

## Section 15.1 – Totipotency and cells specialisation

Some genes are permanently expressed in some cells whereas in other they are “switched off”

Cells that can differentiate into any cell in the body are called totipotent cells

Genes in specialised cells become “switch off” since it would be wasteful to synthesis unnecessary proteins

The ways in which genes are prevented from expressing themselves are:

- Preventing transcription and hence the production of mRNA and polypeptides
- Breaking down mRNA before translation

Only a few totipotent cells exist in mature animals. These are called adult stem cells

Adult stem cells may be found in the inner lining of the intestine, bone marrow and in the skin.

Under certain conditions they can specialise and develop into certain cells

There are also embryonic stem cells that occur in the earliest stage of the development of an embryo

Mature plants have many totipotent cells

Growing cells outside of an organism is called in vitro development

## **Section 15.2 – Regulation of transcription and translation**

### **General principles of preventing gene expression**

For transcription to start, the gene needs to be stimulated by a specific molecule (called a transcriptional factor) that moves from the cytoplasm into the nucleus. Each type of transcription factor has a site capable of binding to a specific region of DNA.

When it binds, transcription can begin and so mRNA forms and thus a polypeptide is synthesised.

An inhibitor molecule can bind to a transcription factor where it would bind to DNA. It therefore blocks the site at which it binds to DNA and so transcription cannot occur.

### ***Oestrogen works as follows***

Oestrogen is lipid soluble and can pass through the phospholipid bi-layer of the plasma membrane into the cytoplasm.

Once inside the cytoplasm it binds to a complementary receptor site on the transcriptional factor molecule.

When it does so the transcriptional factor changes shape and thus releases the inhibitor molecule from the DNA binding site.

The transcriptional factor can now enter the nucleus and bind to a specific region of DNA where it will stimulate transcription.

### **The effect of siRNA on gene expression**

This process involves breaking down mRNA before translation.

siRNA is a double stranded RNA molecule called small interfering RNA.

The process by which it operates is as follows:

An enzyme cuts the large double stranded RNA molecule into two smaller sections called siRNA.

One of the two strands of siRNA now combines with an enzyme.

Since the siRNA molecule has complementary bases to a region of mRNA, it can “guide” the enzyme to the complementary section of mRNA.

Once the enzyme is in the correct position it cuts the mRNA into smaller sections that can no longer be translated.

### ***The uses of siRNA***

Used to identify genes in a biological pathway.

By adding siRNA that can block a particular gene, the effects of the gene can be deduced as a certain function will no longer take place.

siRNA may also be used to block genes that are causing diseases.