AQA Biology A-level

8.2 - Gene expression is controlled by a number of features

Flashcards

What is a stem cell?

What is a stem cell?

Undifferentiated cells, that can divide indefinitely and turn into other specific cell types.

Name and define the three types of stem cell.

Name and define the three types of stem cell.

1. Totipotent = can develop into any cell type including the placenta and embryo.
2. Pluripotent = can develop into any cell type excluding the placenta and embryo.
3. Multipotent = can only develop into a few different types of cell.

What happens to totipotent cells during embryonic development?

What happens to totipotent cells during embryonic development?

Certain parts of the DNA are selectively translated so that only some genes are ‘switched on’, in order to differentiate the cell into a specific type and form the tissues that make up the foetus.

Give a unique feature of pluripotent cells and the use of this feature.

Give a unique feature of pluripotent cells and the use of this feature.

They can divide in unlimited numbers, and can therefore be used to repair or replace damaged tissue.

What is a unipotent cell? Give an example.

What is a unipotent cell? Give an example.

A cell that can only develop into one type of cell. This happens at the end of specialisation when the cell can only propagate its own type. An example is cardiomyocytes (heart cells).

Which types of stem cell are found in embryos?

Which types of stem cell are found in embryos?

Totipotent and pluripotent.

Multipotent and unipotent cells are only found in mature mammals.

Give some uses of stem cells.

Give some uses of stem cells.

Medical therapies e.g. bone marrow transplants, treating blood disorders.

Drug testing on artificially grown tissues.

Research e.g. on formation of organs and embryos.

How are induced pluripotent stem cells produced?

How are induced pluripotent stem cells produced?

From mature, fully specialised (somatic) cells. The cell regains capacity to differentiate through the use of proteins, in particular transcription factors.

What is a transcription factor?

What is a transcription factor?

A protein that controls the transcription of genes so that only certain parts of the DNA are expressed, e.g. in order to allow a cell to specialise.

How do transcription factors work?

How do transcription factors work?

1. Move from the cytoplasm into nucleus.
2. Bind to promoter region upstream of target gene.
3. Makes it easier or more difficult for RNA polymerase to bind to gene. This increases or decreases rate of transcription.

Give an example of a hormone that affects transcription and explain how it works.

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1. Steroid hormone oestrogen diffuses through cell membrane.
2. Forms hormone-receptor complex with ER α receptor in the cytoplasm.
3. Complex enters the nucleus & acts as transcription factor to facilitate binding of RNA polymerase.

What is meant by epigenetics?

What is meant by epigenetics?

A heritable change in gene function **without** change to the base sequence of DNA.

How does increased methylation of DNA affect gene transcription?

How does increased methylation of DNA affect gene transcription?

Involves addition of a CH_3 group to cytosine bases which are next to guanine.

Prevents transcription factors from binding.

Therefore gene transcription is suppressed.

How does decreased acetylation of histones affect gene transcription?

How does decreased acetylation of DNA affect gene transcription?

Positively-charged histones are positively charged bind to negatively-charged DNA. Decreasing acetylation increases positive charge of histones. Binding becomes too tight and prevents transcription factors from accessing the DNA. Therefore gene transcription is suppressed.

How might epigenetic changes affect humans?

How might epigenetic changes affect humans?

They can cause disease, either by over activating a gene's function (such as in cancer) or by suppressing it.

Give an application of epigenetics.

Give an application of epigenetics.

Treatments of various diseases.

Development of ways to reverse epigenetic changes.

Describe the process of RNA interference, including the organisms in which it occurs.

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RNA molecules act to inhibit gene expression, usually by destroying mRNA so that it cannot be translated. Occurs in eukaryotes and some prokaryotes.

Give some characteristics of benign tumours.

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- Slow growth
- Defined by a clear boundary due to cell adhesion molecules
- Cells retain function and normal shape
- Don’t spread easily
- Easy to treat

Give some characteristics of malignant tumours.

Give some characteristics of malignant tumours.

- Rapid, uncontrollable growth.
- Ill-defined boundary (finger-like projections).
- Cells do not retain function and often die.
- Spreads quickly and easily (metastasis).
- Difficult to treat.

Describe the role of tumour-suppressor genes.

Describe the role of tumour-suppressor genes.

Code for proteins that control cell division; in particular, stopping the cell cycle when damage is detected. They are also involved in programming apoptosis i.e. ‘self destruction’ of the cell.

Explain how tumour-suppressor genes can be involved in developing cancer.

Explain how tumour-suppressor genes can be involved in developing cancer.

A mutation in the gene could code for a nonfunctional protein. Increased methylation or decreased acetylation could prevent transcription.

Cells will divide uncontrollably resulting in a tumour.

Describe the role of proto-oncogenes.

Describe the role of proto-oncogenes.

Control cell division; in particular, code for proteins that stimulate cell division.

Explain how proto-oncogenes can be involved in developing cancer.

Explain how proto-oncogenes can be involved in developing cancer.

Mutation in the gene could turn it into a permanently activated oncogene. Decreased methylation or increased acetylation can cause excess transcription.

This results in uncontrolled cell division and formation of a tumour.

Explain how abnormal methylation of genes can cause cancer.

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Hyper-methylation of tumour-suppressor genes or oncogenes can impair their function and cause the cell to divide uncontrollably.

Explain how oestrogen can be involved in developing breast cancer.

Explain how oestrogen can be involved in developing breast cancer.

We already know oestrogen is an activator of RNA polymerase. Therefore in areas of high oestrogen concentration, such as adipose tissue in the breasts, cell division can become uncontrolled.