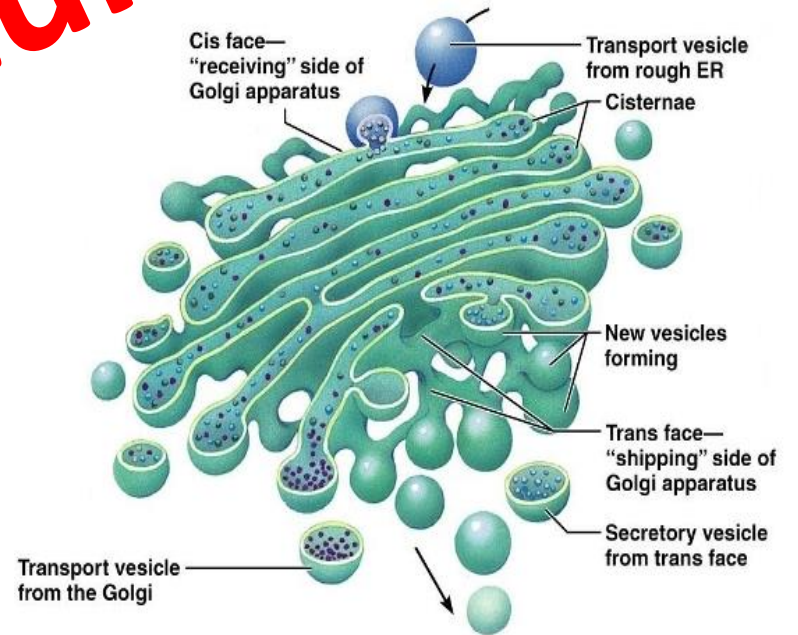
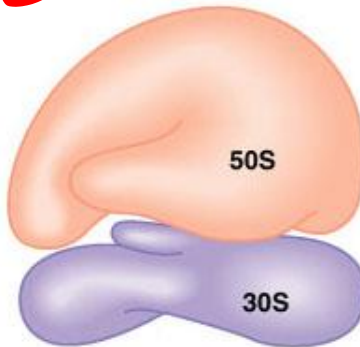
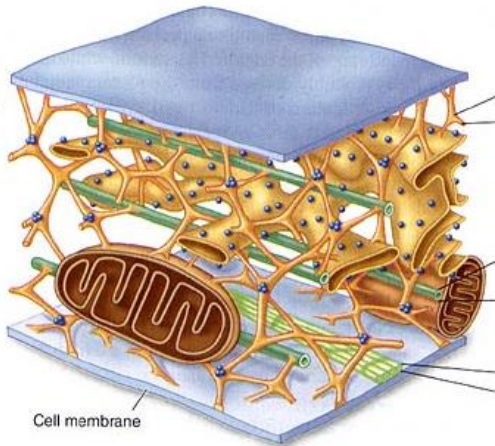
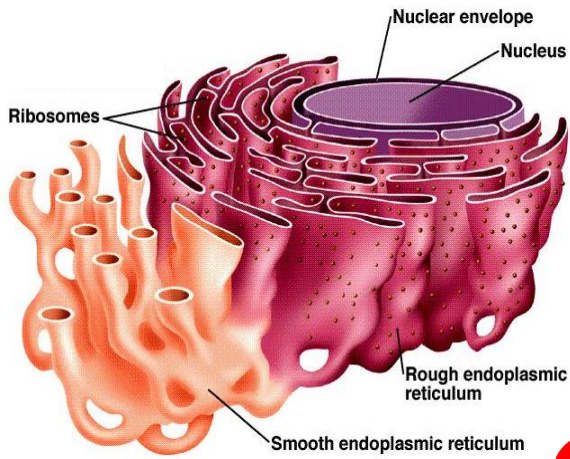
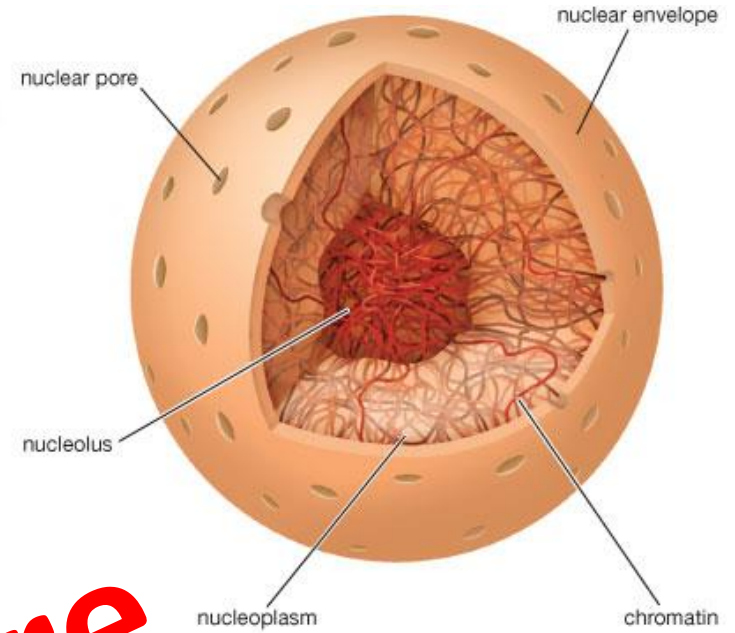
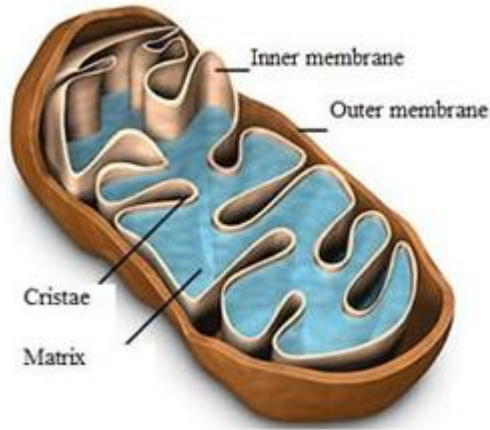
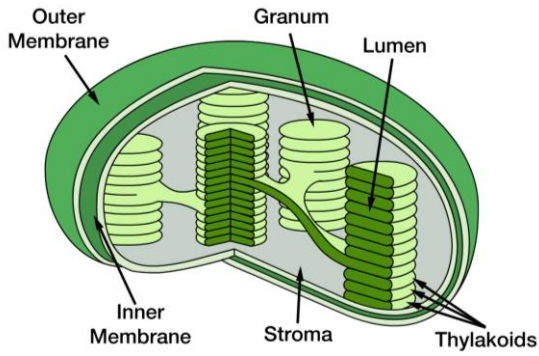
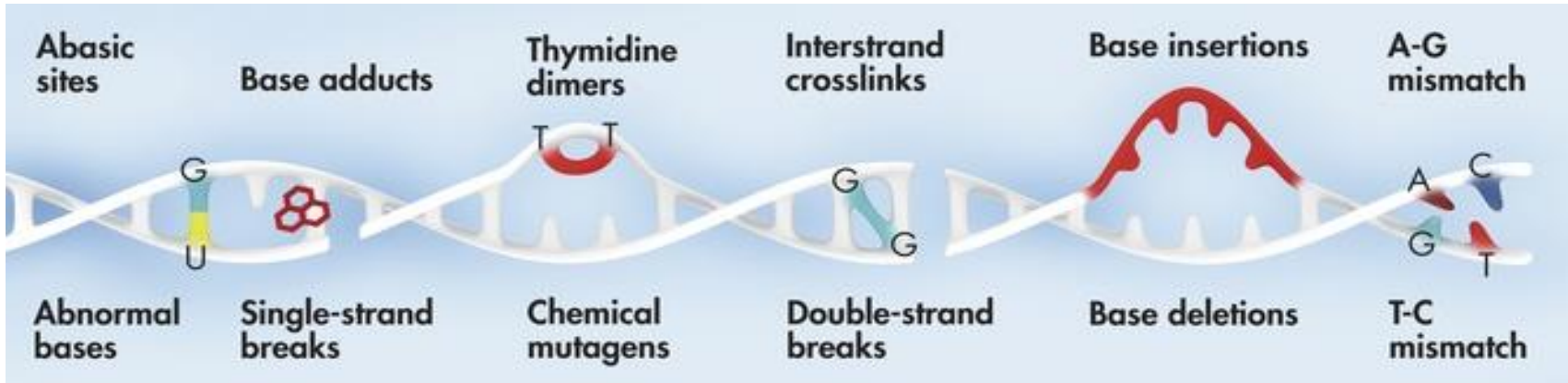


Cell Structure



DNA Damage

DNA is damaged up to 1 million times per cell per day.



- The cells have an **elaborate type-of-damage-specific system of DNA repair** that is constantly active.
- A cell that has accumulated a large amount of DNA damage, or one that no longer effectively repairs damage incurred to its DNA, can enter one of three possible states:
 1. an irreversible state of dormancy, known as *senescence*
 2. cell suicide (apoptosis) or programmed cell death
 3. unregulated cell division, which can lead to cancer

DNA Mutations

A mutation is a **permanent change** in the **DNA sequence**.

- Mutations can be:
 - *spontaneous* (by chance)
 - *induced* by **mutagens** (physical, chemical or biological agents)
- **Factors** that cause mutations:
 - external - environmental factors such as sunlight, radiation, and smoking
 - native - errors during DNA replication
- Mutations can lead to:
 - an *evolutionary advantage* of a certain genotype
 - disease, developmental delays, structural abnormalities, or other effects.



Example: Sickle cell anemia is a disorder in which the body makes sickle-shaped red blood cells as a result of DNA mutation.

DNA Half-Life

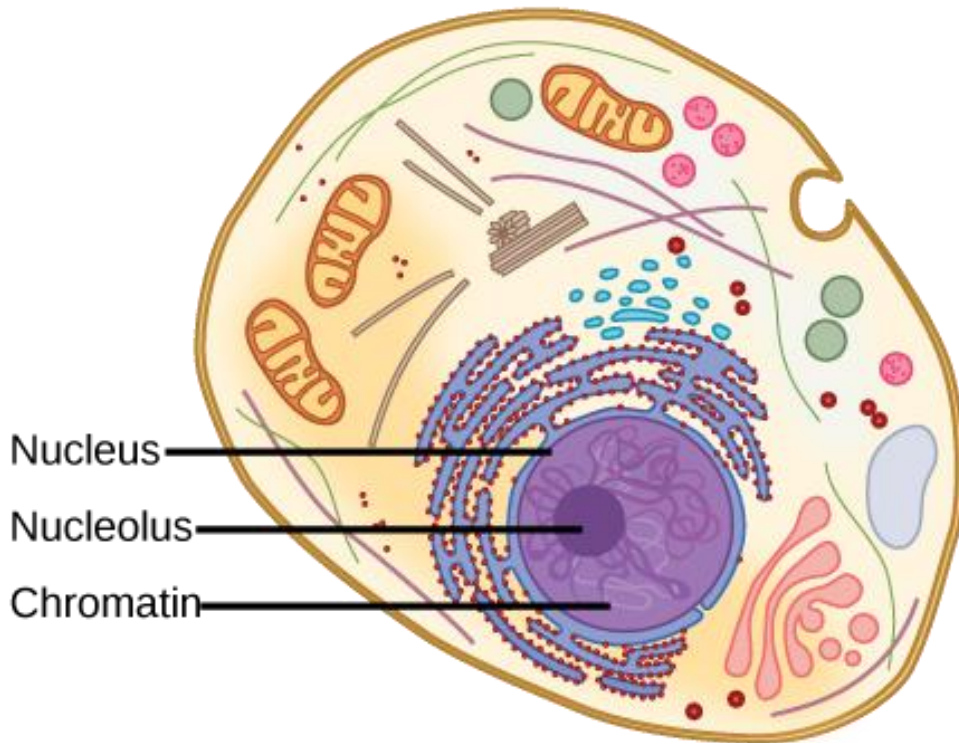
In 2012, researchers have calculated that **DNA from bones** has a **521 year half-life**, which means that the **oldest clone-able samples of DNA** could be no more than **2 million years old**.



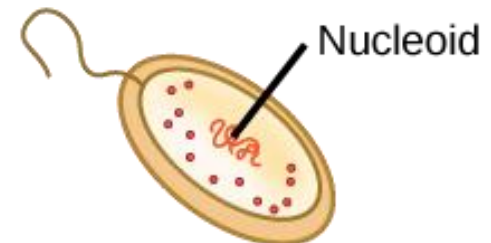
This result **rules out any possibility of ever replicating dinosaurs**, as the youngest dinosaurs were around more than 65 million years ago...

Basic Cell Types

All cells consist of a **cytoplasm** enclosed within a **membrane**.



Cells are typically categorized by how their genetic material is packaged:



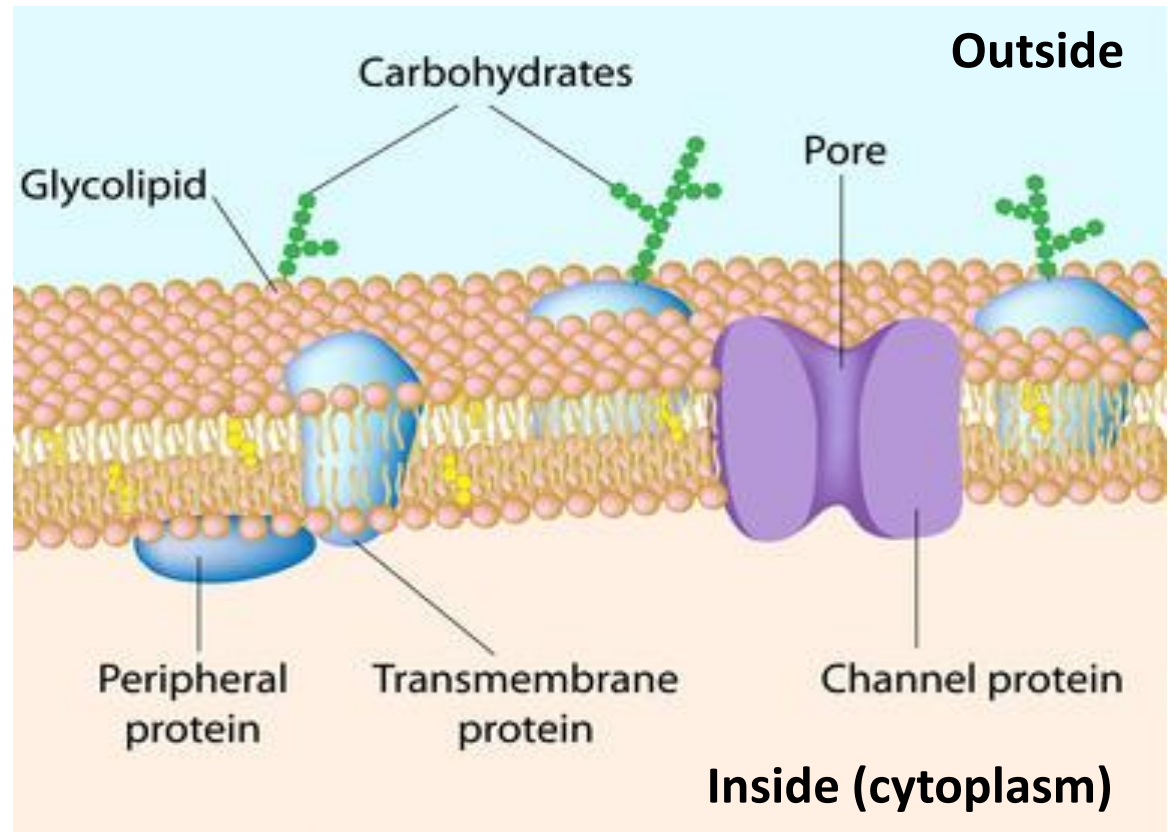
Eukaryote - the DNA is **partitioned off** in its own membrane-bound room called the **nucleus**.

Prokaryote - the DNA within a cell is **not separated from the cytoplasm**.

Cell Membrane

The cell membrane (aka the *plasma membrane*) separates the interior of all cells from the outside environment.

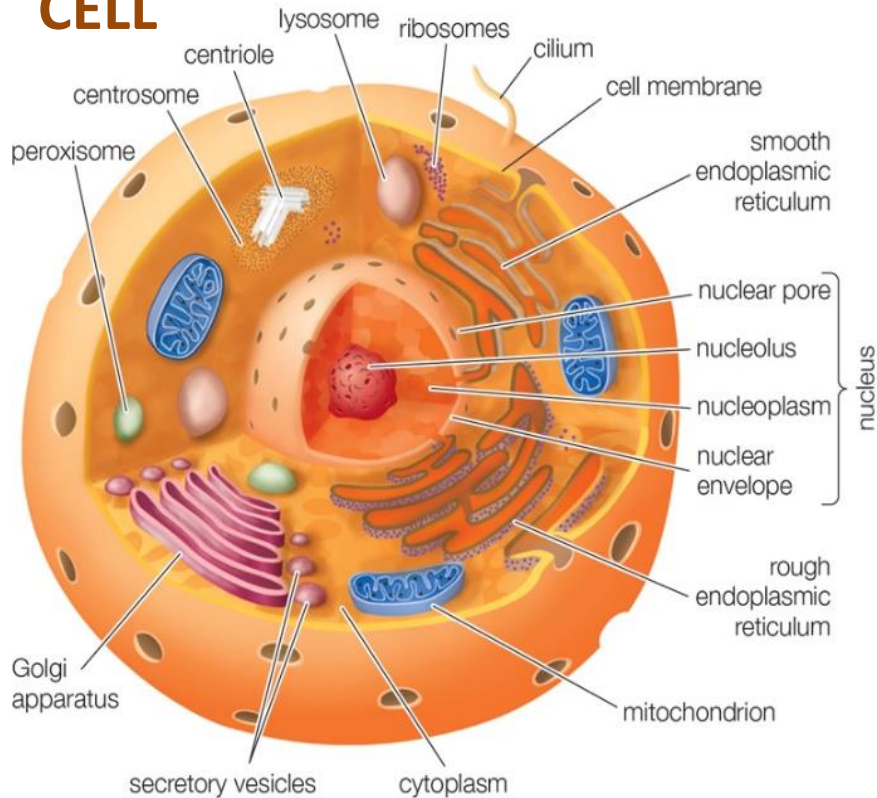
- All membranes are **lipid (fat) double layer**.
- Basic function is to **protect the cell** from its surroundings.
- **Selectively permeable** to ions and organic molecules.
- Control the **movement of substances in and out** of cells.



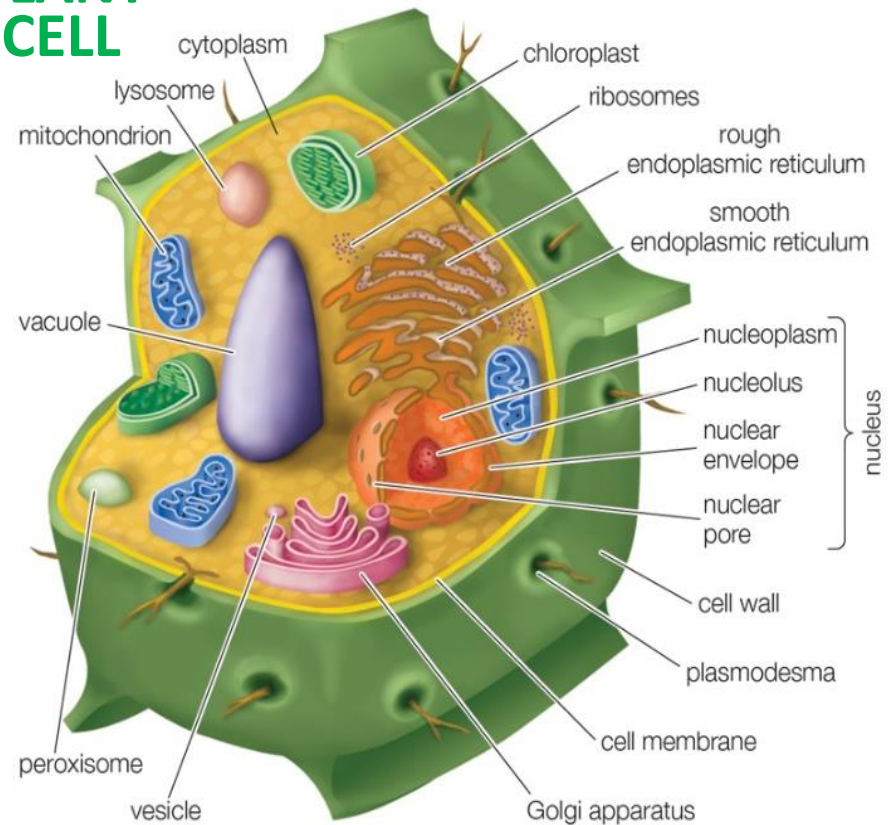
Organelles

Eukaryotic cells have **specialized interior compartments**, called **organelles** (“little organs”), that have specific functions.

ANIMAL CELL



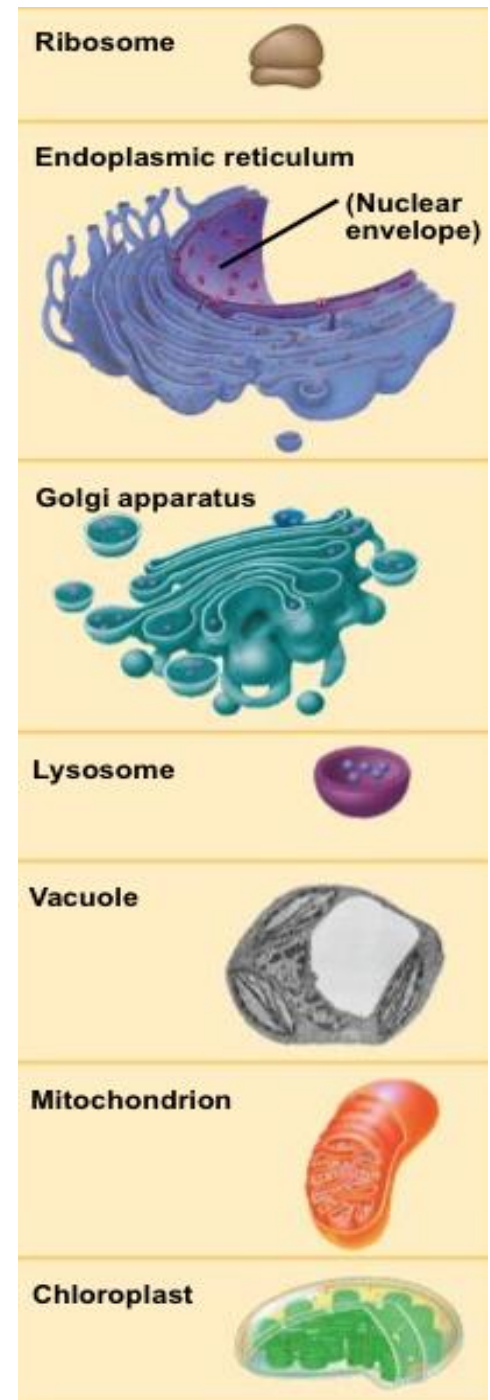
PLANT CELL



Organelles

Organelles are **enclosed by their own lipid membranes** similar to the outermost cell membrane.

- All organelles in a cell perform different functions: details in your **homework** 😊.
- The number of individual organelles of each type found in a given cell varies depending upon the function of that cell.
- The **larger organelles**, such as the *nucleus* and *vacuoles*, are **easily visible with the light microscope**. They were among the first biological discoveries made after the invention of the microscope.
- Both plant and animal cells have many, but not all, of the same organelles.



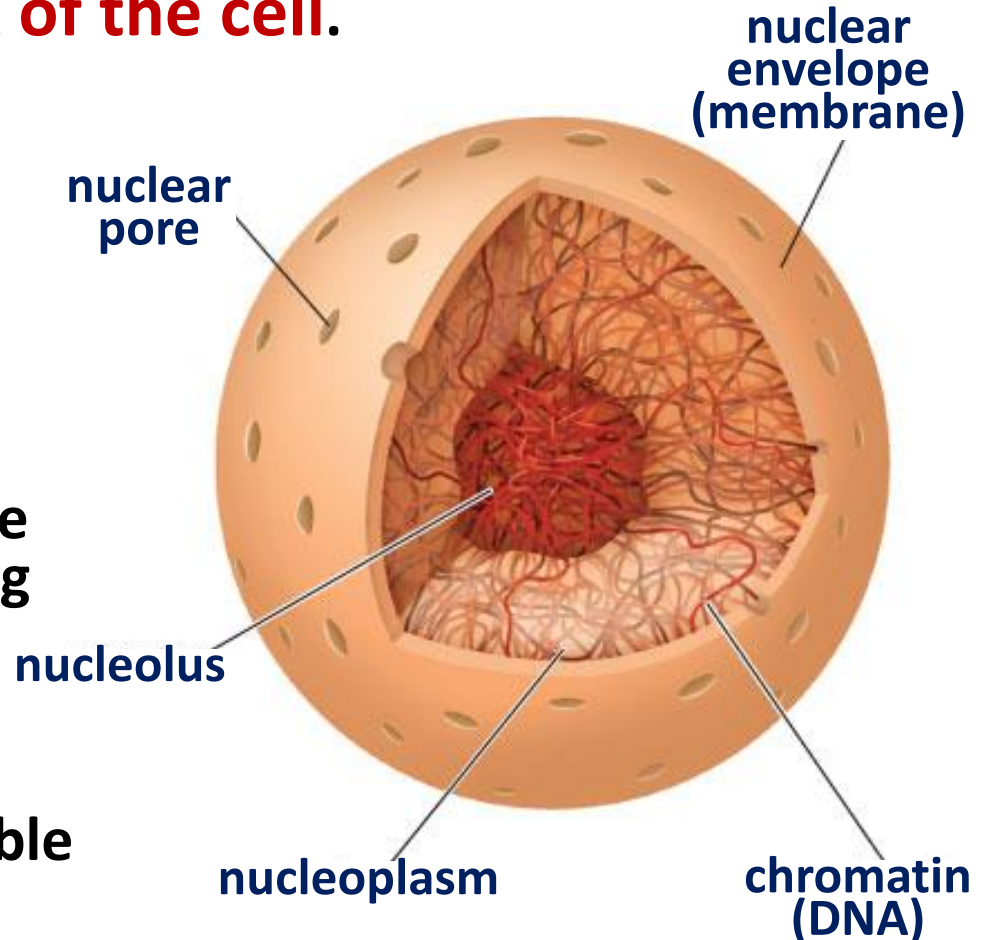
Nucleus

The nucleus is the **control center** of the cell.

- The **largest organelle** in the cell.
- Contains (most of) the **DNA of the cell**.

- The nucleus was **the first organelle to be discovered**:
Antonie van Leeuwenhoek observed a "Lumen", the nucleus, in the red blood cells of salmon.

- Main function - to control gene expression and mediate the replication of DNA during the cell cycle.
- Inside the nucleus is a *suborganelle* called the **nucleolus**, which is responsible for making **ribosomes**.

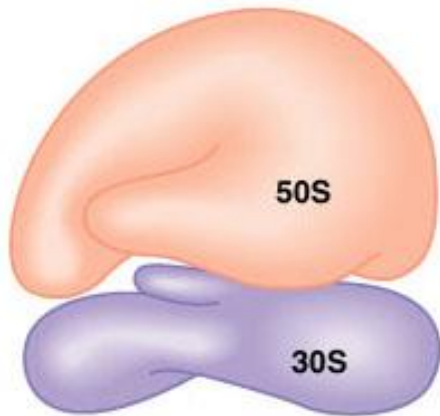


Ribosomes

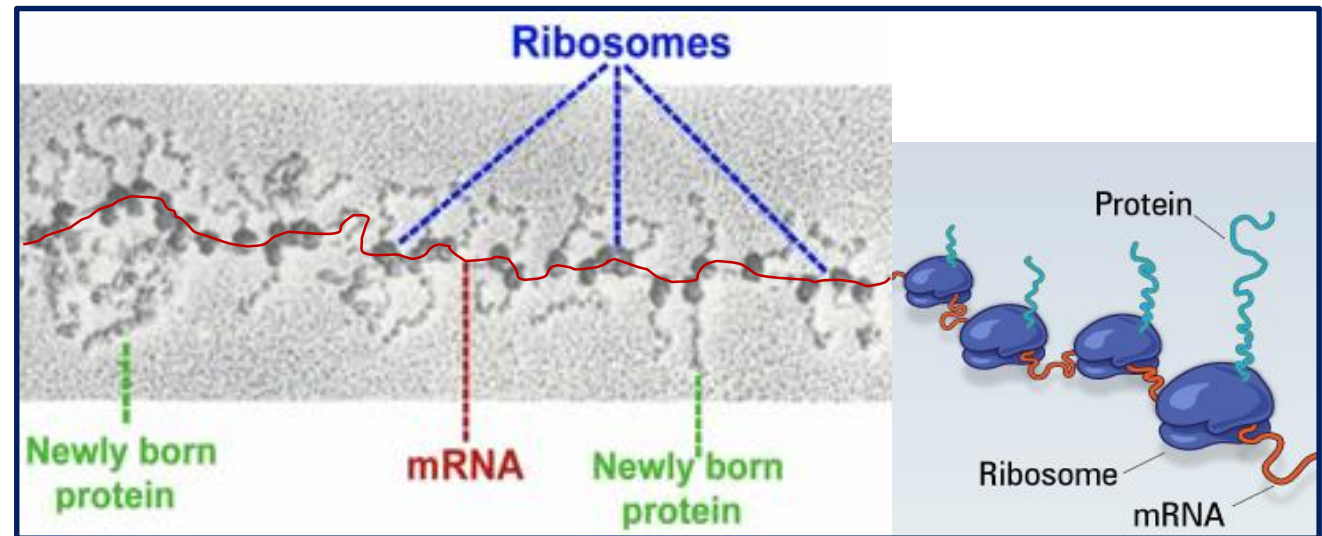
The ribosome is a complex molecular machine responsible for the **synthesis of proteins** in cells.

Two major components:

- the **small subunit** which reads the RNA
- the **large subunit** which **joins amino acids** to form a polypeptide chain.



The process of protein synthesis (translation) →



The **ribosomes** are found within all living cells.

Basic Classification of Organisms

1. Organisms can be classified as unicellular (consisting of a single cell; including most *bacteria*) or multicellular (including *animals, plants* and most *fungi*).
 2. Organisms can be classified as prokaryotic (made of cells that do not have a distinct *nucleus*) or eukaryotic (made of cells that have *true nucleus* and *organelles*)
- All known **prokaryotes** (*bacteria* and *archaea*) are **single cells**.
 - All **multicellular organisms** are **eukaryotes**.
 - Some eukaryotes, like *amoebae*, are free-living, single-celled entities.
 - All **plants** and **animals** are multicellular eukaryotic organisms.
 - While the number of cells in plants and animals varies from species to species, **humans contain ~100 trillion (10^{14}) cells**.
 - The majority of organisms on Earth are prokaryotes...