The Cell Wall

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

Cell walls are present in bacteria, archaea, plants, algae, and fungi - but not in animals. The cell wall surrounds the cell membrane, providing an extra layer of protection and support.

Part A

Plants

The plant cell wall is primarily composed of microfibrils of [ ] (which is a [ ]) embedded in a pectin matrix. A thin, pectin-rich layer called the [ ] surrounds the cell wall and helps stick adjacent cells together.

Items:

protein | capsule | polysaccharide | middle lamella | cellulose | starch

Part B

Bacteria

The bacterial cell wall is composed of [ ] (also called murein): a polymer consisting of long [ ] chains linked together by short oligopeptides.

Gram-positive bacteria have a thick cell wall, whereas gram-negative bacteria have a thin cell wall that is surrounded by an extra membrane (called the bacterial outer membrane), which is made of lipopolysaccharides and proteolipids.

Some bacteria also contain a layer outside of the cell wall/bacterial outer membrane called a [ ] - a thick, mucus-like layer of polysaccharides.

Items:

polysaccharide | cellulose | capsule | peptidoglycan | middle lamella

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The Cytoskeleton

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

Part A

Cytoskeleton definition

What is the cytoskeleton?

- The structure that synthesises ribosomal RNA (rRNA) and combines it with proteins.
- The network of polysaccharides that surround the cell membrane, providing protection and support to the cell.
- The phospholipid bilayer that surrounds the cytoplasm, separating the inside of the cell from the outside of the cell.
- The network of protein-based fibres that spread throughout the cytoplasm, providing structural support to the cell and enabling movement/contraction of the cell.
- The fluid component of the cytoplasm, primarily composed of water and ions.
- The organelle that is surrounded by a double-membrane and is responsible for storing the genetic information of the cell.

Part B

Cytoskeleton processes

Which of the following processes are controlled by the cytoskeleton in eukaryotic cells?

- [ ] DNA replication
- [ ] chromosome arrangement during mitosis & meiosis
- [ ] cytokinesis
- [ ] aerobic respiration
- [ ] simple diffusion
- [ ] endocytosis & exocytosis
- [ ] transport of vesicles & organelles around the cell
- [ ] cell movement & contraction

Part C

Cytoskeleton structures

What is the specific name given to the microtubule bundles that pull apart sister chromatids during mitosis?

What is the name for the long microtubule-based extension of the cell, only found in some eukaryotic cells, that helps propel the cell through the surrounding fluid?

STEM SMART Biology Week 2 - Cell Structure 2

Ribosomes

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

Part A

Structure and types

Ribosomes are small organelles composed of RNAs and [ ]. A single cell may contain millions of ribosomes. Some of these exist as "free ribosomes" in the cytoplasm, and others are bound to the endoplasmic reticulum (eukaryotes only).

Each ribosome is made up of a small subunit and a large subunit. There are two types of ribosomes: 70S ribosomes and 80S ribosomes.

70S ribosomes are found in the cytoplasm of [ ] cells, as well as in mitochondria and in [ ]. The small subunit is composed of 1 ribosomal RNA (rRNA) and several proteins, and the large subunit is composed of 2 ribosomal RNAs (rRNAs) and several proteins.

80S ribosomes are found in the cytoplasm of [ ] cells. The small subunit contains 1 ribosomal RNA (rRNA) and several proteins, and the large subunit contains 3 ribosomal RNAs (rRNAs) and several proteins.

Items:

DNA | lipids | prokaryotic | chloroplasts | lysosomes | proteins | eukaryotic

Part B

Function of ribosomes

Ribosomes are involved in the process of [ ]. During this process, the ribosome binds to a messenger RNA (mRNA) strand and facilitates the binding of complementary transfer RNAs (tRNAs). Each type of tRNA molecule is bound to a specific [ ], and so the binding of tRNAs to an mRNA strand facilitates the formation of a protein.

Free ribosomes are used to synthesise proteins that will remain in the cell, and so these proteins are released into the cytoplasm or transported to the nucleus/mitochondria/chloroplasts.

Bound ribosomes are used to synthesise proteins that will be secreted, and so these proteins are deposited into the [ ] where they undergo post-translational modifications.

Items:

translation | transcription | amino acid | rough endoplasmic reticulum | smooth endoplasmic reticulum | polypeptide

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STEM SMART Biology Week 2 - Cell Structure 2

The Endoplasmic Reticulum

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

Part A

Structure & function

The endoplasmic reticulum (ER) is a network of tubules and flattened sacs (called [ ]). These are bound and connected by a single-membrane which is continuous with the [ ] membrane of the nucleus.

The part of the ER which has ribosomes on the surface is called the [ ]. Proteins that will eventually be secreted from the cell are stored here before being transported to the Golgi apparatus via vesicles.

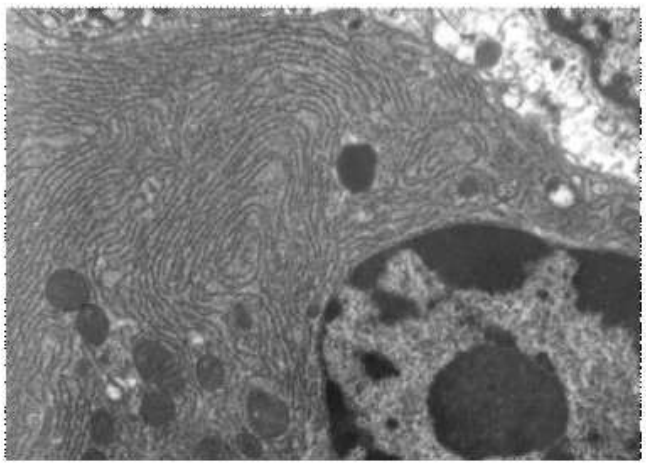
The part of the ER which does not have ribosomes on the surface is called the [ ]. Lipids and carbohydrates are synthesised and stored here.

Items:

smooth endoplasmic reticulum (SER) | thylakoids | cisternae | outer | inner | rough endoplasmic reticulum (RER)

Part B

Identify the structures!



Electron microscope image of a section of mammalian lung tissue, showing part of a nucleus, mitochondria, and the endoplasmic reticulum. Image by Louisa Howard (Public Domain).

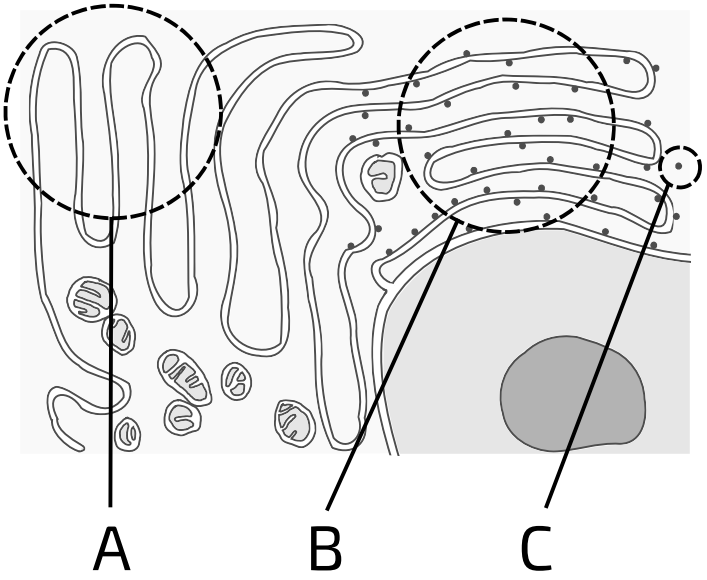


Figure 1: A simplified diagram of the electron microscope image above. The endoplasmic reticulum is show, and three structures are labelled.

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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Question deck:

STEM SMART Biology Week 2 - Cell Structure 2

The Golgi Apparatus

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

Part A

Structure & function

The Golgi apparatus (also called the Golgi, the Golgi body, or the Golgi complex) consists of a stack of flattened sacs (also called [ ]) and vesicles. These are enclosed by a [ ]-membrane.

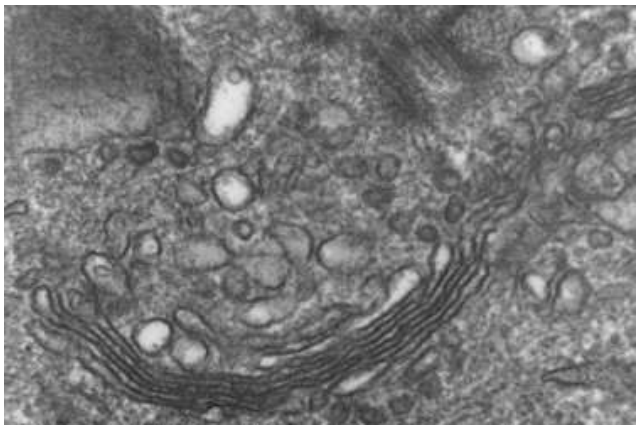
Vesicles transport proteins from the [ ] and then bind to the Golgi apparatus and deposit the proteins inside. Once inside, proteins undergo modification (e.g. phosphorylation, addition of [ ] to form glycoproteins, addition of [ ] to form proteolipids, etc.). Modified proteins are then transported via Golgi vesicles to the cell membrane for secretion.

Items:

carbohydrates | smooth endoplasmic reticulum | double | lipids | cisternae | single | rough endoplasmic reticulum

Part B

Identify the structures!



Electron microscope image of part of a human leukocyte, showing the Golgi apparatus. Image by Louisa Howard (Public Domain)

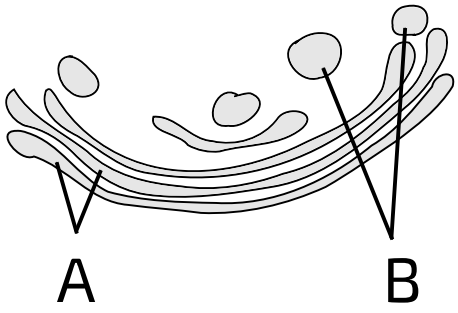


Figure 1: A simplified diagram of the electron microscope image above. The Golgi apparatus is shown, and two structures are labelled.

What is labelled "A" in Figure 1?

What is labelled "B" in Figure 1?

STEM SMART Biology Week 2 - Cell Structure 2

Vesicles, Lysosomes, and Vacuoles

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

Vesicles are small sacs, each one bound by a single membrane. They form by "budding" off from existing membranes (e.g. the endoplasmic reticulum membrane, the Golgi apparatus membrane, or the cell membrane). They move molecules around the cell as well as into and out of the cell. There are also some specialised vesicles which have specific functions: e.g. lysosomes and vacuoles.

Part A

Lysosomes

Lysosomes are specialised vesicles, produced by the [ ], that contain [ ]. They are used to break down ingested material (in [ ] cells) as well as break down old organelles, and they can fuse with the cell membrane to release their contents outside the cell.

Items:

phagocytic | ribosomes | endoplasmic reticulum | carbohydrates | digestive enzymes | Golgi apparatus | lipids | red blood

Part B

Vacuoles

Vacuoles are large vesicles, containing mostly water. Many plant cells have one very large, permanent vacuole called the [ ]. The single-membrane around this is called the [ ]. The central vacuole helps keep plant cells [ ] by pushing other organelles and cell contents to the edges of the cell. It can also act as a store of sugars and amino acids.

Items:

vacuole wall | turgid | tonoplast | plasmolysed | stoma | central vacuole

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Question deck:

STEM SMART Biology Week 2 - Cell Structure 2

Magnification

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

Part A
Magnification formula

Complete the equation for calculating the magnification of an image.

Magnification = [ ] [ ] [ ]

Items:

actual object size | wavelength | image size | image resolution | × | ÷

Part B
Magnification calculation

A student captures an image of a white blood cell on a microscope. The white blood cell has a diameter of $15\,\mu\text{m}$. In the image, the diameter is $150\,\text{mm}$. What is the magnification of this image?

Part C

Cell length calculation

A student captures an image of bacteria on a microscope using $600\times$ magnification. The length of a bacterium in the image produced is $1.5\,\mathrm{mm}$. What is the actual length of this bacterium?

Part D

Image size calculation

A student captures an image of a zebrafish egg, using $200\times$ magnification. The egg has a diameter of $0.7\,\mathrm{mm}$. What will the diameter be in the image produced?

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