

## Types of Cells

**Subject & topics:** Biology | Cell Biology | Cell Structure      **Stage & difficulty:** A Level P1

A biology teacher has a set of prepared microscope slides, each one containing a different cell type. The cell types are as follows:

- bacterial cell
- fungal cell
- mammal red blood cell
- mammal nerve cell
- mammal sperm cell
- plant leaf mesophyll cell

The teacher has forgotten to label the slides. They examine the slides on a microscope and write down a description of each cell type.

Slide	Description
1	Contains a nucleus and other membrane-bound organelles. Has a cell wall. Does not contain chloroplasts.
2	Contains a nucleus and other membrane-bound organelles. Does not have a cell wall or a flagellum.
3	Does not contain a nucleus or any other membrane-bound organelles. Has a cell wall and a flagellum.
4	Contains a nucleus and other membrane-bound organelles, including chloroplasts. Has a cell wall.
5	Does not contain a nucleus. Does not have a cell wall or a flagellum.
6	Contains a nucleus and other membrane-bound organelles. Does not have a cell wall. Does have a flagellum.

Part A

Identify the cell types

Match the cell type to the description in the table below.

Slide	Description	Cell type
1	Contains a nucleus and other membrane-bound organelles. Has a cell wall. Does not contain chloroplasts.	<div></div>
2	Contains a nucleus and other membrane-bound organelles. Does not have a cell wall or a flagellum.	<div></div>
3	Does not contain a nucleus or any other membrane-bound organelles. Has a cell wall and a flagellum.	<div></div>
4	Contains a nucleus and other membrane-bound organelles, including chloroplasts. Has a cell wall.	<div></div>
5	Does not contain a nucleus. Does not have a cell wall or a flagellum.	<div></div>
6	Contains a nucleus and other membrane-bound organelles. Does not have a cell wall. Does have a flagellum.	<div></div>

Items:

- mammal nerve cell
- mammal sperm cell
- plant leaf mesophyll cell
- mammal red blood cell
- bacterial cell
- fungal cell

### Part B

#### Plant root hair cells

Which of the slide descriptions above would also describe a plant root hair cell in a plant with underground roots?

☐ Slide 1

☐ Slide 2

☐ Slide 3

☐ Slide 4

☐ Slide 5

☐ Slide 6

### Part C

#### Chloroplast-containing cells

Name another type of organism (other than plants) that could match the description of slide 4.

# Bacteria, Animals & Plants

**Subject & topics:** Biology | Cell Biology | Cell Structure**Stage & difficulty:** A Level P1

## Part A

### Bacteria

Which of the following are true of a bacterial cell? Select all that apply.

- ☐ The cell is surrounded by a cell wall made of peptidoglycan/murein.
- ☐ The cell is surrounded by a cell wall made of cellulose.
- ☐ The cell contains membrane-bound organelles (including a nucleus).
- ☐ The cell does **not** contain a nucleus or any other membrane-bound organelles.
- ☐ The cell contains chloroplasts.
- ☐ The cell contains mitochondria.
- ☐ The DNA is contained within separate linear chromosomes.
- ☐ The DNA is contained within one circular chromosome. There may also be smaller circular DNA molecules called plasmids.
- ☐ They have smaller ribosomes than eukaryotic cells.
- ☐ They have larger ribosomes than eukaryotic cells.

Part B

## Animals

Which of the following are true of a human white blood cell? Select all that apply.

- ☐ The cell is surrounded by a cell wall made of peptidoglycan/murein.
- ☐ The cell is surrounded by a cell wall made of cellulose.
- ☐ The cell contains membrane-bound organelles (including a nucleus).
- ☐ The cell does **not** contain a nucleus or any other membrane-bound organelles.
- ☐ The cell contains chloroplasts.
- ☐ The cell contains mitochondria.
- ☐ The DNA is contained within separate linear chromosomes.
- ☐ The DNA is contained within one circular chromosome. There may also be smaller circular DNA molecules called plasmids.

## Part C

### Plants

Which of the following are true of a plant leaf palisade cell? Select all that apply.

- ☐ The cell is surrounded by a cell wall made of peptidoglycan/murein.
- ☐ The cell is surrounded by a cell wall made of cellulose.
- ☐ The cell contains membrane-bound organelles (including a nucleus).
- ☐ The cell does **not** contain a nucleus or any other membrane-bound organelles.
- ☐ The cell contains chloroplasts.
- ☐ The cell contains mitochondria.
- ☐ The DNA is contained within separate linear chromosomes.
- ☐ The DNA is contained within one circular chromosome. There may also be smaller circular DNA molecules called plasmids.

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**STEM SMART Biology Week 1 - Cell Structure 1**

# The Nucleus

**Subject & topics:** Biology | Cell Biology | Cell Structure**Stage & difficulty:** A Level P1

## Part A

### Function of the nucleus

The nucleus is the organelle in  cells where most of the cell's DNA is located. DNA here is wrapped around proteins (called ) to form a material called , which exists as separate structures called .

Items:

## Part B

### Structure of the nucleus

The nucleus contains a structure called the , where ribosomal RNAs (rRNAs) and ribosomal proteins are combined to form ribosomes.

The nucleus is surrounded by the  (a double-membrane), of which the outer membrane is continuous with the endoplasmic reticulum. The double-membrane contains many , which allow large molecules (e.g. RNAs and proteins) to move between the nucleus and the cytoplasm.

Items:

nuclear envelope

nuclear pores

nucleolus

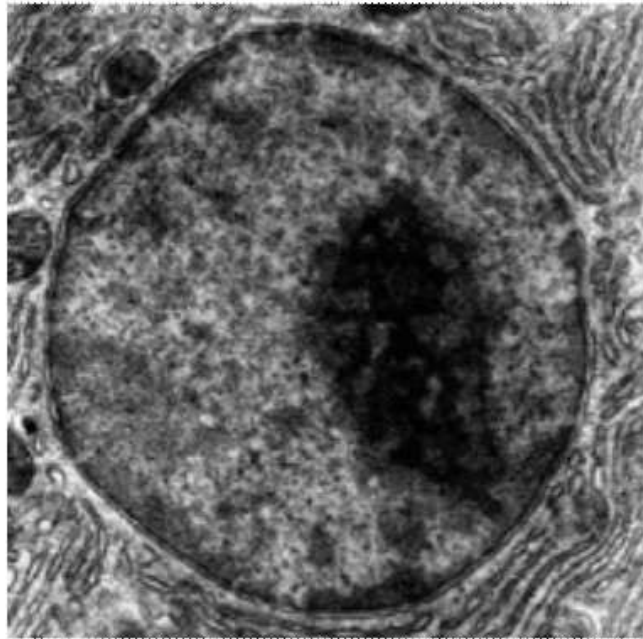
nucleotides

nuclear wall

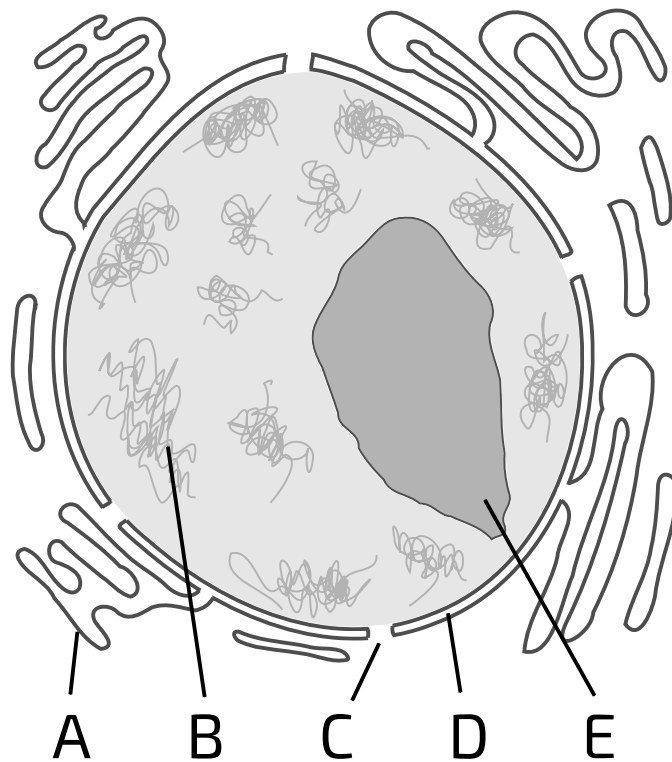
nucleosome



Identify the structures!



Electron microscope image of a nucleus from "Inside the Cell" (Public Domain).



**Figure 1:** A simplified diagram of the electron microscope image above. A cell nucleus is shown, with five different structures labelled.

What is labelled "A" in Figure 1?

What is labelled "B" in Figure 1?

What is labelled "C" in Figure 1?

What is labelled "D" in Figure 1?

What is labelled "E" in Figure 1?

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**STEM SMART Biology Week 1 - Cell Structure 1**

# The Cytoplasm & Cell Membrane

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## Part A

### The cytoplasm

The cytoplasm is the name given to the  of a cell (everything except the nucleus). The main component of the cytoplasm is : a jelly-like fluid that is mostly  but also contains ions and organic molecules.

Items:

## Part B

### The cell membrane

The cell membrane (also called the cell surface membrane, or the plasma membrane) is the  membrane that surrounds the cell. It is composed primarily of a  bilayer, but also contains  (some of which act as channels/carriers to transport molecules in and out of the cell), lipids (including cholesterol), glycoproteins, and glycolipids.

Items:

Question deck:

**STEM SMART Biology Week 1 - Cell Structure 1**

# Mitochondria

**Subject & topics:** Biology | Cell Biology | Cell Structure**Stage & difficulty:** A Level P1

## Part A

### Function of mitochondria

Most eukaryotic cells have hundreds or even thousands of mitochondria. These organelles are where the process of  takes place. This process produces  molecules, which store energy in their chemical bonds between phosphate groups. This energy is released by , which removes one of the phosphate groups.

The energy released is used in other processes e.g. protein synthesis, active transport, muscle contraction (in animals), starch production (in plants), and many more.

Items:

## Part B

### Structure of mitochondria

Each mitochondrion has an outer membrane and an inner membrane, the latter of which is folded. These folds (also called ) extend into the interior of the mitochondrion (also called the mitochondrial ). The folds of the inner membrane increase the surface area, which allows more  to be produced.

Each mitochondrion also contains a small amount of mitochondrial , which is circular rather than linear.

Items:

ATP

thylakoids

matrix

RNA

cristae

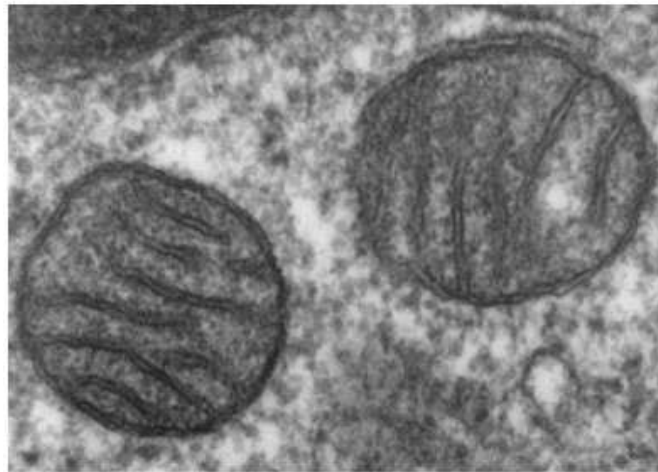
DNA

ADP

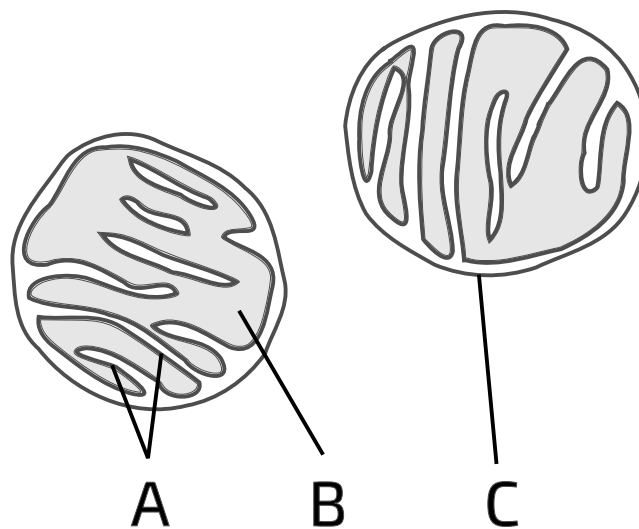
stroma

### Part C

### Identify the structures!



Electron microscope image of a section of mammalian lung tissue, showing two mitochondria. Image by Louisa Howard (Public Domain).



**Figure 1:** A simplified diagram of the electron microscope image above. Two mitochondria are shown, with three different structures labelled.

What is labelled "A" in Figure 1?

What is labelled "B" in Figure 1?

What is labelled "C" in Figure 1?

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**STEM SMART Biology Week 1 - Cell Structure 1**



# Chloroplasts

**Subject & topics:** Biology | Cell Biology | Cell Structure**Stage & difficulty:** A Level P1

## Part A

### Function of chloroplasts

Chloroplasts are unique to plants and . These organelles are where the process of  takes place. They are therefore only found in some parts of a plant (e.g. within the ) and not in other parts (e.g. the ).

Items:

## Part B

### Structure of chloroplasts

Each chloroplast has an outer membrane and an inner membrane. The fluid interior is called the . Photosynthetic pigments (e.g. ) are stored in disc-like structures called , which are arranged in large stacks called . These stacks are connected by .

Each chloroplast also contains a small amount of , which is circular rather than linear. A chloroplast may also contain large starch granules.

Items:

grana

melanin

DNA

chlorophyll

matrix

thylakoids

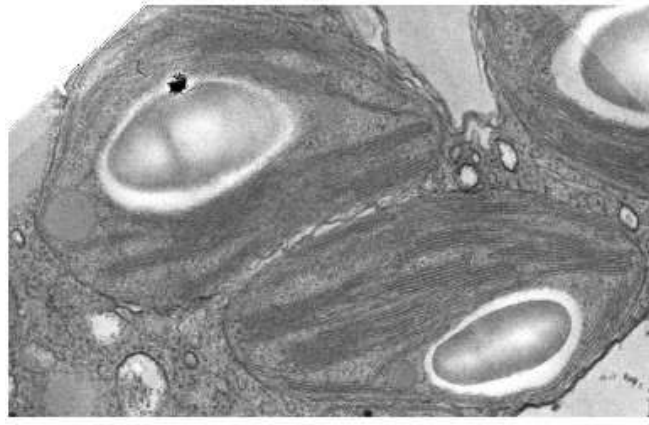
cristae

stroma

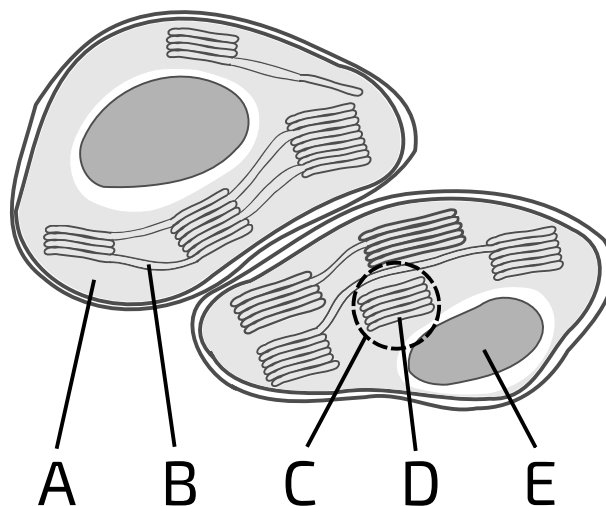
lamellae

## Part C

### Identify the structures!



Electron microscope image of a section of unicellular green alga, showing two chloroplasts. Image by Chris Woodcock & Gayle Miller (Public Domain). CIL 555.



**Figure 1:** A simplified diagram of the electron microscope image above. Two chloroplasts are shown, with five different structures labelled. "E" labels a starch granule.

What is labelled "A" in Figure 1?

What is labelled "B" in Figure 1?

What is labelled "C" in Figure 1?

What is labelled "D" in Figure 1?

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**STEM SMART Biology Week 1 - Cell Structure 1**

# Microscopy

**Subject & topics:** Biology | Cell Biology | Cell Structure**Stage & difficulty:** A Level P1

## Part A

### Microscopy descriptions

Match the type of microscopy to the description.

: light is used to illuminate the sample. Depending on the particular type of microscope, the image can be produced by light that is transmitted through the sample, or by light that is reflected (or fluoresced) by the sample, or by a combination of these.

: a beam of electrons is fired at the sample. The image is produced by electrons that are transmitted through the sample.

: a beam of electrons is fired at the sample. The image is produced by electrons that are emitted by the sample.

Items:

Transmission electron microscopy (TEM)

Light microscopy

Scanning electron microscopy (SEM)

## Part B

### Transmission electron microscopy (TEM)

Which of the following are true of transmission electron microscopy (TEM)? Select all that apply.

- ☐ Can be used to image live or fixed (dead) samples.
- ☐ Provides better resolution than light microscopy.
- ☐ The sample must be enclosed in a vacuum.
- ☐ The natural colour(s) of samples can be observed.
- ☐ Sample preparation is simpler than in light microscopy.
- ☐ Provides higher magnification than light microscopy.
- ☐ The sample must be an extremely thin section in order for electrons to transmit through the sample.
- ☐ Each image shows the 2D structure of the sample.
- ☐ Each image shows the 3D structure of the sample.

## Part C

### Scanning electron microscopy (SEM)

Which of the following are true of scanning electron microscopy (SEM)? Select all that apply.

- ☐ Can be used to image live or fixed (dead) samples.
- ☐ Provides better resolution than light microscopy.
- ☐ The sample must be enclosed in a vacuum.
- ☐ The natural colour(s) of samples can be observed.
- ☐ Sample preparation is simpler than in light microscopy.
- ☐ Provides higher magnification than light microscopy.
- ☐ The sample must be an extremely thin section in order for electrons to transmit through the sample.
- ☐ Each image shows the 2D structure of the sample.
- ☐ Each image shows the 3D structure of the sample.

## Part D

### Light microscopy

Which of the following are true of light microscopy? Select all that apply.

- ☐ Can be used to image live or fixed (dead) samples.
- ☐ Provides better resolution than electron microscopy.
- ☐ The sample must be enclosed in a vacuum.
- ☐ The natural colour(s) of samples can be observed.
- ☐ Sample preparation is simpler than in electron microscopy.
- ☐ Provides higher magnification than electron microscopy.



## Part E

### Resolution

Resolution is defined as...

- ☐ how much larger the image is than the actual object size.
- ☐ the magnification divided by the actual object size.
- ☐ the minimum distance apart that two objects can be in order for them to be seen as distinct objects.
- ☐ the wavelength of the illumination source (light/electrons).

Why does electron microscopy provide better resolution than light microscopy?

- ☐ The electrons have a much shorter wavelength than visible light. This means that the electrons transmitted through/emitted by a sample can be very close to each other without interfering with each other.
- ☐ Electrons do not undergo diffraction, unlike light. This means they will not interfere with each other after being transmitted through the sample.
- ☐ Electron microscopes provide higher magnification, which improves resolution.
- ☐ In electron microscopes, the sample is contained within a vacuum. This prevents any diffraction from happening.