GCSE Biology: The application of knowledge to unfamiliar contexts

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In the new 9-1 Biology GCSE exams there will be a much greater emphasis on how to _**apply**_ what you have learnt to something completely new and unfamiliar. These are some of the toughest questions in the exams. In this blog we go through a few examples and show you strategies for answering this type of question.

The first step in application questions is always to _identify the part of the course that the question relates to_. Then show off what you know about this topic, while ensuring your answers are _relevant_ to the question. Remember to include key words and relevant information from the question itself.

Stem Cells

'Alzheimer's disease causes memory less and is the result of neurones in the brain degrading. Explain how stem cells could be used to treat this disease'.

At first sight, you might think, "How can I answer this, I know nothing about Alzheimer's disease?!" Well, you may not have covered the disease, but you *have* learnt about stem cells. The key words in the question are *stem cells*.

Two alternative answers are:

- *Embryonic stem cells* can be removed from a blastocyst or spare IVF embryo, allowed to divide and differentiate into neurones and then injected into the body/brain to replace the neurones that have degraded.

- *Therapeutic cloning* could be carried out to make an *embryo* with the same DNA as the patient. These *stem cells* can be encouraged to become neurones and then injected into the body/brain to replace the neurones that have degraded.

Regardless of the alternative you use, it's important to refer to stem cells, to state the tissue or organ type you need to create for the treatment and to describe how you would get these cells into the patient.

If the disease given in the question is a blood disease such as leukaemia, then adult stem cells from bone marrow can be used instead. These are simply removed from a donor's bone marrow (in their hip using a long needle) and injected into the patient's blood.

Cell transport

'Below is a table that compares the absorption of two sugars in the small intestine. However, one small intestine has been poisoned with cyanide, a gas that prevents respiration. Use your knowledge of cell transport to explain these results'.

Sugar	Relative rate of absorption	
	Normal small intestine	Poisoned small intestine
X	0.50	0.51
Y	0.95	0.15

The key words in this question are <u>cell transport</u>. But what type of cell transport is it? Osmosis, diffusion or active transport?

First, we can rule out osmosis as it involves water, not sugar. Then the question also tells you that cyanide prevents respiration. It's *active* transport that we're looking for here, because it's active transport that relies on the energy transferred in respiration to move substances against their concentration gradient.

Once you've made that connection, you can apply it to the data. Sugar X had similar absorption rates with or without cyanide, so the absorption of this sugar must be *passive* transport and therefore *diffusion*. But Sugar Y had a significant reduction in the absorption rate in the small intestine that was poisoned by cyanide. This means that the absorption of Sugar Y occurs by *active* transport. As the cyanide prevented respiration, no active transport could take place and less absorption occurred.

Exchange surfaces

'Fish and amoeba both live in water. Fish have gills to obtain dissolved oxygen, while amoeba, single-celled organisms, do not. Explain the similarities and differences between the exchange systems of fish and amoeba.'

The key words in this question are *exchange systems*. You need to apply the features of exchange surfaces that increase diffusion, which include large surface area, moist surface (a given, as both creatures are aquatic) rich blood supply and small diffusion distance. Amoeba have a large surface area to volume ratio, which means they benefit from a small diffusion distance and do not need a sophisticated *exchange system* like the gills of fish. The complex system of gills increases the surface area for oxygen absorption but this is also coupled with a rich blood supply to transport the oxygen around their multicellular bodies.

Natural selection

'The African elephant is a modern descendant of the smaller, trunkless and now extinct Phiomia. Like elephants, Phiomia had to reach up to trees to get food. Explain how the modern African elephant evolved from Phiomia'

As you know from your course, evolution occurs through natural selection, a process which is based on the variation within a species. Variation means that some *Phiomia* would have had longer noses than others. As the environment changed and food in trees became higher and higher, those *Phiomia* with longer noses were able to reach more food. (You are informed in the question that both organisms feed this way so mention it in your answer). Those *Phiomia* which could reach more food survived, reproduced and passed on alleles for longer noses. Eventually, over time this nose evolved into a trunk.

Inherited diseases

In a question about inherited diseases you may be asked to draw a genetic diagram or Punnet square, or even to interpret a pedigree diagram. These questions, the most important thing to know is whether or not the disease is caused by a *recessive* or a *dominant* *allele*. If the allele is recessive, two copies are required to have the disease, but if the allele is dominant only a single copy of the allele will cause the disease. Once you know which type of allele is involved, these application questions are generally straightforward.