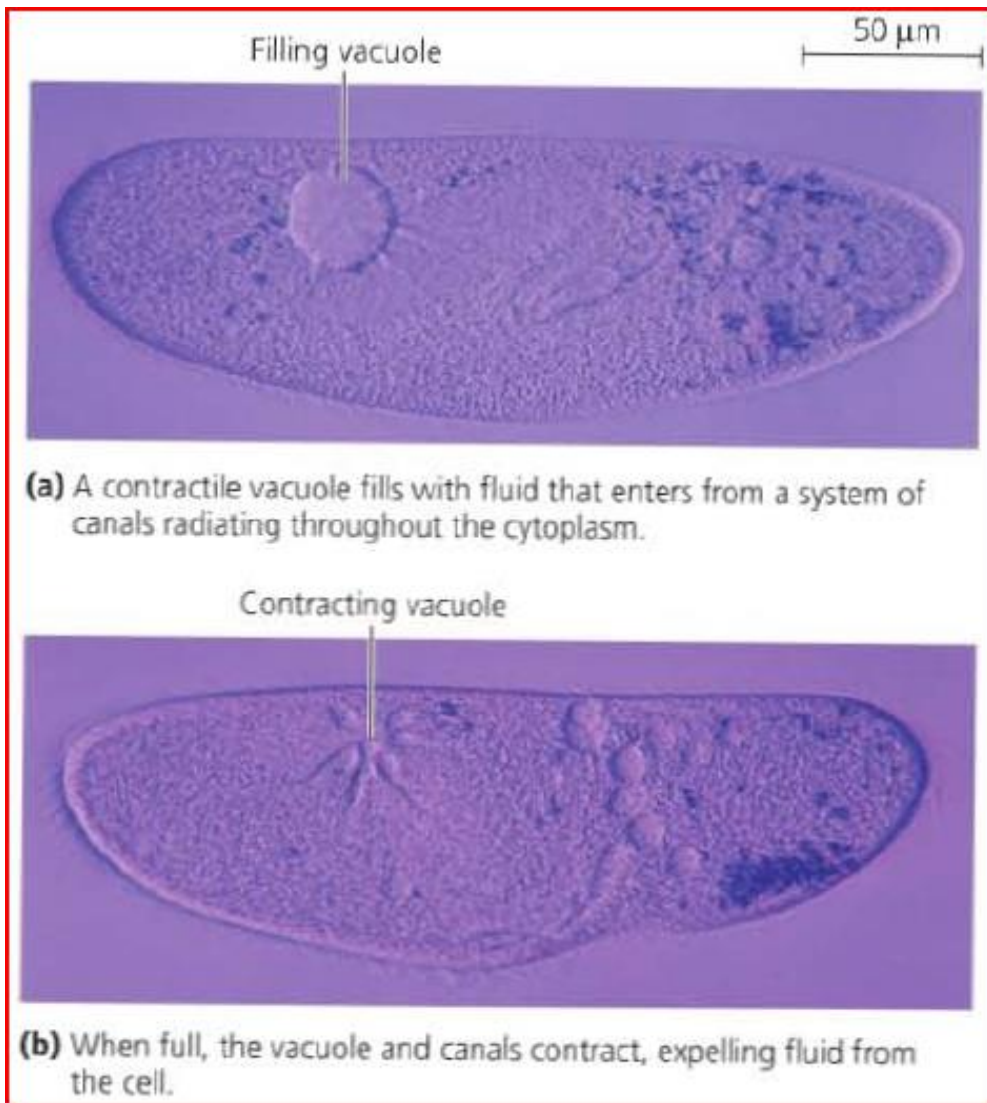


Vacuoles: Diverse Maintenance Compartments

- Vacuoles are membrane-bounded vesicles whose functions vary in different kinds of cells.

Types of vacuoles:

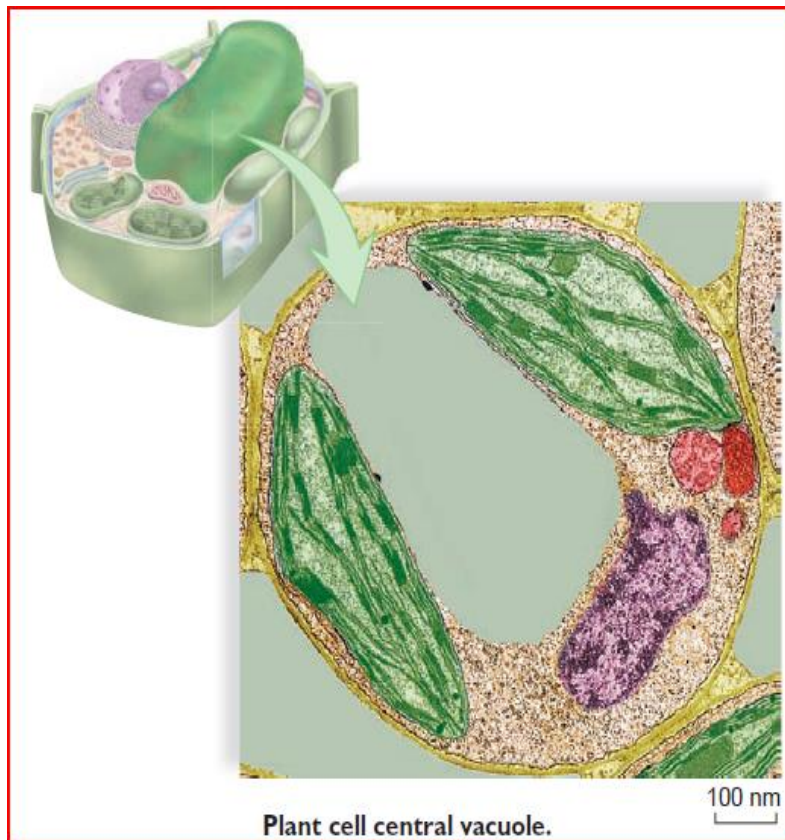
- Food vacuole (phagocytosis).
- Contractile vacuole (pumping excess water out).
- Central vacuole (only in plant & fungi cells).



Contractile vacuole

Central vacuole

- In plants and fungi, which **lack lysosomes**, **vacuoles** carry out **hydrolysis**.
- **Mature** plant cells generally contain a **large** central vacuole.
- The central vacuole develops by **joining** of **smaller** vacuoles, themselves **derived** from the endoplasmic reticulum and Golgi apparatus.
- The **vacuolar membrane** is **selective** in transporting solutes.
- The solution inside the central vacuole, called **cell sap** which differs in composition from the cytosol.



Functions of central vacuole

- Acts as **storage** of an important **organic** compounds (proteins stockpiled in the vacuoles of storage cells in seeds) and **inorganic ions** (K & Cl).

- Acts as **disposal sites** for metabolic waste products.
- **Colour** the cells by storing pigments (**red** & **blue** pigment in petal of flowers) to attract pollinating insects.
- **Protect** plant against predators by containing **poison** or unpalatable to animals.
- Enabling the cell to become **larger** (growth) by absorbing large amount of water.

Mitochondria: Power house: Change energy from one form to another

- In eukaryotic cells, mitochondria (singular, *mitochondrion*) are the organelles that **convert** energy to forms those cells can use for work.
- Mitochondria are the sites of cellular respiration, the metabolic process that **generates ATP** by extracting energy from sugars, fats, and other fuels with the help of **oxygen**.
- Mitochondria are found in nearly **all** eukaryotic cells, including: plants, animals, fungi, and most protists and even in human intestinal parasite.
- Mitochondria are about **1 - 10** μm long.
- Mitochondria have **two** membranes.
- The **membrane proteins** of mitochondria are made by:
 - (1) **Free ribosomes** in the cytosol.
 - (2) **Mitochondrial ribosomes contained within** mitochondria themselves. (But **NOT** by ribosomes **bound** to rough ER).

Mitochondria DNA & proteins

- Mitochondria contain a **small amount** of **DNA** which used to program the synthesis of the most of the organelle's proteins made by its **own ribosomes**.
- **Other types** of proteins imported from the cytosol which used in mitochondria are programmed by **nuclear DNA**.
- Mitochondria are **semiautonomous** organelles that **grow** and **reproduce** within the cell.
- Some cells have a **single large** mitochondrion, but more often a cell has **hundreds** or even thousands of mitochondria; the number **correlates** with the cell's level of metabolic activity.
- Mitochondria can **move** around, **change their shapes**, and fuse or **divide** into two.

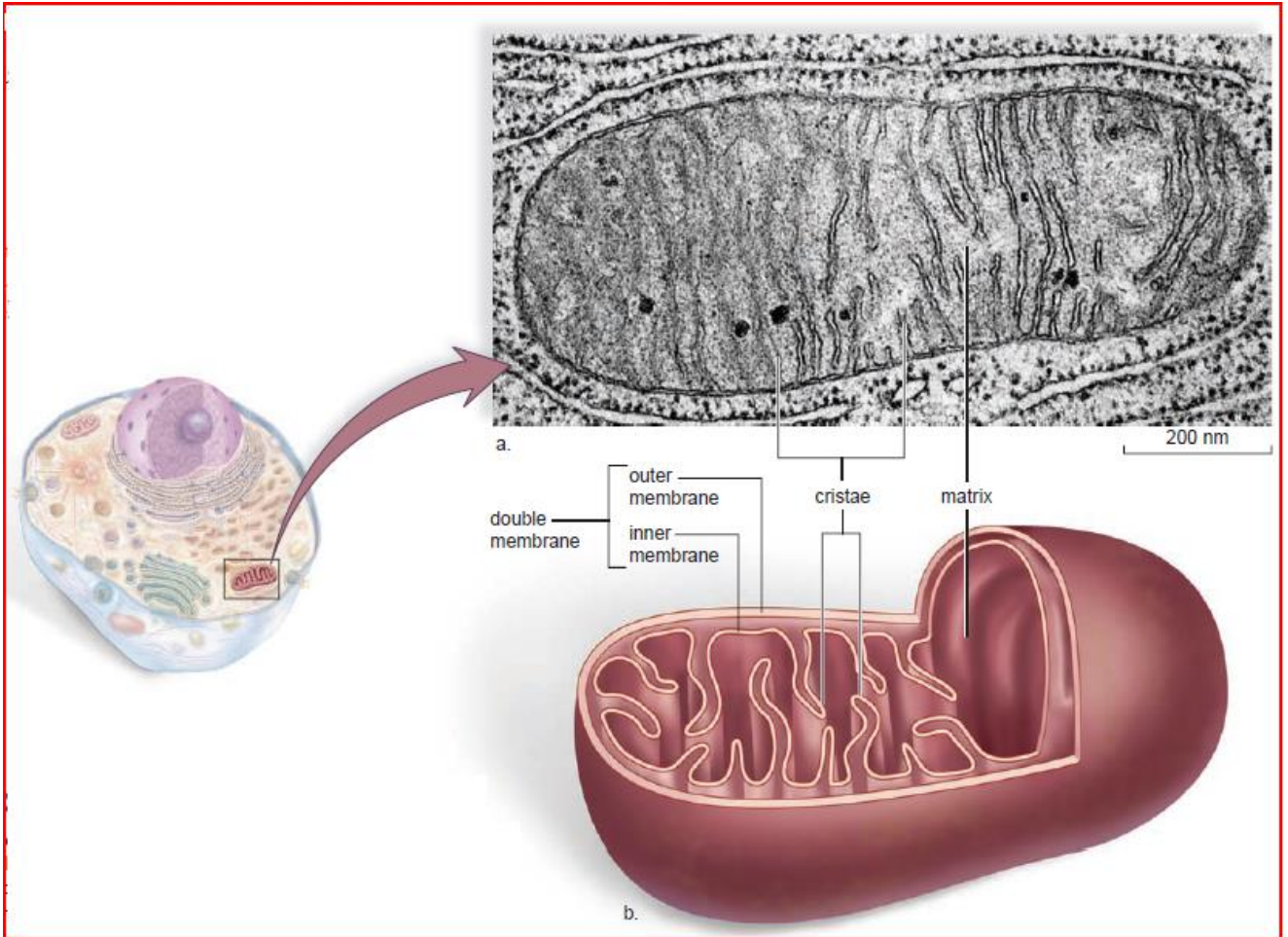
Mitochondria membranes

- Mitochondria have **two membranes** made of **phospholipid bilayer** with embedded **proteins**:
- **Outer membrane**: smooth & separate mitochondria from cytosol.
- **Inner membrane**: convoluted, with infoldings called **cristae** which give **large surface area**, thus **enhancing** the productivity of cellular respiration.

Mitochondria Structure

- The **inner membrane** divides the mitochondrion into **two** internal compartments:
- **Intermembrane space**: the narrow region between the inner and outer membranes.

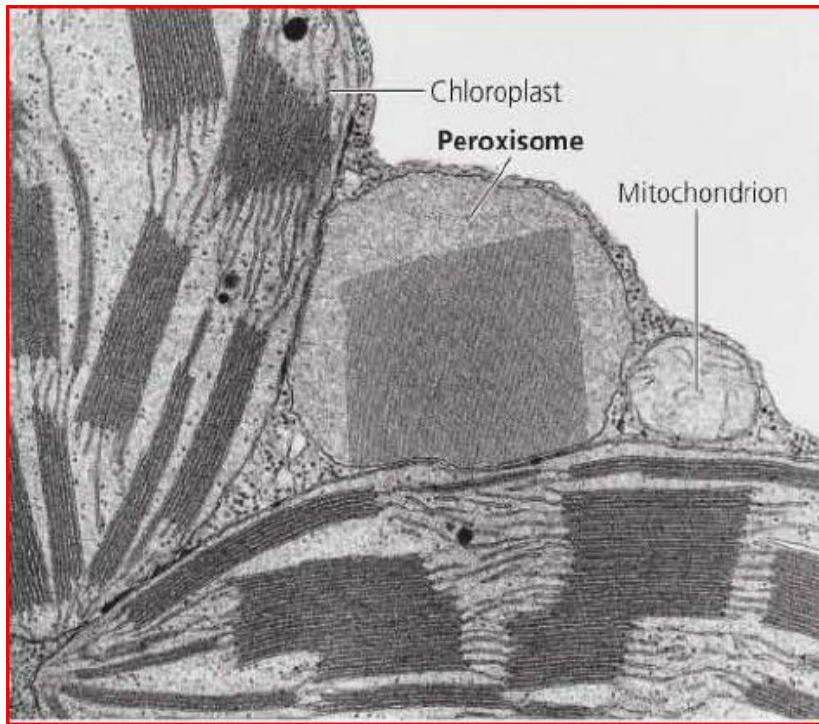
- **Mitochondrial matrix:** enclosed by the inner membrane which contains many different **enzymes**, **mitochondrial DNA** & **ribosomes**.
- **Enzymes** in the matrix **catalyse** some steps of **cellular respiration**.
- Proteins that function in respiration, including the enzyme that makes **ATP** are built into the inner membrane.



Peroxisomes: Oxidation

- Specialised metabolic compartment bounded by a single membrane.
- Roughly spherical & contains a **granular** or **crystalline** core, thought to be a dense collection of **enzyme** molecules.

- These enzymes whose actions result in **hydrogen peroxide (H_2O_2)**, from which the organelle **derives** its name.



- Enzymes in peroxisome **synthesised** by **free ribosomes** and **transported** into a peroxisome from the cytoplasm.

Function of peroxisomes

- Some peroxisomes use **oxygen** to break **fatty acids** down (**oxidation**) into smaller molecules that can then be transported to **mitochondria**, where they are used as **fuel** for **cellular respiration**.
- In liver, peroxisomes **detoxify alcohol** and other harmful compounds by transferring **hydrogen** from the poisons to **oxygen**.
- **H_2O_2** formed by peroxisome enzymes is itself **toxic**, but the organelle also contains an enzyme (**catalase**) that converts **H_2O_2** to **water** and **oxygen** (**important of cellular compartmental structure**).

Peroxisomes in plant

- In **fat-storing tissues** of plant **seeds**, specialised peroxisomes called (**glyoxysomes**) which contain enzymes that convert **fatty acids** to sugar, that uses by seeds as a **source of energy** and **carbon** until it can produce its own sugar by photosynthesis.

Peroxisome growing

- Peroxisomes do **NOT bud** from the endomembrane system like **lysosome**.
- Peroxisomes grow larger by **joining**:
 - A. **proteins** made in cytosol
 - B. **lipids** made: (1) in the ER (2) synthesised within the peroxisome itself.
- Peroxisomes may increase in number by **dividing** in two when they reach a certain size.

Plasma membrane (= Cell membrane = Plasmalemma)

- **Thin semi-permeable** membrane surrounds the cytoplasm in a cell of both prokaryote and eukaryote organisms.
- About **8 nm** in thickness.
- Seen **only** by electron microscope.

Functions of Plasma membrane

- **Selective permeability**:
 - It controls traffic into & out of cell it surrounds.
 - It allows some substances to cross it more easily than others; therefore, its function is to protect the **integrity** of the interior of the cell.
- **Supporting the cell**: it helps **support** the cell and **maintain** its shape because it serves as a base of attachment for the **cytoskeleton**.

Definitions:

Contractile vacuole: is a vacuole that pump excess water out of the cell, thereby maintaining a suitable concentration of ions and molecules inside the cell of many freshwater protists.

Central vacuole: In a mature plant cell, a large membranous sac with diverse roles in growth, storage, colouring and protect the plant against predators.

Cell sap: the solution inside the central vacuole which differs in composition from the cytosol.

Cellular respiration: the metabolic process done by mitochondria that generates **ATP** by extracting energy from sugars, fats, and other fuels with the help of oxygen.

Crista: An infolding of the inner membrane of a mitochondrion that increase the surface area.

Mitochondrial matrix: The compartment of the mitochondrion enclosed by the inner membrane and containing many different enzymes, as well as mitochondrial DNA and ribosomes.

Peroxisome: A specialised metabolic organelle that have roughly spherical and often have a granular or crystalline core that is thought to be a dense collection of enzyme molecules. These enzymes whose actions result in hydrogen peroxide (H_2O_2) which used in oxidation reaction in the cell.

Glyoxysome: A specialised peroxisomes found in the fat-storing tissues of plant seeds. These organelles contain enzymes that initiate the conversion of fatty acids to sugar, which the emerging seedling uses as a source of energy and carbon until it can produce its own sugar by photosynthesis.