Name:..... Class:.....

CELL REPRODUCTION

Domain: 5.8
relates the structure and function of living things to models, theories and laws

23 Pairs of Chromosomes

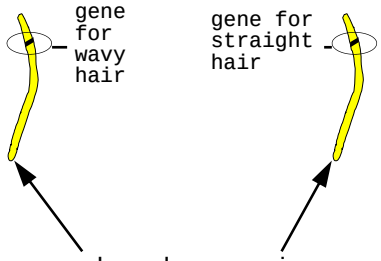
As mentioned, the 46 chromosomes in human body cells are arranged in 23 ***pairs***. One set of 23 chromosomes came from the male parent, and the other 23 from the female parent.

Each pair of chromosomes is known as a ***homologous*** pair. Each homologous pair of chromosomes carry a gene for particular characteristics in the same position on the chromosome. The pair of genes control the characteristic.

Chromosome pairs differ from each other in various ways, such as in size, shape and banding. ***Karyotyping*** is the process of sorting chromosomes into their matched pairs.

Cells have to ***divide***. The DNA is duplicated or ***replicated*** before this happens. The new DNA formed is an exact replica of the original DNA. The chromosome then forms two strands (chromatids), each containing the DNA of the cell.

The diagram shows a homologous pair of chromosomes. The gene on each would be responsible for the same characteristic or trait. For example, the gene for hair shape:



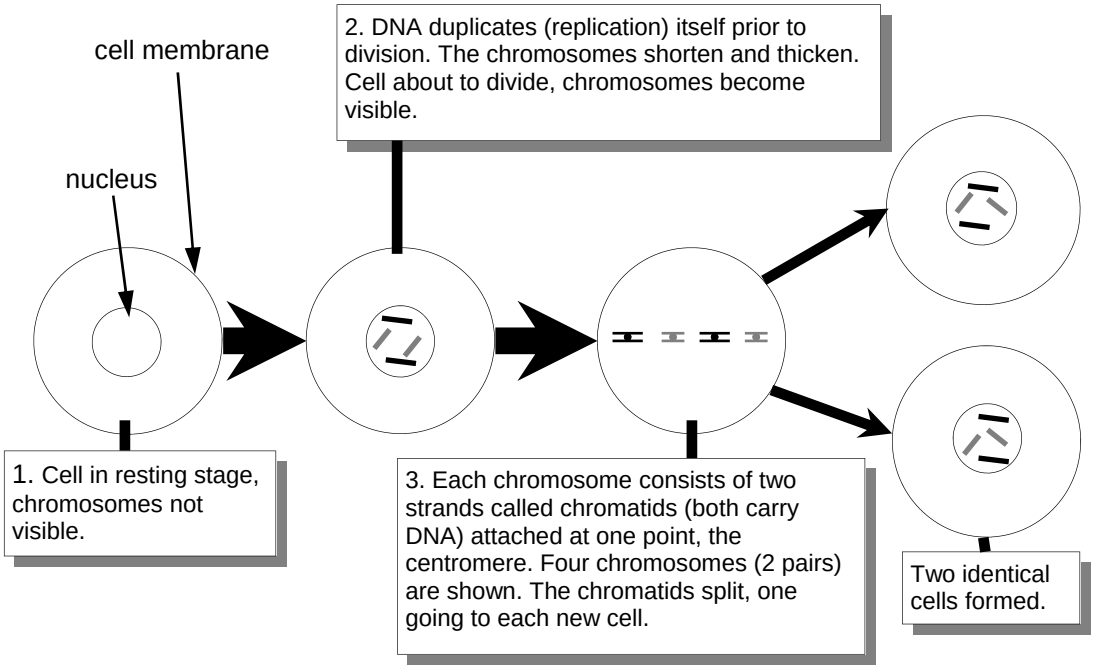
Mitosis

New cells are needed for ***growth*** and to ***replace*** old cells. ***Mitosis*** is a process which provides these cells. In mitosis, a single cell divides to form two new cells. The new cells are exactly the same as the original cell. The original cell is called the ***parent*** cell. The two new cells are called ***daughter*** cells. The diagram below summarises the process of mitosis:

Mitosis is a continuous process which take up to several hours to complete. The important features of mitosis are:

Mitosis:

The diagram shows a cell with four chromosomes undergoing mitosis.



* produces new cells for growth & replacement of old cells * the new cells are exactly the same as the original cell	* the number of chromosomes in daughter cells is exactly the same as the number in the parent cell

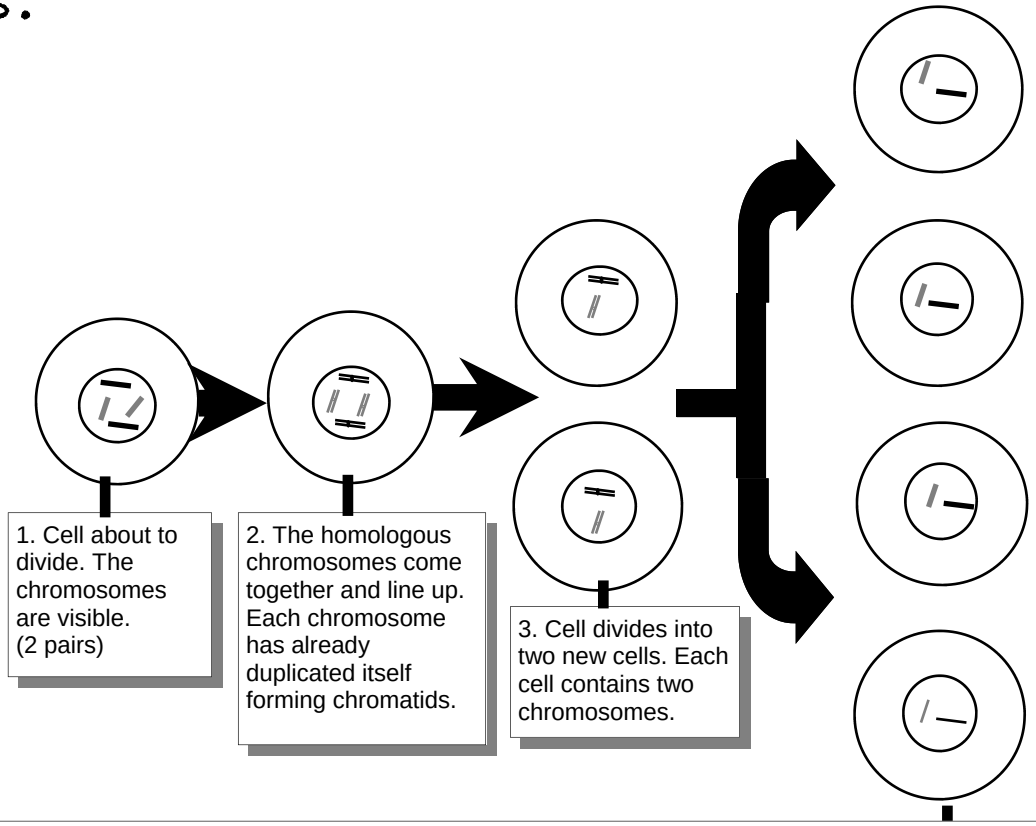
Meiosis

In sexual reproduction, the first cell of the new individual is formed by the ***fusion*** (joining together) of two ***sex*** cells- the male sex cell and the female sex cell. The sex cells are called ***gametes*** and they are produced in the reproductive organs. The male sex cells are produced in the ***testes*** and the female sex cells are produced in the ***ovaries***.

These sex cells are produced by a special process called ***meiosis***. In meiosis, the number of chromosomes is ***halved***. This is necessary because, in fertilisation, ***two*** sex cells join together. If they didn't have half the normal number of chromosomes, the new individual would have twice as many chromosomes as it should have. The diagram below summarises the process of meiosis:

Meiosis:

The diagram shows a cell with four chromosomes undergoing meiosis.



1. Cell about to divide. The chromosomes are visible. (2 pairs)

2. The homologous chromosomes come together and line up. Each chromosome has already duplicated itself forming chromatids.

3. Cell divides into two new cells. Each cell contains two chromosomes.

4. The cells divide again to produce four cells. These are sex cells, each with half the number of chromosomes of the original parent cell. Each new cell contains one of the chromatids from the original chromosomes.

Meiosis is different to mitosis because there is a second division. The important features of meiosis are:

* meiosis produces sex cells or gametes * occurs in testes (male) or ovaries (female) * there are two successive divisions	* the new cells only have half the number of chromosomes of the original parent cell

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CELL REPRODUCTION

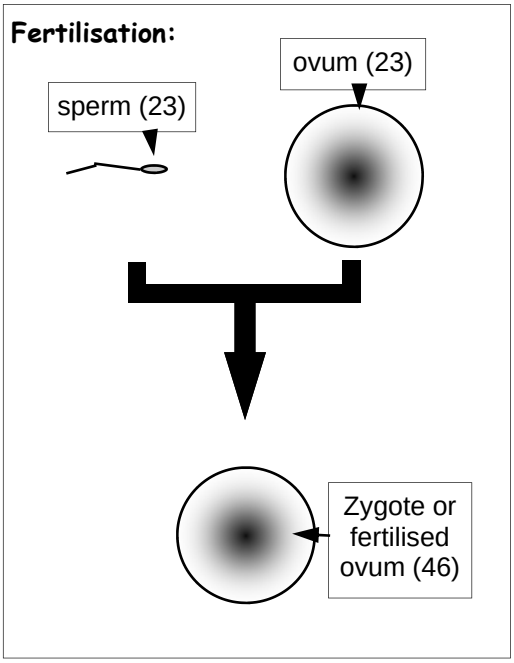
Fertilisation

Fertilisation is the union of a male and female gamete. The new cell formed is called a ***zygote***. The zygote is the first cell of a new individual. It obtains half of its chromosomes from the male parent and half from the female parent. Therefore, a zygote has the ***full*** number of chromosomes.

It is a matter of chance which combination of chromosomes appears in the zygote. Each male gamete (called sperm) and each female gamete (called an ovum or egg) only carries ***one*** of the chromosomes for a particular homologous pair. Each of these chromosomes from the pair may carry different information for a particular characteristic (e.g. eye colour- blue or brown).

In the case of human reproduction, the cells of a baby could contain 70 000 000 000 000 combinations of chromosomes. For this reason, no two children in a family look exactly the ***same*** (except for identical twins).

The diagram summarise the process of fertilisation.



Sex Determination

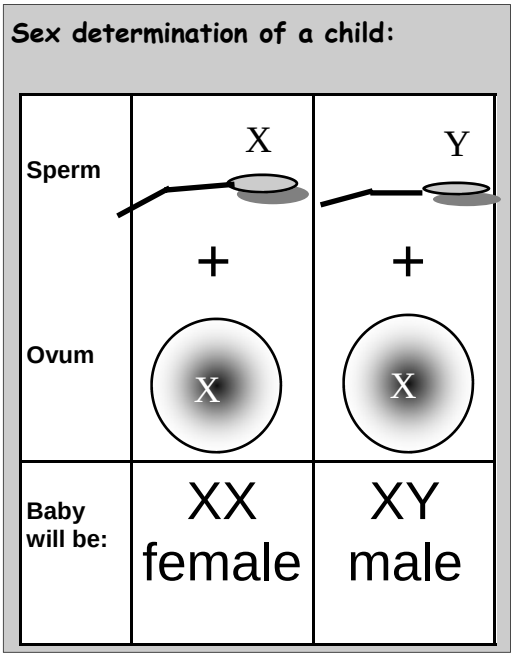
Humans have 23 pairs of chromosomes. One of these pairs is responsible for determining the ***sex*** of an individual.
They are called the *sex chromosomes*. They are identified as X or Y.
A male has the combination:

XY →

A female has the combination:

XX →

The sex of a new individual is determined by the ***father***. This is because the sperm can carry either an X or a Y chromosome. The ovum can only carry an X chromosome.
Thus, if fertilisation takes place and the sperm is carrying a Y chromosome, the child will be a ***boy***. If the sperm is carrying an X chromosome, the child will be a ***girl***. The diagram opposite summarises this.



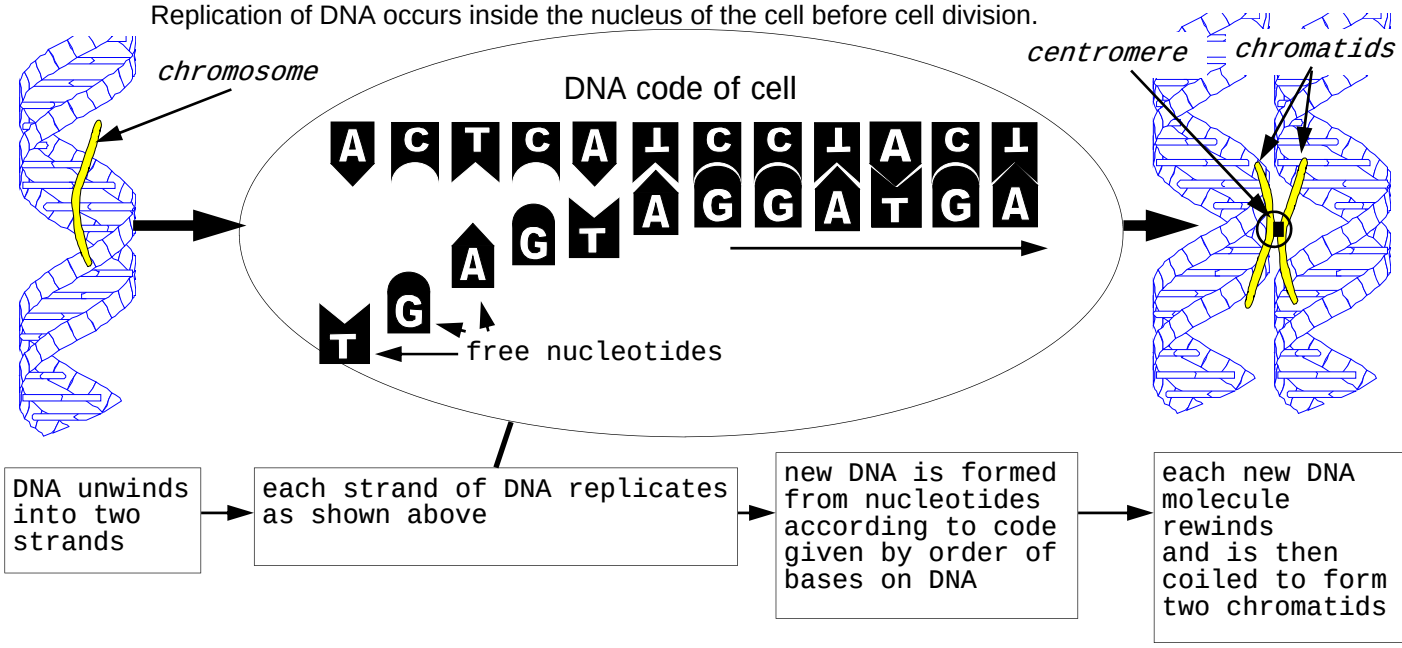
Haploid vs. Diploid

Two important terms used in the study of cell reproduction are:

- *Haploid*- half the full set of chromosomes for an organism; 23 for humans.
- *Diploid*- the full set of chromosomes for an organism; 46 for humans.

Replication of DNA

Replication of DNA occurs inside the nucleus of the cell before cell division.



Questions:

1. How many chromosomes are in the body cells of humans?
2. What does homologous mean in relation to chromosomes?
3. Complete the sentence: “a homologous pair carry a gene for a particular characteristic in the same _____ on the chromosome”.
4. What is karyotyping?
5. What happens to the DNA in the nucleus of a cell before it divides?
6. What are chromatids?
7. Why are new cells needed by an organism?
8. The following questions are about mitosis:
   (a) Are chromosomes visible in the resting stage? (b) What does each chromosome do before dividing?
   (c) Are the new cells formed the same as the original cell? (d) What is the original cell called?
   (e) What are the new cells called? (f) What happens to the number of chromosomes in mitosis?
9. What are sex cells called?
10. Copy and complete the table:

Type of sex cell:	Where are they produced?
Male	
Female	

11. Why do sex cells have to have half the number of chromosomes of normal body cells?
12. Answer the following questions about meiosis:
    (a) After duplication, what happens in meiosis? (b) What happens in the second division of meiosis?
    (c) What happens to the number of chromosomes in meiosis?
13. Why is mitosis different to meiosis?
14. What is fertilisation?
15. What is the first cell of a new individual called?
16. What is a male sex cell called?
17. What is a female sex cell called?
18. Complete the sentence: “replication occurs so that each chromatid has its own _____”.