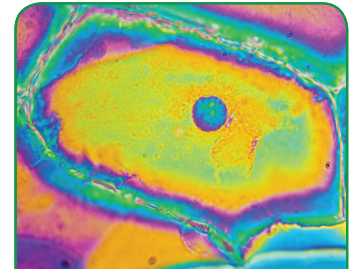


Section 1: Cells

• What is a cell?

All organisms are made of cells, whether they are unicellular organisms, such as bacteria, or multicellular, such as plants and animals. The cell is the fundamental building block of life, and consists of a membrane which encloses a watery liquid called cytoplasm, in which various chemical reactions take place. The cell membrane is selectively permeable, meaning it has some control over what enters and leaves the cell, and thereby is able to achieve conditions inside the cell which are different from those outside.



A plant cell from an onion epidermis

• Suggested Films

- What Is a Cell?
- The Cell Membrane

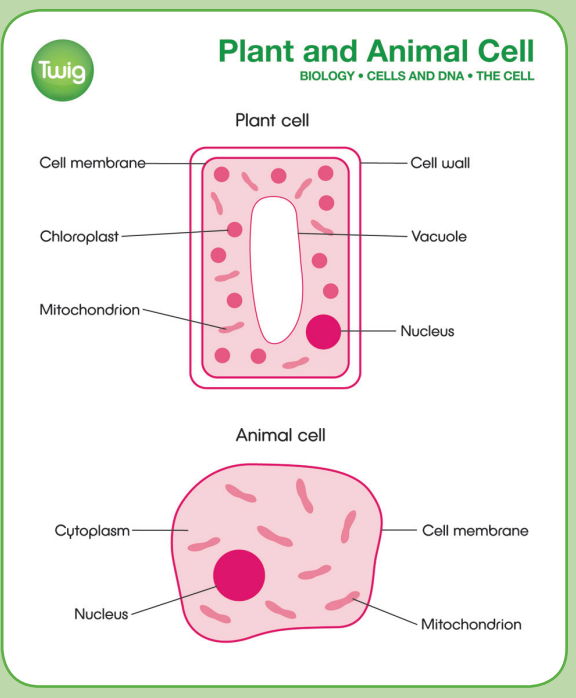
Extension Question

Q1. Why is it important for the cell membrane to be selectively permeable?

A selectively permeable barrier allows the cell to create conditions inside the cell which are different to those outside. This is essential as conditions outside cells are likely to fluctuate, and the chemical reactions inside can be better controlled in a stable environment.

• What are organelles?

DIAGRAM 01:



Within the cytoplasm are various organelles, such as the nucleus, mitochondria and chloroplasts, that create additional compartments inside the cell in which specific chemical reactions can take place. The nucleus contains chromosomes which carry the genetic instructions for the cell. Mitochondria are the sites of respiration, releasing the energy that the cell needs for its various functions, and small structures in the cytoplasm, called ribosomes, are the site of protein synthesis.

Plant cells contain additional organelles. They have chloroplasts in order to carry out photosynthesis, a permanent vacuole to store substances and add turgidity to the cell, and a cell wall for structure and protection.

• Suggested Films

- What Is a Cell?
- FactPack: Enzymes
- What Is Cancer?
- Tumours: The Kill or Cure Virus

Extension Question**Q2. What is turgidity?**

Turgidity refers to the pressure that a plant cell can exert within its cytoplasm. The vacuole can fill with water and press out against the cytoplasm and cell wall, making the cell stiff (or turgid). Plants use this turgidity to help support themselves. Without sufficient water the cells lose their turgidity (they become flaccid) and the plant is seen to wilt.

- How big are cells?

The size of cells varies enormously, from a few millionth of a meter (known as a micrometer or micron) to several centimeters. However, most cells are invisible to the naked eye and have typical diameters of 10 - 50 microns. This means that to examine them we need a light microscope, and to study their internal structures, such as the organelles, we need an electron microscope.

- Suggested Film

– The History of the Microscope

Extension Question**Q3. What cells are really big?**

Unfertilized eggs are only one cell big and could include ostrich eggs which are several centimeters in diameter. Some neurons (nerve cells) can be over a meter in length, although they are usually extremely thin.

Section 2: Different Types of Cells

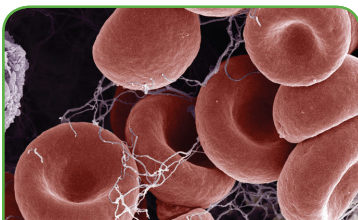
- Why are cells different?

Cells are adapted to carry out different functions. A leaf cell is adapted to carry out photosynthesis, while a muscle cell is programmed to contract. These differences are determined by the genetic material inside the nucleus of every cell. So, the genes inside a leaf cell are very different to those inside a muscle cell.

Interestingly, the genes inside every cell of one multicellular organism are the same even though the cells of that organism can be very different. For example, muscle cells are very different to nerve cells and blood cells. This is achieved because different genes are expressed in the different cell types in order to instruct the cells to develop differently. So, the genes to build muscle proteins are expressed in muscle cells, but not in nerve cells.

- Suggested Film

– The Different Types of Cell



Red blood cells carry oxygen around the body

Extension Question**Q4. What is a tissue and an organ?**

A tissue refers to a collection of similar cells that perform a specific function. For example, muscle tissue is made of muscle cells, and nervous tissue is made of nerve cells.

An organ is a structure which is made out of several different tissue types, and performs a specific function. The heart is an organ, which is made of cardiac muscle tissue and nervous tissue. Similarly, the leaf is an organ made of epidermal tissue and mesophyll tissue.

• What is a gene?

A gene is a length of DNA which codes for the production of a particular protein. For example, there is a gene for hemoglobin and a gene for insulin. A human cell contains about 25,000 genes packaged in the nucleus. To achieve this, DNA has to be tightly coiled up into structures called chromosomes.

• Suggested Film
– What Is DNA?

Extension Question

Q5. What is a chromosome?

A chromosome is rod-like structure found inside the nucleus of a cell. It consists of a long length of DNA wrapped tightly around proteins called histones. The number of chromosomes in the nucleus varies from species to species, but is the same within a species. Human cells have 46 chromosomes, whereas a dog has 78.

• What does the DNA do?

DNA carries the genetic instructions to make proteins inside cells. The code in the DNA consists of four chemical bases which can be organized in any sequence in order to determine a gene. So, the code for the hemoglobin gene is made up of a different order and length of bases to the gene for insulin and any other protein.

As well as coding for proteins, DNA is able to replicate itself. This is critical as it allows new cells and new organisms to be created, which inherit genetic information from the original cell or organism.

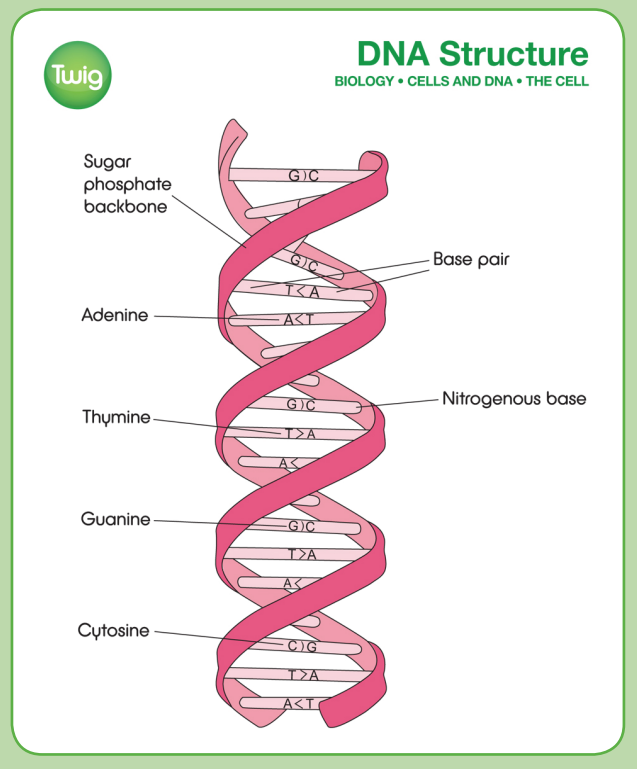
• Suggested Films
– What Is DNA?
– FactPack: DNA

Extension Question

Q6. What does DNA stand for?

DNA stands for deoxyribonucleic acid. It is a long macromolecule constructed of repeating units called nucleotides. Each of these consists of a sugar (deoxyribose) attached to a base (adenine, thymine, cytosine or guanine) and a phosphate group.

DIAGRAM 02:



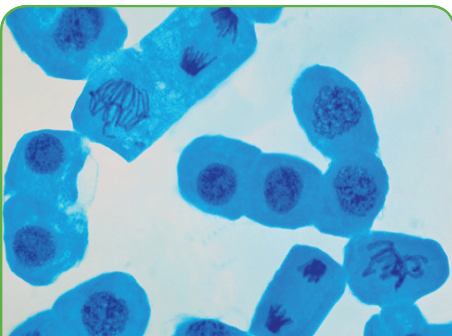
Section 3: Cell Formation

• How are new cells formed?

New cells are formed from preexisting cells. Preexisting cells grow, replicate their DNA, and then divide. All cells, except sex cells, are formed by a process called mitosis. In mitosis the DNA within the parent cell is replicated, and the chromosomes are then sorted so that the two daughter cells end up with a full set of identical genetic material. This process is used to produce new cells for growth, repair, and in some organisms, asexual reproduction.

• Suggested Films

- Cell Division: Mitosis
- What Is Cancer?
- Tumours: The Kill or Cure Virus



Root cells undergoing mitosis

Extension Question

Q7. How do the cells produced by mitosis compare to the original cell?

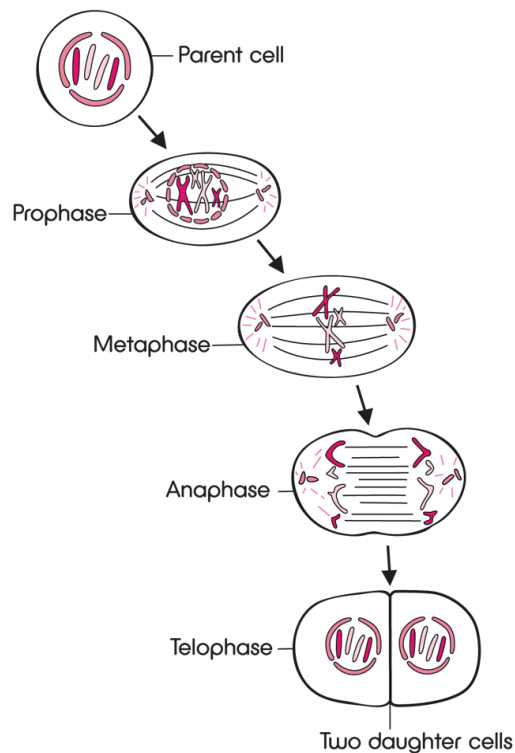
The cells produced, called daughter cells, are genetically identical containing exactly the same number and type of chromosomes as the parent cell. In humans, a cell with 46 chromosomes creates two cells, each with 46 identical chromosomes. This is achieved because the DNA replicated itself at the start of the mitotic process.

DIAGRAM 03:



Mitosis

BIOLOGY • CELLS AND DNA • THE CELL



• How are sex cells formed?

Sex cells, or gametes, such as sperm and eggs carry half the amount of genetic information of a normal body cell. They are formed in special organs in the body called gonads: the ovaries in woman and testes in men. A different type of cell division called meiosis is used to create them and it involves two cell divisions rather than one in order to halve the chromosome number.

• Suggested Film

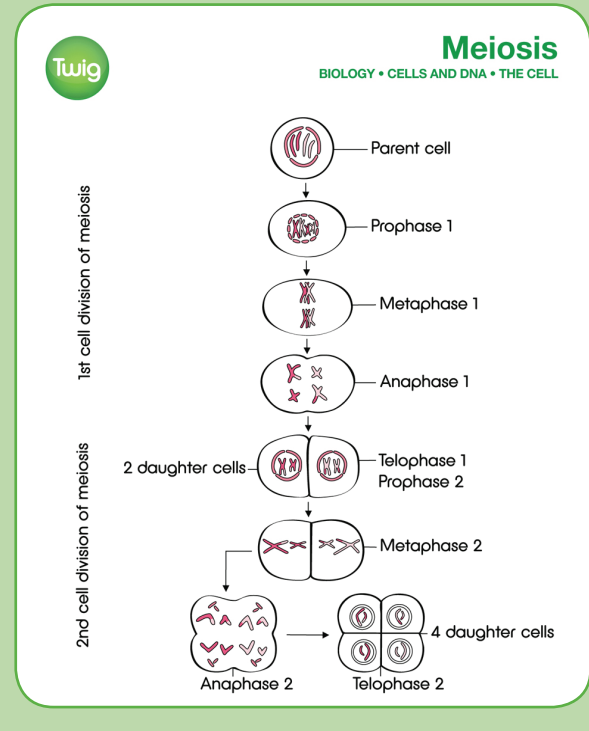
– Cell Division: Meiosis

Extension Question

Q8. How do the cells produced by meiosis compare to the original cell?

The cells produced by meiosis contain half the number of chromosomes (one from each pair) compared to a normal body cell. They are genetically different from each other and described as haploid gametes. Sperms and eggs are examples.

DIAGRAM 04:



• Where did the first cell come from?

No one knows for sure where the first cell came from, but it is likely that at some stage a membrane was formed around genetic material which was capable of replicating itself and coding for proteins. After that, mutations in the genetic material will have created new proteins and shown new cell features, some of which will have been advantageous and so selected for through the process of natural selection.

• Suggested Film

– The Very First Cell

Extension Question

Q9. How long ago did the first cells appear?

We think the Earth is about 4.6 billion years old, and that the first simple cells appeared about a billion years after the Earth formed.

• Quizzes

What Is a Cell?

Basic

• What is the name of the instrument used to view cells?

- A – a scanner
- B – a section
- C – a microscope
- D – a photometer

• What cell structure acts as a barrier?

- A – the nucleus
- B – the cell membrane
- C – the cytoplasm
- D – a ribosome

• What structure contains the genetic information?

- A – the nucleus
- B – the cell membrane
- C – the cytoplasm
- D – the mitochondrion

• Which three structures are found in plant cells only?

- A – cell membrane, cell wall, chloroplast
- B – cell membrane, cell wall, vacuole
- C – cell wall, chloroplast, vacuole
- D – cell wall, cell membrane, mitochondria

Advanced

• What is the function of ribosomes?

- A – respiration
- B – to control the activities of the cell
- C – protein production
- D – to act as a barrier

• What is the function of mitochondria?

- A – respiration
- B – to control the activities of the cell
- C – protein production
- D – to act as a barrier

• What is the function of chloroplasts?

- A – respiration
- B – to control the activities of the cell
- C – protein production
- D – photosynthesis

• Which three structures are found in plant cells only?

- A – cell membrane, cell wall, chloroplast
- B – cell membrane, cell wall, vacuole
- C – cell wall, chloroplast, vacuole
- D – cell wall, cell membrane, mitochondria

Different Types of Cell

Basic

• Genes control the activities of the cell. In which organelle are they found?

- A – mitochondrion
- B – chloroplast
- C – nucleus
- D – ribosome

• What do red blood cells carry around the body?

- A – plasma
- B – carbon dioxide
- C – platelets
- D – oxygen

• Which of the following organelles will be found in great number in a leaf cell?

- A – the nucleus
- B – chloroplast
- C – cell membrane
- D – vacuole

• What is the function of a root hair cell?

- A – to photosynthesize
- B – to anchor the plant in the ground
- C – to absorb water and minerals
- D – to be elongated

Advanced

• What is the term used to describe the lengths of DNA which control the activities of the cell?

- A – nucleus
- B – histones
- C – genes
- D – ribosomes

• What protein is found inside red blood cells?

- A – hemoglobin
- B – ribosome
- C – insulin
- D – DNA

• Which of the following organelles contains chlorophyll?

- A – nucleus
- B – chloroplast
- C – cell membrane
- D – vacuole

• What term is used to describe a group of similar cells carrying out a particular function?

- A – an organ
- B – a specialized cell
- C – a membrane
- D – a tissue

Mitosis

Basic

• What is the name of the process that produces two genetically identical cells?

- A – division
- B – meiosis
- C – mitosis
- D – replication

• What are the structures inside the nucleus called which hold the genetic material?

- A – filaments
- B – chromosomes
- C – double helixes
- D – mitochondria

• Which cells of the body are not produced by mitosis?

- A – brain cells
- B – bone cells
- C – muscle cells
- D – sex cells

Advanced

• What is mitosis used for in the human body?

- A – asexual reproduction
- B – movement
- C – growth and repair
- D – sexual reproduction

• What must the chromosomes do before the cell divides?

- A – divide
- B – grow
- C – uncoil
- D – replicate

• Which cells of the body are not produced by mitosis?

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Meiosis

Basic

• What is the name of the process that produces sex cells?

- A – division
- B – meiosis
- C – mitosis
- D – replication

• Which of the following is an example of a sex cell?

- A – brain cell
- B – bone cell
- C – muscle cell
- D – sperm cell

• Human body cells contain 46 chromosomes. How many chromosomes are there in a human sex cell?

- A – 46
- B – 92
- C – none
- D – 23

Advanced

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- C – none
- D – 23

• How many cell divisions take place in meiosis?

- A – 1
- B – 2
- C – 3
- D – 4

• Answers

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