Recap

We previously learnt that genetic information is found in chromosomes in the nucleus, where DNA is packaged in genes. Chromosomes are found in pairs due to one set in each pair coming from each biological parent.

Key Aims

1. *Interphase*
2. *Mitosis*
3. *Cytokinesis*
4. *Mitosis for Growth and Development*

AQA Specification

Cells divide in a series of stages called the cell cycle. Students should be able to describe the stages of the cell cycle, including mitosis.

1.2.2. Mitosis and the Cell Cycle

Cell Cycle

- **The cell cycle is a set of steps that take place in cell division.** The cell cycle is how cells duplicate and divide. Cells need to divide all the time to replace dead cells, for growth and for repair.

- **The length of the cell cycle can vary.** The length of the cell cycle varies between organisms, and depends on the type of cell. Hair follicles, blood, skin and the digestive system lining all have a very quick cell cycle and so divide divide fast.

The cell cycle has three steps:

1. **Interphase** - the cell gets ready to divide. The cell grows, DNA duplicates and more organelles are made.

2. **Mitosis** - the genetic material separates to different ends of the cell, and the cell gets ready to divide into two daughter cells

3. **Cytokinesis** - at the end of mitosis, the cytoplasm and cell membrane split, and two new daughter cells are made.

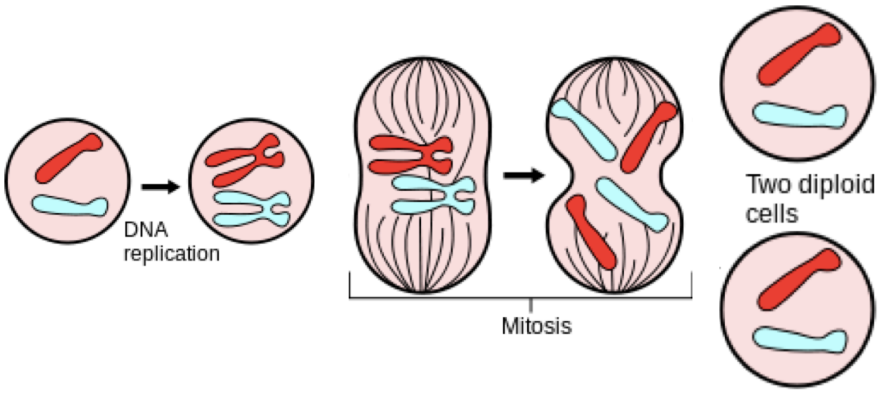

Fig 1. Mitosis. The end result is 2 identical daughter cells.

AQA Specification

During the cell cycle, the genetic material is doubled and then divided into two identical cells.

1. Interphase

Interphase involves DNA replication, cell growth and production of organelles. Interphase is the longest stage

DNA Replication

- **Cells replicate their DNA.** In this stage cells replicate their DNA. This involves the cells growing and forming two copies of each chromosome. At the end of interphase the cell has double the DNA, so that when it finally divides into two cells, each cell gets the normal share of DNA.

AQA Specification

Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria.

Making Organelles

- Organelles are made. Each daughter cell needs the full allocation of organelles, so there is also organelle production in interphase.

- There is an increase in mitochondria. Protein synthesis requires energy. This energy is provided by mitochondria, thus mitochondria are required for cell growth.

AQA Specification

The DNA replicates to form two copies of each chromosome.

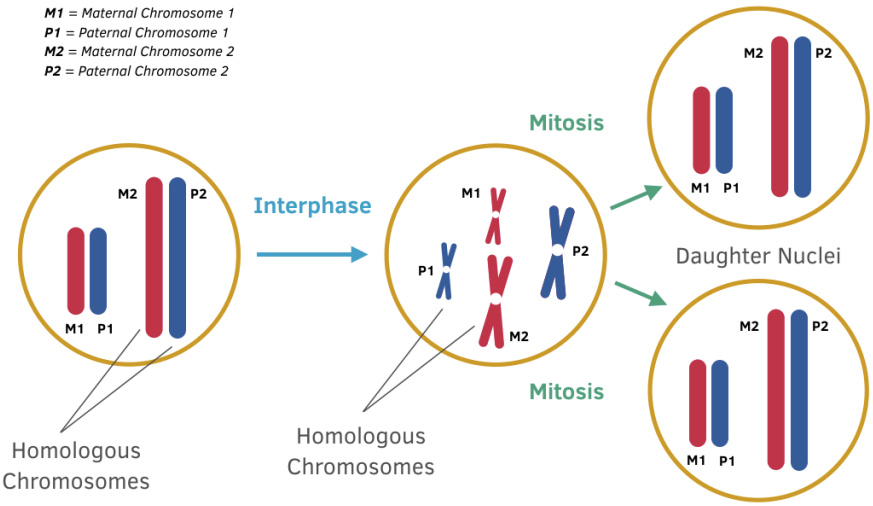

Fig 2. Interphase. During interphase DNA replicates, so the cells produced are genetically identical.

- **There is an increase in ribosomes.** Protein synthesis occurs in ribosomes. Therefore, ribosomes must be made by the original cell,

AQA Specification

In mitosis, one set of chromosomes is pulled to each end of the cell and the nucleus divides

before it can divide into daughter cells, to allow the growth of these new cells.

- **There is also cell growth.** The cell grows, the cell surface membrane extends outwards, and the cytoplasm grows.

2. Mitosis

AQA Specification

Students need to understand the three overall stages of the cell cycle but do not need to know the different phases of the mitosis stage.

Mitosis is defined as the division of the parent cell into two genetically identical daughter cells.

The cell now has double the chromosomes, more organelles and is bigger. It is ready to divide into two daughter cells. This occurs in **mitosis**.

1. **Chromosomes line up on the equator.** When mitosis begins, chromosomes line up on the equator (middle) of the cell.

2. **Chromosomes are pulled to opposite poles of the cell.** The separate ends of the cells are called the poles. The chromosomes are pulled to the poles by spindle fibres.

3. **Two new nuclei form.** New membranes are built around these chromosomes, so they become new nuclei. This means that the nucleus has divided into two.

Study Mind Tip

Many textbooks might go into more detail about the different stages of mitosis (prophase, metaphase, anaphase, telophase), but the AQA specification says that you don't need to know this.

3. Cytokinesis

AQA Specification

Finally the cytoplasm and cell membranes divide to form two identical cells.

- **The final stage involves the formation of new cells**. Two new daughter cells are formed by the division of the cytoplasm and cell membranes to surround the new nuclei formed.

Mitosis for Growth and Development

AQA Specification

Cell division by mitosis is important in the growth and development of multicellular organisms.

- **Mitosis is required to grow.** Cells are constantly growing and dividing. Mitosis allows this to happen, with the formation of identical daughter cells. This is so important in all eukaryote cells and is needed for their growth.

AQA Specification

Students should be able to recognise and describe situations in given contexts where mitosis is occurring.

Study Mind Tip

It is important to understand that mitosis produces two genetically identical daughter cells. They are identical to the original parent cell too. Mitosis of one cell produces two cells, but if you have four cells undergoing mitosis, then eight cells with be produced after one round of mitosis.

Study Mind Tip

How do you get from a fertilised egg to a big multicellular human? Through cell division by mitosis!

- **Mitosis occurs in all eukaryotic cells.** Whenever cell division occurs and two identical cells with copies of both chromosomes are formed, mitosis has occurred. Here are some examples:

  - **Replacing skin cells** - skin cells are constantly damaged when you touch objects, so cells need to be continuously replaced by dividing skin cells underneath the surface layer.

  - **Growth of an organism** - for an organism to grow, its cells need to divide

  - **Asexual reproduction** - a single-celled organism can reproduce by mitosis, producing two daughter organisms.

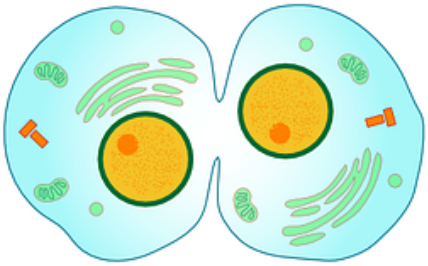

Fig 3. Mitosis. Mitosis occurs in all eukaryotic cells.