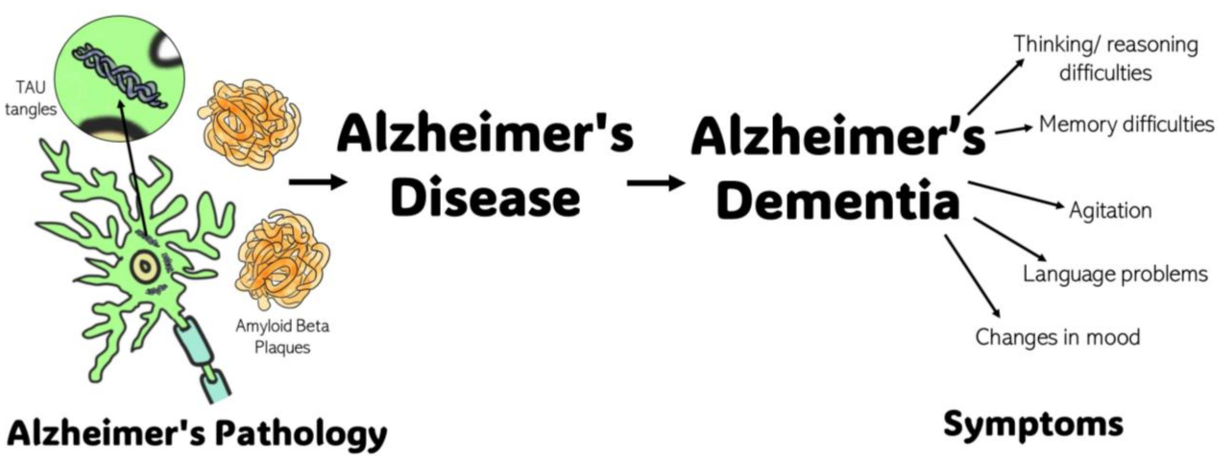
This section includes descriptions of cognitive decline and dementia that some students may find distressing.

Neurodegeneration and dementia are often used interchangeably in the media; however, scientifically, they are very different. ***Neurodegeneration*** is the pathological progressive loss of structure or function of neurons in the CNS that occurs in diseases such as Alzheimer's disease (AD). Neurodegeneration does not describe the clinical symptoms of a dementia, but instead characterises the physical deterioration of brain tissue of the underlying disease.

For example, a person with severe and progressive memory problems might be diagnosed with Alzheimer's dementia based on their symptoms, but only by looking at a **postmortem** investigation after the person has passed away, would doctors be able to say that the patient had the neurodegeneration and **pathology** of Alzheimer's disease. This can be a confusing concept. Figure 19 shows how dementia and neurodegeneration differ.

Figure 19:

Diagram illustrating the difference between neurodegeneration & dementia



Resource Four Data Source

Section A

What is Neurodegeneration & Dementia? *(continued)*

We identify neurodegeneration on postmortem **pathology** by looking at brain tissues macroscopically to identify lesions and brain atrophy, and **microscopically** to identify abnormal **aggregates** and **plaques** in brain tissue.

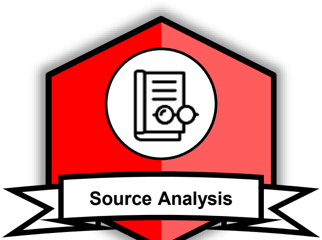
Section B

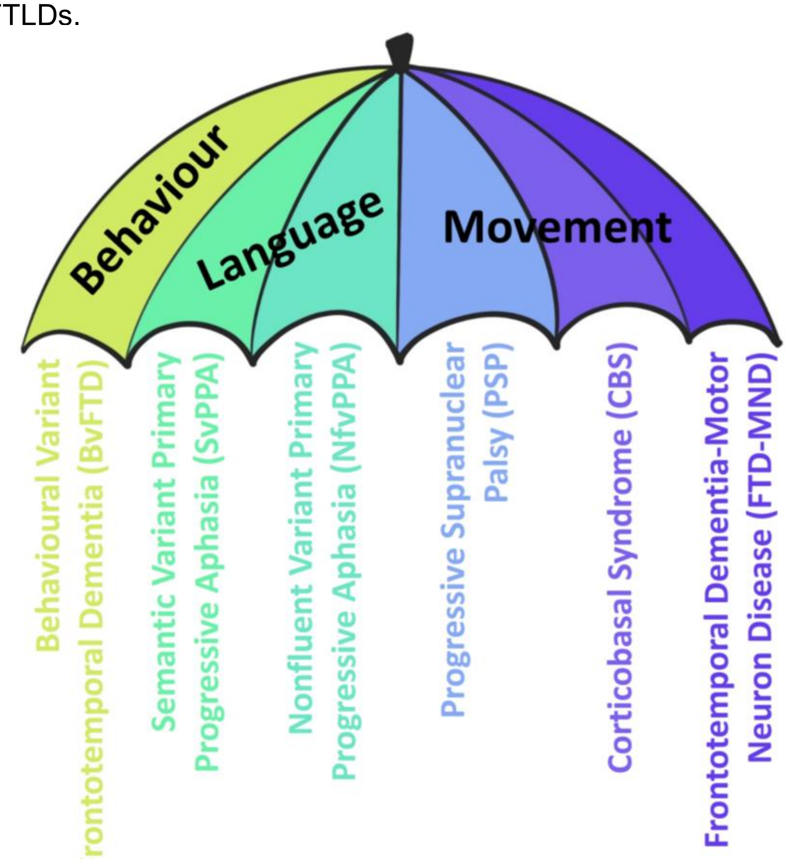
Frontotemporal Lobar Degeneration (FTLD)

One group of neurodegenerative diseases is called **Frontotemporal Lobar Degeneration (FTLD)**. FTLDs are a group of neurodegenerative disorders that affect the frontal and temporal lobes of the brain. We call FTLD an umbrella term because several disorders are classified as FTLDs. Each of these conditions is very different but can share overlapping symptoms and underlying pathologies, which make them FTLDs.

Figure 20:

FTLD clinical syndrome umbrella





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Resource Four
Data Source

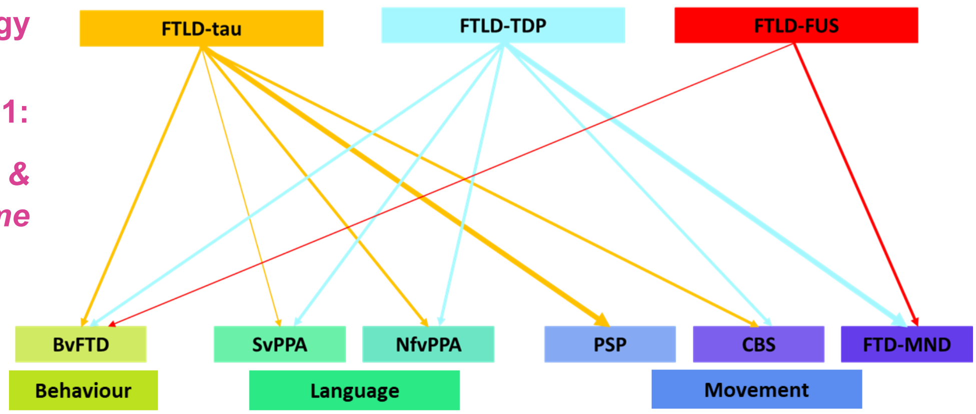
Section C

FTLD Pathology

Figure 21:

FTLD pathology & clinical syndrome

Frontotemporal Lobar Degenerative Pathology



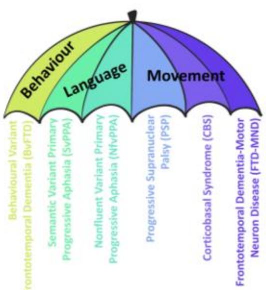


Figure 21 shows the underlying pathology in FTLD conditions. In FTLD, abnormal accumulation of specific malfunctioning proteins in the brain is thought to cause the disease. As per our understanding from research so far, there are three main molecular pathologies underlying FTLD. Research has shown that the three main proteinopathies underlying FTLD are Tau, TDP-43 and FUS/FET family proteins. Each of these **proteinopathies** can affect different brain regions, which can influence the symptoms first observed in patients. For example, in bvFTD (see resource five), key predominant behavioural symptoms might be linked to FTLD-Tau or FTLD-TDP build-up in the frontal and temporal lobes.

Tau is a microtubule-associated protein found in the microstructure of a neuron. In FTLD, irregular phosphorylation of the tau protein can cause it to misfold and accumulate toxically inside neurons, forming tangles, which can cause the cell to die. For example, Tau acts as scaffolding for neurons, providing strength and structure. When this gets damaged, the building, i.e., the neuron, becomes unstable and starts to collapse.

Resource Four
Data Source

Section C

FTLD Pathology *(continued)*

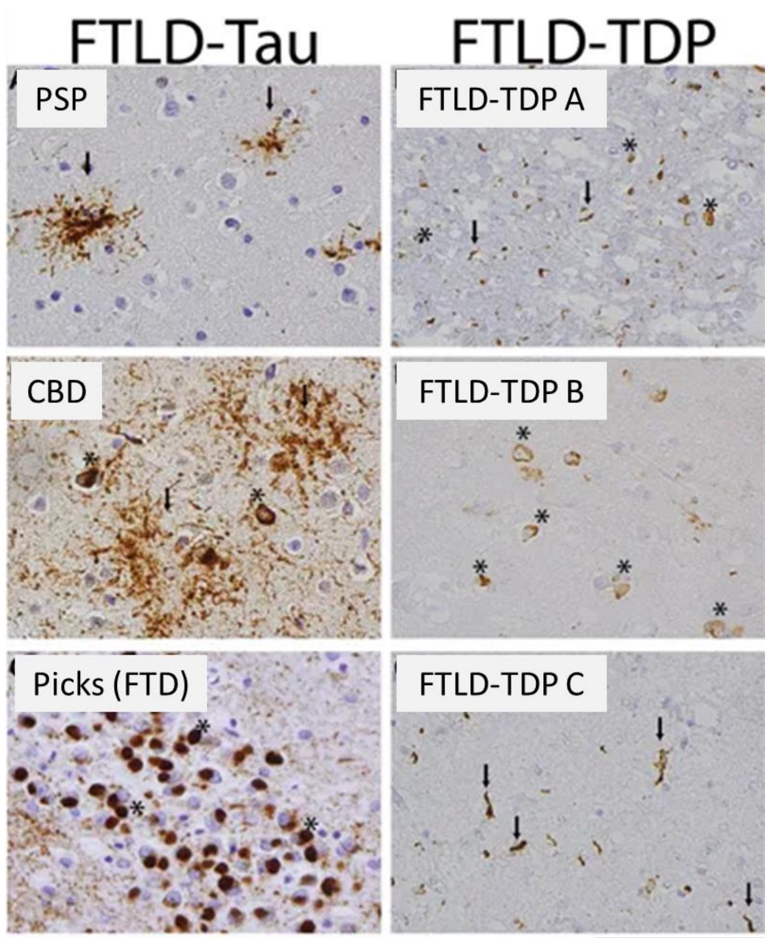
Research

FTLD-TDP is another type of FTLD pathology. It involves the protein TAR DNA-binding protein 43 (TDP-43), which is involved in RNA processing. In FTLD-TDP, hyperphosphorylated TDP-43 accumulates in the cytoplasm, forming intracellular inclusions, and causes cell death.

Figure 22 below shows the difference between FTLD-Tau and FTLD-TDP under the microscope on brain tissue.

Figure 22:

FTLD pathology



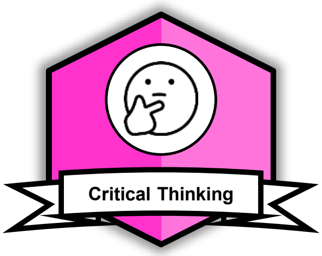
Source Analysis

Data Analysis

There are other types of FTLD pathologies, including FTLD-FUS, and you can learn more about these by visiting: https://pmc.ncbi.nlm.nih.gov/articles/PMC2768659/.

Resource Four Activities

Activities



1. Define neurodegeneration.
2. Create a spider diagram of the neurodegenerative FTLD diseases, categorising them into their predominant defining symptoms (e.g., behavioural, language or movement).
3. Name the two key proteinopathies underlying Frontotemporal lobar degenerative disorders described in resource four.
4. Describe one key difference between FTLD-TDP-43 and FTLD-TAU.
5. Using your knowledge of neurons, synapses and protein accumulations (proteinopathies), in 500 words, explain how TAU accumulations in Frontotemporal Lobar degeneration might lead to brain cell death and behavioural symptoms.

Tip:

- *First, explain how tau accumulates in neurons (proteinopathy) (resource four).*
- *Explain how this disrupts neural function and synaptic communication (resources two and four).*
- *Think about where this might be happening in the brain if someone has behavioural changes and cognitive symptoms (resource one).*

Resource Four
Further Reading

Explore

1. Neuroscientifically Challenged, 2020. *Neurodegenerative Diseases* [video online]. YouTube. Available at: https://www.youtube.com/watch?v=B06NNNHqq1s [Accessed 30 January 2026].
2. Alzheimer's Society, 2017. What is frontotemporal dementia? [video online]. YouTube. Available at: https://www.youtube.com/watch?v=QuJFLr5Ib9k [Accessed 30 January 2026].

References

1. Alzheimer's Association, n.d. Frontotemporal Dementia (FTD) | Symptoms & Treatments. [online] Available at: https://www.alz.org/alzheimers-dementia/what-is-dementia/types-of-dementia/frontotemporal-dementia [Accessed 24 October 2025].
2. Grossman, M., Seeley, W.W., Boxer, A.L., Hillis, A.E., Knopman, D.S., Ljubenov, P.A., Miller, B., Piguet, O., Rademakers, R., Whitwell, J.L., Zetterberg, H. and van Swieten, J.C., 2023. Frontotemporal lobar degeneration. Nature Reviews Disease Primers, 9(1), p.40. doi:10.1038/s41572-023-00447-0.
3. Irwin, D.J., Trojanowski, J.Q. and Grossman, M., 2013. Cerebrospinal fluid biomarkers for differentiation of frontotemporal lobar degeneration from Alzheimer's disease. Frontiers in Aging Neuroscience, 5, p.6. doi:10.3389/fnagi.2013.00006.

Image Sources

1. Cover Image: Rawpixel.com.

access ed

Resource Four
Further Reading

Image Sources *(continued)*

2. Page 53, Figure 19, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
3. Page 54, Figure 20, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
4. Page 55, Figure 21, Original illustration by Emily Todd using Microsoft PowerPoint.
5. Page 56, Figure 22, Adapted from Irwin DJ, Cairns NJ, Grossman M, McMillan CT, Lee EB, Van Deerlin VM, Lee VM, Trojanowski JQ. Frontotemporal lobar degeneration: defining phenotypic diversity through personalized medicine. Acta Neuropathol. 2015 Apr;129(4):469-91. doi: 10.1007/s00401-014-1380-1. Epub 2014 Dec 31. PMID: 25549971; PMCID: PMC4369168.CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/).

Resource Five Overview

Topic	**The Unhealthy Brain: A Brief Introduction to Dementia**
Key Stage 4 or 5 Subject Area	**A-Level psychology: 4.2.2 Biopsychology** **A-Level psychology: 4.3.6 Eating behaviour** **A-Level psychology: 4.3.8 Aggression**

Objectives

By completing this resource, you will be able to:

✓ Describe Dementia.

✓ Explain the difference between different dementias.

✓ Describe and explain the synaptic degeneration hypothesis in the context of FTD.

Instructions

1. **Read the data source**
2. **Complete the activities**
3. **Explore the further reading**
4. **Move on to Resource Six**

Resource Five
Data Source

Section A
Dementia

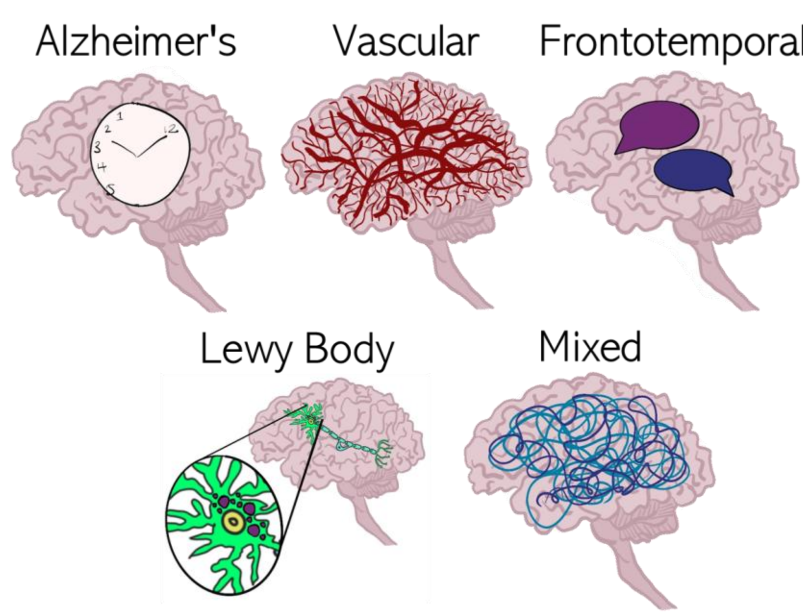
This section includes descriptions of cognitive decline and dementia that some students may find distressing.

Active Reading

As we age, our body and brain change, and this is normal and in line with the healthy ageing process. However, for some people, as they get older, their brains can start to change at a faster-than-normal rate, which can affect a person's **cognition** and ability to perform everyday functions and activities. When a person's cognition progressively declines in at least two cognitive domains and impacts everyday function, this is known as ***dementia***. Specifically, dementia is defined as a clinical **syndrome** whereby a person's cognitive abilities have progressively declined, affecting their ability to look after themselves and function normally in everyday life. Dementia can affect several cognitive processes, including memory, language, problem-solving and ***behaviour***. Dementia is not technically a disease, but instead is a clinical label that doctors give to a group of symptoms which are thought to be caused by a ***neurodegenerative disease*** (see resource four).

Source Analysis

Figure 23:
Types of dementias



Resource Five
Data Source

Section B

Frontotemporal Dementia (FTD)

Frontotemporal dementia (FTD) is one of the clinical manifestations of Frontotemporal Lobar Degeneration. FTD was first described by the physician Arnold Pick in 1892 and is sometimes still referred to as Pick's disease. There are two key clinical variants of FTD: the behavioural variant (bvFTD) and the language variants.

For this resource, we will focus on the behavioural variant of FTD. In bvFTD, the frontal and temporal lobes are significantly affected, with other **subcortical** structures also being affected.

The main symptoms of bvFTD include personality and behavioural changes, increased impulsivity and poorer judgement, increased **executive dysfunction**, emotional blunting, also known as **apathy**, and a notable lack of **insight**, meaning that people with bvFTD often don't have **insight** into their condition or can minimise their behavioural changes. BvFTD is often an early-onset type of dementia, typically affecting people in their 50s and 60s, but it can affect people as young as 20 or later in their 70s or 80s.

Sometimes, people with bvFTD can also have overlapping symptoms with some language symptoms or some movement symptoms. Memory is usually remarkably preserved in the early stages of bvFTD, and this can be very helpful when doctors are differentiating the diagnosis from Alzheimer's Dementia.

Bruce Willis is a renowned American actor best known for his roles in films such as Die Hard. In 2023, Bruce Willis was diagnosed with FTD. Watch this podcast of his wife, Emma Hemming-Willis, an advocate and campaigner for FTD carers, describe what FTD is, its impact on Bruce and their family, and the various challenges they have faced along their journey: The Unexpected Journey: Emma Heming Willis on Caregiving and Resilience.

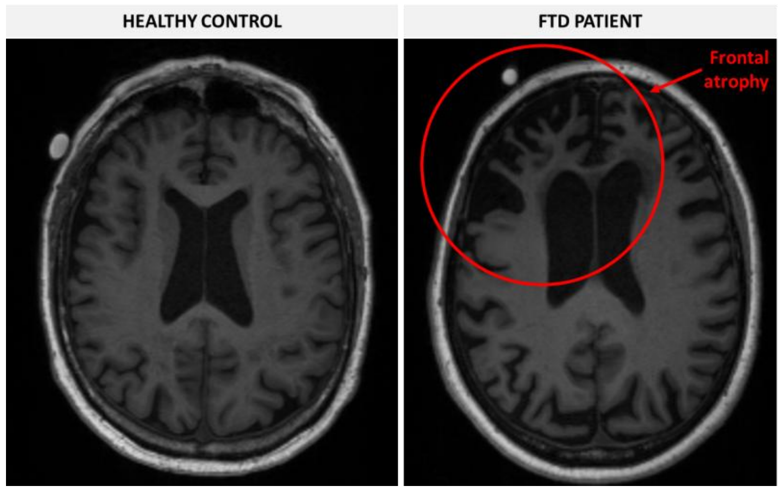
Resource Five
Data Source

Section B

Frontotemporal Dementia (FTD) *(continued)*

Figure 24:

FTD structural MRI scan vs healthy control



Section C

Familial Frontotemporal Dementia (fFTD)

In rare cases, bvFTD can be caused by a faulty **gene** in someone's **DNA**. Research has identified 3 main genes that are known to play a role in the development of some bvFTD, including the Microtubule Associated Protein Tau (MAPT) gene, the Progranulin (GRN) gene, and the **Chromosome 9 Open Reading Frame 72 (C9orf72)** gene. There is a lot of research underway to understand how these genes affect the disease and how they are inherited. Some of these studies are even looking at the young healthy offspring of people with a genetic form of bvFTD to investigate any early brain changes before symptoms might start. We call these volunteers “presymptomatic gene carriers”. Multiple international studies are investigating genetic forms of bvFTD, and these studies have repeatedly shown that brain changes (increased atrophy) can occur in healthy presymptomatic gene carriers up to 10-15 years before expected symptom onset (Rohrer et al 2015). These findings are vital for our broader understanding of the disease and have implications for the development of treatments and therapies, as well as for clinical trials, so that we can treat these illnesses before people develop symptoms and hopefully stop progression before someone gets ill.

Active Reading

access ed

Resource Five
Data Source

Section D

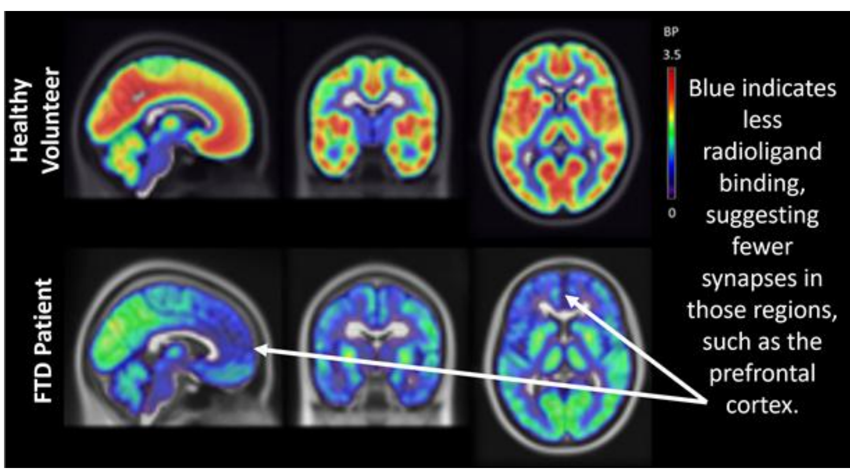
Synaptic Degeneration Hypothesis

Active Reading

We don't yet have a definitive understanding of the causes of bvFTD, but research into the disease is fast-paced, and in recent years, some proposed mechanisms have been hypothesised. One such hypothesis involves synaptic degeneration. New research suggests that the earliest pathological changes in bvFTD occur in synapses before brain cells die off. Using PET imaging with specific synaptic binding ligands (such [^{11}C]-UCBJ), studies have shown that for people with bvFTD, not only do they have reduced synaptic density in the frontal and temporal lobes compared to healthy volunteers, but synaptic loss is also correlated with disease severity, meaning that for those further along in their illness, they have fewer synapses. They also showed that synapse loss was more extensive than visible atrophy on an MRI scan, indicating that synapse loss might happen before neuronal death (Malpetti et al 2023).

Figure 25:

Example of UCBJ binding maps in healthy volunteer vs FTD patient



Research

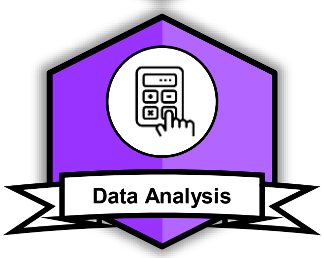
Data Analysis

In presymptomatic healthy volunteers, Malpetti et al (2021) showed reduced synaptic density in the **thalamus** of C9orf72 mutation carriers, adding to the finding that brain atrophy occurs years before symptom onset. This is a vital finding for the understanding of disease development and progression.

Resource Five
Data Source

Section D

Synaptic Degeneration Hypothesis *(continued)*



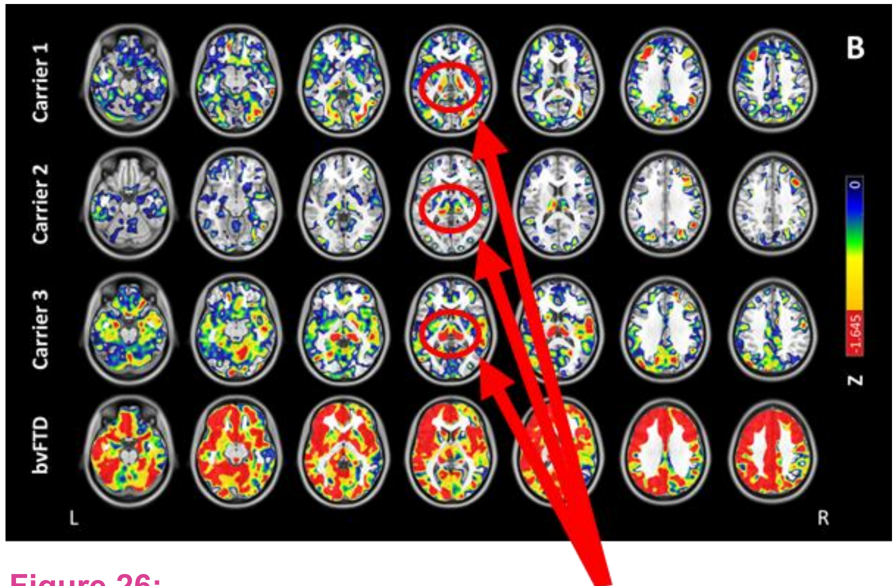


Figure 26:

UCBJ binding in presymptomatic c9ORF72 mutation carriers vs bvFTD patient

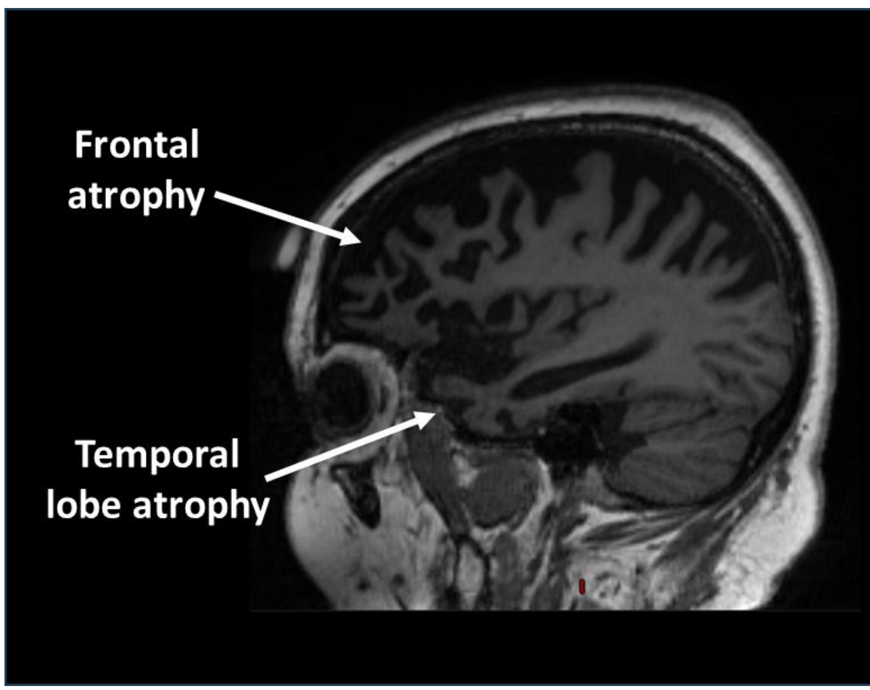
Resource Five Activities

Activities

1. Define dementia.
2. Watch these videos below about living with FTD. Describe the common symptoms of bvFTD.

   [Frontotemporal Dementia - Mayo Clinic]

   [Diane Fehon: A FTD Caregiver Story]
3. Discuss how their symptoms might be related to the brain regions affected on the brain scan below:



4. List the 3 most common genes associated with bvFTD
5. Referring to your list from (4), describe the finding from the presymptomatic synaptic PET study outlined in the resource (Malpetti et al 2021).

Critical Thinking

Research

Source Analysis

access ed

Resource Five
Further Reading

Explore

1. Neuroscientifically Challenged, 2020. Neurodegenerative Diseases [video online]. YouTube. Available at: https://www.youtube.com/watch?v=B06NNNHqq1s [Accessed 30 January 2026].

References

1. Alzheimer's Association, n.d. Frontotemporal Dementia (FTD) | Symptoms & Treatments. [online] Available at: https://www.alz.org/alzheimers-dementia/what-is-dementia/types-of-dementia/frontotemporal-dementia [Accessed 24 October 2025].
2. Malpetti, M., Holland, N., Jones, P.S., Ye, R., Cope, T.E., Fryer, T.D., Hong, Y.T., Savulich, G., Rittman, T., Passamonti, L., Mak, E., Aigbirhio, F.I., O'Brien, J.T. and Rowe, J.B., 2021. Synaptic density in carriers of C9orf72 mutations: a [^{11}C]UCB-J PET study. Annals of Clinical and Translational Neurology, 8(7), pp.1515–1523. doi:10.1002/acn3.51363.
3. Malpetti, M., Jones, P.S., Cope, T.E., Holland, N., Naessens, M., Rouse, M.A., Rittman, T., Savulich, G., Whiteside, D.J., Street, D., Fryer, T.D., Young, T.H., Sephton, S.M., Aigbirhio, F.I., O'Brien, J.T. and Rowe, J.B., 2023. Synaptic loss in frontotemporal dementia revealed by [^{11}C]UCB-J positron emission tomography. Annals of Neurology, 93(1), pp.142–154. doi:10.1002/ana.26668.

Resource Five
Further Reading

References (continued)

4. Rohrer, J.D., Nicholas, J.M., Cash, D.M., van Swieten, J.C., Dopper, E.G.P., Jiskoot, L., Meeter, L.H., Borroni, B., Galimberti, D., Masellis, M., McLaughlin, P.M., Seelaar, H., Pijnenburg, Y.A., Fox, N.C. and GENFI investigators, 2015. Presymptomatic cognitive and neuroanatomical changes in genetic frontotemporal dementia in the Genetic Frontotemporal Dementia Initiative (GENFI) study: a cross-sectional analysis. The Lancet Neurology, 14(3), pp.253–262. doi:10.1016/S1474-4422(14)70324-2.

Image Sources

1. Cover Image by www.rawpixel.com.
2. Page 61, Figure 23, Original illustration by Emily Todd using Procreate, Savage Interactive, 2026. Procreate [computer software]. Version [5.4.8]. Available at: https://procreate.art/.
3. Page 63, Figure 24, Scan images courtesy of Dr Timothy Rittman and Tatjana Schmidt, University of Cambridge.
4. Page 64, Figure 25, FTD vs Control UCBJ binding map, adapted from: Malpetti et al. (2023) *Synaptic loss in frontotemporal dementia revealed by [11C]UCB-J positron emission tomography*, **Annals of Neurology**, 93(1), pp. 142–154, doi: 10.1002/ana.26543. Reproduced under CC BY 4.0.
5. Page 65, Microphone image by rawpixel.com.
6. Page 65, Figure 26, UCBJ binding in C9 carriers vs FTD patient, adapted from: Malpetti, M., Holland, N., Jones, P.S., Ye, R., Cope, T.E., Fryer, T.D., Hong, Y.T., Savulich, G., Rittman, T., Passamonti, L., Mak, E., Aigbirhio, F.I., O'Brien, J.T. and Rowe, J.B., 2021. *Synaptic density in carriers of C9orf72 mutations: a [^{11}C]UCB-J PET study*, **Annals of Clinical and Translational Neurology**, 8(7), pp.1515–1523, doi:10.1002/acn3.51363. Reproduced under CC BY 4.0.

Resource Six Overview

Topic Diagnosis, Support and Real-life Impact of Dementia

Key Stage 4 or 5 Subject Area
A-Level Sociology: 3.2.2.3 Health
A-Level Sociology: 4.2.3 Health

Objectives

By completing this resource, you will be able to:

- ✓ Describe the prevalence of dementia and neurodegenerative diseases.
- ✓ Discuss diagnosis and prognosis for different dementias, including treatment and support.
- ✓ Debate the importance of dementia research for individual healthcare and wider social and financial concerns.

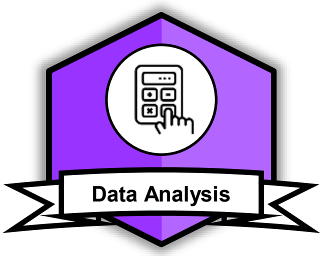
Instructions

1. **Read the data source**
2. **Complete the activities**
3. **Explore the further reading**
4. **Move on to Resource Six**

Resource Six
Data Source

Section A

Incidence, Prevalence & Global Disparities



This section includes descriptions of cognitive decline and dementia that some students may find distressing.

The WHO reports that in 2021, over 57 million people worldwide were thought to have dementia, with over ten million new cases arising each year. Over 60% of those diagnosed with dementia are thought to live in low-and middle-income countries. This number is likely higher due to limited access to healthcare in some countries.

FTD accounts for approximately 10-20% of all dementia cases. However, it accounts for 3-25% of cases under the age of 65, with 10-15% of those cases caused by a genetic mutation in one of three main genes (described in resource 5). However, these statistics are all taken from high-income countries, and there is little to no data available for low- and middle-income countries (LMICs), thus FTD rates may differ. This doesn't mean that FTD is less common in LMICs, but instead reflects socioeconomic, systemic and cultural factors that impact diagnosis and reporting. These factors include limited access to specialists, diagnostic procedures, and biomarkers, as well as the structural implementation of healthcare services in certain areas.

Section B

Risk Factors

We cannot currently prevent dementia. However, research has shown that several factors increase the risk of someone developing dementia, some of which are modifiable, and these include:

Figure 27:

Dementia risk factors

Fixed	Potentially Modifiable	
- Age - Genetics - Biological Sex	- Hypertension - Diabetes - Obesity - Smoking - High alcohol intake	- Sedentary lifestyle - Social isolation - Depression - Hearing loss

Resource Six
Data Source

Section C
Diagnosis

To get a diagnosis of a rare dementia like Frontotemporal dementia, patients will often need to be evaluated by a specialist, such as a neurologist.

A clinical neurologist will use certain tools, in conjunction with the determined diagnostic criteria, to assess the likelihood that someone has dementia.

In 2011, Rascovsky and colleagues revised the diagnostic criteria for behavioural variant frontotemporal dementia (bvFTD). The criteria describe how three or more core diagnostic features must be present to receive a diagnosis of possible bvFTD. These core features include:

- Early behavioural disinhibition (socially inappropriate or impulsive behaviours)
- Early apathy/inertia (loss of motivation/withdrawal)
- Early loss of sympathy/empathy (diminished response to others' needs)
- Early perseverative, stereotypes or compulsive/ritualistic behaviours (repetitive movements, hoarding)
- Hyperorality or dietary changes (preference for sweet foods, eating non-foods)
- Executive dysfunction with relatively preserved memory and visuospatial skills (difficulty planning/organisation)

In conjunction with these diagnostic symptoms, clinical neurologists may also use biomarkers. These are tools/techniques that can include an MRI scan, a blood test, or a cognitive assessment. Figure 28 shows a spider diagram of the diagnostic tools.

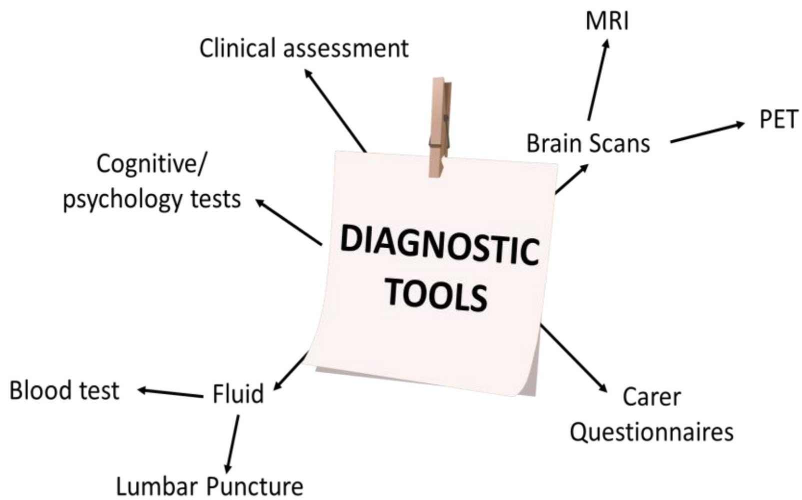
Resource Six
Data Source

Section C

Diagnosis *(continued)*

Figure 28:

Diagnostic tools



These techniques can be used to evaluate **biomarkers** of dementia. A biomarker is a biological indicator of what is happening inside the body and can be used to monitor disease progression. A neurologist will first evaluate the symptoms described by patients or carers and may assess performance on neuropsychiatric and cognitive tests. For someone with bvFTD, patients may describe impulsive or socially inappropriate behaviours and are likely to perform poorly at complex tasks involving executive function, but may perform well on memory tasks. The neurologist may then ask a patient to undergo a structural MRI scan to assess brain atrophy in areas affected in FTD, such as the frontal or temporal lobes, and, more specifically, in the orbitofrontal cortex and anterior cingulate cortex (see resource one). If the MRI scan is inconclusive, the neurologist may request a functional PET scan, such as an FDG-PET scan, to assess glucose metabolism (see resource three). This can be useful for seeing whether certain areas of the brain, such as the frontal and temporal lobes, are not working as they should.

Resource Six
Data Source

Section C

Diagnosis *(continued)*

Finally, the neurologist may request blood tests and possibly even a lumbar puncture to rule out other diagnoses. **Cerebrospinal fluid** (CSF) taken from a lumbar puncture can be used to identify if any proteins linked with Alzheimer's disease are present. If so, this might rule out a diagnosis of FTD. Genetic analyses of blood samples can identify genetic mutations known to cause FTD (see resource 5). Using all of these diagnostic biomarker tools and techniques can aid in diagnosing FTD.

Section D

Treatments

There is currently no cure for FTD. However, doctors may use existing medications and treatments to help manage some of the symptoms.

For example, some evidence suggests that Selective Serotonin Reuptake Inhibitors (SSRIs), which are more commonly prescribed to treat depression and anxiety, may be prescribed to patients to alleviate some of the behavioural symptoms of disinhibition, irritability or agitation. These medications work by increasing the level of a neurotransmitter called serotonin in the synaptic cleft (see resource two) by blocking its reabsorption. This increases neurotransmitter availability in the synaptic cleft, allowing for neurotransmission to the postsynaptic neuron. Other antidepressants such as Trazodone, which is a Serotonin Antagonist and Reuptake Inhibitor (SARI), can also be used to treat agitation or sleep disturbances in bvFTD, as they have a sedative or calming effect. These medications work by blocking the reabsorption of serotonin on the presynaptic terminal and also blocking some other serotonergic receptor sites, increasing the availability of serotonin in the synaptic cleft.

Resource Six
Data Source

Section D
Treatments *(continued)*

Other treatments can be non-pharmaceutical, utilising specialist speech and language therapists to help with any speech or swallowing problems, or occupational therapists to adapt tasks of daily living to improve everyday functioning. Environmental modifications might also be suggested, such as structuring a routine to reduce distress, simplifying the home to reduce distractions, redirecting attention away from harmful things, or spending more time in social interactions or activities, such as at **Dementia cafes** or **support groups**.

Section E
Real Life Impact

Caring for someone with FTD can be extremely challenging, both for the person affected and their loved ones. Watch these videos to understand better the real-life impact of caring for someone with FTD.

1. The impact of frontotemporal dementia on loved ones
2. LearnFTD Caregiver Story: Deb
3. Elaine Biles on caring for her husband with FTD
4. Jamie Arking: A FTD Caregiver Story

Care and future planning are very important once someone has received an FTD diagnosis. It is important to consider what the person themselves might have wanted if they are no longer able to make decisions for themselves. This, in turn, can be very difficult for carers and loved ones. Figure 29 shows considerations to take into account following an FTD diagnosis, including links to websites offering support and advice for carers.

Resource Six
Data Source

Section E

Real Life Impact *(continued)*

Figure 29: ***Considerations***

Links for support:

Alzheimer's Research UK - the UK's leading Alzheimer's research charity | What is frontotemporal dementia? | Alzheimer's Research UK | Alzheimer's Society | Rare Dementia Support | AFTD - The Association for Frontotemporal Degeneration | Caring Together Charity | Carers' Support | Homecare | Cambs, Peterborough and Norfolk

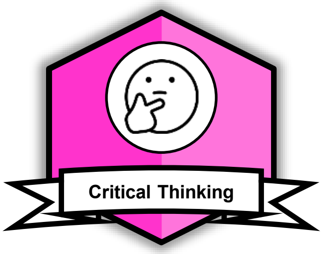
Section F

A Moment of Hope

Dementia is a very challenging illness, and the previous resources have described how and why dementia research, care and support are in dire need of funding and exploration. However, as a final message at the end of this resource, I wanted to express my great hope and optimism for the future of dementia research and for finding a cure. It is the result of the tireless efforts of the charities, doctors, nurses, support staff, researchers, but most importantly, people living with dementia themselves and their carers, that we grow ever closer to finding a cure for dementia. We desperately need more funding to expand our research into wider communities in pursuit of a cure. I hope this resource has given you a brief insight and inspired you to learn more about neurodegeneration and dementia.

Resource Six
Activities

Activities



1. Describe the prevalence of FTD.
2. How are dementias diagnosed? Write a short passage about the different diagnostic methods used in clinical practice
3. Briefly explain why current treatments do not cure dementia but can alleviate symptoms.
4. In a group, discuss the core reasons why dementia research is important at an individual and societal level and make a spider diagram of your ideas.
5. Using your spider diagram from (4) and the information in this resource, prepare a 5-slide presentation on why we urgently need dementia research. Focus on **what** the current challenges are, **where** and **whom** they affect, **how** we might work towards a cure, and **why** this is important.

Resource Six
Further Reading

Explore

1. The Association for Frontotemporal Degeneration (AFTD), 2018. Fast Facts about FTD [pdf]. Available at: https://www.theaftd.org/wp-content/uploads/2018/03/Fast-Facts-about-FTD-for-web.pdf [Accessed 30 January 2026].X.
2. Alzheimer's Research UK, 2024. What is frontotemporal dementia? [pdf] Alzheimer's Research UK. Available at: https://www.alzheimersresearchuk.org/wp-content/uploads/2024/02/FTD-0124_0126_WEB.pdf [Accessed 30 January 2026].Etc.

References

1. Alzheimer's Association, n.d. Frontotemporal Dementia (FTD) | Symptoms & Treatments. [online] Available at: https://www.alz.org/alzheimers-dementia/what-is-dementia/types-of-dementia/frontotemporal-dementia [Accessed 24 October 2025].
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Resource **Six**
Further Reading

References *(continued)*

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5. National Institute on Aging, 2024. How is Alzheimer's disease diagnosed? [online] Available at: https://www.nia.nih.gov/health/how-alzheimers-disease-diagnosed [Accessed 24 October 2025].

6. Rascovsky, K., Hodges, J.R., Knopman, D., Mendez, M.F., Kramer, J.H., Neuhaus, J., van Swieten, J.C., Seelaar, H., Dopper, E.G.P., Onyike, C.U., Hillis, A.E., Josephs, K.A., Boeve, B.F., Kertesz, A., Seeley, W.W., Rankin, K.P., Johnson, J.K., Gorno-Tempini, M.L., Rosen, H., Prioleau-Latham, C.E., Lee, A., Kipps, C.M., Lillo, P., Piguet, O., Rohrer, J.D., Rossor, M.N., Warren, J.D., Fox, N.C., Galasko, D., Salmon, D.P., Black, S.E., Mesulam, M., Weintraub, S., Dickerson, B.C., Diehl-Schmid, J., Pasquier, F., Deramecourt, V., Lebert, F., Pijnenburg, Y., Chow, T.W., Manes, F., Grafman, J., Cappa, S.F., Freedman, M., Grossman, M. and Miller, B.L., 2011. Sensitivity of revised diagnostic criteria for the behavioural variant of frontotemporal dementia. Brain, 134(9), pp.2456–2477. doi:10.1093/brain/awr179.

7. Rohrer, J.D., Guerreiro, R., Vandrovcova, J., Uphill, J., Reiman, D., Beck, J., Isaacs, A.M., Authier, A., Ferrari, R., Fox, N.C., Mackenzie, I.R., Warren, J.D., de Silva, R., Holton, J., Revesz, T., Hardy, J., Mead, S. and Rossor, M.N., 2009. The heritability and genetics of frontotemporal lobar degeneration. Neurology, 73(18), pp.1451–1456. doi:10.1212/WNL.0b013e3181bf997a.

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Resource Six
Further Reading

References *(continued)*

8. Brain Made Simple, 2019. *Dementia*. [online] Available at: https://brainmadesimple.com/dementia/ [Accessed 30 January 2026].

9. The Association for Frontotemporal Degeneration (AFTD), 2018. *Fast Facts about FTD*. [pdf] Available at: https://www.theaftd.org/wp-content/uploads/2018/03/Fast-Facts-about-FTD-for-web.pdf [Accessed 30 January 2026].

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11. Ratnavalli E, Brayne C, Dawson K, Hodges JR. The prevalence of frontotemporal dementia. Neurology. 2002 Jun 11;58(11):1615-21. doi: 10.1212/wnl.58.11.1615. PMID: 12058088.

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Final Reflection Activity
Further Guidance

For the final reflection activity, you are asked to create a presentation (max 8-10 slides) or write a short-form essay (max 1500 words), using dementia as an example, to answer the question “Why is it important to study when things go wrong in the brain?” Please use the structure below as a guide, drawing on everything you have learned within this resource.

Your presentation/ essay should explore the following:

- **Introduction:** Outline what you will cover.
- **Dementia:** Briefly define dementia and neurodegeneration, including prevalence, prognosis and key symptoms. ***Hint:*** *To make this easier for yourself, pick bvFTD*.
- **Brain regions:** Outline the key brain regions affected in this type of dementia and how this relates to the core symptomology of the syndrome.
- **Methods for diagnosis and investigation:** Discuss the different methods for diagnosing and researching dementia. Include brain imaging techniques and other diagnostic tools briefly outlined in the resource.
- **Hypotheses of dementia:** Outline how pathology and synaptic degeneration might underlie neurodegeneration.
- **Current treatment approaches and finding a cure:** Discuss the current options for treatment and how scientists are working to develop a cure.
- **Conclusion:** Briefly explain and discuss why this matters, relating to prevalence and burden of the disease and how this is important on an individual and societal level.

Study Skills, Tips & Guidance

This section includes helpful tips to help you complete this pack and improve your study skills for school.

It also includes a few fantastic, easy-to-use resources to know what to do next and where else you can look for more information on the subject.

Helpful information you will find in this section:

1. Cornell Notes
2. Academic Terminology (keywords)
3. Academic Writing Style
4. Referencing
5. How to Evaluate Your Sources
6. Subject Guidance
7. University Guidance

Psst! Learning these tips to improve your school skills could help you do better in exams and make assignments easier!

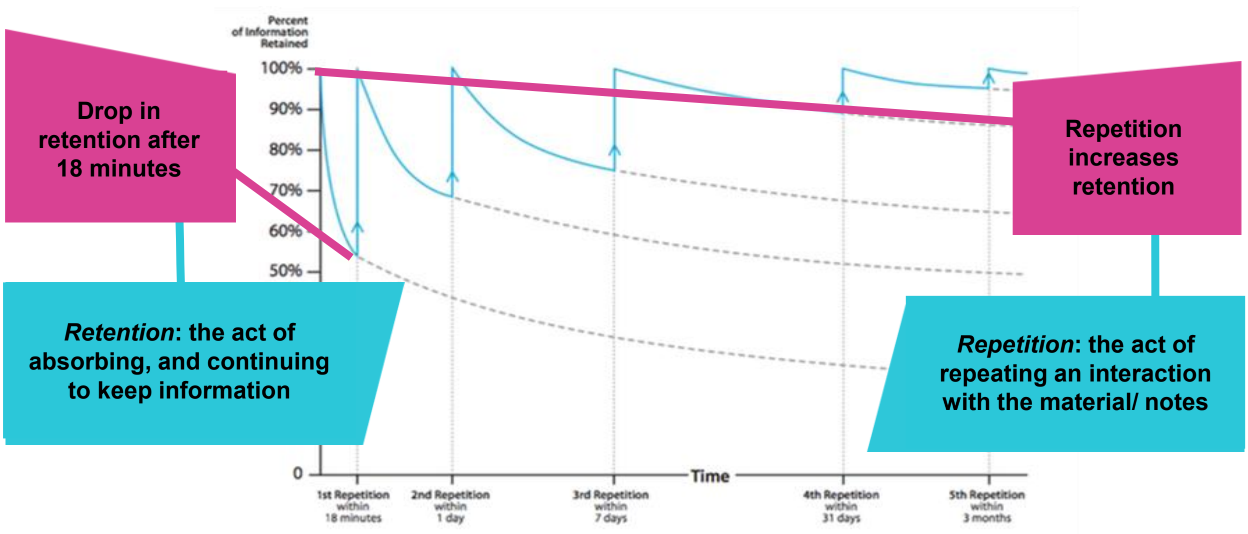
You can use the tips and web links in this section throughout your pack!

Academic Study Skills
Cornell Notes

Why is good note-taking important?

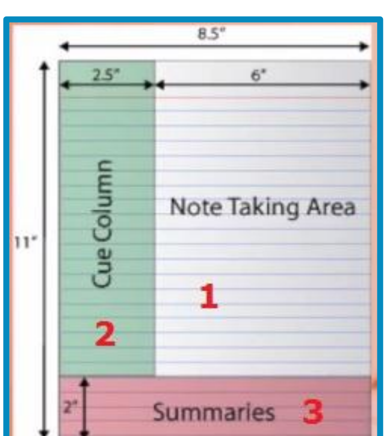
If you forget new information almost as quickly as you hear it, even if you write it down, you tend to lose nearly 40% of new information within 24 hours of first reading or hearing it.

However, if we take notes effectively, we can retain and retrieve almost 100% of the information we receive. Consider this graph on the rate of forgetting with study/ repetition:



Learning a new system

The Cornell Note System was developed in the 1950s at the University of Cornell in the USA. The system includes interacting with your notes and is suitable for all subjects. There are three steps to the Cornell Note System.



Step 1: Note-Taking

1. ***Create Format:*** Notes are set up in the Cornell Way. This means creating three boxes like the ones on the left. You should put your name, date, and topic at the top of the page.
2. ***Write and Organise:*** You then take your notes in the 'note taking' area on the right side of the page. It would be best if you organised these notes by keeping a line or a space between 'chunks'/ main ideas of information. You can also use bullet points for lists of information to help organise your notes.

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Academic Study Skills
Cornell Notes

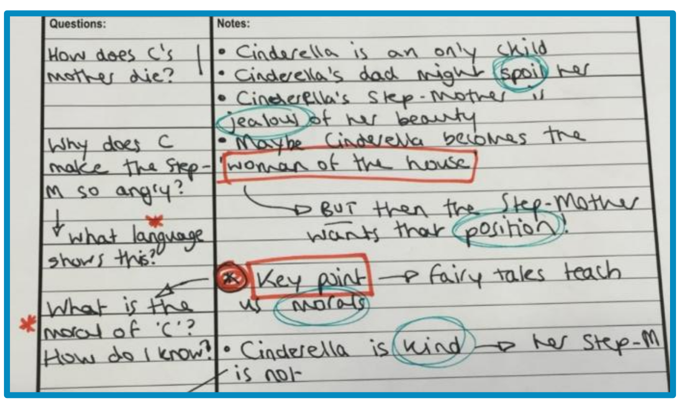
Step 2: Note-Making

1. ***Revise and Edit Notes***: Go back to box 1, the note-taking area and spend some time revising and editing. You can do this by highlighting 'chunks' of information with a number or a colour; circling all keywords in a different colour; highlighting main ideas; adding new information in another colour.

2. ***Note Key Idea:*** Go to box two on the left-hand side of the page and develop some questions about the main ideas in your notes. The questions should be 'high level'. This means they should encourage you to think deeper about the ideas. Example 'high level' questions would be:

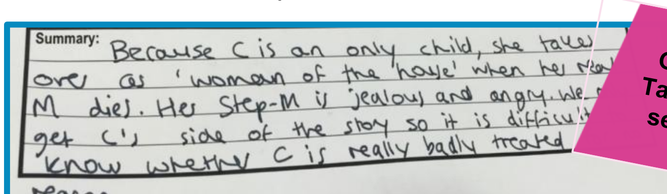
   - Which is the most important/ significant reason for…
   - To what extent…
   - How does the (data/ text/ ideas) support the viewpoint?
   - How do we know that…

Here is an example of steps 1 and 2 for notes on the story of Cinderella



Step 3: Note-Interacting

1. ***Summary:*** Go to box three at the bottom of the page, summarise the main ideas in box one, and answer the essential questions in box 2.



Give the Cornell Note-Taking System a try and see if it works for you!

Academic Study Skills
Key Words

Below is a series of key terms you will come across from teachers and tutors as you go through school, especially as you enter upper secondary.

Knowing these will help you understand what you are being asked to do!

- ***Analyse:*** When you analyse something, consider it carefully and in detail to understand and explain it. To analyse, identify the main parts or ideas of a subject and examine or interpret the connections between them.
- ***Comment on:*** When you comment on a subject or the ideas in a subject, you say something that gives your opinion or an explanation.
- ***Compare:*** To compare things means to point out their differences or similarities. A comparison essay would involve examining the qualities/ characteristics of a subject and emphasising the similarities and differences.
- ***Contrast:*** When you contrast two subjects, you show how they differ when compared with each other. A contrast essay should emphasise striking differences between two elements.
- ***Compare and contrast:*** To write a compare and contrast essay, you would examine the similarities and differences between two subjects.
- ***Criticise:*** When you criticise, you make judgments about a subject after thinking about it carefully and deeply. Express your judgement concerning the correctness or merit of the factors under consideration. Give the results of your analysis and discuss the limitations and contributions of the factors in question. Support your judgement with evidence.
- ***Define:*** When you define something, you show, describe, or state clearly what it is and what it is like; you can also say its limits. Do not include details but do include what distinguishes it from the other related things, sometimes by giving examples.
- ***Describe:*** To describe in an essay requires you to give a detailed account of a subject's characteristics, properties or qualities.
- ***Discuss:*** To discuss in an essay, consider your subject from different points of view. Examine, analyse and present considerations for and against the problem or statement.

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Academic Study Skills
Key Words

- ***Evaluate:*** When you evaluate in an essay, decide on your subject's significance, value, or quality after carefully studying its good and bad features. Similar to assess. Use authoritative (e.g. from established authors or theorists in the field) and, to some extent, personal appraisal of both contributions and limitations of the subject.
- ***Illustrate:*** If asked to illustrate in an essay, explain the points that you are making clearly by using examples, diagrams, statistics, etc.
- ***Interpret:*** In an essay that requires you to interpret, you should translate, solve, give examples, or comment upon the subject and evaluate it in terms of your judgement or reaction. Explain what your subject means. Similar to explain.
- ***Justify:*** When asked to justify a statement in an essay, you should provide the reasons and grounds for the conclusions you draw from the statement. Present your evidence in a form that will convince your reader.
- ***Outline:*** Outlining requires that you explain ideas, plans, or theories in a general way, without giving all the details. Organise and systematically describe the main points or general principles. Use essential supplementary material, but omit minor details.
- ***Prove:*** When proving a statement, experiment or theory in an essay, you must confirm or verify it. You must evaluate the material and present experimental evidence and/ or logical argument.
- ***Relate:*** To relate two things, you should state or claim the connection or link between them. Show the relationship by emphasising these connections and associations.
- ***Review:*** When you review, critically examine, analyse and comment on the major points of a subject in an organised manner.

Write any other keywords you come across below. Ask your teacher to explain their meaning or use a dictionary to find out.

Academic Study Skills
Academic Writing Style

What is academic writing?

'Academic writing' is a specific way of writing when communicating research or discussing a point of view. You will most often do this in essays and reports.

Academic writing has a logical structure and uses formal language. Unlike creative or narrative writing, academic writing uses different sources of information to support what is being said (see next page about various sources).

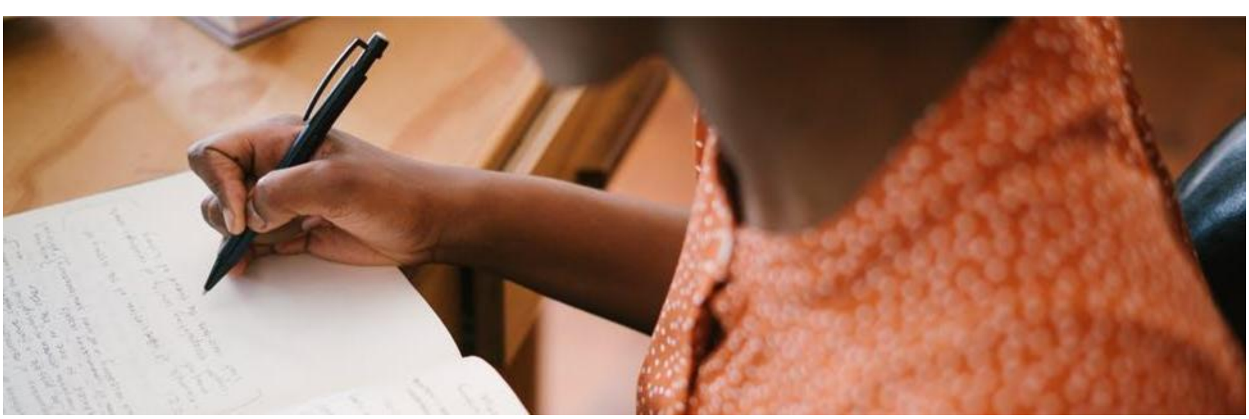
Top Academic Writing Tips

Do's

- Do use words you know the meaning of and are confident using.
- Remember, words don't have to be complicated to be clear!
- Do write words out fully, e.g., do not, cannot, does not, it would.
- Use the third person point of view
- Minimise the use of informal adjectives, such as cool, amazing and wonderful.

Don'ts

- Do not use contractions, e.g., don't, can't, doesn't, it'd.
- Do not use public speaking phrases like "We can all agree that…" and "As I previously mentioned…".
- Do not use conversational phrases, such as 'literally' or 'basically' too often.
- Do not use slang or jargon, for example, 'awks', 'lit', 'woke'.
- Do not use words that express value judgements, e.g., crazy, ridiculous, terrible. Suitable synonyms are surprising, unjustified or distressing.



Academic Study Skills
Academic Writing Style

Expressing your opinion in academic writing

In academic writing, it is best practice to express an opinion without writing in the first person.

Rather than saying, 'In my opinion, this proves that you can express your opinion by saying:

- 'Based on (insert fact/ theory/ finding) it shows that….';
- 'The graph here indicates that…';
- 'The aforementioned problems in Smith's argument reveal that…';
- 'Such weaknesses ultimately mean that…'; and so on.

Signposting

Signposting guides your reader through different sections of your writing. It lets those who read your writing know what is being discussed and why and when your piece is shifting from one part to another. This is crucial for clear communication with your audience.

Signposting stems for a paragraph which expands upon a previous idea	Signposting stems for a paragraph which offers a contrasting view
Building on from the idea that ... (mention the previous idea), this section illustrates that ... (introduce your new idea).	However, another angle on this debate suggests that ... (introduce your contrasting idea)
To further understand the role of ...(your topic or your previous idea), this section explores the idea that ... (introduce your new idea)	In contrast to evidence which presents the view that ... (mention your previous idea), an alternative perspective illustrates that ...
Another line of thought on ... (your topic or your previous idea) demonstrates that ...	However, not all research shows that ... (mention your previous idea). Some evidence agrees that ...

Academic Study Skills
Referencing

What is a reference or referencing?

A reference is just a note in your assignment that tells your reader where particular ideas, information or opinions that you have used from another source have come from. It can be done through 'citations' or a 'bibliography'.

You must include references in your writing assignments when you get to university. As well as being academic good practice, referencing is very important because it will help you to avoid plagiarism.

Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. You must be careful to reference your sources correctly.

Why should I reference?

Referencing is essential in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps prevent you from losing marks or failing due to plagiarism.

When should I use a reference?

- You should use a reference when you:
- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

Academic Study Skills
Referencing

How do I reference?

There are several different ways of referencing, but most universities use the Harvard Referencing Style. Please speak with your teacher about which style they want you to use because the most important thing is that you remain consistent!

The two main aspects of referencing you need to be aware of are:

1. In-text citations

These are used when directly quoting a source. They are in the body of the work after you have referred to your source in your writing. They contain the surname of the source's author and the year it was published in brackets.

- E.g. *Daisy describes her hopes for her infant daughter, stating, "I hope she'll be a fool—that's the best thing a girl can be in this world, a beautiful little fool." (Fitzgerald, 2004).*

2. Bibliography

This is a list of all the sources you have referenced in your assignment. In the bibliography, you list your references by the numbers you have used and include as much information as possible about the reference. The list below gives what should be included for different sources.

- ***Websites:*** Author (if possible), *title of the web page*, 'Available at:' website address, [Accessed: date you accessed it].
  - E.g. *'How did so many soldiers survive the trenches?',* Available at: http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [Accessed: 11 July 2019].

- ***Books:*** Author surname, author first initial, (year published), *title of book*, publisher
  - E.g. Dubner S. and Levitt, S., (2007) *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything,* Penguin Books

- ***Articles:*** Author, *'title of the article'*, where the article comes from (newspaper, journal, etc.), date of the article.
  - E.g. Maev Kennedy, *'The lights to go out across the UK to mark First World War's centenary',* The Guardian Newspaper, 10 July 2014.

Academic Study Skills
Referencing

Is it a source worth citing? Use these tips to question your sources before referencing them.

- ***Currency – the timelines of the information:*** When was it published or posted? Has it been revised or updated? Does your topic require current information, or will older sources also work?

- ***Relevancy – the importance of the information for your needs:*** Does the information relate to your topic or answer your question? Have you looked at a variety of sources? Who is the intended audience?

- ***Authority - the source of the information:*** Who is the author/ publisher/ source/ sponsor? What are the author's credentials? Is the author qualified to write on the topic?

- ***Accuracy – the reliability and correctness of the source:*** Does evidence support the information? Has the information been reviewed or refereed? Can you verify whether it is a personal or professional source? Are there errors?

- ***Purpose – the reason the information exists:*** Does the author clarify the intentions/ purpose? Is the information fact opinion or propaganda? Are there biases? Does the viewpoint appear objective?

accessed

Academic Study Skills
Evaluating Your Sources

What is a source?

When you learn new things, you might get information from different places. These places are called sources. Some sources are more reliable than others. For example, information in a textbook written by an expert is more reliable than the information in a non-expert's social media post.

How do you decide which source to use? From newspaper articles to books to tweets, this provides a brief description of each source type and breaks down the factors to consider when selecting a source.

Twitter

A platform for millions of concise messages on a variety of topics.

Blog

Blogs (e.g. WordPress) are an avenue for sharing both developed and unpublished ideas and interests with a niche community.

Youtube

A collection of millions of educational, inspirational, eye-opening and entertaining videos.

Newspaper

A reporting and recording of cultural and political happenings that keeps the general public informed. Opinions and public commentaries can also be included.

Journal

A collection of analytics reports that outline the objectives, background, methods, results and limitations of new research written for and by scholars in a niche field.

Academic book

The information presented is supported by clearly identified sources. Sometimes each chapter has a different author.

Encyclopaedia

Books or online – giving information on many different subjects. Some are intended as an entry point into research; some provide detailed information and onwards references.

Popular magazine

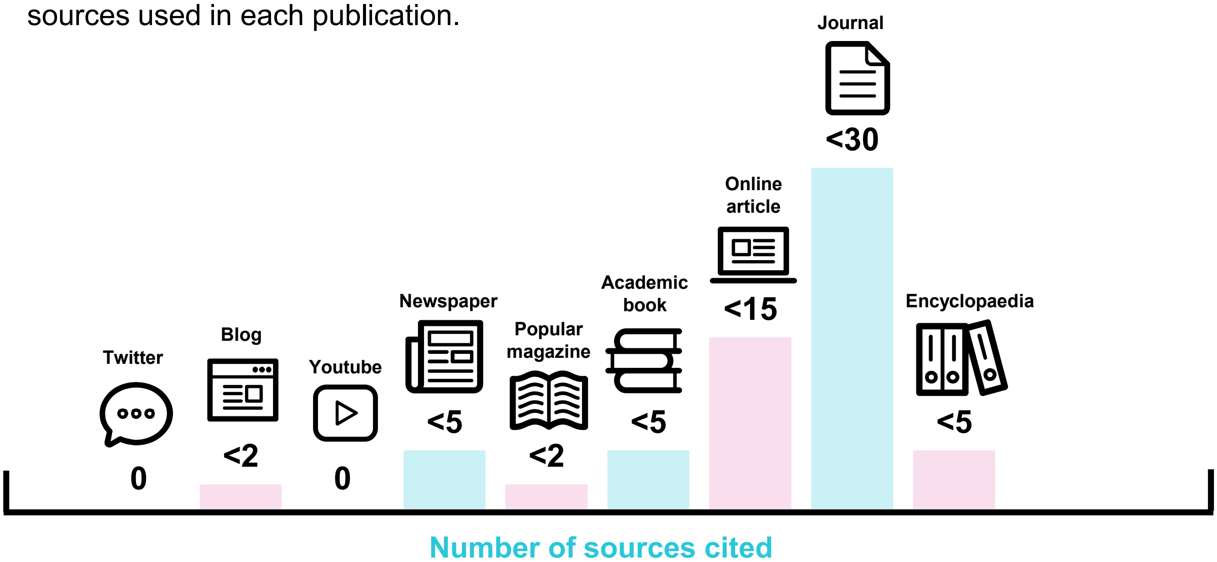
A glossy compilation of stories with unique themes intended for specific interests.

Academic Study Skills

Evaluating Your Sources

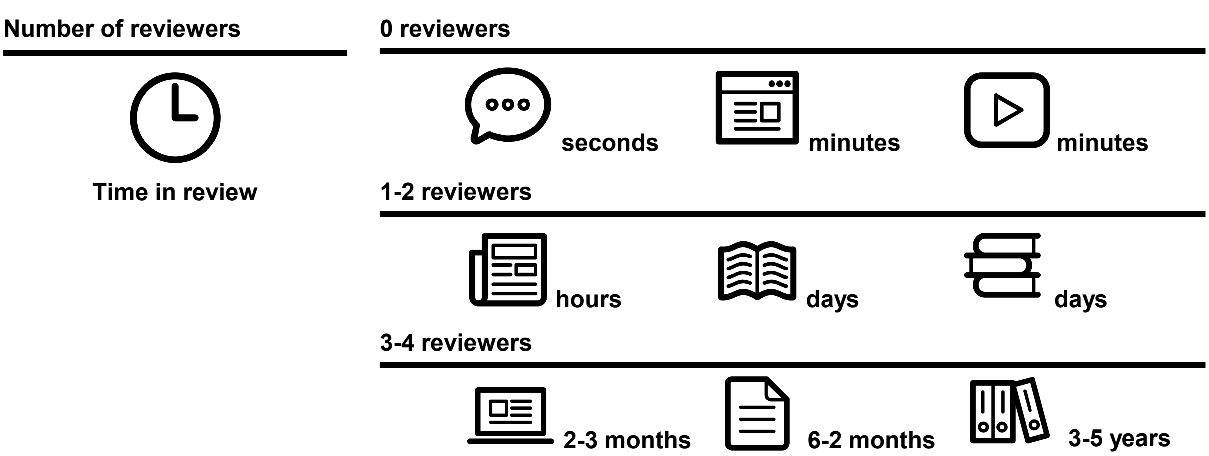
Number of outside sources

When an author used many outside sources in their writing, they demonstrate familiarity with ideas beyond their own. As more unique viewpoints are pulled into a source, it becomes more comprehensive and reliable. This shows the typical number of outside sources used in each publication.



Degree of review before a source is published

Two factors contribute to the amount of inspection a source receives before it might be published: the number of reviewers fact-checking the written ideas and the total time spent by reviewers as they fact-check. The more people involved in the review process and the longer the review process takes, the more credible the source is likely to be.



What's next?

Where can this subject take me?

Pathways

A degree in Psychology opens doors to a wide range of career options. While many graduates choose to continue their studies with a master's or doctoral degree, others pursue careers in counselling, clinical psychology, organisational psychology, or educational settings. Psychology graduates are also highly sought after in fields such as human resources, research, market analysis, and mental health advocacy. Additionally, the analytical, communication, and interpersonal skills gained through a psychology degree are valuable in consulting and broader roles across scientific and technical industries.

Psychology
• Developing empathy and a strong interest in people allows for better understanding and connection with others. • Enhancing analytical research skills enables the critical evaluation of information and evidence-based decision-making. • Strengthening problem-solving abilities helps identify challenges and develop practical, effective solutions. • Collaborating effectively within teams contributes to achieving shared goals. • Improving written and verbal communication skills supports clear and effective report writing and presentations. • Advancing information technology proficiency facilitates research, communication, and collaboration. • Gaining expertise in handling data and statistics ensures accurate analysis and interpretation of findings.

Read more about subject selection and career pathways

- **https://targetjobs.co.uk**
- **https://www.prospects.ac.uk**
- **https://thinkuni.org/**

What's next?
University Guidance

Different people go to university for different reasons. You might have a particular job in mind or want to study a subject you are passionate about.

Whatever your motivations, going to university can help improve your career prospects and develop your confidence, independence and academic skills.

Choosing a course and university

Choosing the right course to study is important, so research the options available to you. Here are some top tips:

- You don't have to choose a course you have already studied; many courses don't require prior knowledge of the subject. You can apply skills gained from school studies to a new field.
- The same subject can be taught differently depending on your chosen course and university. Search university websites to learn more about the course content, teaching styles and assessment types.
- When choosing a university, think about what other factors are important to you. Do you want to study at a campus university or be based in a city center? What accommodation options are there? Does the university have facilities for any extracurricular activities you're involved in?
- To research your options, look at university prospectuses and websites and see if there are opportunities to speak to current students who can give you a real insight into what life is like there.

What's next?
University Guidance

Exploring careers and subject options

- Find job descriptions, salaries and hours, routes into different careers, and more at **https://www.startprofile.com/**
- Research career and study choices, and see videos of those who have pursued various routes at **http://www.careerpilot.org.uk/**
- See videos about what it's like to work in different jobs and for different organisations at **https://www.careersbox.co.uk/**
- Find out what different degrees could lead to, how to choose the right course for you, and how to apply for courses and student finance at **https://www.prospects.ac.uk/**
- Explore job descriptions and career options, and contact careers advisers at **https://nationalcareersservice.direct.gov.uk/**
- Discover which subjects and qualifications (not just A levels) lead to different degrees and what careers these degrees can lead to at **http://www.russellgroup.ac.uk/media/5457/informed-choices-2016.pdf**

Other useful resources

- **https://www.ucas.com/**
- **https://www.whatuni.com/**
- **https://www.opendays.com/**
- **https://www.thecompleteuniversityguide.co.uk/**

You may or may not have thought about studying at university.

Don't worry – you have plenty of time to think about this and explore your options if you would like to go!

What's next?
University Guidance

UCAS and the university application process

All applications for UK degree programmes are made through UCAS. There is lots of information on the UCAS website to guide you through the process and what you need to do at each stage.

Apply	• Applications **open in September** the year before you plan to start university. • You can apply for up to **five courses.** • The deadline for most courses is **15 January**, though there is an earlier deadline of **15 October** for Oxford and Cambridge, medicine, veterinary medicine/science and dentistry.
Decisions	• Some courses may require an interview, portfolio or admissions test in addition to a UCAS application. Check individual university website details. • Check UCAS Track which will be updated with decisions from the universities you have applied for, and to see your deadline for replying to any offers. • You should choose a firm (or first) choice university and an insurance choice. If you already have your exam results or a university thinks your application is particularly strong, you might receive an **unconditional offer**.
Results	• If you're holding a conditional offer, then you will need to wait until you receive your exam results to have your place confirmed. • Clearing & Adjustment allows you to apply to courses which still have vacancies if you didn't meet the conditions of your offer, have changed your mind about what or where you want to study, or have met and exceeded the conditions of your offer and would like to look at alternate options.

Personal statements

An important part of your application is the personal statement. The personal statement allows you to tell universities why they should offer you a place.

Here are a few top tips for making your personal statement stand out:

- You can only submit one personal statement, so it's important that you are consistent in your course choices. Make sure you have done your research to show your understanding of the subject area and your passion for it.

What's next?
University Guidance

Personal Statement (cont.)

- Start by brainstorming all your skills, experience and attributes. Once you have everything written down, you can begin to be selective – you only have 47 lines so won't be able to include everything.

- The ABC method: action, benefit and course can be a useful way to help demonstrate your relevant experience and how it applies to the course you're applying for.

Personal Statement do's and don'ts

Read the tips below from real life professors and admissions staff in university Science departments, on the 'do's' and 'don'ts' of what to include in your personal statement.

Science

- Tell us why you want to study Science.
- What area of Science fascinates you?
- Demonstrate your interest by telling us what you have recently read, watched or listened to and how they helped your understanding of Science.
- Describe how your school or individual work has equipped you with the necessary knowledge and ability to be a successful Science student.

Other useful resources

- An easy template to start practising your personal statement: **https://www.ucas.com/sites/default/files/ucas-personal-statement-worksheet.pdf**

- Untangle UCAS terminology at **https://www.ucas.com/corporate/about-us/who-we-are/ucas-terms-explained**

- Discover more about the application process including when to apply and how to fill in your application on the **UCAS website.**

- Read more useful advice about what to include in your personal statement on **UCAS**, **the Complete University Guide** and **The UniGuide.**

Insight into the University of Cambridge

The University of Cambridge and its Colleges are committed to widening participation to higher education. Hundreds of outreach initiatives and events are run each year both in Cambridge and in schools and colleges across the UK.

Outreach Projects

neaco

The Network for East Anglian Collaborative Outreach (neaco) delivers activities across East Anglia to help students in Years 9-13, with little or no experience of university, to explore the world of higher education. Find out more.

(Pre-16 Team Projects)

Insight Discover

Insight Discover is a programme that students follow from Year 7 to Year 8, which aims to develop key academic skills to support them in their academic work. In addition, the programme introduces students to university and the options which are available to them in the future. Find out more.

Insight Explore

Insight Explore is an academic programme which aims to develop participants interests and tackle the barriers many students face when applying to university. Find out more.

Realise

The Realise project's aim is to encourage more young people in care to consider higher education. We run a large number of events ranging from science days to theatre days to give a taste of life as a student at Cambridge. Find out more.

Insight into the University of Cambridge

Post-16 Team Projects)

HE+

HE+ is a collaboration between the University of Cambridge's Admissions Office and Colleges, and state schools/colleges across the UK. The University and schools across 20 regions collaborate to form regional consortia to support high-achieving students from underrepresented areas and backgrounds, involving approximately 4,000 Year 12 students each year. Find out more.

Sutton Trust Summer Schools

Sutton Trust Summer Schools are free, subject-specific residential courses for Year 12 students studying at state-maintained schools in the UK. The five-day summer schools in July and August allow students to explore their interest in one of 26 subjects and gain an insight into what it is like to live and study as a first-year undergraduate student at Cambridge. Find out more.

Think Cambridge

Think Cambridge is a series of webinars aimed at inspiring Year 10, 11, and 12 students, as well as international and mature students, to consider applying to the University of Cambridge. Find out more.

Apply Cambridge

Apply Cambridge is a specialist, free programme designed to support highly able students from underrepresented backgrounds and areas in making successful applications to the University of Cambridge. We work with students every step of the way over a 6-month period, helping them navigate the process and effectively prepare for the Cambridge application. Find out more.

STEM SMART

STEM SMART is a free, 17-month programme to support students in raising their attainment at school and developing their confidence to apply to study physical sciences and engineering at top universities. Find out more.

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