The Brain and Learning
**Suggested Year: 9 or 10**

This unit helps pupils to improve their own learning and their ability to recall information by finding out how the brain and nervous system function. In the introductory activities, pupils explore how reliable their own memories are and how events can be remembered differently. They explore and test strategies for improving their memories. Pupils learn about the structure and functions of the brain and nervous system. At the end of the unit, pupils consolidate the knowledge they have developed by making a personalised plan for better learning. Although this unit is suitable for pupils in Years 9 and 10, it might be particularly suitable for pupils at the end of Year 10. It can help them to prepare for the demands of GCSE study and organise their learning more effectively.

**Statutory topic covered in this unit**

» Organisms and Health

**Unit links to the Big Picture**

| Learning for Life and Work | Personal Development  
|                           | Employability        |
| Key Elements              | Personal understanding |
| Cross-Curricular Skills   | Using Mathematics    
|                           | Communication        |
| Thinking Skills and Personal Capabilities | Thinking, Problem Solving, Decision Making  
|                           | Being Creative       |
|                           | Self-Management     |
| Learning Experiences      | Investigating and problem solving  
|                           | Relevant and enjoyable |
|                           | Linked to other curriculum areas |
|                           | Enquiry based        |
| Assessment for Learning   | Clear learning intentions shared with pupils  
|                           | Celebrate success against agreed success criteria |
|                           | Advice on what to improve and how to improve it |
The Brain and Learning

Attitudes and Dispositions
» Personal responsibility
» Commitment, determination, resourcefulness
» Openness to new ideas
» Self-belief, optimism, pragmatism

Classroom Activities

Activity 1: Exploring the Reliability of Memory

Activity 2: Exploring the Link between Memory and Learning

Activity 3: The Brain

Activity 4: The Central Nervous System and Communication

Activity 5: The Ideal Learning Environment
Activity 1:
Exploring the Reliability of Memory

Learning Intentions
Pupils are learning to:
» understand the differences between long-term and short-term memories;
» distinguish between fact and opinion;
» understand the limitations of memory; and
» develop memory skills.

Suggested Activities
My Earliest Memory
Ask the pupils to recall their earliest memory or their first day at school. Ask them to write down the details and compare them with another pupil’s. Ask the pupils if there are any smells, sounds, music or emotions associated with this memory?

Discuss with the pupils the ways people differ in how they remember things. For example the sounds, colours, events and names. The pupils then discuss what age they were in their first memory and why they can’t remember anything before this.

Ask the pupils:
» Can some factors help us remember or prevent us from remembering?
» Do we remember happy or sad events, or funny or frightening events more clearly?

Eyewitness Testimony
Organise for someone to come into the classroom while the pupils are working. The person carries out tasks, such as:
» removing a book;
» changing the time on the clock; and
» placing an item on a desk.
When they leave, ask the pupils several questions, such as:

» What clothes was the person wearing?
» What type of footwear were they wearing – shoes, boots or trainers?
» How long were they in the room?
» What book did they remove?
» What item did they leave in the room?

Are the pupils’ answers facts or opinions? What language are the pupils using? ‘I think..., maybe..., perhaps...’ Then present the facts to the class – the correct answers.

Ask the pupils can we rely on eyewitness testimony in court?

The following websites include information and resources that you might find useful for this lesson.

» **Eyewitness Memory is Unreliable** available at [www.visualexpert.com](http://www.visualexpert.com)
  (This website could be useful for your background research.)

» **Eyewitness Testimony** available at [www.simplypsychology.org](http://www.simplypsychology.org)

» **Eyewitness mistakes lead to tragic errors in court** available at [www.foxnews.com](http://www.foxnews.com)

Pupils can explore their memory skills in more depth by carrying out a simple memory test.

Call out a list of five words. After two minutes, ask the pupils to write down the words they remember. Ask them to record how many they got right.

Repeat the exercise using 10 words. Then repeat the exercise using five words but during the two minute wait, ask the pupils to carry out an unrelated task such as moving desks or books.

The pupils then collate the data for the class in an appropriate table. They work out the class average for the correct number of words recalled each time. Ask the pupils what conclusions can they draw from doing this exercise? Discuss the limitations and barriers to recall.
Improving Memory

You can find more memory tests on Neuroscience for Kids, available at faculty.washington.edu/chudler/chmemory.html

Ask the pupils to investigate strategies to improve memory. For example, they could research mnemonics, which can help us to remember information that can be difficult to recall.

The following resources outline other strategies to improve memory.

» Strategies to Improve Memory available at www.lanecce.edu
» 7 Tricks to Improve Your Memory available at www.mercola.com

In groups, ask the pupils to choose one strategy and try using it for a week. Then carry out the memory recall exercise again and see if there is any improvement.
Activity 2: Exploring the Link between Memory and Learning

Learning Intentions
Pupils are learning to:
» connect memory and learning;
» design a fair test; and
» evaluate outcomes.

Suggested Activities
Discussion Questions
Ask the pupils:
» What is learning?
» How is learning connected to memory?
» What factors could affect learning? For example:
  – environment: light, music and temperature;
  – emotions;
  – relevance; and
  – cues such as trigger words and associations (important for retrieving information).
» How can we change our environment for better learning?
» Is listening to music when studying a good idea?

Investigation
The pupils design an investigation to see if music affects learning.

Ask them to think about:
» How will they make it a fair test?
» What are the independent, dependent and controlled variables?
» How will they record their results?
The pupils then carry out the investigation. They should:

» accurately record their results; and

» present their results in a suitable format.

Ask the pupils: Now that we know the factors that can help or hinder recall, can we improve our recall in an exam?

Pupils can each design a poster to illustrate good learning and revision techniques based on the first two activities. These can be displayed in a variety of classrooms and along corridors.
Activity 3: The Brain

Learning Intentions

Pupils are learning to:

» describe and explain the structure and functions of the brain; and

» understand the link between the parts of the brain and how the rest of the body functions.

Suggested Activities

Key question: What is the brain?

The brain is an organ protected inside the skull. It contains:

» two hemispheres, which control opposite sides of the body;

» the cerebral cortex (cerebrum), which is where conscious thought takes place;

» the occipital lobe, which is the visual centre;

» the parietal lobe, which processes sensory information;

» the temporal lobe, which is involved in learning and memory;

» the frontal lobe, which controls higher emotions and language;

» the cerebellum, which controls balance and co-ordination and stores learned patterns of movement;

» the medulla oblongata (brainstem), which controls unconscious behaviour such as breathing and heart rate;

» the amygdala and hippocampus (limbic system), which are involved in emotions; and

» Wernicke’s area and Broca’s area in the midbrain, which are involved in speech.

You can find more information about each part of the brain on the Brain Made Simple, available at www.brainmadesimple.com. The BBC Bitesize video about the brain and the hypothalamus, available at www.bbc.co.uk/education, shows a brain being dissected and this might not be suitable for all pupils.
Pupils can identify these parts on a diagram of the brain, such as the one available at www.timvandevall.com.

The first five minutes of this YouTube video on how the human brain works provide an overview of the brain and introduce neurones.

Discussion
Why have neuroscientists been able to learn about the function of different parts of the brain by studying people who have had specific head injuries?

In groups, the pupils try to come up with reasons. Then discuss the types of accidents that lead to these head injuries. Pupils could use a diamond sorting exercise to prioritise these accidents.

The about brain injury section of www.headway.org.uk might be useful for this lesson.
Activity 4: The Central Nervous System and Communication

Learning Intentions

Pupils are learning to:

» explain how electrical impulses travel along nerve cells;
» accurately measure reaction times; and
» apply this mathematical knowledge to everyday contexts.

Key Stage 4 Link (Biology)

Suggested Activities

Explain to the pupils that the brain is made up of nerve cells that allow the brain to communicate with the rest of the body. The nerve cells consist of a long axon with a cell body and dendrites. They carry information in the form of electrical impulses.

Ask the pupils to draw the central nervous system and peripheral nervous system (or use a pre-drawn diagram) to show how the brain is connected to every part of the body.

The nervous system diagram from www.gojiactivesdiet.com might be useful for this activity.

Use the following activity to demonstrate to the pupils how electrical impulses pass from one nerve to another.
Place an empty glass basin on the table.
Place a toy truck with a paper boat or toy boat in it on one side of the table and an empty toy truck on the other side.
The boat the truck is carrying represents the electrical impulse.
The trucks represent the neurones.
The truck drives to the basin. How can the boat get across the basin to the other truck (neurone)?
Fill the basin with water and then the boat (electrical impulse) can float across the gap.

In reality, the empty basin is a gap called a synapse. The water that fills the gap represents the neurotransmitter chemicals. Once the synapse is filled with the neurotransmitters, the electrical impulse can pass to the next neurone and continue its journey through the body. Pupils can visualise the speed of this process by performing a Mexican wave.

The following websites include information and resources that you might find useful for this lesson.
- Nerves and the Nervous System available at www.easyscienceforkids.com
- The Nervous System available at www.ducksters.com
- Your Brain and Nervous System available at www.kidshealth.org
- The Nervous System for Kids available at www.makemegenius.com

How do we react to a stimulus such as pain?

Question: What happens if we put our hand on a very hot radiator?
Answer: We move our hand away very quickly.

Explain to the pupils that the receptors in the skin detect the heat and pain. An electrical impulse travels along the sensory neurone to our spinal cord and a response travels back along the motor neurone to the muscle in our arm, telling it to contract and move our hand out of danger. This is known as the reflex arc.
Ask the pupils to work in pairs to demonstrate the knee-jerk reaction. One pupil sits with one leg crossed over the other. Their partner gently taps below the kneecap with the side of a ruler. The lower leg will jerk upwards. Ask the pupils to write or draw an explanation of what has happened and why.

**Measuring Reaction Times**

**Ruler Activity**
A pupil holds a ruler at the 0 cm mark. They then let it go and catch the ruler. The number at which the pupil catches the ruler shows the reaction time.

**Stopwatch Activity**
The pupils line up in a row holding hands. The first pupil has a stopwatch, starting it as they squeeze the hand of the person beside them. The pupil with the stopwatch moves to the end of the row. The pupils pass the squeeze along the row. When it reaches the end of the row, the pupil stops the stopwatch. Divide the total time taken by the number of pupils in the row. The result gives the average reaction time for each person in the row.

Ask the pupils:
» Can the reaction time be improved?
» Why are reaction times very important when driving?
» What could affect them?
» Which sports need a fast reaction time? Why?

To conclude these activities, ask the pupils:
» What have you learned about the brain and nerves in these activities?
» How could this information make a difference to your everyday life?
» Is there anything you want to find out more about?
» What was it? What will you do?
Activity 5: The Ideal Learning Environment

Learning Intentions

Pupils are learning to:

» review how they learn and develop a plan to improve some aspects of their learning; and

» summarise an activity’s main points and evaluate them.

Suggested Activities

The pupils can work in groups for the initial planning but they should design their own learning environment.

In groups of four, ask each pupil to summarise the main points of one activity. They then explain these main points to the rest of the group. This will encourage the pupils to listen to each other and to explain themselves briefly and clearly.

Once the pupils have reviewed each activity, the group decides whether to base their design at home or in school.

On separate Post-it notes, each pupil writes three or four features that they believe are important in their new learning environment. They must explain how it will help them learn.

The pupils then arrange these Post-it notes into levels of importance, with the points that will contribute the most to learning and recall at the top level.

Once the group have agreed, they separate and draw their own learning environment.