# B2.2 Organelles and compartmentalization

Organelles have a discrete structure within a cell that is adapted to perform a specific function.

- Organelles can be enclosed by a single membrane or a double membrane.

| No membrane | Single membrane | Double membrane |
|---|---|---|
| Ribosomes | Vesicles and vacuoles | Nucleus |
| Nucleolus | rER, sER | Mitochondria |
| Centrioles | Golgi Apparatus | Chloroplasts |
| | Lysosmes | |

The cell wall, cytoskeleton and cytoplasm are not considered to be organelles

- The cell wall is extracellular
- Cytoskeleton is not a discrete structure
- Cytoplasm is not specialized to perform a specific function

**Advantage of the separation of the nucleus and cytoplasm into separate compartments**

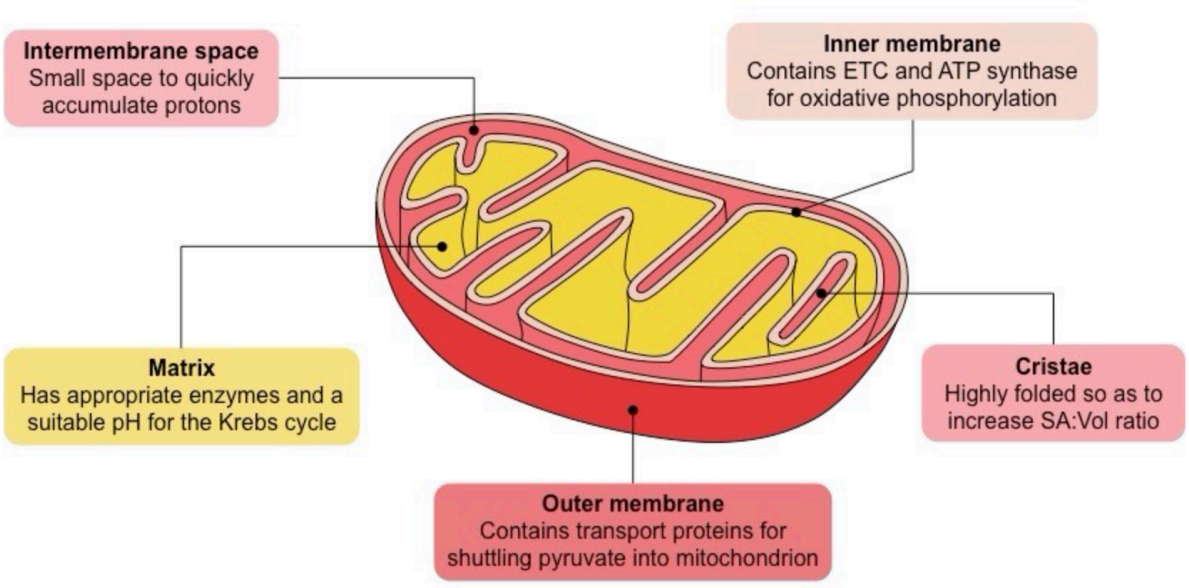
→ The membrane of each organelle creates a compartment with specific controlled conditions inside

a) Enzymes can be concentrated in a small space, increasing the chance for the binding of a substrate to the enzyme's active site
b) Substances that can damage cells can be isolated within a membrane, protecting remaining structures from dehydration
c) Conditions, such as pH, can be maintained at an optimal value for a specific reaction
d) Large areas of membrane can become dense with proteins for specific processes.

Example: The DNA in the nucleus being compartmentalized from the cytoplasm.

a) Keeping chromosomes inside the nucleus protects the DNA
b) Translation can't begin if the mRNA hasn't passed out of the nucleus in eukaryotes as opposed to prokaryotes allowing for post transcriptional modification.

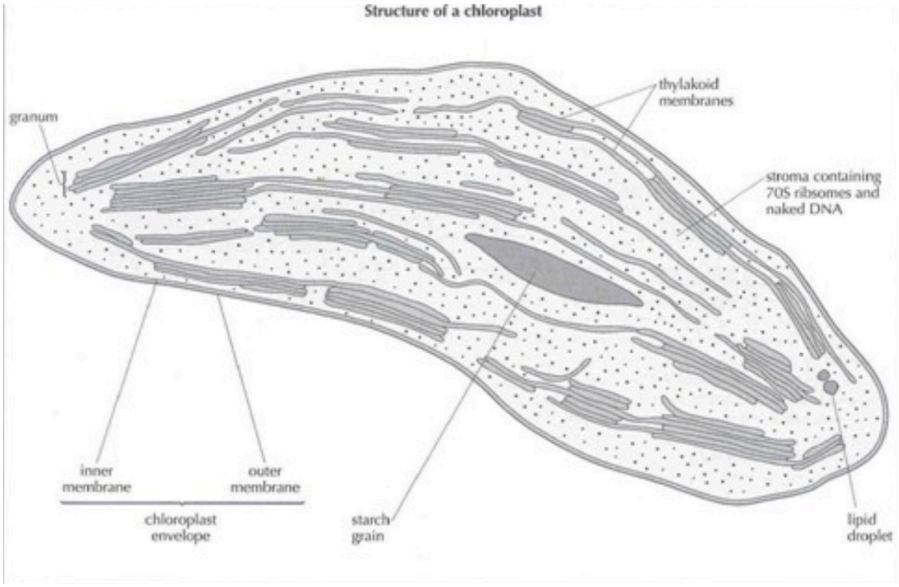
**Structure and Function of a Mitochondrion**




The structure of the mitochondrion is adapted to the function it performs:

- *Outer membrane* – the outer membrane contains transport proteins that enable the shuttling of pyruvate from the cytosol
- *Inner membrane* – contains the electron transport chain and ATP synthase (used for oxidative phosphorylation)
- *Cristae* – the inner membrane is arranged into folds (cristae) that increase the SA:Vol ratio (more available surface)
- *Intermembrane space* – small space between membranes maximises hydrogen gradient upon proton accumulation
- *Matrix* – central cavity that contains appropriate enzymes and a suitable pH for the Krebs cycle to occur
- They have their own DNA (circular and naked) and ribosomes (70S)

## Structure and function of a chloroplast




The structure of the chloroplast is adapted to the function it performs:

- *Thylakoids* – flattened discs have a small internal volume to maximize hydrogen gradient upon proton accumulation
- *Grana* – thylakoids are arranged into stacks to increase SA:Vol ratio of the thylakoid membrane
- *Photosystems* – pigments organised into photosystems in thylakoid membrane to maximize light absorption
- *Stroma* – central cavity that contains appropriate enzymes and a suitable pH for the Calvin cycle to occur
- *Lamellae* – connects and separates thylakoid stacks (grana), maximizing photosynthetic efficiency
- They have their own DNA (circular and naked) and ribosomes (70S)