

# EB Education Revision Guide



How to work with Reproduction and Cell Division



# Reproduction

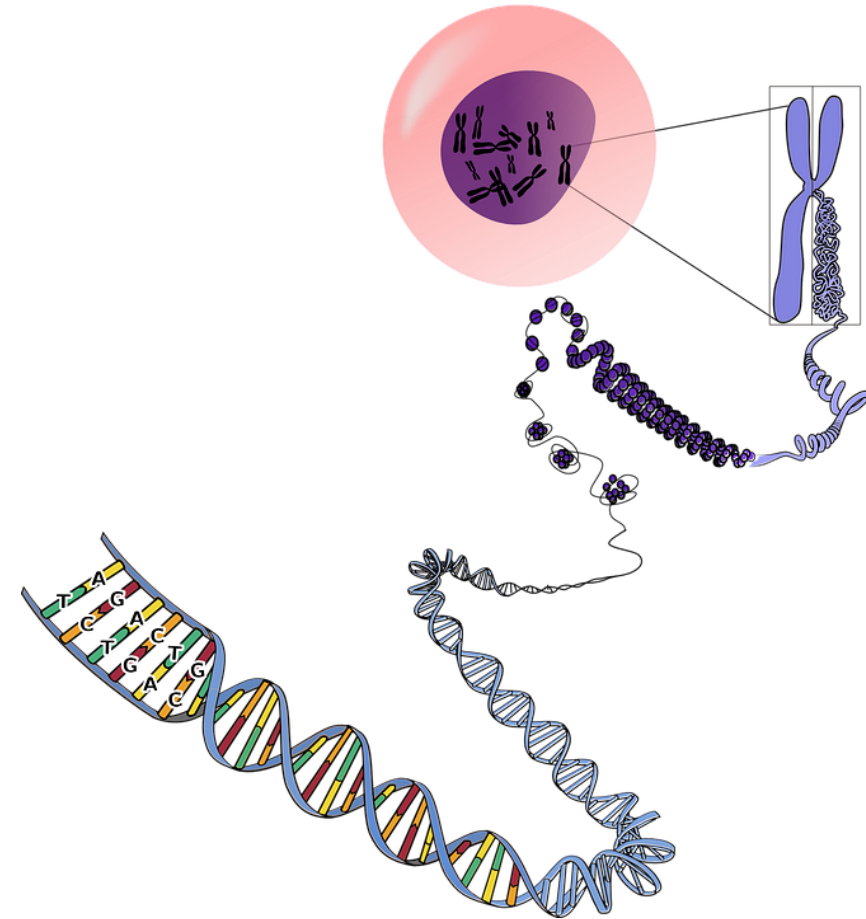
## Types of reproduction

There are two types of reproduction, asexual reproduction and sexual reproduction.

All living organisms reproduce – this is how genes are passed on. Some use asexual reproduction (e.g. bacteria), some sexual reproduction (e.g. humans) and some can use both (e.g. plants).

When cells reproduce asexually they divide by **mitosis**. The daughter cells are genetically identical to each other and the parent.

Sexual reproduction involves cells dividing by **meiosis**. This results in genetically different gametes.



# Asexual Reproduction

## Advantages

- When organisms reproduce asexually, they can produce large numbers of offspring very quickly. For example, bacteria can divide and double their population every 20 minutes.
- Only 1 parent is required to reproduce asexually. This means that reproduction can happen whenever the conditions are favourable, without a mate having to be found.

## Disadvantages

- The offspring are all genetically identical. If there are any changes in the environment which are unfavourable, the whole population will be affected. For example, if a disease infected a genetically identical population, no individuals would be resistant.

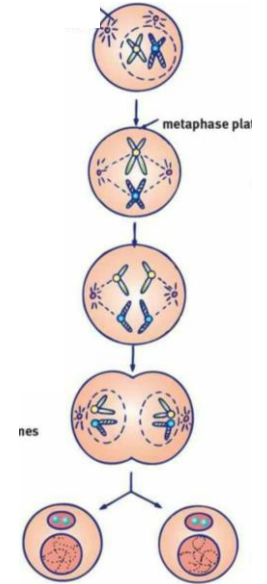
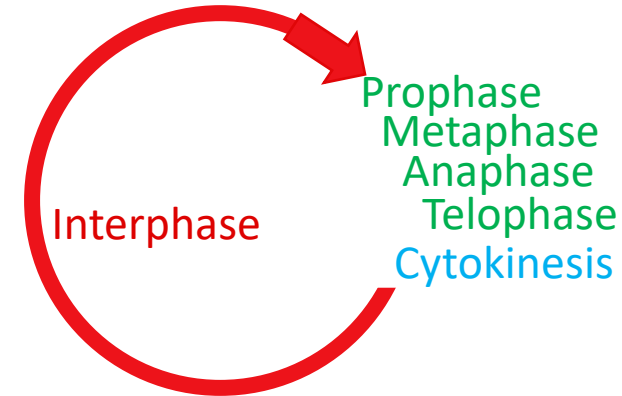
# Mitosis

## What is the cell cycle?

Body cells have 2 copies of each chromosome, one from the mother and one from the father – they are known as diploid cells.

Humans have 23 pairs of chromosomes (46 chromosomes in total).

When cells divide by mitosis, two identical daughter cells are made, with the same number of chromosomes as the parent cell.



The diagram above shows the cell cycle. The cell cycle makes new cells for growth and repair.

Some organisms use mitosis to reproduce asexually.

# Mitosis

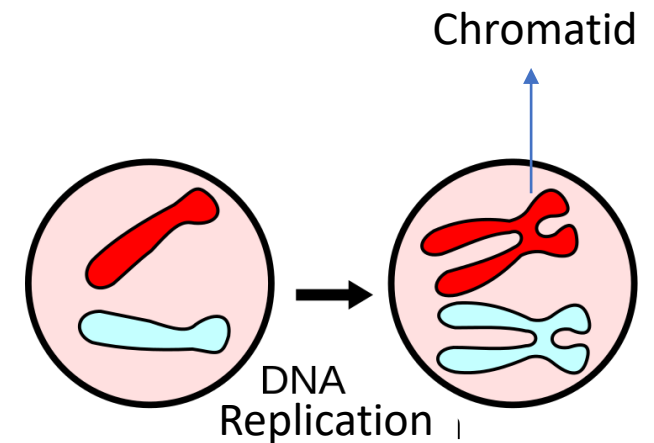
## Interphase

Before the cell undergoes mitosis and divides, there is interphase.

At this stage, the DNA is spread out in long strands in the nucleus.

Before it can divide:

- The cell grows and increases the number of subcellular structures, like ribosomes and mitochondria.
- The DNA is duplicated to provide a copy for each new cell. It is copied and forms X-shaped chromosomes (each chromatid is an exact copy of the other)

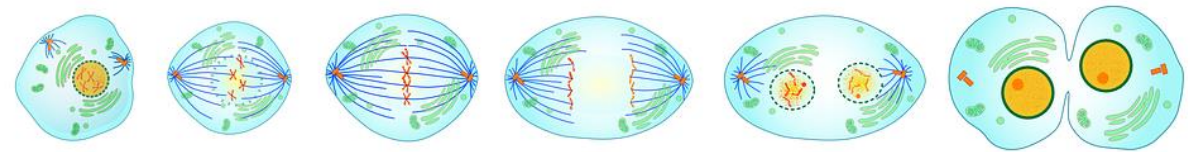


# Mitosis

## Stages of mitosis

Mitosis is divided into four stages.

- 1) **Prophase** – the chromosomes condense and the membrane around the nucleus breaks down.
- 2) **Metaphase** – the chromosomes line up along the centre of the cell.
- 3) **Anaphase** – a spindle pulls the chromatids apart –so one from each chromosome goes to the opposite ends of the cell.
- 4) **Telophase** – membranes form around each of the new sets of chromosomes, to become nuclei. The cytoplasm and cell membrane divide – and form two separate cells. This is called **cytokinesis**.



Mitosis produces:

- Two daughter cells
- Genetically identical cells (clones)
- Diploid cells

# Sexual Reproduction

## What is it?

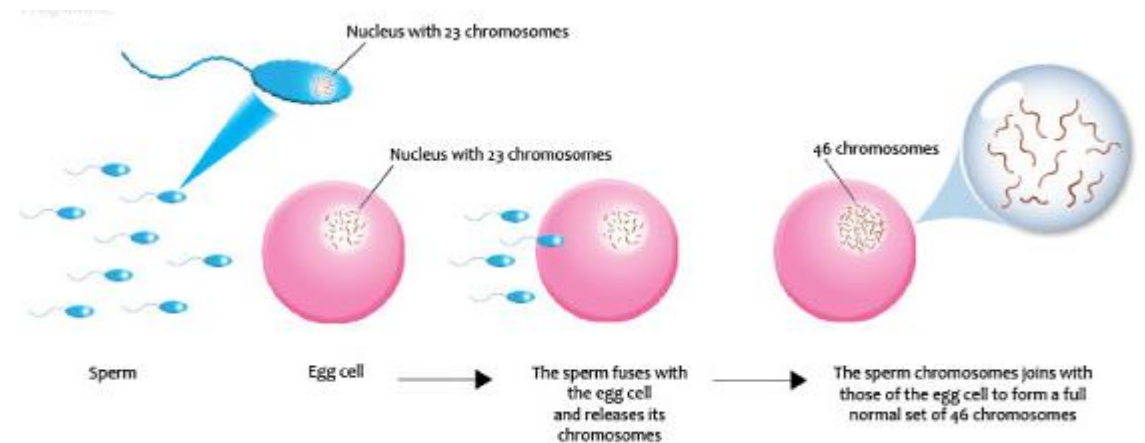
Sexual reproduction involves two parents and results in offspring which are genetically different to the parents.

The father and the mother produce gametes (sex cells) by meiosis. In animals these are known as sperm cells and egg cells.

Gametes are **haploid** cells. They only contain half the number of chromosomes as body cells. In humans, sperm cells and egg cells contain 23 chromosomes each.

Fertilisation happens when the nucleus of a male gamete fuses with the nucleus of female gamete. The resulting fertilised egg is known as a **zygote**. The zygote will then have a full set of chromosomes so is diploid.

When the zygote divides – it will be by mitosis and it will develop into an embryo



# Sexual Reproduction

## Advantages

- Sexual reproduction creates genetic variation in a population. This means there will be variation between individuals and they will have different characteristics. If there is a change in the environment, it is more likely that some individuals will have the characteristics required to survive the change.
- Over a long period of time this can lead to natural selection and evolution, as organisms become better adapted to the environment.

## Disadvantages

- Sexual reproduction requires two parents – some organisms, such as polar bears, live alone so may need to travel long distances to find a mate.
- Organisms need to invest more time and energy to reproduce sexually, they need to find and attract mates. Therefore fewer offspring are produced.



## Stages of meiosis

Meiosis only happens in the reproductive organs (ovaries and testes) and produces gametes.

- DNA is duplicated, each chromatid is an exact copy of the other.

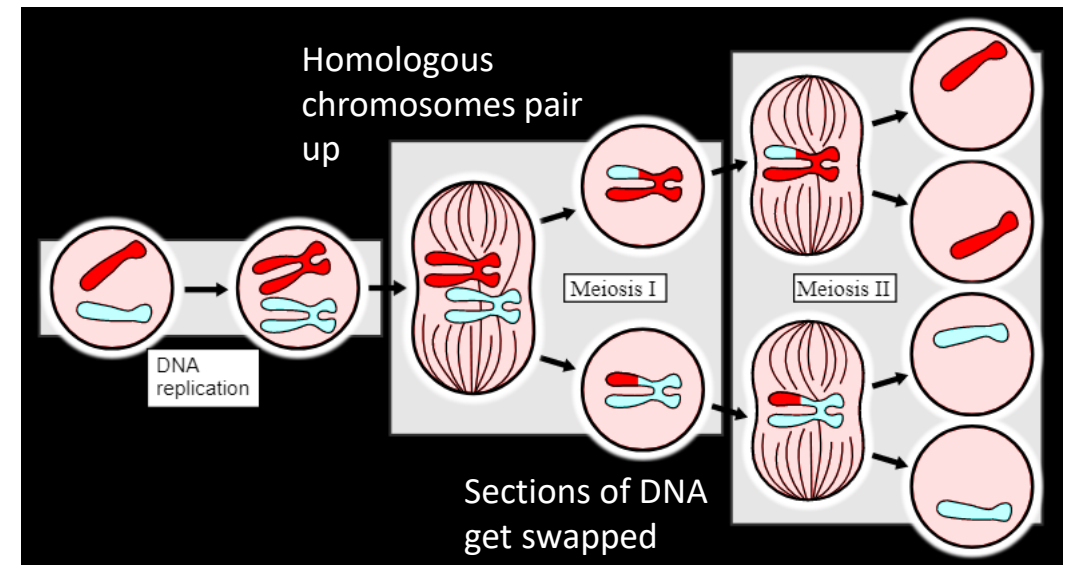
### DIVISION 1:

- In the first division the chromosomes line up in matching pairs in the centre of the cell. One chromosome in each pair is from the mother, and the other from the father. Sections of DNA get swapped between them.
- The pairs of chromosomes are pulled apart. This means each new cell has only one copy of each chromosome. Some chromosomes from the mother and some from the father will end up in each new cell. This process is random and this mixing up of genes will create variation in the offspring

### DIVISION 2:

- This is similar to mitosis. The chromosomes line up in the centre of the cell – and the chromatids are pulled apart.
- This results in four haploid daughter cells known as gametes. Each gamete is genetically different and has a single set of chromosomes.

# Meiosis

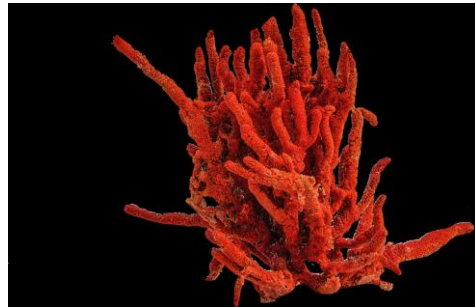


Meiosis produces:

- Four daughter cells
- Genetically different cells
- Haploid cells

# Your turn:

1. There are animals living on the sea bed called corals. The photo shows an example of a coral.



- a) Corals can reproduce by sexual reproduction, where sperm cells are released into the sea.

The mass of DNA in a sperm from one species of coral is 0.3 picogram. What would be the mass of DNA in an unfertilised egg cell from the same species of coral?

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- b) What is the term used to describe the number of chromosomes in an egg or sperm cell?

.....

- c) Complete the sentence.

The base pairs in DNA are:

- A) Thymine with guanine, adenine with cytosine
- B) Uracil with adenine, guanine with cytosine
- C) Thymine with adenine, cytosine with guanine
- D) Uracil with thymine, guanine with cytosine

- d) What is the bond that joins the base pairs together?

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- e) Once fertilisation has taken place, an embryo is formed when mitosis takes place. The embryo will then develop into new coral. Describe what mitosis is.

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# Your turn:

f) Describe what happens when the embryo develops into coral.

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2 a) In human sexual reproduction, sperm cells and egg cells are needed. In detail, describe the type of cell division that produces sperm and egg cells.

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b) Name two differences between asexual and sexual reproduction.

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2. In human sexual reproduction, sperm cells and egg cells are needed. In detail, describe the type of cell division that produces sperm and egg cells.

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# Your turn:

3. Compare mitosis and meiosis.

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4. Growth involves mitosis. Describe mitosis.

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# Answers:

1. There are animals living on the sea bed called corals. The photo shows an example of a coral.



- a) Corals can reproduce by sexual reproduction, where sperm cells are released into the sea.

The mass of DNA in a sperm from one species of coral is 0.3 picogram. What would be the mass of DNA in an unfertilised egg cell from the same species of coral?

.....  
**0.3 picogram**  
.....

- b) What is the term used to describe the number of chromosomes in an egg or sperm cell?

.....  
**haploid**  
.....

- c) Complete the sentence.

The base pairs in DNA are:

- A) Thymine with guanine, adenine with cytosine
- B) Uracil with adenine, guanine with cytosine
- C) Thymine with adenine, cytosine with guanine**
- D) Uracil with thymine, guanine with cytosine

- d) What is the bond that joins the base pairs together?

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**hydrogen**  
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- e) Once fertilisation has taken place, an embryo is formed when mitosis takes place. The embryo will then develop into new coral.

Describe what mitosis is.

**After DNA is copied:**

- .....  
**Chromosomes condense (prophase)**  
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  - .....  
**Chromosomes line up in middle of cell (metaphase)**  
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  - .....  
**Chromatids (arms of the chromosomes) are pulled to either side of the cell (anaphase)**  
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  - .....  
**New membranes are formed and cell divides (telophase)**  
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- 2 new cells produced which are genetically identical and diploid**

# Your turn:

f) Describe what happens when the embryo develops into coral.

There are many cell divisions.

The embryo grows.

Stem cells differentiate/specialise.

2 a) In human sexual reproduction, sperm cells and egg cells are needed. In detail, describe the type of cell division that produces sperm and egg cells.

The cell division is meiosis.

4 cells are produced from 2 parent cells after 2 cell divisions.

The cells are haploid (have half the number of chromosomes)

The cells are all genetically different.

b) Name two differences between asexual and sexual reproduction.

Sexual reproduction involves 2 parents, asexual reproduction only involves 1 parent.

Sexual reproduction needs gametes, asexual reproduction does not.

Sexual reproduction produces genetically different organisms, asexual reproduction produces genetically identical offspring.



# Your turn:

3. Compare mitosis and meiosis.

Mitosis:

- Genetically identical cells produced
- 2 daughter cells
- One division
- Diploid daughter cells
- Occurs for growth, replacement and repair

Meiosis:

- Genetically different cells produced
- 4 daughter cells
- Two divisions
- Haploid daughter cells
- Occurs in the formation of gametes for sexual reproduction

4. Growth involves mitosis. Describe mitosis.

After DNA is copied:

- Chromosomes condense (prophase)
- Chromosomes line up in middle of cell (metaphase)
- Chromatids (arms of the chromosomes) are pulled to either side of the cell (anaphase)
- New membranes are formed and cell divides (telophase)

2 new cells produced which are genetically identical and diploid

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