

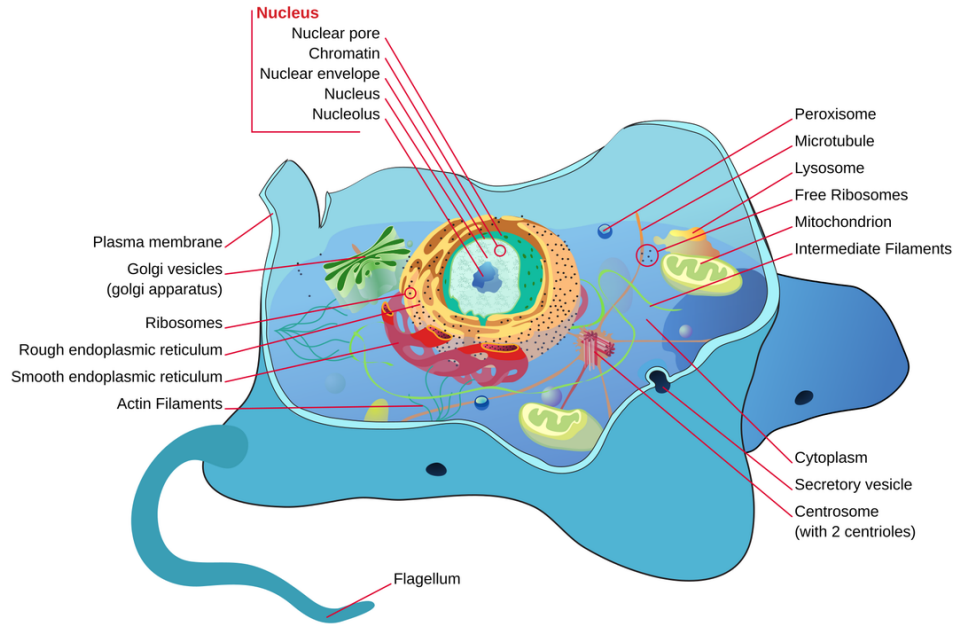
Exercise walk-through

1.2

Cells as the basic units of living organisms

A-Level Biology

The animal cell



A **eukaryotic cell** keeps its DNA in a **nucleus** ; **organelles** float in the **cytoplasm** . Every job that needs energy uses ATP made in respiration.

Organelles and their jobs

nucleus

holds DNA, controls the cell

mitochondria

respiration → ATP

rough ER

makes proteins

Golgi body

packs into vesicles

ribosomes

join amino acids

lysosomes

break down waste

The protein production line

Nucleus

Large, surrounded by a **nuclear envelope** – a double membrane with pores – and containing a **nucleolus**, which makes ribosomes.

Ribosomes

80S in the cytoplasm, 70S in chloroplasts and mitochondria. They join **amino acids** to **synthesise** proteins.

Rough ER

Rough endoplasmic reticulum : sheets of membrane with ribosomes on the surface, making and transporting proteins – **antibodies**, for instance.

Smooth ER

Smooth endoplasmic reticulum : no ribosomes, and it makes **lipids**.

Golgi body

A stack of flat sacs that changes and packs proteins and lipids into **vesicles** for **secretion**.

Lysosomes are small sacs of **enzymes** that break down old organelles and waste – the same production line, run backwards.

The remaining organelles, and how they are recognised

smooth ER	sheets of membrane with no ribosomes – makes lipids
rough ER	membrane studded with ribosomes – processes proteins
centrioles and mi- crotubules	small protein tubes – move chromosomes, and form the cell's “skeleton”
cilia	tiny beating hairs on the surface – move fluid, or move the cell
microvilli	tiny folds of the cell surface membrane – increase surface area for absorption
how to identify them	in a micrograph by shape, size and position ; in a drawing, by outline and label

Cilia *move*, microvilli *absorb*. Both are surface projections, and telling them apart by function is the mark.

The organelles a plant cell has and an animal cell does not

Organelle	What it is, and what it does
chloroplasts	green, stacked membranes, its own circular DNA – photosynthesis
cell wall	a strong outer layer of cellulose – supports the cell and stops it bursting
large permanent vacuole	a watery sac inside a membrane, the tonoplast – stores water, keeps the cell turgid
plasmodesmata	tiny channels through the walls, linking neighbouring cytoplasm

The other way round: **centrioles** are present in animal cells and absent from most plant cells, and an animal cell is rounder and more flexible where a plant cell holds a fixed shape.

Exercises 2.1-2.2

2.1 Name the organelle that carries out each function.

[4]

function	organelle
makes and transports proteins (has ribosomes on it)	
packs and modifies proteins into vesicles	
site of photosynthesis	
breaks down old organelles and waste	

2.2 State **three** structures found in a plant cell that are **not** found in a typical animal cell.

[3]

Exercises 2.1·2.2

2.1 Name the organelle that carries out each function.

[4]

function	organelle
makes and transports proteins (has ribosomes on it)	
packs and modifies proteins into vesicles	
site of photosynthesis	
breaks down old organelles and waste	

2.1

- rough endoplasmic reticulum; Golgi body (Golgi apparatus); chloroplast; lysosome

2.2 State **three** structures found in a plant cell that are **not** found in a typical animal cell.

[3]

2.2

- Any three of: cellulose cell wall; chloroplasts; large permanent vacuole (tonoplast); plasmodesmata

Exercise 2.3

2.3 Give the size (S value) of the ribosomes found in (a) the cytoplasm of a eukaryotic cell, and (b) a prokaryotic cell. [2]

Exercise 2.3

2.3 Give the size (S value) of the ribosomes found in (a) the cytoplasm of a eukaryotic cell, and (b) a prokaryotic cell. [2]

2.3

(a)

- 80S

(b)

- 70S

Exercise 3.1

3.1 Which structures are found in **both** a prokaryotic cell and a eukaryotic cell? [1]

☐

A cell surface membrane, cytoplasm, ribosomes

B mitochondria, nucleus, ribosomes

C chloroplasts, cell wall, vacuole

D nuclear envelope, Golgi body, lysosomes

Exercise 3.1

3.1 Which structures are found in **both** a prokaryotic cell and a eukaryotic cell? [1]

☐

A cell surface membrane, cytoplasm, ribosomes

B mitochondria, nucleus, ribosomes

C chloroplasts, cell wall, vacuole

D nuclear envelope, Golgi body, lysosomes

3.1 A

- A cell surface membrane, cytoplasm and ribosomes occur in all cells; the others are eukaryote-only

Exercise 3.2

3.2 An organelle has a **double membrane** and contains small **circular DNA**. Which organelle could it be? [1]

☐

A lysosome

B mitochondrion

C ribosome

D smooth endoplasmic reticulum

Exercise 3.2

3.2 An organelle has a **double membrane** and contains small **circular DNA**. Which organelle could it be? [1]

☐

A lysosome

B mitochondrion

C ribosome

D smooth endoplasmic reticulum

3.2 B

- Mitochondria (and chloroplasts) have a double membrane and their own circular DNA

Exercise 3.3

3.3 Which feature is present in a prokaryotic cell but **not** in a eukaryotic cell? [1]

☐

A 70S ribosomes only

B a cell surface membrane

C a Golgi body

D linear DNA wound on histones

Exercise 3.3

3.3 Which feature is present in a prokaryotic cell but **not** in a eukaryotic cell? [1]

☐

A 70S ribosomes only

B a cell surface membrane

C a Golgi body

D linear DNA wound on histones

3.3 A

- Prokaryotes have only 70S ribosomes; the cell surface membrane is in both, and a Golgi body and histone-wound linear DNA are eukaryote features

Exercise 3.4 (a)

3.4 A student views an electron micrograph of an animal cell.

(a) One organelle is described as “*a stack of flat membrane sacs near the nucleus*”. Name this organelle and state its function. [2]

Exercise 3.4 (a)

3.4 A student views an electron micrograph of an animal cell.

(a) One organelle is described as “*a stack of flat membrane sacs near the nucleus*”. Name this organelle and state its function. [2]

(a)

- Golgi body / Golgi apparatus; modifies and packages proteins/lipids into vesicles for secretion

Exercise 3.4 (b)

3.4 A student views an electron micrograph of an animal cell.

(b) Another organelle has “*sheets of membrane covered with ribosomes*”. Name it and state what it makes. [2]

Exercise 3.4 (b)

3.4 A student views an electron micrograph of an animal cell.

(b) Another organelle has “*sheets of membrane covered with ribosomes*”. Name it and state what it makes. [2]

(b)

- rough endoplasmic reticulum; makes (and transports) proteins

Exercises 3.5-3.6

3.5 The diagram of the prokaryotic cell above shows several features. Compare the structure of a prokaryotic cell with that of a eukaryotic cell. Give **two** differences and **one** similarity. [3]

3.6 Describe the structure of a virus. [3]

Exercises 3.5-3.6

3.5 The diagram of the prokaryotic cell above shows several features. Compare the structure of a prokaryotic cell with that of a eukaryotic cell. Give **two** differences and **one** similarity. [3]

3.5

- Two differences, e.g. prokaryote has no nucleus while eukaryote has a true nucleus; prokaryote has 70S ribosomes while eukaryote has 80S; prokaryote has no membrane-bound organelles while eukaryote does. One similarity, e.g. both have a cell surface membrane / cytoplasm / ribosomes / DNA

3.6 Describe the structure of a virus. [3]

3.6

- A nucleic acid core, either DNA or RNA; surrounded by a protein coat called a capsid; some have an outer phospholipid envelope / it is non-cellular with no organelles

Exercise 3.7 (a)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(a) State, with **three** pieces of evidence from the description, whether this is a prokaryotic or a eukaryotic cell. [3]

Exercise 3.7 (a)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(a) State, with **three** pieces of evidence from the description, whether this is a prokaryotic or a eukaryotic cell. [3]

(a)

- Eukaryotic. It has membrane-bound organelles – mitochondria and a Golgi body – which prokaryotes lack; it has rough endoplasmic reticulum, again absent in prokaryotes. (The absence of a cell wall additionally suggests an animal cell.)

Exercise 3.7 (b)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(b) Suggest the function of this cell, and justify your suggestion using **two** of the organelles named. [3]

Exercise 3.7 (b)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(b) Suggest the function of this cell, and justify your suggestion using **two** of the organelles named. [3]

(b)

- A secretory cell – for example a gland cell producing enzymes or hormones. The extensive rough ER means very high rates of protein synthesis; the many mitochondria supply the ATP for that synthesis and for moving the vesicles

Exercise 3.7 (c)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(c) Describe the route taken by a protein from the gene that codes for it to the outside of the cell, naming each organelle involved. [4]

Exercise 3.7 (c)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(c) Describe the route taken by a protein from the gene that codes for it to the outside of the cell, naming each organelle involved. [4]

(c)

- The gene is transcribed to mRNA in the **nucleus**; the mRNA is translated by **ribosomes** on the rough ER, and the protein enters the ER lumen; vesicles carry it to the **Golgi body**, where it is modified and packaged; Golgi vesicles then fuse with the **cell surface membrane**, releasing the protein by exocytosis

Exercise 3.7 (d)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(d) State **two** reasons why the mitochondria could not have been seen in this detail with a light microscope. [2]

Exercise 3.7 (d)

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(d) State **two** reasons why the mitochondria could not have been seen in this detail with a light microscope. [2]

(d)

- A light microscope resolves only to about 200 nm, limited by the wavelength of light, so internal detail cannot be separated; its maximum useful magnification, about $\times 1500$, is far too low – electrons have a much shorter wavelength and resolve to about 0.5 nm