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Genetic
Disorders
UK

TEACHER'S NOTES

THE MYSTERIOUS BRAIN

OVERVIEW

Aimed at **key stage 4** pupils. This worksheet explores how brain damage affects people physically, emotionally and mentally.

LEARNING OBJECTIVES

- To understand that people diagnosed with Huntington's disease (HD) have experienced damage to particular areas of the brain
- To understand that specialised areas of the brain perform certain tasks

CURRICULUM LINKS

- KS4:** Human health is affected by a range of environmental and inherited factors, by the use and misuse of drugs and by medical treatments
- KS4:** the use of contemporary scientific and technological developments and their benefits, drawbacks and risks
- KS4:** to consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

Activity

- Introduce that Huntington's disease is a genetic condition and that over time significant areas of the brain are damaged, which causes the symptoms
- Show the film Luke's story on www.genesareus.org
- Give pupils the worksheet and ask them to complete the questions

ANSWERS

1. What is a brain cell otherwise known as?

b) neuron

2. Name a key role of these two brain areas:

a) The cortex

Controlling personality/who we are (the cortex has a huge number of roles – essentially, everything that requires any kind of thought involves the cortex, but personality is a particularly 'stand-out' feature)

b) The basal ganglia

Crucial for ensuring smooth, co-ordinated movements

3. Like HD, Parkinson's disease (PD) also affects people's movement – which part of the brain does that suggest is damaged in PD?

Basal ganglia

4. Think about having a conversation. Break down the steps that your brain might take and think about how many different parts of the brain might be needed.

- hearing words (auditory cortex)
- comprehending words (Wernicke's area)
- thinking about saying a word (Broca's area)
- saying a word (motor cortex)

So [at least] four distinct areas of the brain are needed to have a conversation (pupils wouldn't be expected to name these different brain areas!).

Note that this is a very simplified model of speaking and other processes/brain areas are also involved.

5. What problems did performing lobotomies cause?

Serious changes in individuals' ability to display emotion – for example, inability to empathise, feel happy or sad and so on.

6. Why do you think lobotomies were used so widely?

At the time, this was the only course of action available to doctors – drugs, such as anti-depressants and so on, had not been discovered/invented. When doctors performed the procedures they genuinely believed they were doing good. Their reports on the patients following the lobotomies were usually positive, stressing that the patients' original problems were often alleviated. With the benefit of hindsight it is easy to say the procedures should not have been carried out, but it is interesting to think what current medical practices might be considered barbaric in 50 or 100 years time.

ANSWERS

continued

7. Complete the table below:

Statement	True or false
People can survive after damage to a large part of their brain	True
Scientists understand exactly how the brain works	False
The cortex is the smallest part of the brain	False
Each of us has billions of brain cells	True
The same area of the brain controls speaking and understanding language	False
Different areas of the brain have different functions	True
Drugs can be used to treat neurological conditions	True

8. If treating someone with a neurological condition involves changing their personality, is it ethical to treat them? Explain your answer.

Currently, conditions such as depression and anxiety are not considered the 'usual' state of being for affected individuals. Although they are not always considered so, they are not so different from an infectious disease in that they represent a part of the body that is not working properly. It can be argued that not treating such a condition is as inconsistent as treating it, given that when a person is in that state they are not 'themselves'.

FURTHER information

- 'The brain from top to bottom' is an excellent introduction to neuroscience. It offers explanations at beginner, intermediate and advanced levels <http://thebrain.mcgill.ca>
- 'Your amazing brain' has a range of engaging facts about the brain, as well as surprising optical illusions and online tests www.youramazingbrain.org
- For further information about Huntington's disease the website created by the Huntington's Disease Youth Organization is fantastic and provides extensive information on the condition in a style suitable for teenagers <http://en.hdyo.org/you>

FOR MORE RESOURCES GO TO WWW.GENESAREUS.ORG

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THE MYSTERIOUS BRAIN

Huntington's disease (HD) is a genetic condition that damages specific parts of the brain. Neurological conditions such as HD, but also Parkinson's disease and Alzheimer's disease, damage specific areas of the brain and therefore have predictable symptoms.

People affected by HD mainly experience damage to two important parts of the brain: the cortex and the basal ganglia. In humans, the cortex is the single biggest part of the brain. It does all the complex 'higher' things that make us human – like language, thinking and giving us our personality. The basal ganglia are involved in controlling movement, when they are damaged movement is affected; HD patients very often have tremors and find co-ordinating movements difficult.

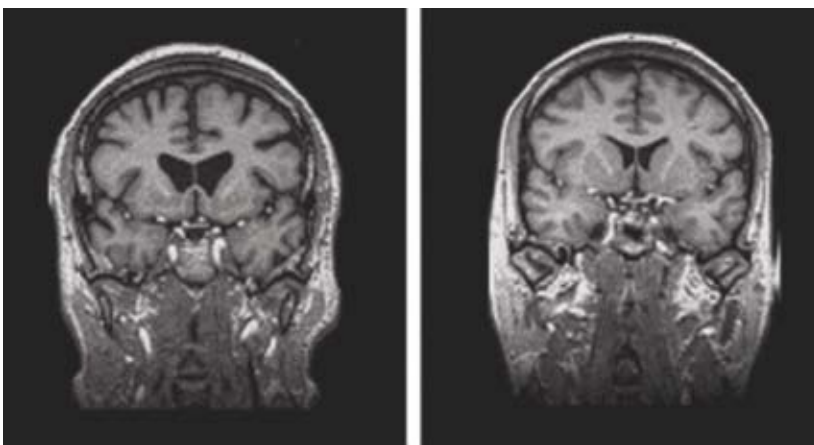


Figure 1

The left hand picture is of the brain of a person with HD; the right hand picture is of the brain of a healthy person. The cortex is on the outside (the area that looks like a walnut, just underneath the skull) and is clearly smaller in the person with HD.

Image © American Journal of Psychiatry

Large changes in the structure of the brain itself, such as happens in HD, cannot be reversed. At best, some drugs can help treat the symptoms, but once the brain cells are lost there is currently no way of replacing them: they are lost forever and the damage is permanent.

- 1** What is a brain cell otherwise known as?
- a) cortex
 - b) neuron

- 3** Like HD, Parkinson's disease (PD) also affects people's movement – which part of the brain does that suggest is damaged in PD?

- 2** Name a key role of these two brain areas:
- a) The cortex
 - b) The basal ganglia

Although very distressing for affected individuals, we can learn about the brain when specific areas are damaged and patients experience distinct symptoms. The brain is immensely complicated and there are still many mysteries surrounding the way it works.

In 1848 the worlds of railway construction and neuroscience collided. An American railroad worker called Phineas Gage was packing some explosive powder with an iron rod that was about 3cm in diameter and over a metre long. Unexpectedly, the powder exploded, sending the rod through his head, passing through his brain. The rod entered the skull on the left side of his face, passed behind his left eye and exited through the top of the skull. Yet, miraculously, Gage survived.

The rod damaged part of his brain called the left frontal lobe, which is part of the cortex. People's accounts vary about Gage, but many reports from the time say that after the accident he was angrier and swore a lot more. Nonetheless, he regained many skills, such as walking and talking, and lived for many years

THE MYSTERIOUS BRAIN

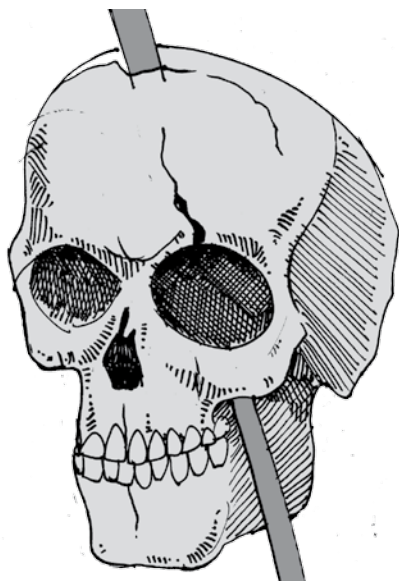


Figure 2 Shows the position of the iron bar and the scale of the injury to Phineas Gage.

after the accident. Shortly after Gage's accident a French doctor called Paul Broca examined the brain of a patient nicknamed 'Tan'; so-called because he could only say the word 'tan'. What was notable about Tan was his ability to fully understand language, combined with an inability to speak properly. When Tan died, Broca investigated his brain and discovered an area that was damaged. By looking at the brains of other people with a similar condition, Broca showed that a particular part of the brain is responsible for speaking words. Damage to Broca's area affects an individual's ability to speak, but not to understand words.

4 *Think about having a conversation. Break down the steps that your brain might take and think about how many different parts of the brain might be needed.*

As recently as the mid 20th century doctors thought that individuals suffering from a range of mental illnesses, but particularly severe depression, anxiety disorders and schizophrenia, could be 'cured' using a procedure called a lobotomy. In 1945 the procedure for a lobotomy involved inserting a thin metal rod under the top eyelid and hammering it through the thin bit of bone at the back of the eye, into the brain. Inside the brain the wire was then moved around in a precise way, severing the connections between the front of the frontal lobe and

the rest of the brain. Lobotomies were typically successful in alleviating some of the symptoms associated with their conditions. However, they had the devastating side effect of removing all emotion from the patient. These are no longer performed, but thousands were carried out at one point in history.

5 *What problems did performing lobotomies cause?*

6 *Why do you think lobotomies were used so widely?*

7 *Complete the table below:*

Statement	True or false
People can survive after damage to a large part of their brain	
Scientists understand exactly how the brain works	
The cortex is the smallest part of the brain	
Each of us has billions of brain cells	
The same area of the brain controls speaking and understanding language	
Different areas of the brain have different functions	
Drugs can be used to treat neurological conditions	

8 *If treating someone with a neurological condition involves changing their personality, is it ethical to treat them? Explain your answer.*

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