

GCSE Biology B (Twenty First Century Science)
J257/04 Depth in biology (Higher Tier)

Question Set 17

1 Huntington's disease is caused by a faulty allele of a single gene.

(a) The allele that causes the disease is dominant. The other allele is recessive.

A couple are planning to have a baby.

- The female's genotype is heterozygous dominant.
- The male's genotype is homozygous recessive.

Complete the Punnett square to show the predicted proportion of their offspring that will have Huntington's disease.

	h	h
H	Hh	Hh
h	hh	hh

Proportion of offspring with Huntington's disease = 50% [2]

(b) Give **two** reasons why a Punnett square **cannot** be used to predict most of a person's features.

- Lethal alleles can cause death before birth thus the distribution of phenotypes would be different.
- A single feature can be determined by multiple genes and the effect of each gene can be graded.
- There is a potential chance of mutation leading to feature not inherited from the parents.

(c) When a person has Huntington's disease, neurons in their brain start to die. The person becomes confused. Eventually they cannot control their body movements and cannot speak.

(i) Explain why it is difficult to investigate brain function in a person with Huntington's disease. [2]

It causes damage to certain brain cells.

(ii) The neurons that make up the brain cannot undergo mitosis.

Explain what this means, and therefore why the brain damage caused by Huntington's disease does not heal. [2]

These neurones cannot divide and produce new neurones. The number of healthy neurones would go down.

(iii) Doctors hope to use embryonic stem cells to treat the brain damage caused by Huntington's disease.

Explain how stem cells can be used for this type of treatment. [2]

They can differentiate into any cell including neurones. Thus damaged neurones can be replaced with new neurones.

(iv) Discuss risks and ethical issues associated with this type of treatment. [2]

- Using embryonic stem cell involves destroying potential life/human thus this may violate the human right of embryo.
- Stem cell could be used in human cloning causing risk of generation of human embryo in the lab. This may raise ethical concerns.

(d) The allele that causes Huntington's disease contains instructions to make a protein that kills neurons in the brain.

Scientists have developed a drug that destroys the mRNA made from the instructions in the allele. This prevents the brain damage caused by Huntington's disease.

(i) Explain how the drug prevents the brain damage caused by Huntington's disease. [3]

Drug breaks down the mRNA preventing mRNA from being translated ^{fully} in the ribosomes. The protein which damages the brain would not be formed thus preventing brain damage.

(ii) The drug is injected into the patient's blood.

Give two reasons why the drug must be able to move through cell membranes but does not need to enter the cell nucleus. [2]

- To destroy mRNA which are present in cytoplasm as they are going to be translated if not destroyed.
- To prevent the drug from bonding e.g. DNA in nucleus and causing damage.



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