

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

Question Set 11

(a) Red blood cells are made from adult stem cells in the bone marrow.

(i) A stem cell divides by mitosis to make red blood cells.

Mitosis is one stage of the cell cycle. The other stage is interphase.

Complete the table to describe three things that happen during each stage of the cell cycle.

Interphase		Mitosis	
1	The cell grows larger	1	The nuclear envelope breaks down
2	DNA is replicated	2	The nucleus divides
3	Organelles are synthesised.	3	The cell divides

[3]

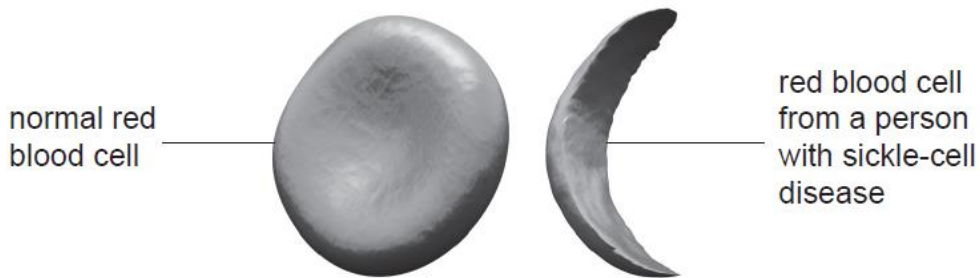
(ii) Explain how a stem cell is able to become a different type of cell.

They continuously undergo cell division. All the genes in a stem cell can be expressed so they can give rise to all types of cell.

[3]

Sickle-cell disease affects the shape of red blood cells.

(b) Look at the picture of red blood cells.



Explain why people with sickle-cell disease often have difficulty in getting enough oxygen to their body tissues.

The blood cells are shaped like crescents so can get stuck in small blood vessels, which can slow or block blood flow and oxygen to parts of the body.

[3]

- (c) Sickle-cell disease is common in regions of the world in which malaria is also common.

Read the information about sickle-cell disease and malaria.

Sickle-cell disease is caused by a faulty allele. It causes pain from a young age but average life expectancy with the disease is 40 to 60 years.

Only people who are homozygous for the sickle-cell allele have sickle-cell disease.

People who are heterozygous do not have sickle-cell disease, and also have some resistance to malaria.

People who are homozygous for the normal allele do not have sickle-cell disease and have no resistance to malaria.

- (i) Use the information to explain why sickle-cell disease is common in regions in which malaria is widespread. [5]

People with sickle cell disease are homozygous for the sickle cell allele and could have no resistance to bacteria. Whereas, those with some level of resistance to bacteria do not have sickle cell disease so malaria does not spread in these populations. Thus the number of people with sickle cell disease and the number of people with malaria (without sickle cell allele) are both decreasing. Whilst, sickle cell allele carriers would be protected against malaria while not suffering sickle cell disease. Hence they will survive and reproduce (due to natural selection). Over time, the number of sickle cell allele increases.

- (ii) Suggest why sickle-cell disease would be less common in these regions if malaria was wiped out. [2]

sickle cell allele no longer provide advantage and protection thus the number of sickle cell would decrease (now disadvantageous) via natural selection.

Total Marks for Question Set 11: 16

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