

Read this document to learn about cellular organelles and answer the questions at the end of it using the information from the all the Module 1 documents. Answer the questions directly on this document. When done, submit it on Brightspace as a PDF file.

There are 6 pages in this questionnaire. Make sure you do not skip one page.

## I- Features of Plant and Animal Cells:

All living organisms are made of one or more cells. Cells in animal and plants, like all other **eukaryotic** organisms, contain **organelles**. Organelles are defined as a specialized subunit within a cell that has a specific function.

Here is a basic reminder of the role of the main organelles. Refer to your lecture notes or any biology textbook to learn more about the organelle structure and function:

The **nucleus** controls the cell's activities. It contains a substance called the **chromatin**. Chromatin is made up of DNA and proteins and serves as the blueprint for controlling the cell's functions and for building more cells.

Inside the nucleus is the **nucleolus**. The **nucleolus** is used in the production of molecules (rRNA and proteins) that will make up **ribosomes**.

Outside the nucleus is the **cytoplasm**. This aqueous material contains numerous other **organelles**. The liquid in the cytoplasm is called the **cytosol**.

**Ribosomes** can be either be floating in the cytosol or attached to the **rough endoplasmic reticulum**. They synthesize proteins.

The **Endoplasmic reticulum (ER)** is a series of interconnecting flattened tubular channels. The ER takes two forms: **rough ER** and **smooth ER**. The rough ER has ribosomes attached to its membrane and plays a role in the synthesis of various types of protein including proteins that will be secreted outside of the cell, and protein folding. It is flatter than the smooth ER and connected to the exterior membrane of the nuclear envelope. The smooth ER does not have ribosomes on its surface. It plays a role in lipid synthesis and is composed of a series of tube-like structures.

Small vesicles containing newly synthesized proteins separate from the ends of the **rough ER**. The vesicles are used to ship them to other parts of the cell or to the outside of the cell. They can also be shipped to the **Golgi apparatus** for further **protein modification, sorting, and packaging**. The Golgi apparatus is a stack of membranous fattened sacs closely associated with the endoplasmic reticulum.

Additional organelles include **small vacuoles, lysosomes, peroxisomes, and mitochondria**.

**Small vacuoles** are mostly involved in storage. **Lysosomes** are specialised membrane vesicles that contain hydrolytic enzymes that are necessary for intercellular digestion of

macromolecules. They also degrade worn out organelles. Products of their degradation can be reused. **Peroxisomes** are responsible for protecting the cell as they rid the body of toxic substances such as hydrogen peroxide. Peroxisomes also break down lipids.

**Mitochondria** are the site of aerobic respiration, and the major energy production center in cells. They produce ATP, the universal energy carrier in cells.

**Chloroplasts** are large organelles found in plants and certain unicellular **eukaryotes**. They contain a pigment, the chlorophyll, that allow them to capture the light's energy, and use it to make carbon rich molecules (glucose) that will be used by the cell to make energy, and built cellular components.

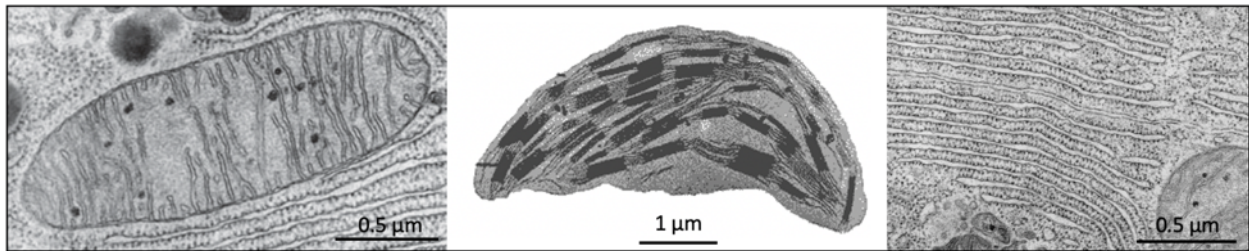


Fig.1. TEM picture of a mitochondria (left), chloroplast (middle) and rough endoplasmic reticulum (right)

Cells have **cytoskeletal components: microtubules, actin microfilaments, and intermediate filaments.**

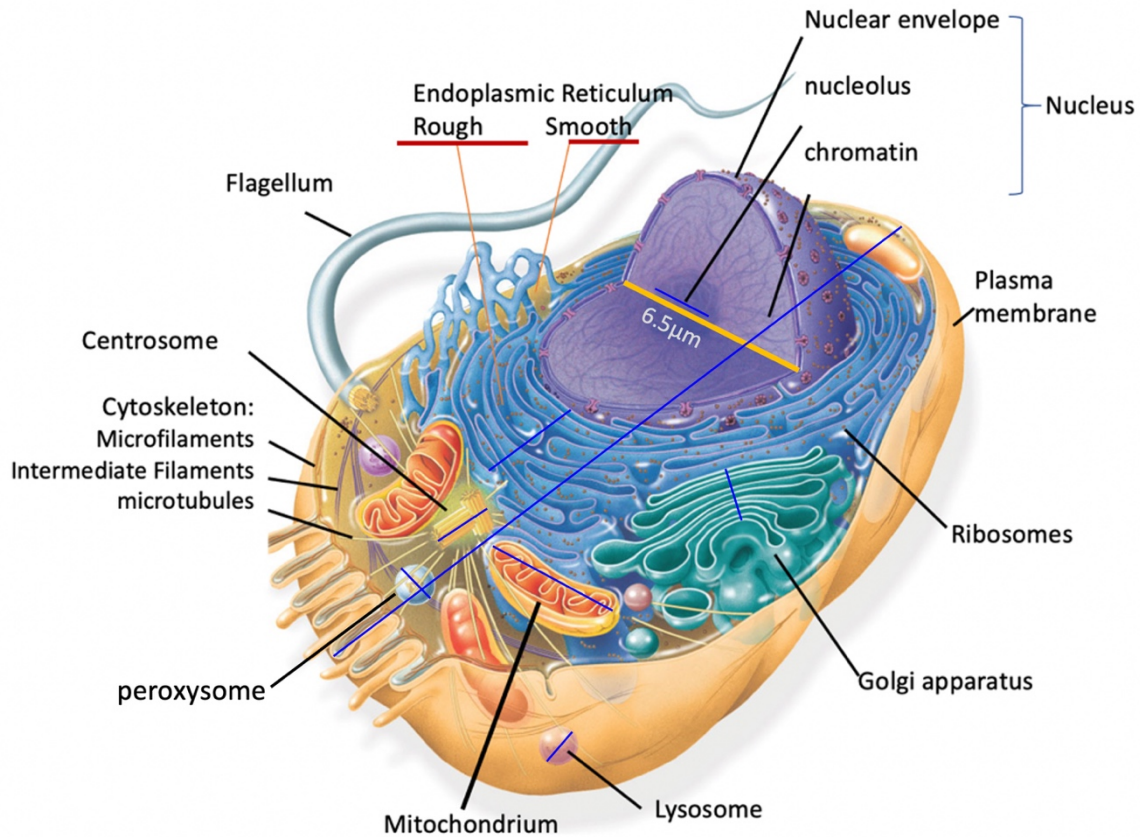
These components play numerous roles in the cell such as support, structure, and movement.

Microtubules are found in the cytosol, cilia (hair-like organelles located on the outside membrane of certain cells such as lung epithelial cells), and flagella (similar to cilia but longer, found in sperm cells).

All cells possess a **plasma membrane**. This thin membrane bilayer, associated with proteins and cytoskeleton elements, is essential in controlling exchange between the cell and its environment. It acts as a very efficient barrier, but also allows a controlled traffic of materials across it in both directions. The membrane is therefore considered as **semi-permeable**. It allows some materials to pass but not others. You will learn more about how molecules cross the membrane in the 2<sup>nd</sup> module about osmosis and diffusion

Watch this video of the Canadian museum of Nature presenting the organelles in the cell (computer generated animation): <https://www.youtube.com/watch?v=2KQbVr9kFO0>

## II- Measuring the size of organelles



On the illustration above, determine the size of all organelles and cell structures knowing that the diameter of the nuclear envelope surrounding the nucleus, is  $6.5\mu\text{m}$  (yellow line)

Organelle / Structure	Size
Nucleus	$6.5\ \mu\text{m}$
Nucleolus	$2.1\ \text{mm}$
Rough ER (distance from nuclear envelope to cytosol)	
Smooth ER (diameter of one tube-like structure)	$0.2\ \mu\text{m}$
Golgi apparatus (depth of several saccules)	$1.52\ \mu\text{m}$
Centrosome	
Mitochondrion (length)	$4.4\ \text{nm}$
Peroxisome	$1.1\ \text{nm}$
Lysosome	$1.1\ \text{mm}$

Whole cell (longest dimension)	21 nm
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Modified from an exercise by Tracie Hudson, Department of Biology at Malcom X College (Chicago IL), published on the National Center for Case Study Teaching in Science.

### III- Measurements of microscopy photographs

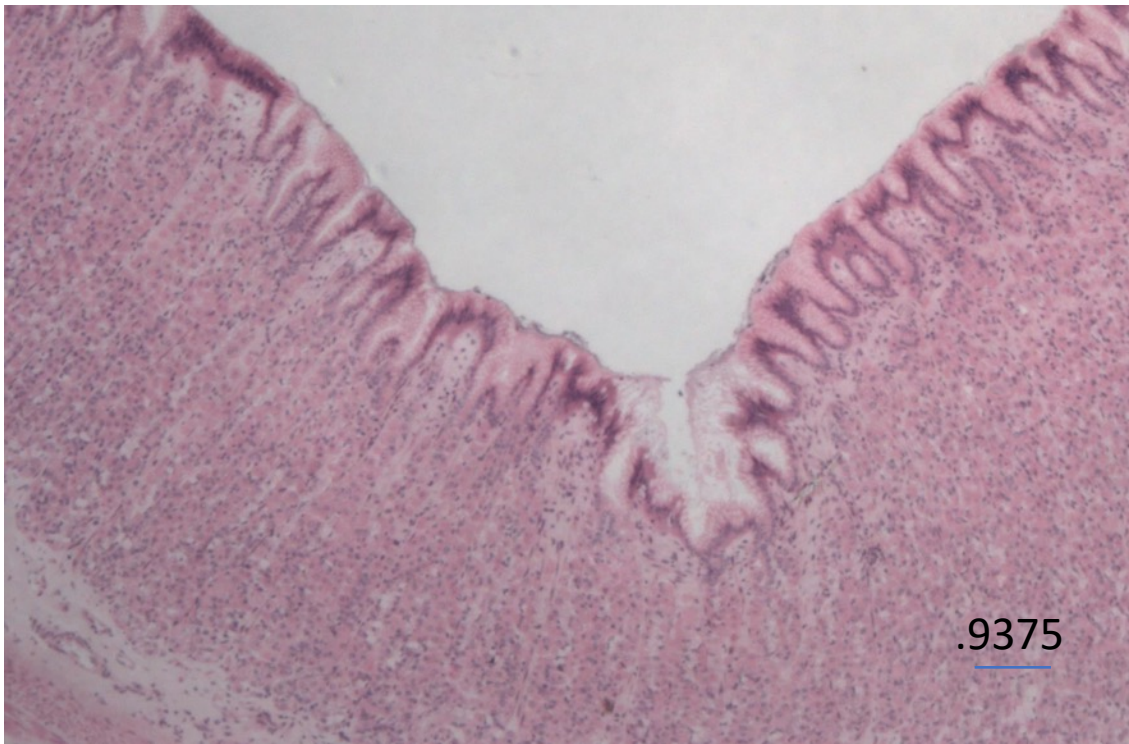


**Question 1:** What is the size in  $\mu\text{m}$  of the structures indicated on the photo?

- A: 8500  $\mu\text{m}$
- B: 1700  $\mu\text{m}$
- C: 43300  $\mu\text{m}$
- D: 7000  $\mu\text{m}$

(continues next page)





**Question 2:** Considering that this picture shows 1.5mm for left to right, draw a scale bar that represents 240 $\mu$ m

Write the on-screen length of the scale bar: .9375 cm (on this document)

$$[(1.5 \text{ mm} / 240 \mu\text{m}) \times 1500 \mu\text{m}]$$

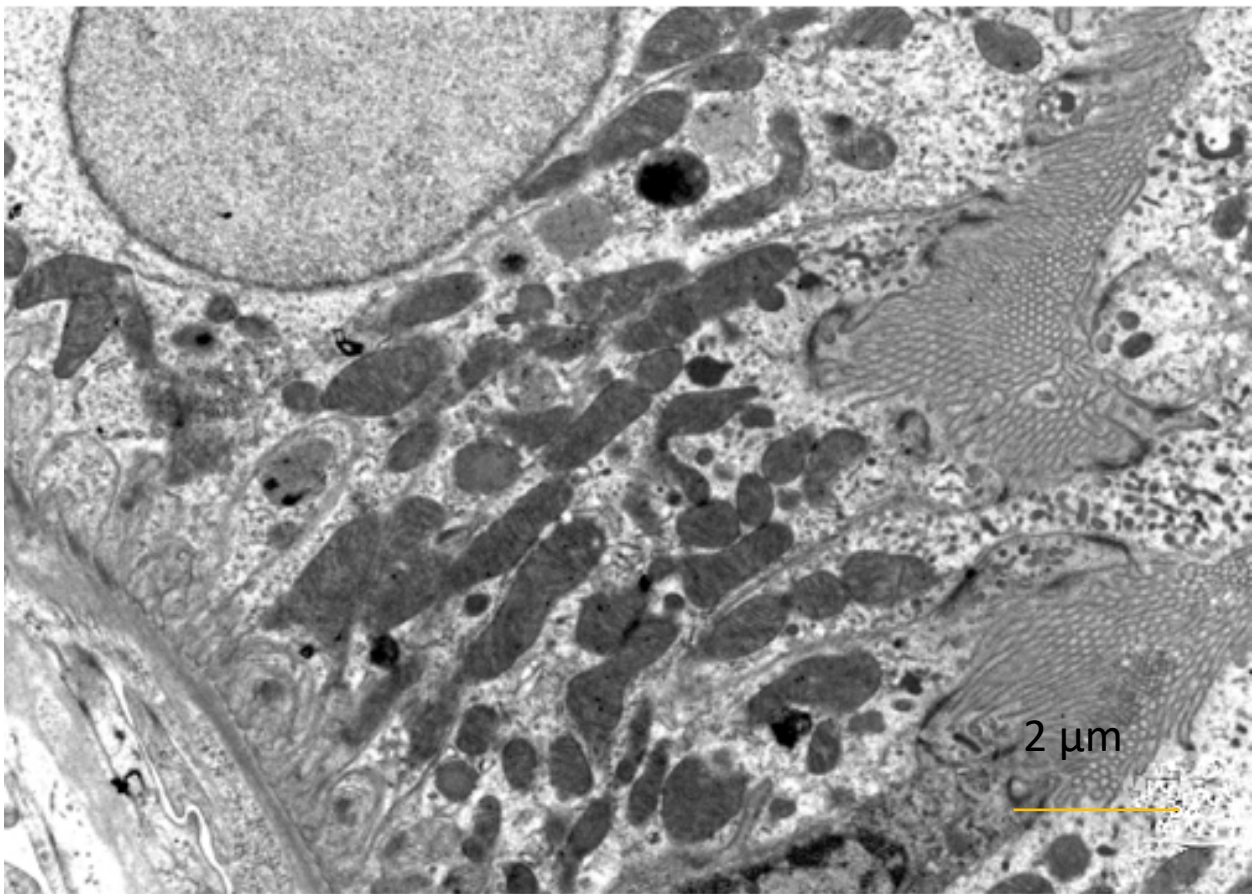
$$= 1500 \mu\text{m} / 240 \mu\text{m}$$

$$= 6.25 \mu\text{m} \times 1500 \mu\text{m}$$

$$= 9375 \mu\text{m}$$

$$= .9375 \text{ cm}$$

(continues next page)



**Question 3:** Add a scale of appropriate size bar on this transmission electron microscope picture that shows 15  $\mu\text{m}$  from left to right.

X = 2.20 cm

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