TEACHER'S NOTES
YOUR BRILLIANT BRAIN

OVERVIEW

Aimed at key stage 4 pupils. This is a worksheet to help pupils understand how the brain works.

LEARNING OBJECTIVES

- To understand that the brain is the centre of the nervous system
- To understand that the brain controls many aspects of an organism
- To understand that the human brain is a highly structured organ comprised of billions of interconnected neurons
- To understand that Huntington's disease is caused by damage to the brain

CURRICULUM LINKS

- **KS4:** chemical and electrical signals enable body systems to respond to internal and external changes, in order to maintain the body in an optimal state

Activity

- Show Luke's film on the **www.genesareus.org** to explain how Huntington's disease effects the brain and its symptoms
- Ask pupils to read through the worksheet and answer the questions

ANSWERS

1. Copy the paragraph below and fill in the gaps:

When neurons are stimulated they transmit an ***electrical*** impulse. The part of a neuron along which a message is sent is called the ***axon***. Neurons do not directly touch one another. The small gaps between neurons are called synapses and chemical signals are used to send messages across ***synapses***. These chemical messengers are called ***neurotransmitters***.

2. Fill in the table below

Action	Brain required?
Writing your name	Yes
Reading a book	Yes
Keeping your temperature constant	Yes
Respiration	No
Copying the DNA in your cells	No
Breathing	Yes
Building muscles	No
Pupil of your eye getting smaller in response to bright light	No*
Talking to a friend	Yes
Being happy	Yes
Digesting food	No
Making red blood cells	No

** when the pupils in the eye change size it is a reflex reaction – reflex reactions do not require the brain, even though they do require neurons.*

ANSWERS continued

3. Rank the brains of the following organisms according to size:
-Blue whale – largest
-Human being – in between
-Tyrannosaurus rex – smallest

4. True or false: Einstein's brain was slightly larger than average?
False – in fact some parts of Einstein's brain were smaller than average. What made him exceptional was the number of connections between neurons

5. How heavy is the average human brain?
c) 1,500g

6. Looking at the picture of the homunculus, which parts of the body can be controlled most carefully? Why do you think that is?
The hands and the face can be controlled more carefully than any other part of the body. This reflects how much we use our hands to manipulate things around us and also how expressive our faces are – we convey a lot of information through our facial expressions!

7. What do you think would happen if the basal ganglia were damaged?
The basal ganglia send inhibitory messages to the motor cortex – by removing this inhibition the motor cortex is able to start unintentional movements, which can result in shaking. It also means that intentional movements are less well co-ordinated.

FURTHER information

- The Wellcome Collection had an exhibition on brains in mid 2012 – their website has an excellent interactive that explores a real brain **www.wellcomecollection.org**
- Your amazing brain is has a number of online activities and experiments for young people to take part in **www.youramazingbrain.org.uk**
- SciberBrain has been developed by the Biochemical Society and has some excellent interactive animations on how neurons and the brain work, as well as a whole lesson plan for finding out about the brain **www.sciberbrain.org**

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YOUR BRILLIANT BRAIN

The symptoms of Huntington's disease (HD) are caused by damage to the brain. It is a rare genetic condition that typically affects people between the ages of 30-50. People affected by the condition eventually notice symptoms of HD when large numbers of brain cells have died in specific areas of the brain.

A network of specialised cells called neurons carry signals around the nervous system. Neurons send signals to each other by electrical and chemical processes – they can be thought of a bit like wires connecting to each other via switches. In neurons the wires are called 'axons' and the switches are called 'synapses'.

1 Copy the paragraph below and fill in the gaps:

When neurons are stimulated they transmit an ..... impulse. The part of a neuron along which a message is sent is called the .....

Neurons do not directly touch one another. The small gaps between neurons are called .....
and chemical signals are used to send messages across synapses. These chemical messengers are called .....

The brain is a specialised part of the nervous system. The human brain is widely acknowledged to be the most complex thing in the known universe: it has around 100 billion neurons in it, and each neuron is connected to roughly ten thousand other neurons – so there are over 100 trillion connections. It co-ordinates all sorts of different activities in the body, from movements to feeling hungry to thinking about a maths problem – and just because you're not thinking about things, doesn't mean that your brain is needed! Although your brain only accounts for around 2% of your body weight it can account for up to 20% of your energy requirements.

Your brain controls a large number of your activities, but some things in your body happen without the brain's involvement.

2 ***Go through the list below and decide whether you think the brain is required***

Action	Brain required?
Writing your name	Yes
Reading a book	
Keeping your temperature constant	
Respiration	
Copying the DNA in your cells	
Breathing	
Building muscles	
Pupil of your eye getting smaller in response to bright light	
Talking to a friend	
Being happy	
Digesting food	
Making red blood cells	

YOUR BRILLIANT BRAIN

Your brain works thanks to all the carefully inter-connected neurons. Although the brain looks like a solid lump of dense, grey jelly, it is actually very carefully structured. Different parts of the brain are specialised to do different tasks. For example, imagine having a conversation with someone – first you hear words, you then think about the words you've heard and the words you would like to say, before finally saying words in response. Each part of this process (hearing, thinking and speaking) has a separate part of the brain dedicated to it.

3 ***Rank the brains of the following organisms according to size:***

- ***Tyrannosaurus rex***
- ***Human being***
- ***Blue whale***

4 ***True or false: Einstein's brain was slightly larger than average?***

5 ***How heavy is the average human brain?***

a) 500g
b) 1,000g
c) 1,500g

One of the things that makes the human brain so special is the size of the part of the brain called the cortex. The cortex is the outermost part of the brain and it contains a huge number of neurons and connections. The human cortex is heavily folded in on itself, which increases the amount of neurons that can be packed in.

Part of the cortex is called the motor cortex. This has been well studied and scientists know quite well which part of the motor cortex controls the movement of which parts of the body. This is shown in the picture underneath, called a 'homunculus'. In this picture the size of different parts of the body are shown in proportion to how much of the motor cortex is dedicated to them.

6 ***Looking at the picture of the homunculus, which parts of the body can be controlled most carefully? Why do you think that is?***

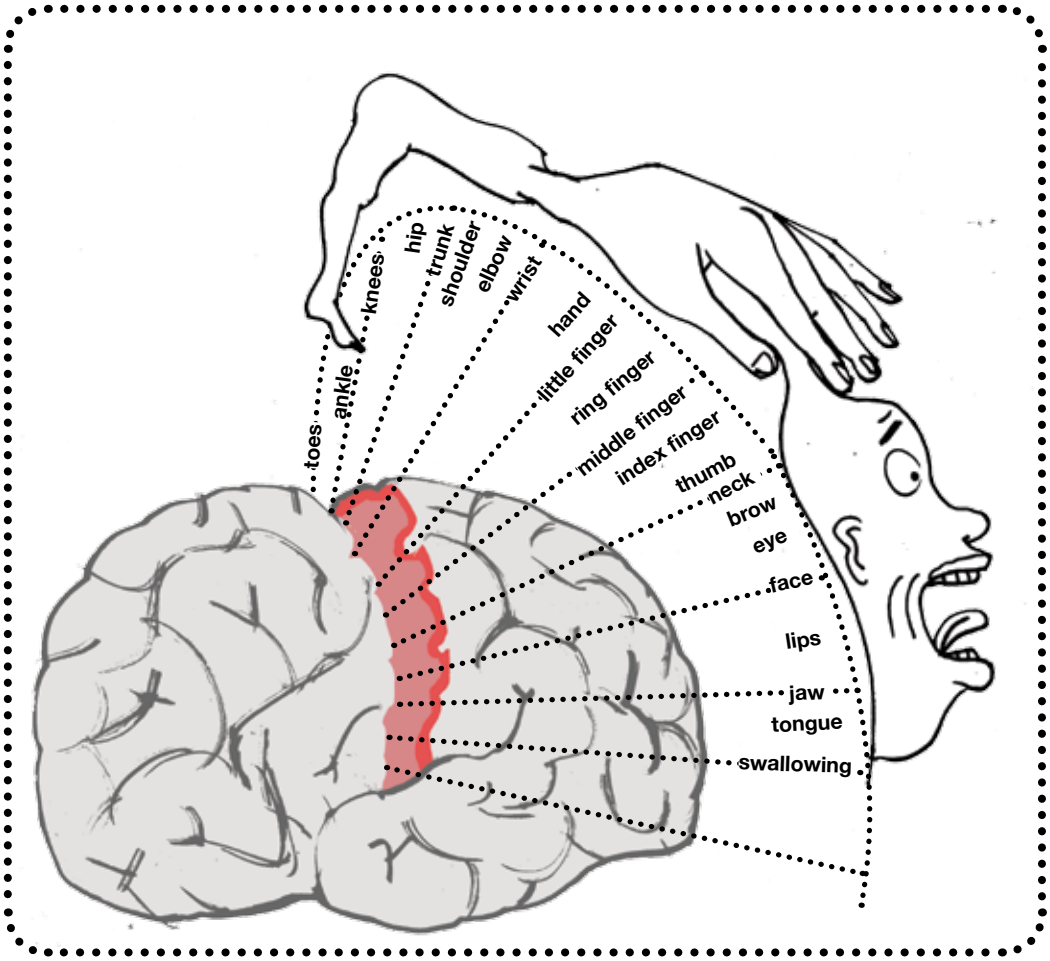

Figure 1
A motor homunculus – the size of each body part represents how much of the motor cortex is dedicated to that part.

YOUR BRILLIANT BRAIN

An important feature of neurons is that they can either turn on another neuron (activate it) or stop it doing something (inhibit it). Some neurons only activate others, while others only inhibit them. Both are important – if neurons could only activate other neurons your brain would find it impossible to filter information.

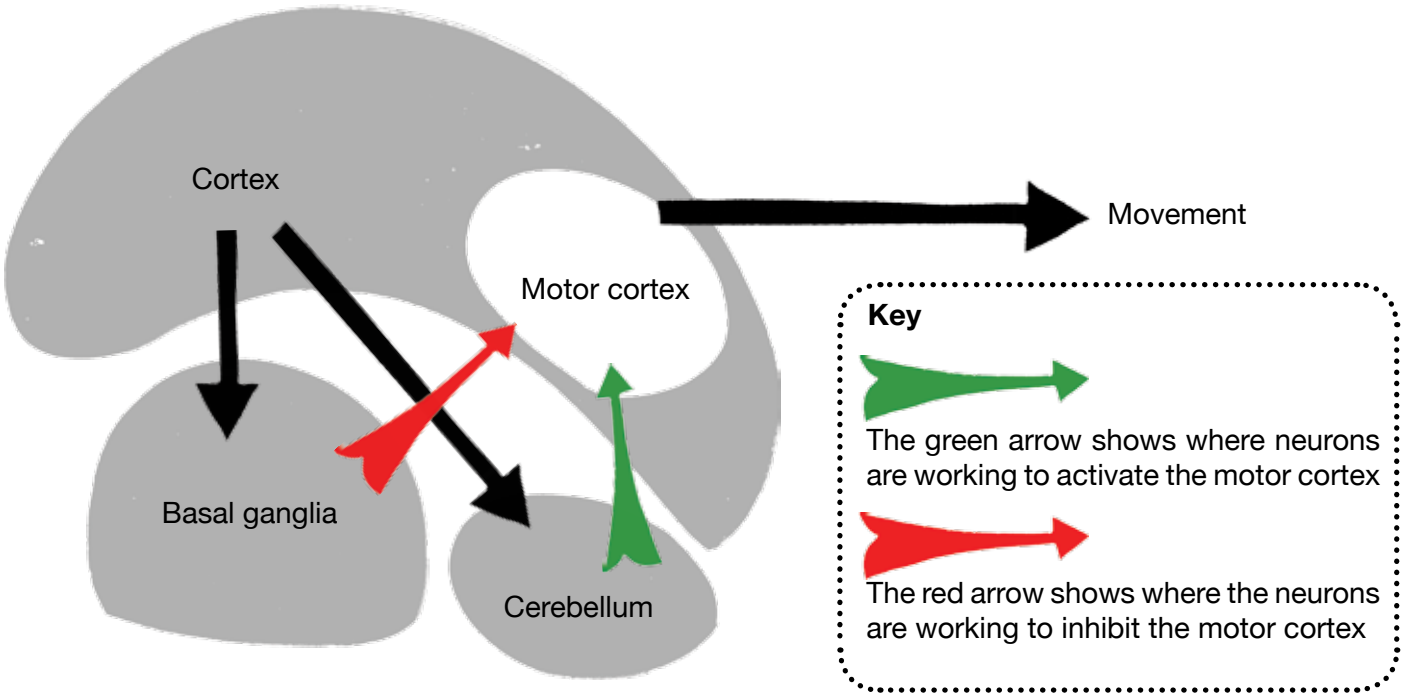

Figure 2
This shows some of the connections between different areas of the brain. When you think about moving, part of your cortex sends signals to two other parts of the brain - the basal ganglia and the cerebellum. The basal ganglia send 'stop' messages, while the cerebellum sends 'go' messages – between the two of them they ensure a smooth movement.

7 ***What do you think would happen if the basal ganglia were damaged?***

In Huntington's disease the basal ganglia are damaged. The symptoms of the condition are related to the areas of the brain that are unable to work properly.