

CONTROL OF GENE EXPRESSION end of topic questions

1. Scientists carried out a study into the use of stem cells to treat 14 patients with heart disease. The patients were injected with their own stem cells. The injections into the damaged tissue led to improvements in heart contraction within a few weeks

(a) What are stem cells?

Cells that can divide to form other types of cell

(b) Suggest why the patients were injected with their own stem cells?

To prevent rejection or an immune response

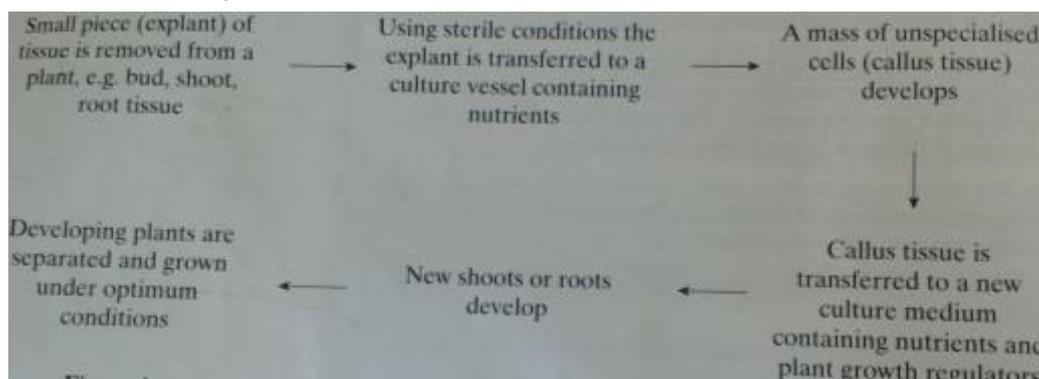
(c) Suggest and explain how the injection of stem cells led to improvements in heart contraction

The stem cells developed into muscle cells with certain genes being expressed

(d) A newspaper reported that this study showed heart disease could be treated successfully using stem cells. Give 2 reasons why the results of this study should be viewed with caution

It was only a small sample size so the study would have to be repeated. The long-term effect is not known and 'improvement' is not quantified.

2. Plant tissue culture is a method used to propagate plants. The flow diagram below shows one method of plant tissue culture.



(a) Name the type of cells division involved in plant tissue culture

mitosis

(b) Give 2 advantages of producing plants using this method rather than from seeds

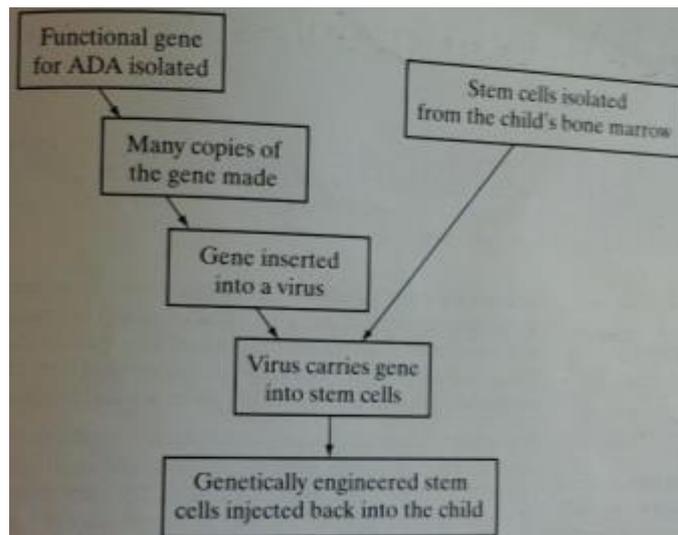
Rapid. Large numbers can be produced. All genetically identical so favourable characteristics can be maintained. Sterile conditions so 'disease free'

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- (c) Callus tissue develops into either shoots or roots depending on the relative concentration of the plant growth regulators used. Explain how these un specialised cells can develop into different types of plant tissue

Cells are totipotent so can develop into any cell type. Different genes are expressed relating to the relative concentration of growth regulators. Different enzymes/proteins determine the tissue formed

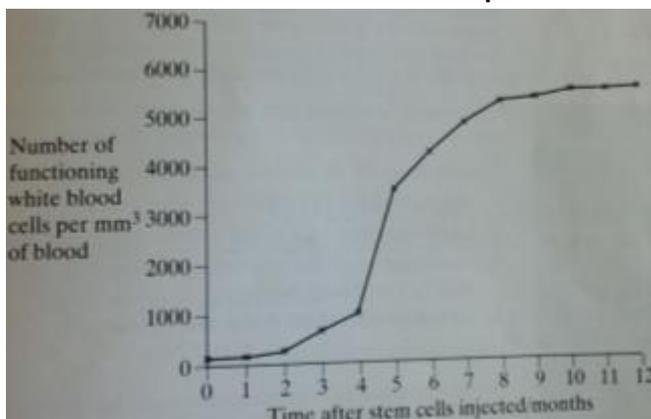
3. Children with severe combined immunodeficiency disorder (SCID) cannot produce the many types of white blood cells that fight infections. This is because they do not have the functional gene to make the enzyme ADA. Some children with SCID have been treated with stem cells. The treatment used is described in the chart below



- (a) Using the information given, suggest and explain 2 reasons why stem cells were used in this treatment

Cells can divide to form white blood cells so restore the ability to fight infections by replacing existing faulty cells. Also it is the child's own cells so there is little risk of rejection

- (b) A child was treated with genetically engineered stem cells. The graph below shows the number of functioning white blood cells in the child during the year following treatment. Children who do not suffer from SCID have between 5000 and 8000 white blood cells per mm^3 of blood. Describe and explain these results



It shows a sigmoid curve. There are few modified cells to start with so mainly non-functional white cells are present. Stem/modified cells replace non-functional cells to form a new population of functional cells. It eventually levels off because the number of white cells reaches to normal level.

4. The hormone oestrogen stimulates some types of breast cancer cells to divide and multiply. Tamoxifen is a drug used in the treatment of breast cancer. It reduces the rate at which breast cancer cells divide.

(a) Tamoxifen acts on cancer cells by binding to oestrogen receptors. Use your knowledge of the role of oestrogen in gene regulation to explain how tamoxifen affects cancer cells

Less oestrogen binds to the receptor so less receptors change shape. Fewer transcriptional factors so less protein synthesis.

(b) Scientists are investigating the use of siRNA molecules to interfere with gene expression in cancer cells.

(i) Describe the structure of siRNA molecules.

Small (20-25 nucleotides) double stranded RNA

(ii) Explain how siRNA molecules interfere with gene expression.

Single stranded siRNA binds to mRNA by complementary pairing. Enzyme breaks down mRNA to prevent transcription of certain genes.