Prokaryote or Eukaryote?

A Level

Part A Prokaryotes

Which of the following are prokaryotes? Select all that apply.

- [ ] *Leucobryum glaucum* (a species of moss, i.e. a plant)
- [ ] *Passer domesticus* (house sparrow)
- [ ] *Escherichia coli* (a species of bacterium)
- [ ] *Plasmodium falciparum* (a unicellular protist)
- [ ] *Dictyostelium discoideum* (a species of amoeba, i.e. a protist)
- [ ] *Staphylococcus aureus* (a species of bacterium)
- [ ] *Pyrococcus furiosus* (a species of archaeon)

Part B Eukaryotes

Which of the following are eukaryotes? Select all that apply.

- [ ] *Quercus robur* (a species of oak tree)
- [ ] *Homo sapiens* (human)
- [ ] *Macrocystis pyrifera* (a species of brown alga, i.e. a protist)
- [ ] *Felis catus* (domestic cat)
- [ ] *Escherichia coli* (a species of bacterium)
- [ ] *Pyrococcus furiosus* (a species of archaeon)
- [ ] *Saccharomyces cerevisiae* (a species of yeast, i.e. a unicellular fungus)

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Bacteria, Animals & Plants

A Level

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 strands (chromatin).
- [ ] 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 strands (chromatin).
- [ ] 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 strands (chromatin).
- [ ] The DNA is contained within one circular chromosome. There may also be smaller circular DNA molecules called plasmids.

The Nucleus

A Level

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 linear strands called [ ]. During mitosis, these strands coil and condense to form structures called [ ].

Items:

eukaryotic **chromosomes** **histones** **proteasomes** **chromatin** **centrosomes** **prokaryotic**

Part B Structure of the nucleus

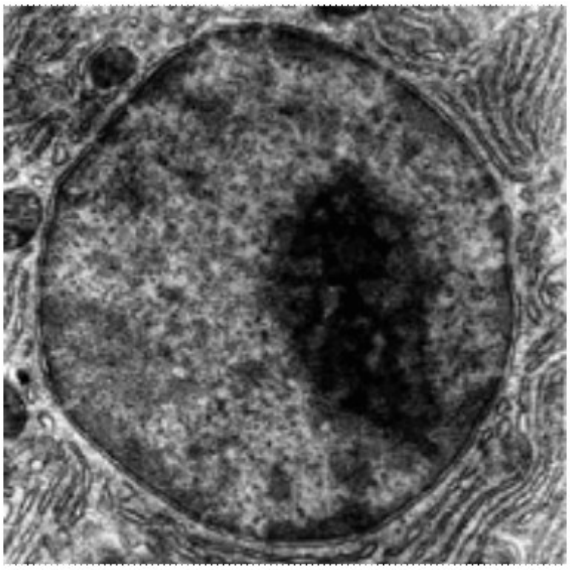
The nucleus contains a structure called the [ ], where ribosomal RNAs (rRNAs) and ribosomal proteins are combined to form ribosomes.

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:

nucleolus | **nuclear pores** | **nuclear wall** | **nucleosome** | **nucleotides** | **nuclear envelope**

Part C Identify the structures!



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

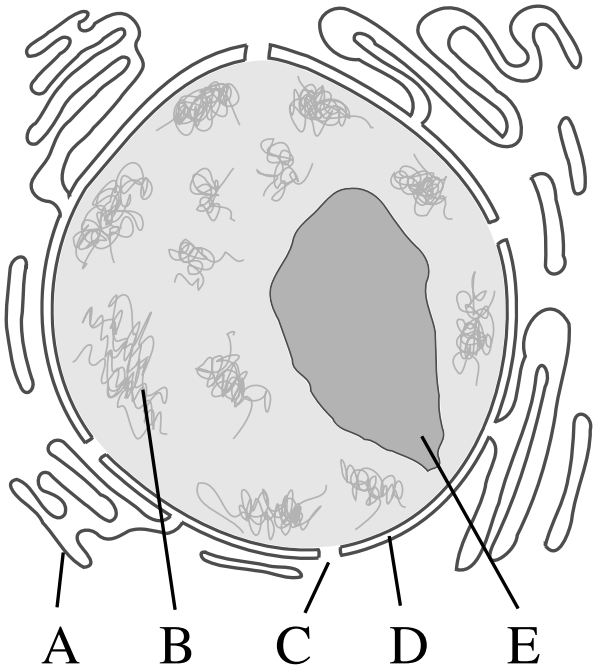


Figure 1: A simplified diagram of the electron microscope image above. A cell nucleus is shown, with five different structures labelled.

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?

The Cytoplasm & Cell Membrane

A Level

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:

interior **lipids** **water** **cytosol** **cytokines** **exterior**

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:

phosphate **proteins** **double** **carbohydrates** **phospholipid** **single**

Mitochondria

A Level

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:

ADP **condensation** **ATP** **hydrolysis** **aerobic respiration** **photosynthesis**

Part B Structure of mitochondria

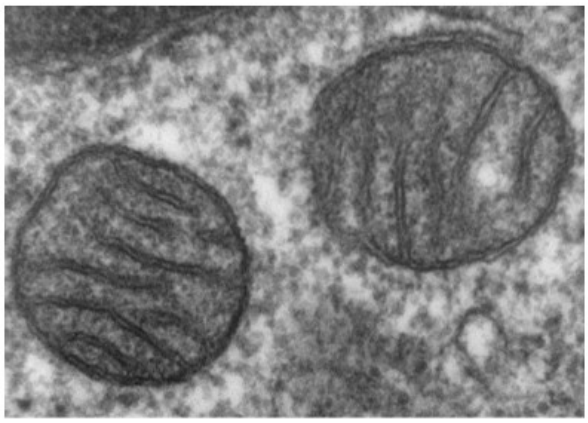
Each mitochondrion has an outer membrane and an inner membrane, the latter of which is folded. These folds (also called [ ]) extend into the interior of the mitochondrion (also called the mitochondrial [ ]). The folds of the inner membrane increase the surface area, which allows more [ ] to be produced.

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

Items:

DNA **cristae** **matrix** **thylakoids** **RNA** **stroma** **ATP** **ADP**

Part C Identify the structures!



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

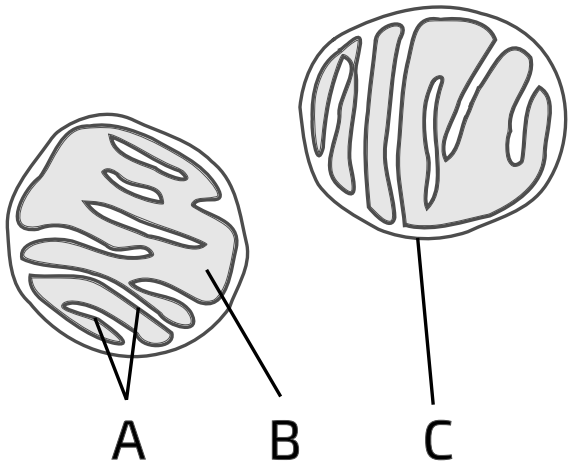


Figure 1: A simplified diagram of the electron microscope image above. Two mitochondria are shown, with three different structures labelled.

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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Chloroplasts

A Level

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:

photosynthesis **algae** **fungi** **leaves** **aerobic respiration** **roots**

Part B Structure of chloroplasts

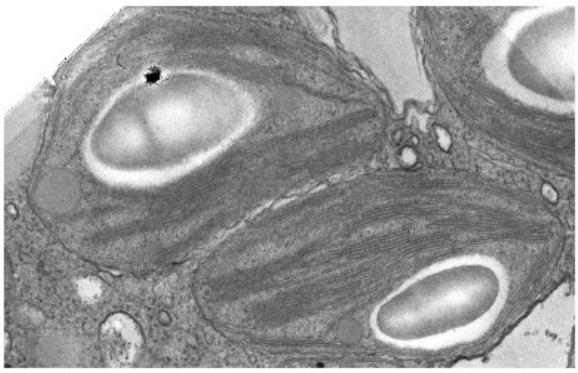
Each chloroplast has an outer membrane and an inner membrane. The fluid interior is called the [ ]. Photosynthetic pigments (e.g. [ ]) are stored in disc-like structures called [ ], which are arranged in large stacks called [ ]. These stacks are connected by [ ].

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

Items:

cristae **DNA** **grana** **chlorophyll** **stroma** **matrix** **thylakoids** **melanin** **lamellae**

Part C Identify the structures!



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

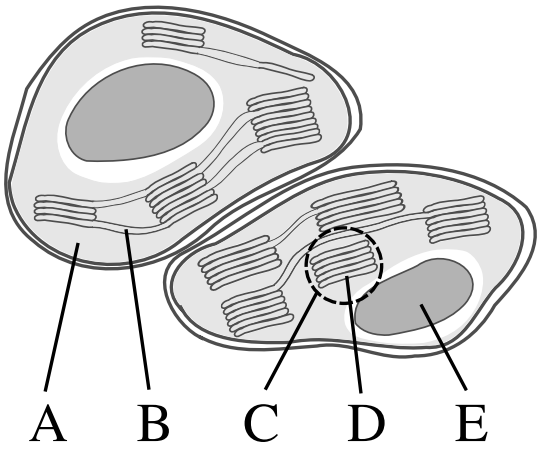


Figure 1: A simplified diagram of the electron microscope image above. Two chloroplasts are shown, with five different structures labelled. "E" labels a starch granule.

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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Microscopy

A Level

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:

Light microscopy **Scanning electron microscopy (SEM)**

Transmission electron microscopy (TEM)

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...

- 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).
- how much larger the image is than the actual object size.

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.
