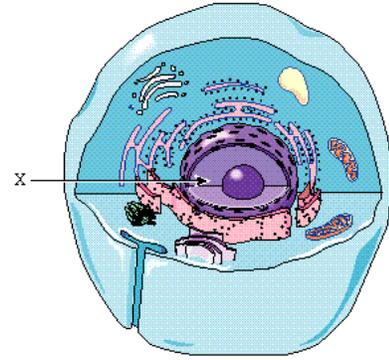


BIOLOGY Yr 12 - CELL STRUCTURE & FUNCTION: Notes

Interesting Facts

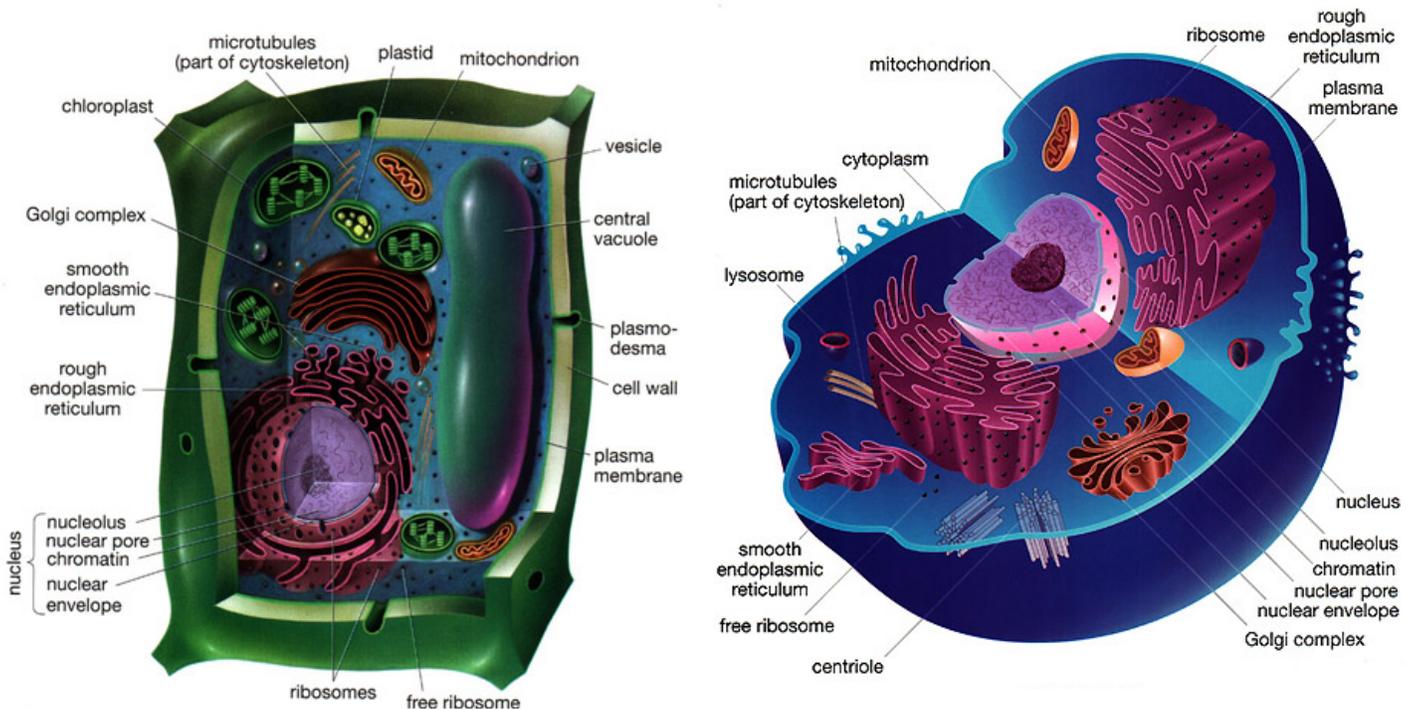
- Some cells are large. e.g. some giant algal cells may be several centimeters long. A chicken's egg is a single cell.
- **40,000 red blood cells** would fill the letter "O" on a page of type. You produce about 2.5 million new red blood cells every second! Each square cm of your skin contains about **150,000 skin cells**.
- Human beings are composed of about **50 to 100 trillion cells**.



EUCARYOTIC CELL STRUCTURE

- You should still recall some aspects of cell structure. At the most basic Level, the cell's overall structure can be viewed as:

1. Cell Membrane
2. Nucleus
3. Organelles
4. Cytoplasm



1. **Cell Membrane:** the thin layer which separates the cell contents from it's environment. Plant cells also have a **cell wall** surrounding the cell membrane.
2. **Nucleus:** specialized structure within the cell which contains DNA and controls cell functioning and reproduction.
3. **Organelles:** small bodies with specific structures and functions within the cell.
4. **Cytoplasm:** the liquid substance between the nucleus and the cell membrane, in which the organelles are located.

Questions

What is the semi-liquid material that surrounds the organelles of a cell?

- A. the chromatin
- B. the cytoplasm
- C. the cytoskeleton
- D. the endoplasmic reticulum

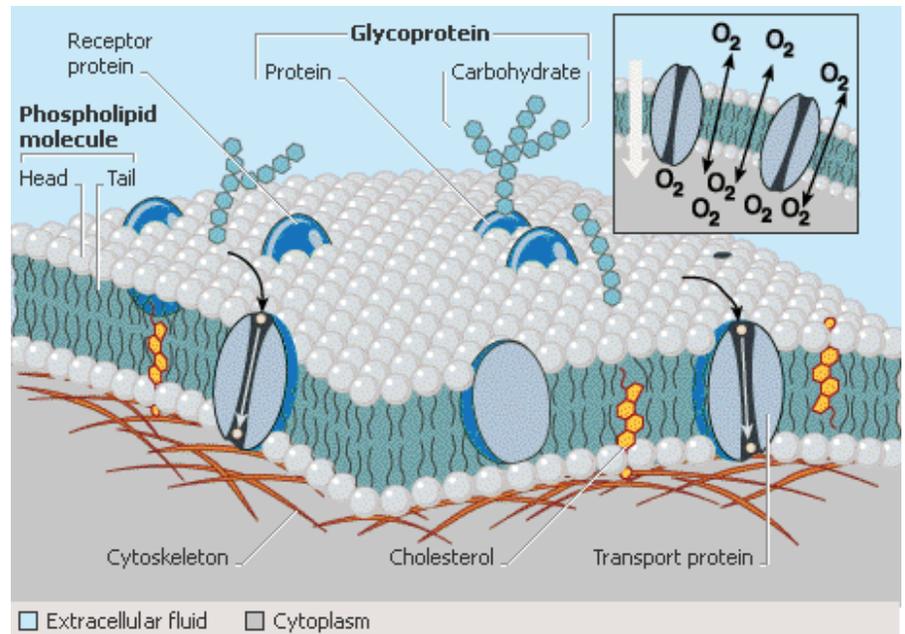
Now Let's Have a DETAILED look at CELL ORGANELLES

The Cell Membrane and the "Fluid Mosaic" Model

- the cell membrane functions in transport of materials in and out of cell, recognition, communication, and homeostasis.

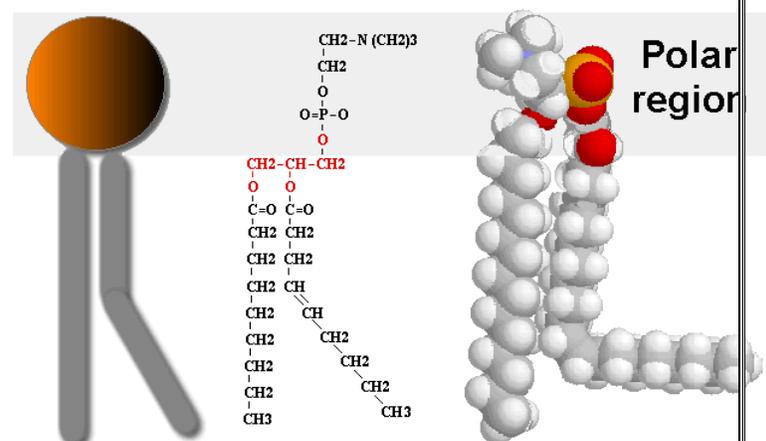
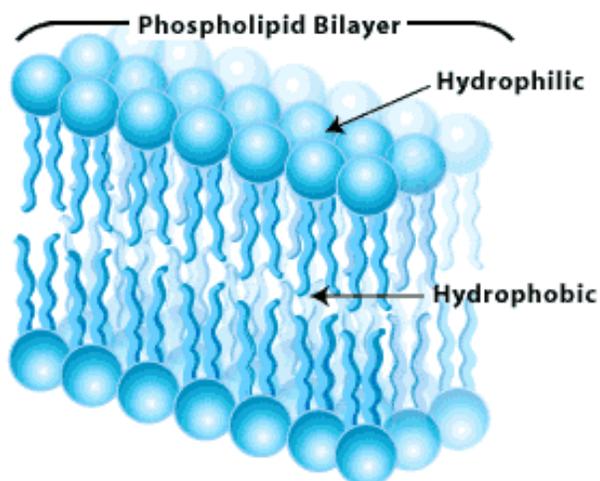
The Fluid Mosaic Model:

- scientists today agree upon **The Fluid Mosaic Model** of membrane structure. The cell membrane is a remarkable structure that has **properties of a solid and a liquid**.
- It forms a "**fluid sea**" in which **proteins** and other molecules like **other lipids** or **carbohydrates** are suspended (like icebergs) or anchored at various points on its surface.
- the "sea" or "fluid" part is composed of **side by side phospholipids arranged in a bilayer** (called a **lipid bilayer**).



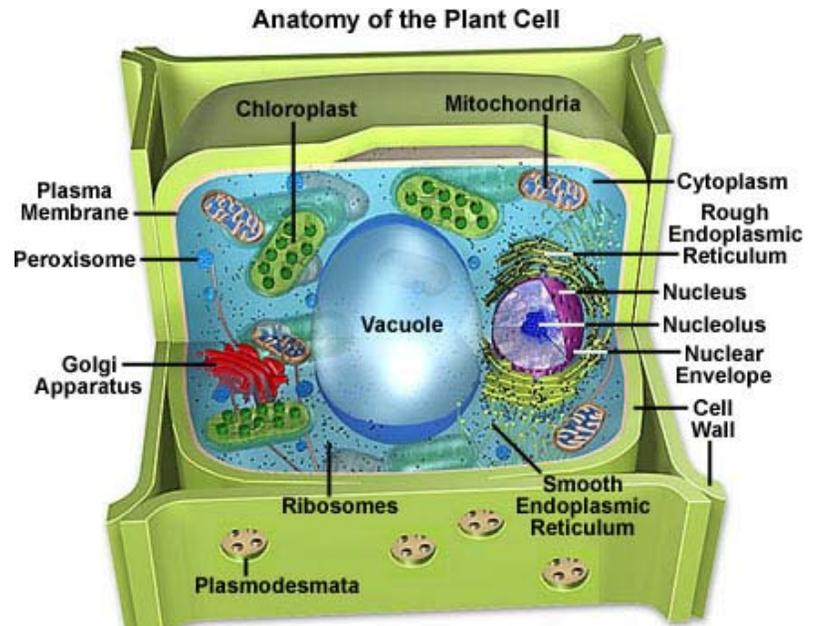
- The solid part (the "mosaic") is the variety of proteins etc. embedded in the bilayer.
- each phospholipid has a **hydrophobic tail** and a **hydrophilic head**.
- the membrane has consistency of **light machine oil**.
- the membrane is **SELECTIVELY PERMEABLE** (*will let some substances in but not others of the same size*).

Phospholipids



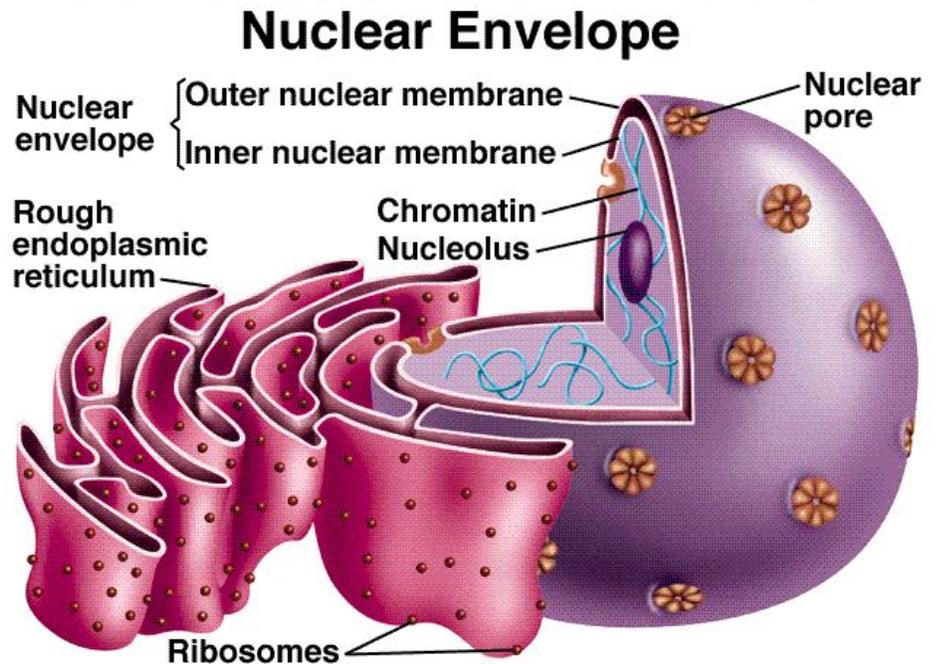
Cell Wall

- **Plant Cells** also have a **Cell Wall** surrounding their cell membrane.
- the cell wall is made up of a large number of **cellulose fibers** cemented together (like the cellulose fibers in paper). **Small molecules** have little difficulty penetrating the cell wall, while **larger molecules** may not be able to pass through. (the cell wall is said to be **semi-permeable**)



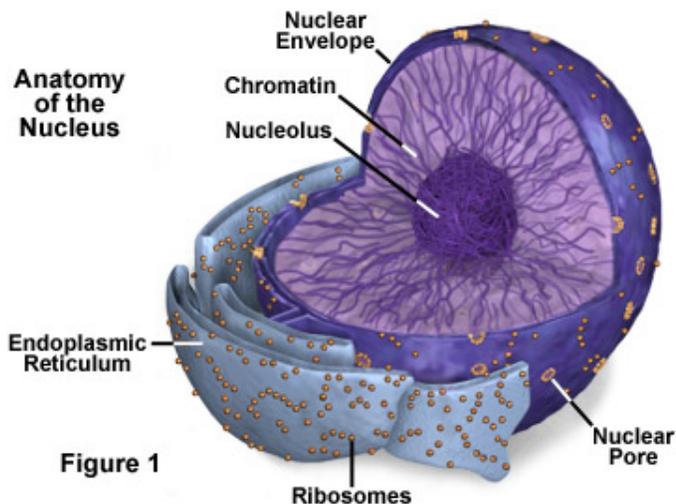
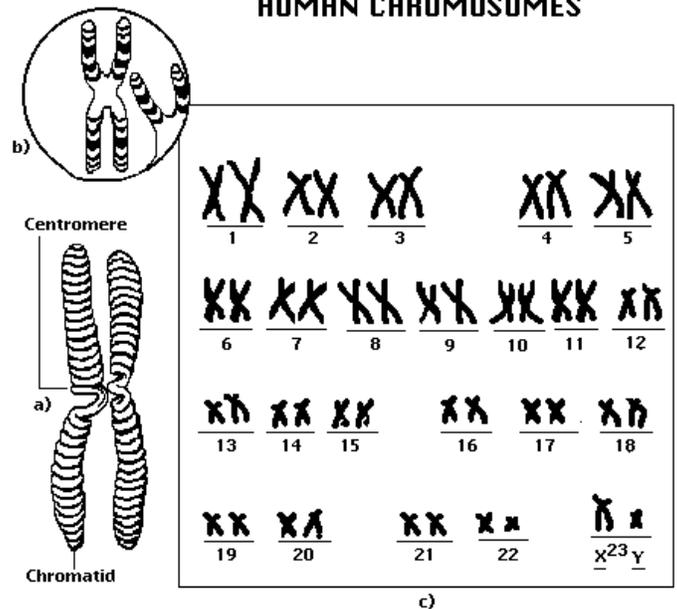
The Nucleus: the Cell's CPU

- the nucleus is a **large, centrally located organelle** surrounded by **nuclear envelope**. The nuclear envelope is a **double membrane** (2 phospholipid bilayers thick) that has **nuclear pores** in it for genetic messages (RNA) pass into the cytoplasm.



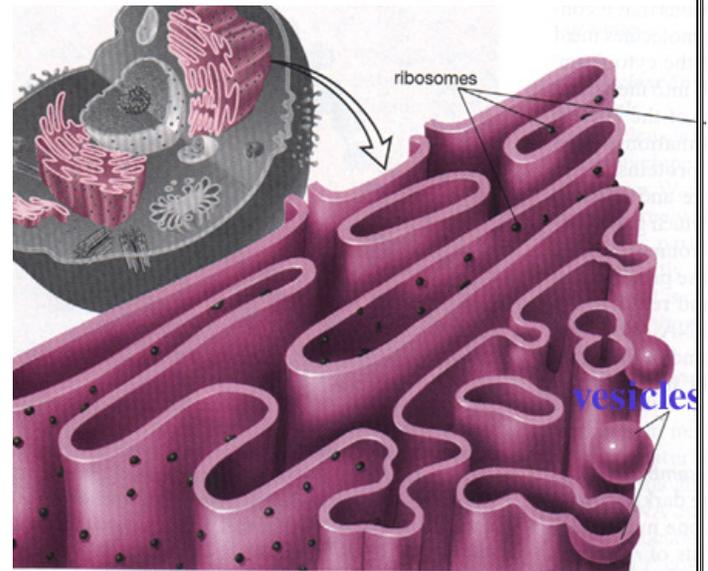
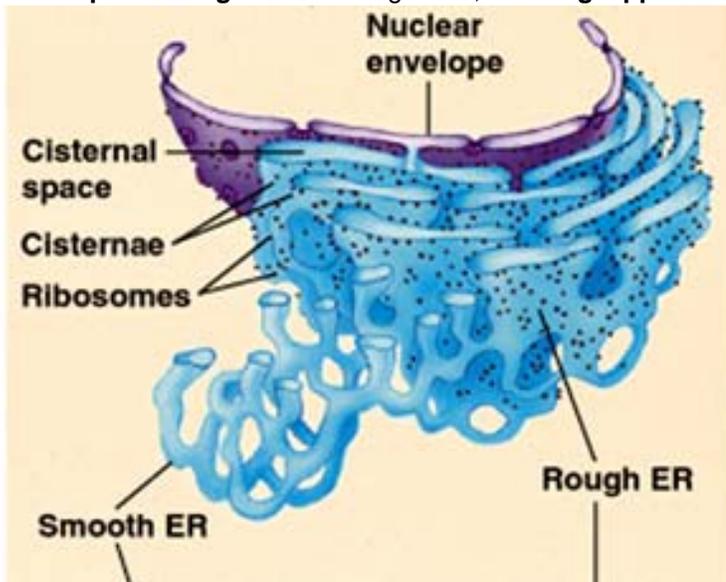
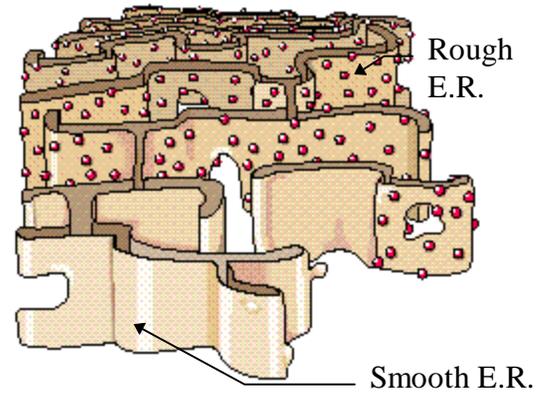
- The nucleus is the **control center** or "brain" of cell. Contains the DNA and is site of manufacture of RNA. The DNA is contained by a number of **chromosomes**, which consist of long strands of DNA tightly wound into **coils** with **proteins** called **histones**. The combination of DNA and histone proteins is known as **CHROMATIN**. **Chromosomes** function in **packaging of DNA** during nuclear division and **control of gene expression**
- The nucleus, therefore, determines the **metabolism, growth, differentiation, structure, and reproduction** of cell.
- The nucleus contains one or more **DARK-STAINING** discrete structures, known as **NUCLEOLI**, which are **sites of ribosomes** synthesis.

HUMAN CHROMOSOMES

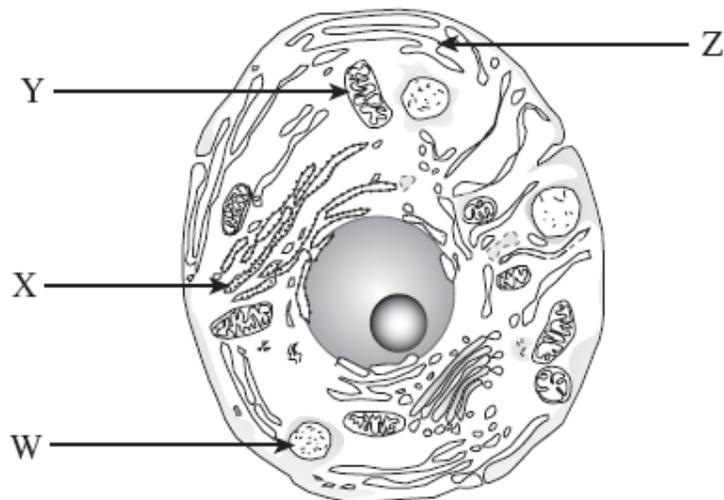


Endoplasmic Reticulum (ER)

- the ER is a system of **MEMBRANOUS TUBULAR CANALS** that begins just outside the nucleus and branches throughout the cytoplasm.
- if **ribosomes** are attached to the ER, it is called **ROUGH Endoplasmic Reticulum**. The function of rough ER is **protein synthesis**.
- if no ribosomes are attached to the ER, it is called **SMOOTH Endoplasmic Reticulum**. The function of smooth ER is **synthesis of lipids** (fats, steroids and phospholipids), store calcium and also to **detoxify drugs**.
- Most of the proteins leaving the endoplasmic reticulum are still **not mature**. They must undergo **further processing** in another organelle, the **Golgi apparatus**.



Questions

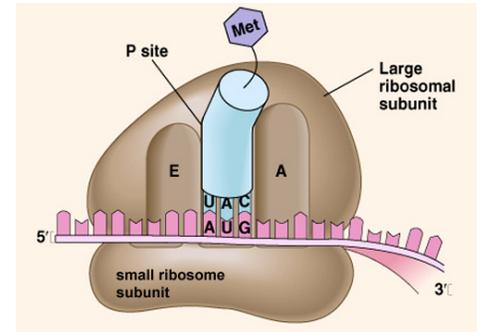


Where are drugs detoxified in liver cells?

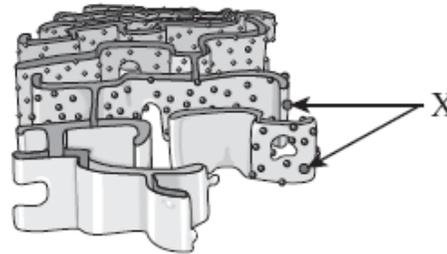
- A. W
- B. X
- C. Y
- D. Z

Ribosomes

- consist of **rRNA** and **proteins** and is made of 2 **non-identical subunits**
- rRNA is produced in the nucleolus and joined with proteins -- then migrate through the nuclear pore to the cytoplasm for final assembly
- ribosomes attach themselves to the endoplasmic reticulum
- function is **site** for **PROTEIN SYNTHESIS**



Questions

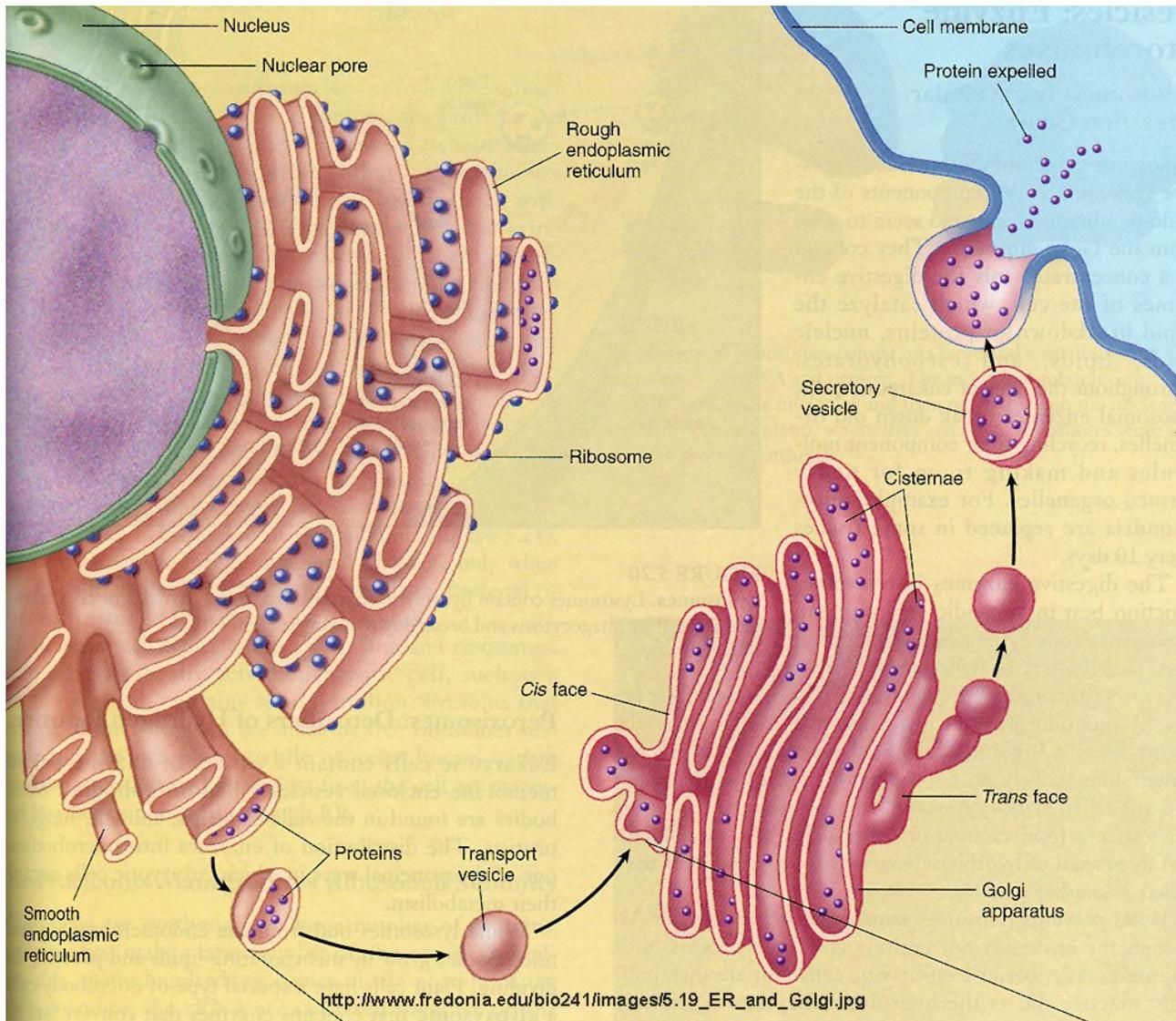
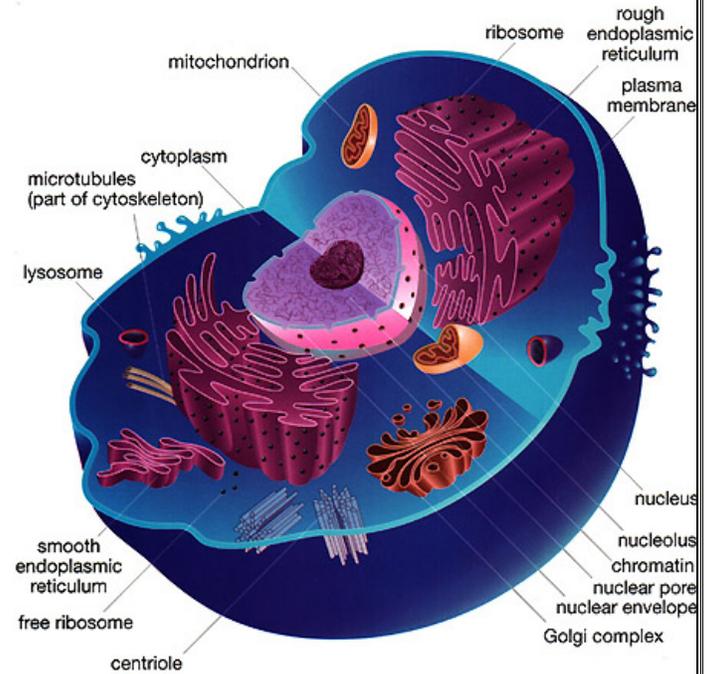


What is a product of the process that occurs at the structures labelled X?

- A. bile
- B. glycogen
- C. hemoglobin
- D. phospholipids

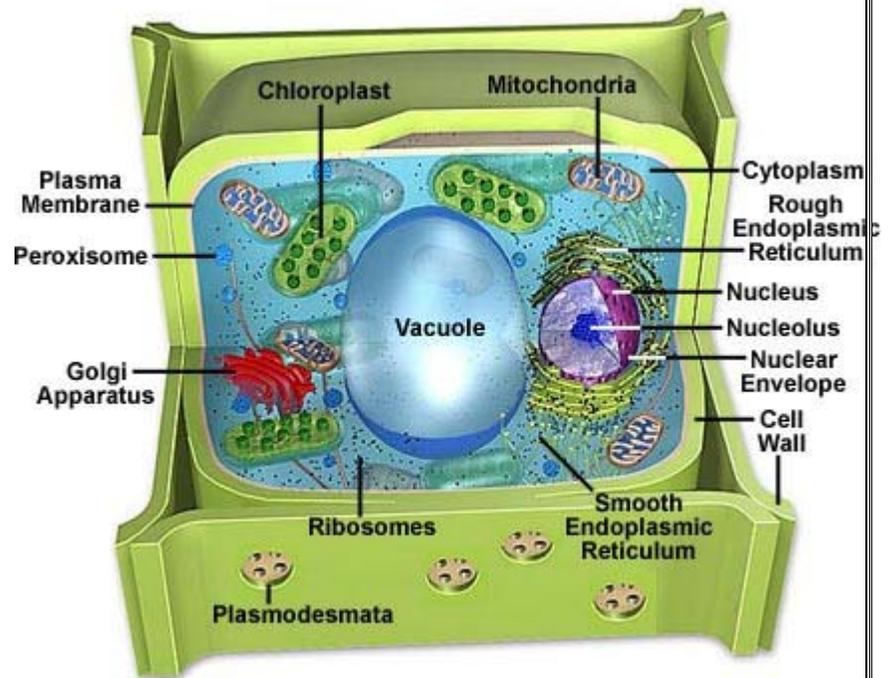
Golgi Apparatus

- The Golgi Apparatus are **stacks of flattened, hollow cavities with the membranes**.
- Each sac in the organelle contains **enzymes** that **modify proteins** as they pass through.
- Thus, the Golgi apparatus functions in **modification, assembly, packaging, storage** and **secretion** of substances.
- it receives newly manufactured protein (from the ER) on it's inner surface. Within the Golgi apparatus, the proteins are **sorted out, labeled, and packaged into vesicles** that "**pinch off**" the outer surface of the saccuoles. These vesicles can then be transported to where they are needed within the cell, or can move to the cell membrane for export to the outside of the cell by **exocytosis**.



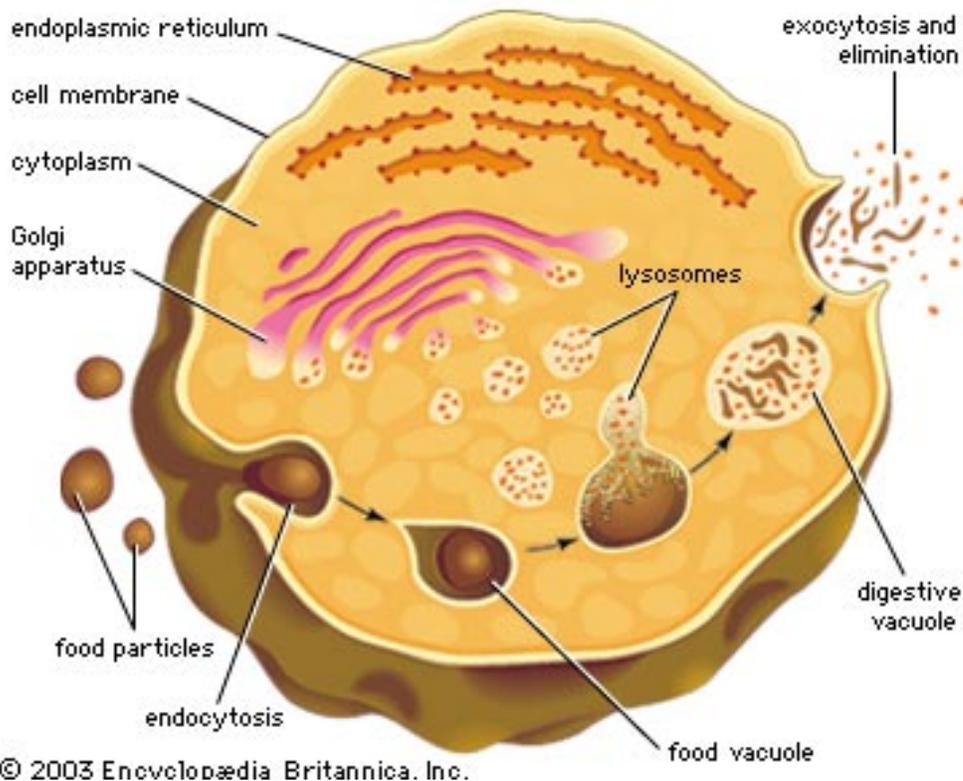
Vacuoles and Vesicles:

- A **VESICLE** is a small **vacuole**
- are used for **transport** and **storage** of materials
- **Plant cells** usually have one large **Central Vacuole**.
- the plant cell's central vacuole functions in 1) water storage 2) food storage 3) waste storage 4) cell support



Lysosomes: Cellular “Stomachs”

- **special vesicles** which are formed by the Golgi apparatus.
- **contain powerful hydrolytic enzymes**
- functions in 1) **cellular digestion** 2) **autodigestion** or disposal of damaged cell components like mitochondria 3) **breakdown of a whole cell** (by releasing their contents into the cell cytoplasm). For this reason, they are sometimes called “**suicide sacs.**”
- Lysosomes are known to contain over **40 different enzymes** that can **digest almost anything** in the cell, including **proteins, RNA, DNA, and carbohydrates.**
- Lysosomes help **destroy invading bacteria.**
- **PEROXISOMES** are like Lysosomes but use **hydrogen peroxide for breakdown.**



Provincial Questions

Which of the following are found in lysosomes?

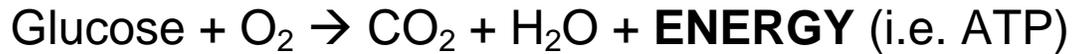
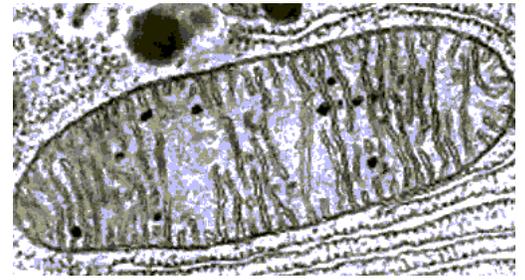
- A. ATP
- B. RNA
- C. enzymes
- D. glycogen

Which of the following breaks down old blood cells?

- A. a lysosome
- B. the nucleolus
- C. a chromosome
- D. the smooth endoplasmic reticulum

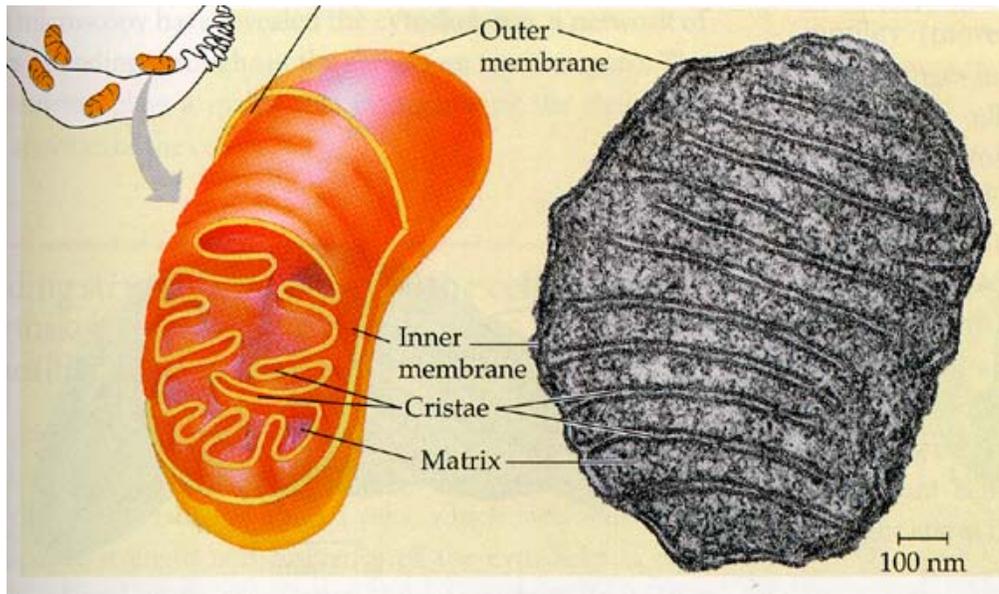
Mitochondria: the Cell's Powerhouse

- Mitochondria are the **largest organelles** in an animal cell, after the nucleus.
- Are sausage-shaped surrounded by a **double-layered membrane**.
- The inner is convoluted into shelf-like folds called **cristae**. This is where **energy is produced**.
- function is **CELLULAR RESPIRATION**. Converts **glucose** to **ATP**, the cell's primary energy molecule, as well as lesser amounts of other energy rich molecules. The overall formula for cellular respiration is:



Interesting Facts

- Mitochondria have some of their **own DNA molecules** and **ribosomes** that resemble those of **prokaryotic** cells.
- Mitochondria are also **self-replicating**. They "reproduce" by splitting in half.
- **mitochondria** may have evolved from bacteria that once developed a close relationship with primitive eucaryotic cells, and then lost the capacity to live outside the cell.
- Another interesting characteristic of human mitochondria is fact that all of a person's mitochondria are descendants of those of his or her **mother**.



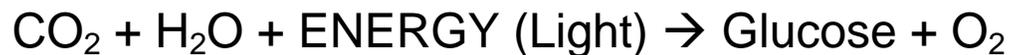
Chloroplasts & Plastids: Food Makers for the World

- found in plant cells only.
- membrane-bound structures that usually contain **pigments** and give plant cells their green colours. The **most prominent plastid** is the **CHLOROPLAST**.
- some plastids are **storage bodies** for **starch, proteins, oils**.

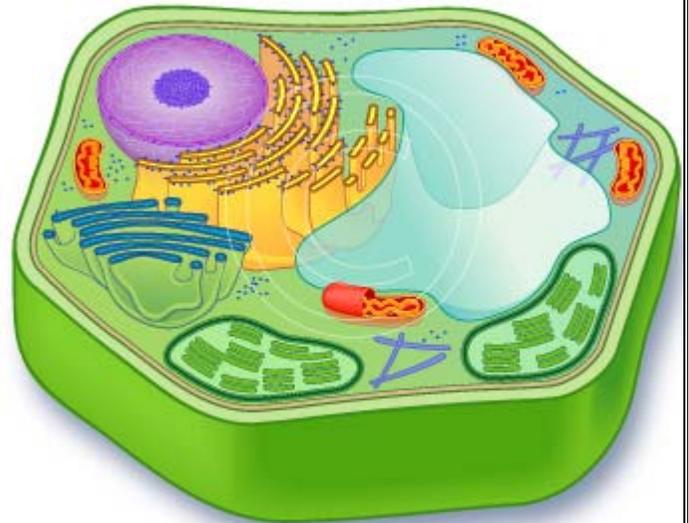
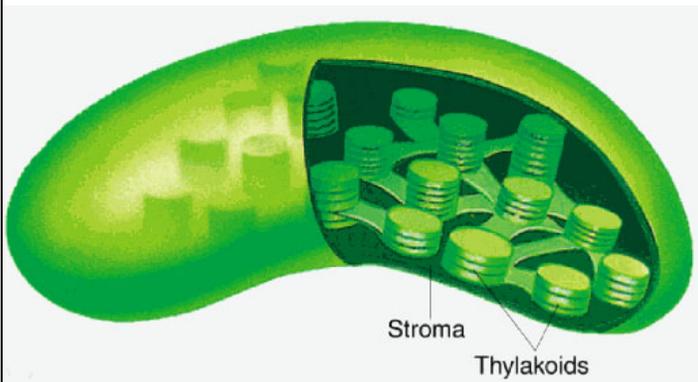
Chloroplast

- these are the **double-membrane bound organelles** in which **PHOTOSYNTHESIS** (the conversion of light energy to carbohydrates) occurs. **Chlorophyll** is the chemical that absorbs the energy of the sun to provide the energy required for reducing **CO₂** to **Glucose**.

- Process is basically the **opposite** of cellular respiration:



- inside the chloroplast are membranous stacks of **grana** (look like **pancakes!**) where the chlorophyll is located.

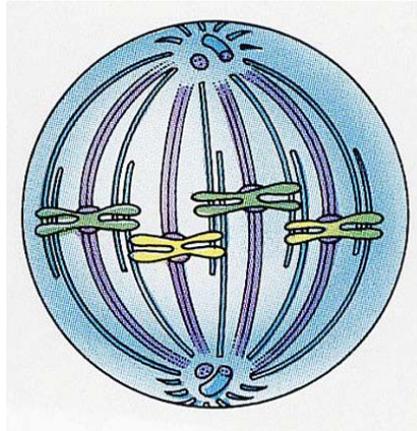
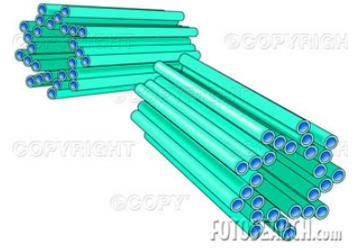


In which one of the following organelles is light energy used to produce simple sugars?

- A. Lysosomes.
- B. Chloroplasts.
- C. Mitochondria.
- D. Endoplasmic reticulum.

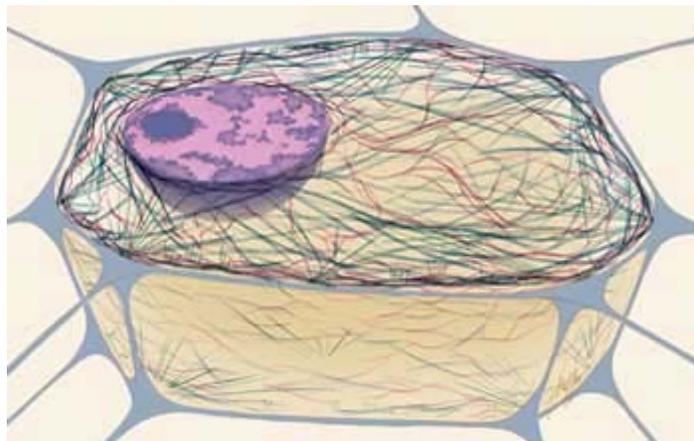
Centrioles

- **Animal cells** have two cylindrical bodies, called **centrioles**, located **near the nucleus**. Centrioles play a part in cell division by assisting in the **formation of the spindle apparatus**
- each animal cell has one pair of centrioles lying at right angles to each other next to the nucleus
- centrioles **give rise to basal bodies**. **Basal bodies direct the formation of cilia and flagella**



The Cytoskeleton

- The **network of microtubules** and **microfilaments** within the cell that **help it maintain shape, anchor organelles**, or **help the organelles move** as necessary.

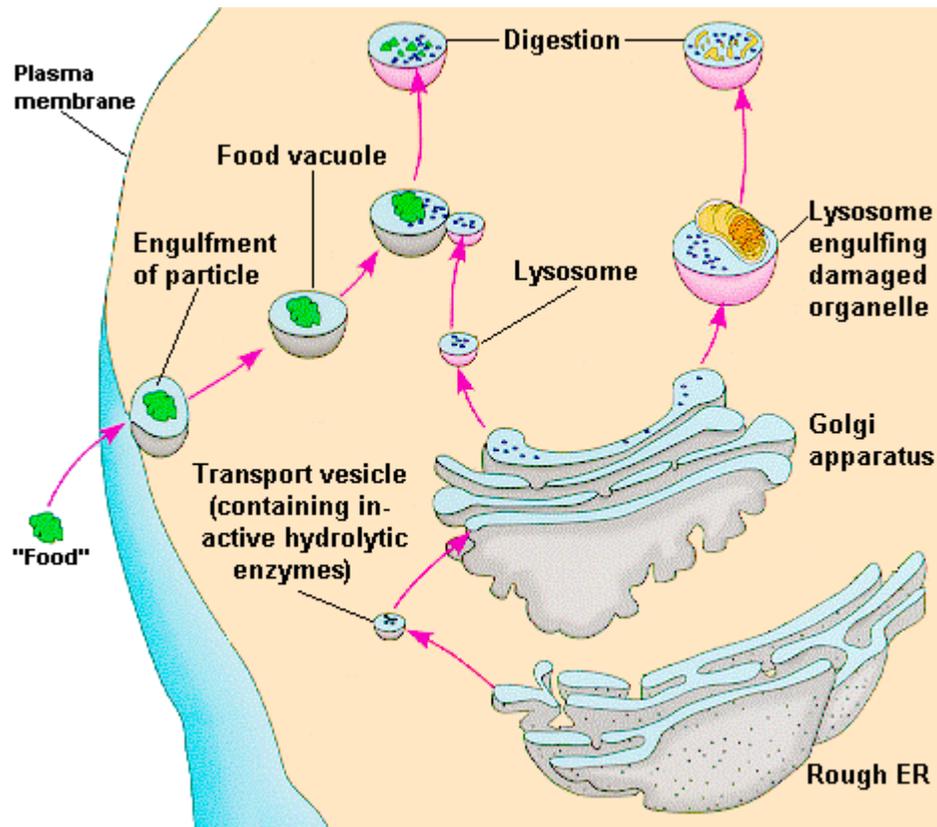


Interrelationships:

All the organelles in the cell work together to make the cell function

Below the RER makes the proteins (digestive enzymes) and send them to the Golgi Body for modification. The Golgi body then produces active lysosomes.

The Lysosomes can be seen fusing with food vacuoles for digestion in one part of the cell and engulfing a mitochondria to be recycled in another part of the cell.



Questions

What organelle functions with the endoplasmic reticulum during protein production?

- A. the ribosome
- B. the lysosome
- C. the chloroplast
- D. the cell membrane