

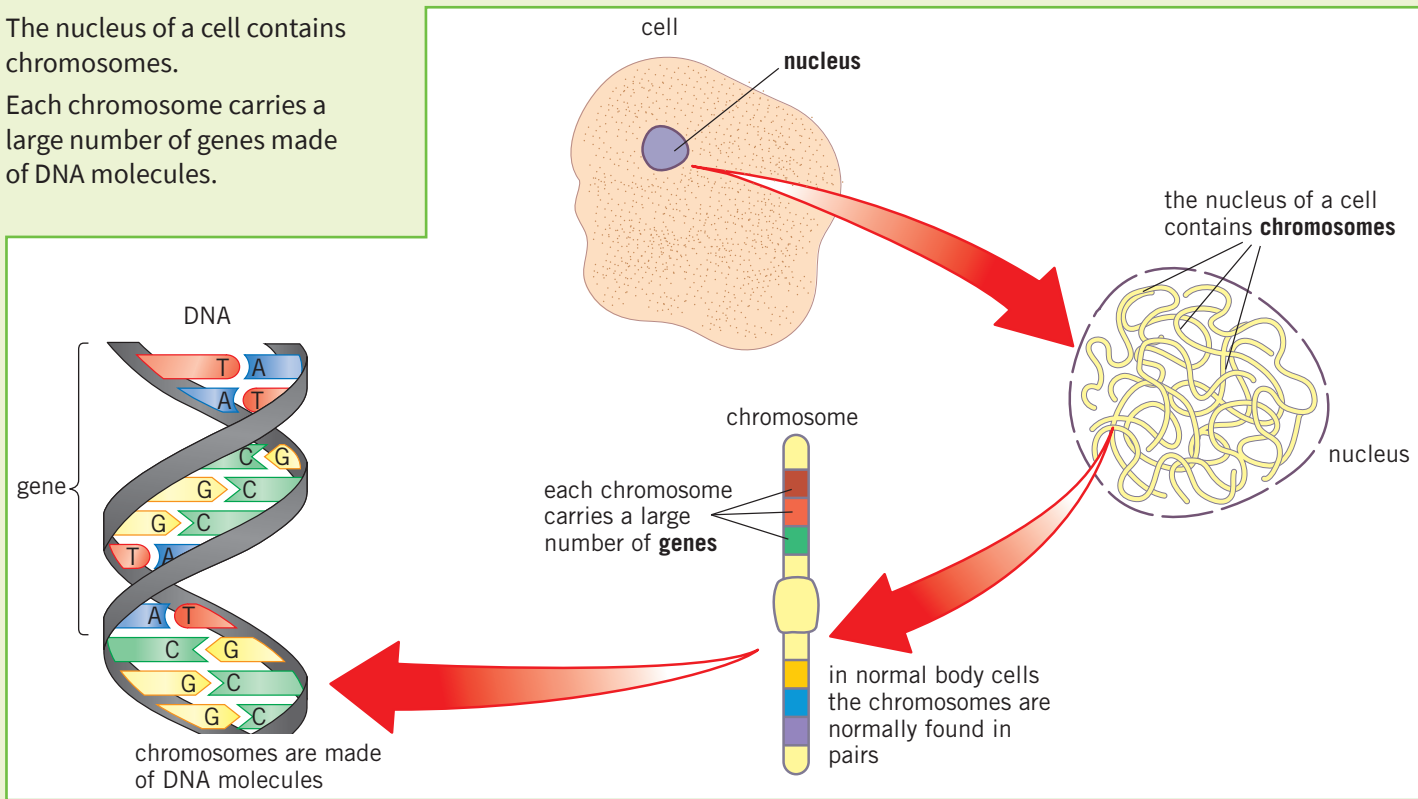
# Chapter 2: Cell division

## Knowledge organiser

### Chromosomes

The nucleus of a cell contains chromosomes.

Each chromosome carries a large number of genes made of DNA molecules.

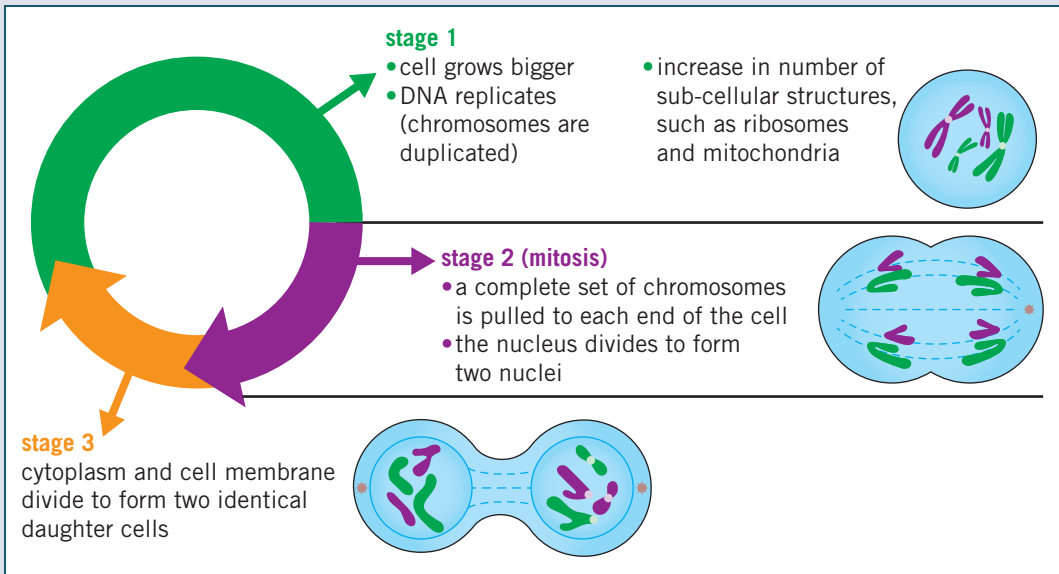


### The cell cycle

Body cells divide to form two identical **daughter cells** by going through a series of stages known as the **cell cycle**.

Cell division by **mitosis** is important for the growth and repair of cells, for example, the replacement of skin cells. Mitosis is also used for asexual reproduction.

There are *three* main stages in the cell cycle:



### Stem cells in medicine

A stem cell is an undifferentiated cell that can develop into one or more types of specialised cell.

There are two types of stem cell in mammals: **adult stem cells** and **embryonic stem cells**.

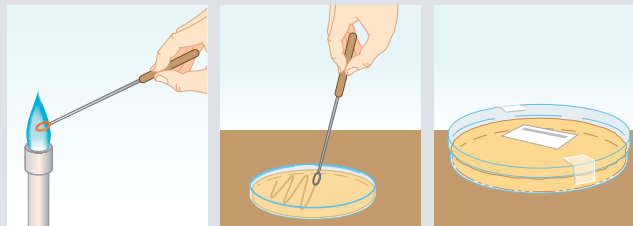
Stem cells can be **cloned** to produce large numbers of identical cells.

Type of stem cell	Where are they found?	What can they differentiate into?	Advantages	Disadvantages
adult stem cells	specific parts of the body in adults and children – for example, bone marrow	can only differentiate to form certain types of cells – for example, stem cells in bone marrow can only differentiate into types of blood cell	<ul style="list-style-type: none"><li>fewer ethical issues – adults can consent to have their stem cells removed and used</li><li>an already established technique for treating diseases such as leukaemia</li><li>relatively safe to use as a treatment and donors recover quickly</li></ul>	<ul style="list-style-type: none"><li>requires a donor, potentially meaning a long wait time to find someone suitable</li><li>can only differentiate into certain types of specialised cells, so can be used to treat fewer diseases</li></ul>
embryonic stem cells	early human embryos (often taken from spare embryos from fertility clinics)	can differentiate into any type of specialised cell in the body – for example, a nerve cell or a muscle cell	<ul style="list-style-type: none"><li>can treat a wide range of diseases as can form any specialised cell</li><li>may be possible to grow whole replacement organs</li><li>usually no donor needed as they are obtained from spare embryos from fertility clinics</li></ul>	<ul style="list-style-type: none"><li>ethical issues as the embryo is destroyed and each embryo is a potential human life</li><li>risk of transferring viral infections to the patient</li><li>newer treatment so relatively under-researched – not yet clear if they can cure as many diseases as thought</li></ul>
plant meristem	meristem regions in the roots and shoots of plants	can differentiate into all cell types – they can be used to create clones of whole plants	<ul style="list-style-type: none"><li>rare species of plants can be cloned to prevent extinction</li><li>plants with desirable traits, such as disease resistance, can be cloned to produce large numbers of identical plants</li><li>fast and low-cost production of large numbers of plants</li></ul>	<ul style="list-style-type: none"><li>cloned plants are genetically identical, so a whole crop is at risk of being destroyed by a single disease or genetic defect</li></ul>

### Binary fission

Cell division in bacteria is called binary fission. In optimum temperature and nutrients, bacteria can multiply as often as every 20 minutes. In a lab, bacteria can be grown in sterile conditions on an agar gel plate or in a nutrient broth.

The lid of the petri dish must be sealed but not all the way so that oxygen can still get in. This is so that harmful bacteria that do not need oxygen aren't able to grow.



### Therapeutic cloning

#### In therapeutic cloning

- cells from a patient's own body are used to create a cloned early embryo of themselves
- stem cells from this embryo can be used for medical treatments and growing new organs
- these stem cells have the same genes as the patient, so are less likely to be rejected when transplanted.



#### Key terms

Make sure you can write a definition for these key terms.

adult stem cell	binary fission	cell cycle
chromosome	clone	embryonic stem cell
gene	meristem	therapeutic cloning
	mitosis	nucleus
		daughter cells

# Chapter 2: Cell division

## Retrieval questions

Learn the answers to the questions below, then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B2 questions		Answers
1	What is a stem cell?	undifferentiated cell that can differentiate into one or more specialised cell types
2	What are adult stem cells?	stem cells from adults that can only differentiate into certain specialised cells
3	Where can adult stem cells be found?	bone marrow
4	What are embryonic stem cells?	stem cells from embryos that can differentiate into any specialised cell
5	Where are embryonic stem cells found?	early human embryos (usually from spare embryos from fertility clinics)
6	What is therapeutic cloning?	patient's cells are used to create an early embryo clone of themselves – stem cells from the embryo can then be used to treat the patient's medical conditions
7	Give one advantage of using therapeutic cloning.	stem cells from the embryo are not rejected when transplanted because they have the same genes as the patient
8	Give one advantage of using adult stem cells.	fewer ethical issues as obtained from adults who can consent to their use
9	Give two disadvantages of using adult stem cells.	<div>can take a long time for a suitable donor to be found</div> <div><ul style="list-style-type: none"><li>• can only differentiate into some specialised cell types, so treat fewer diseases</li></ul></div>
10	Give two advantages of using embryonic stem cells.	<div><ul style="list-style-type: none"><li>• can differentiate into any specialised cell, so can be used to treat many diseases</li><li>• easier to obtain as they are found in spare embryos from fertility clinics</li></ul></div>
11	Give two disadvantages of using embryonic stem cells.	<div><ul style="list-style-type: none"><li>• ethical issues surrounding their use, as every embryo is a potential life</li><li>• potential risks involved with treatments, such as transfer of viral infections</li></ul></div>
12	What are plant meristems?	area where rapid cell division occurs in the tips of roots and shoots
13	Give two advantages of using plant meristems to clone plants.	<div><ul style="list-style-type: none"><li>• rare species can be cloned to protect them from extinction</li><li>• plants with special features (e.g., disease resistance) can be cloned to produce many copies</li></ul></div>
14	Give one disadvantage of using plant meristems to clone plants.	no genetic variation, so, for example, an entire cloned crop could be destroyed by a disease
15	What is cell division by mitosis?	body cells divide to form two identical daughter cells
16	What is the purpose of mitosis?	growth and repair of cells, asexual reproduction

17	What happens during the first stage of the cell cycle?	cell grows bigger, chromosomes duplicate, number of subcellular structures (e.g., ribosomes and mitochondria) increases
18	What happens during mitosis?	one set of chromosomes is pulled to each end of the cell and the nucleus divides
19	What happens during the third stage of the cell cycle?	the cytoplasm and cell membrane divide, forming two identical daughter cells
20	What is the term for cell division in bacteria?	Binary fission