2.3.8 Explain how meiosis results in the halving of chromosomes numbers and the introduction of variation through random assortment

The process of meiosis:

- Cell prepares for meiosis just how it does for mitosis.
- There are identical chromosomes pairs.
- Each chromosome then duplicates itself.
- The homologous chromosomes line up on the equator of the cell and then separate.
- Sister chromatids separate and gametes are formed, each with half the number of original chromosomes.

During the process of meiosis, only one chromosome from each homologous pair ends up in each gamete, which is a random process. This is known as random assortment. Furthermore, because the gametes join with another gamete at fertilsation this pretty much ensures variation.

2.3.9 Explain what is meant by stem cells, pluripotency and totipotency

Totipotent is a word used to describe a cell which can develop into any type of cell. Pluripotent is a cell which can only develop into many types of cells but not all, for example, embryonic stem cells. These cells are unspecialised.

As the embryo develops, the cells of which it is made from become increasingly differentiated, that is they become specialised.However, even in adults, some cells retain the ability to give rise to a variety of different cell types, which are known as multipotent stem cells (blood stem cells in bone marrow can develop into red blood cells etc.)

2.3.10 Discuss the moral, ethical and and spiritual implications of stem cell research

Just about everyone agrees that there are no ethical objections to using multipotent stem cells derived from adults. However, most scientists believe that these stem cells are likely to be of less value than the pluripotent cells available from an embryo. Some people believe that the embyro should be granteded full human status from the moment of it's creation. But some people say that as the embryo develops, it increases in it's ability to become a human being, and so early stages of research can be weighed up against the potential benefits of the research.

2.3.11 Explain how genes can be switched on and off by DNA transcription factors and how this gene switching gives rise to specialised cells

As the embryo develops, cells differentiate and become specialised for one function. The function of each cell type is dependent on the proteins that it synthesises. This is determined by which genes in a cell are expressed (that is, the ones which are transcribed and translated to produce the proteins they code for). So what is it that switches on the genes appropriate for a cell's specialised function?

Genes are switched on by succesful formation and attachment of the transcription initiation complex on the promoter region of the DNA. Genes remained switched off by failure of the transcription initiation complex to form and attach to the promoter region, which can be due to the absence of protein transcription factors or the action of repressor molecules.

The technical term for switching on of a gene is called induction.

2.4.7 Compare how William Withering developed his digitalis soup with drug developing and testing nowadays

William Withering had a friend who was showing signs of Dropsy, and who had some of her special tea containing some 20 herbs, one being Foxglove. So, Withering then got his friend to sell him the special tea, so he could investigate the plant properly. One of his patients was a brewer who was suffering from swollen limbs and an irregular heartbeat. After a few doses of Witherings 'digitalis soup', he became healthy and his pulse became more regular. But his next patient died so Withering gave up. But then Withering was persuaded to renew his investigations, and he led onto important research which found that the active ingredient in the foxglove is a single chemical called digitalin.

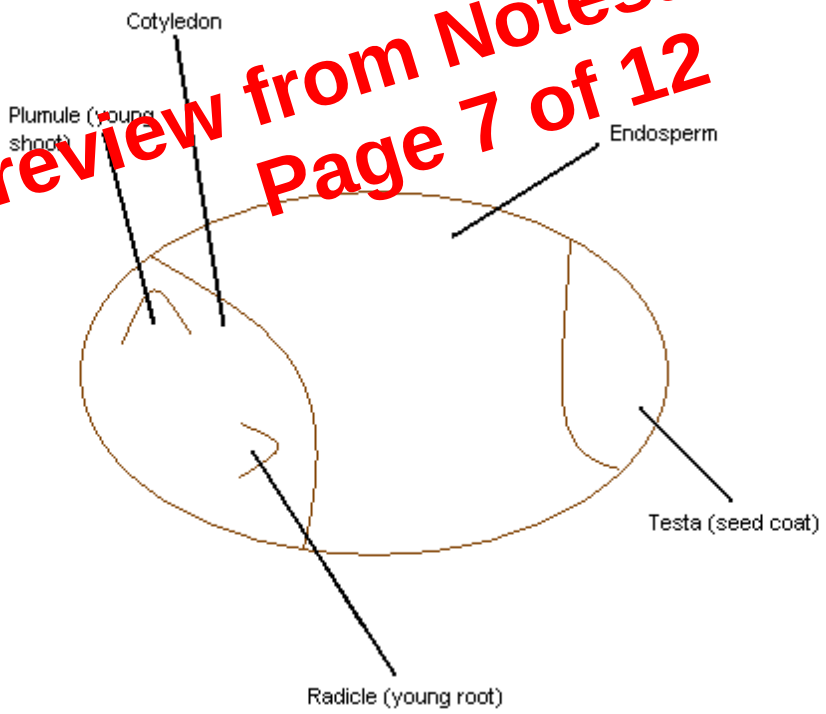
Today, a potetial new drug must pass a series of tests before it is safe to use. It has to be proven to be effective, safe, and capable of making profit.

2.4.8 Relate the structure of seeds to their role in the dispersal and survival of the plant (adaptations for dispersal, protection and nutrition of the embryo)

Seeds are vital to the survival of a plant, they:

- protect the embryo
- aid dispersal
- provide nutrition for the new plant

The embryo develops into three distinct parts- a radicle (young root), a plumule (young shoot) and one or two cotyledons (seed leaves).



In some species, the stored food in the seed remains outsice the embryo in storage tissue called the endosperm. The outer layers of the ovule become lignified forming a tough seed coat (testa) which helps to protect the embryo.