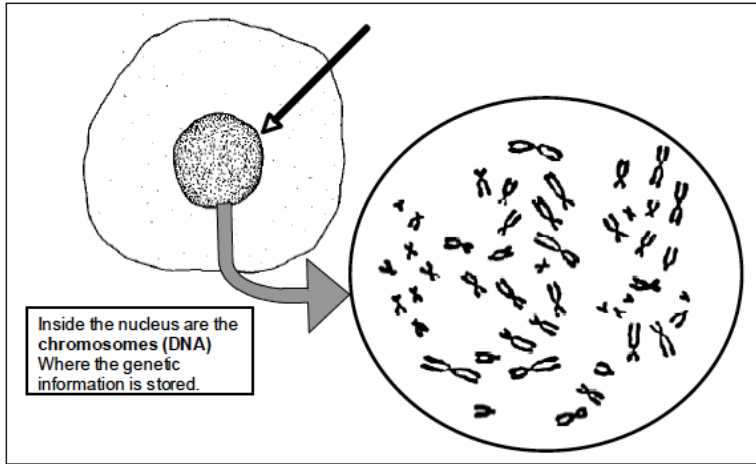


Cell Division and Stem Cells

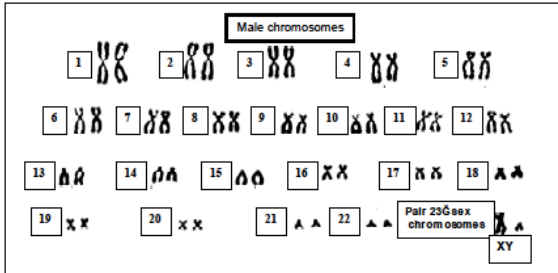
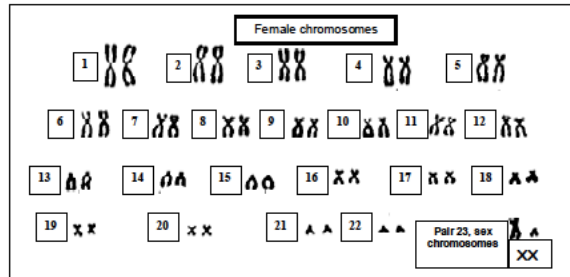
Genetic Information



The genetic information to build your body is inside the **nucleus** of each cell.

In humans, there are 23 pairs of chromosomes.

Chromosomes are arranged by **size** and **shape**.

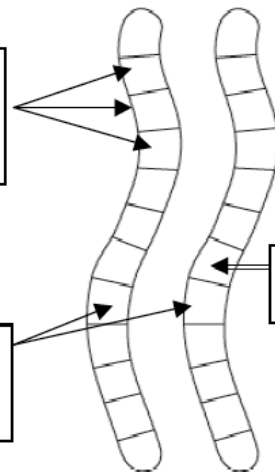


In humans, pair 23 is called the sex chromosomes.

Male = XY
Female = XX

A single chromosome has lots of information on how to build your body. Each bit of information is called a **gene**.

Pairs of genes are found opposite each other at the same position.



In body cells, chromosomes are found in pairs.
Genes are therefore found in pairs.

Different genes control different characteristics.

Genes are arranged in a row along a chromosome.

Cell Division and Stem Cells

Cell Division

1. Mitosis

- This cell division produces **2 genetically identical** cells;
- Each new cell contains **the same number of chromosomes** as the original cell.

Mitosis is needed to:

- Make new cells for **growth** of the body.
- Make new cells to **replace** those that have been **damaged**.
- Make new cells to **replace** those that have **worn out**.

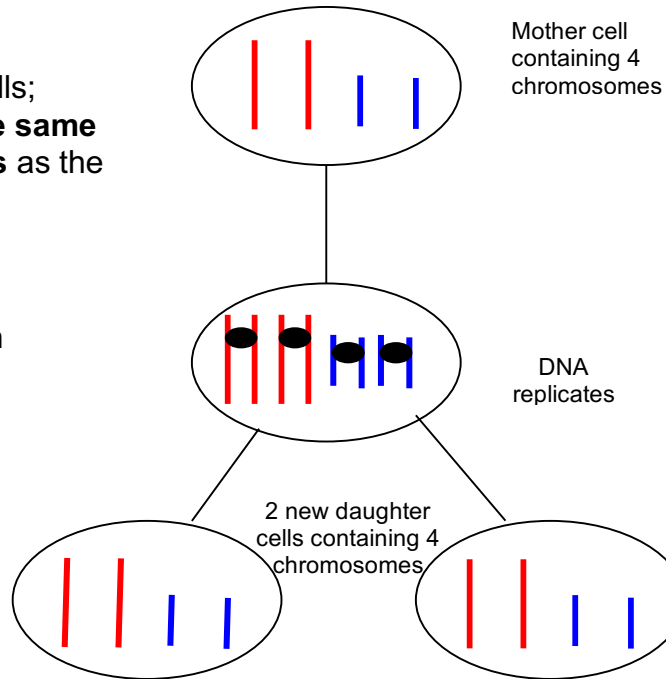


Fig. 1

Mitosis in an organism with 4 chromosomes in a normal cell.

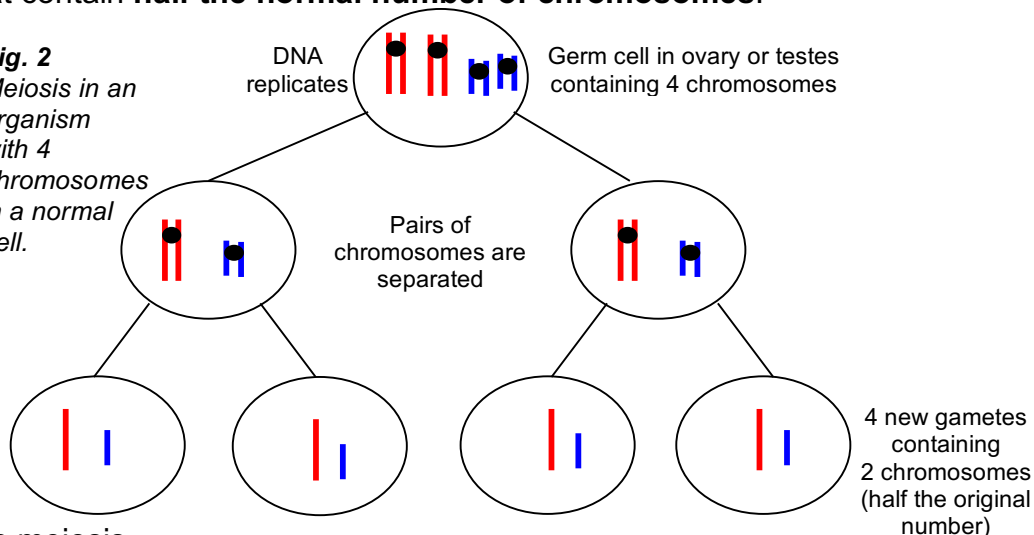
Remember, humans have 46 chromosomes!

2. Meiosis

This cell division produces **4 genetically different** gametes, (sperm or eggs) that contain **half the normal number of chromosomes**.

Fig. 2

Meiosis in an organism with 4 chromosomes in a normal cell.



In meiosis

- Four **gametes** (sex cells) are produced.
- Each **gamete** contains only **one of each pair of chromosomes**, so they only contain **half the chromosome number** of the original cell.

Cell Division and Stem Cells

Comparing Mitosis and Meiosis

Mitosis	Meiosis
Two daughter cells produced.	4 gametes produced.
New cells contain original number of chromosomes.	New cells contain half the original number of chromosomes.
New cells genetically identical to mother cell.	New cells genetically different to mother cell.

*Be careful, **MITOSIS** and **MEIOSIS** have similar spelling, so examiners expect you to spell them correctly!*

What is the link between mitosis and cancer?

Cell division is controlled by genes. If these genes stop functioning correctly, cells can divide without control.

Cancer is a result of uncontrolled mitosis.

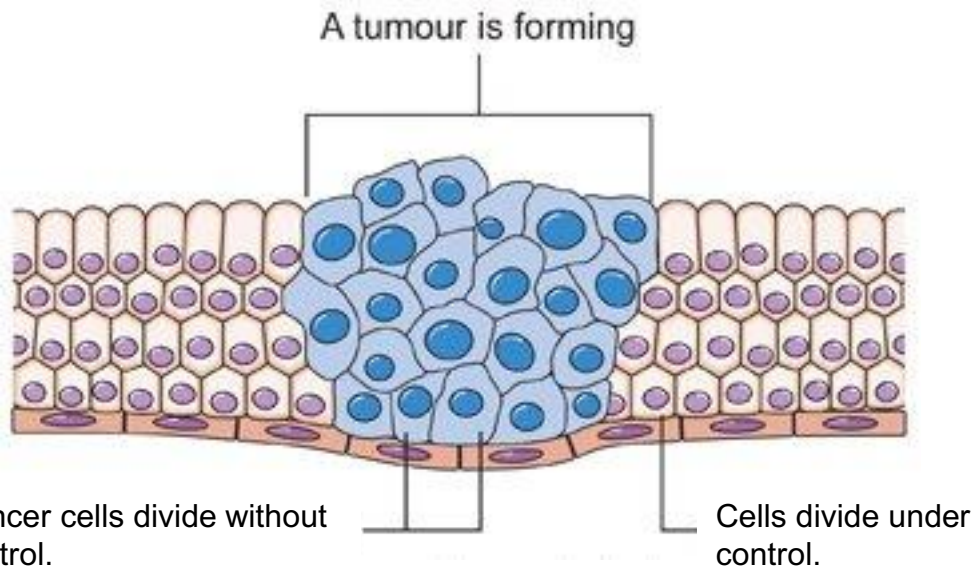


Fig. 1 Illustration of a cancerous tumour developing.

<https://www.pathwayz.org/Tree/Plain/FACTORS+THAT+AFFECT+MITOSIS>

A cancerous tumour is a group of cells growing out of control. The tumour damages the tissues and organs in which they form. If some of the cells from the tumour reach the blood they may be carried to other parts of the body where they will continue to grow and form a new tumour.

Stem Cells

Unspecialised cells which have the ability to develop into other cells.

When tissues and organs start to develop, they form specialised cells, e.g. muscle, skin or liver cells.
Once a cell has specialised, it is unable to change into another type of cell, e.g. you cannot use a muscle cell to try and grow skin cells.

Stem cells retain the ability to differentiate into some different types of cells and therefore have the **potential for producing cells by mitosis to replace damaged tissue.**

Source of stem cells in plants:

- **Meristems** – these are growing points in the **tips** of **shoots** and **roots**.

Sources of stem cells in animals:

- Adult stem cells – e.g. from bone marrow, umbilical cord, babies' teeth.
- Embryonic stem cells – from embryo's left over from *in vitro* fertility (IVF) treatment.

What are the uses of stem cell technology?

- Can lead to the **treatment** or a **cure** for many **diseases**.
- Can be used to **replace damaged tissues**, e.g. trachea

The use of stem cell technology raises many issues, which are summarised below:

Type of stem cell	Advantages	Disadvantages
Adult stem cell	<ul style="list-style-type: none"> • The body will accept the cells so there will be no rejection issues. • No moral or ethical issues involving the destruction of embryos. 	<ul style="list-style-type: none"> • Complicated and the technology is still being developed. • They are unable to differentiate into as many different types of cells.
Embryonic stem cell	<ul style="list-style-type: none"> • Source of cells readily available from <i>in vitro</i> fertility (IVF) treatment. 	<ul style="list-style-type: none"> • Some people believe that destroying embryos means the destruction of potential human life.