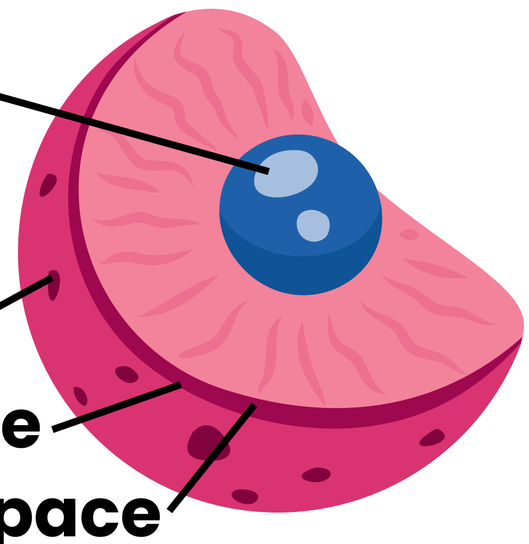
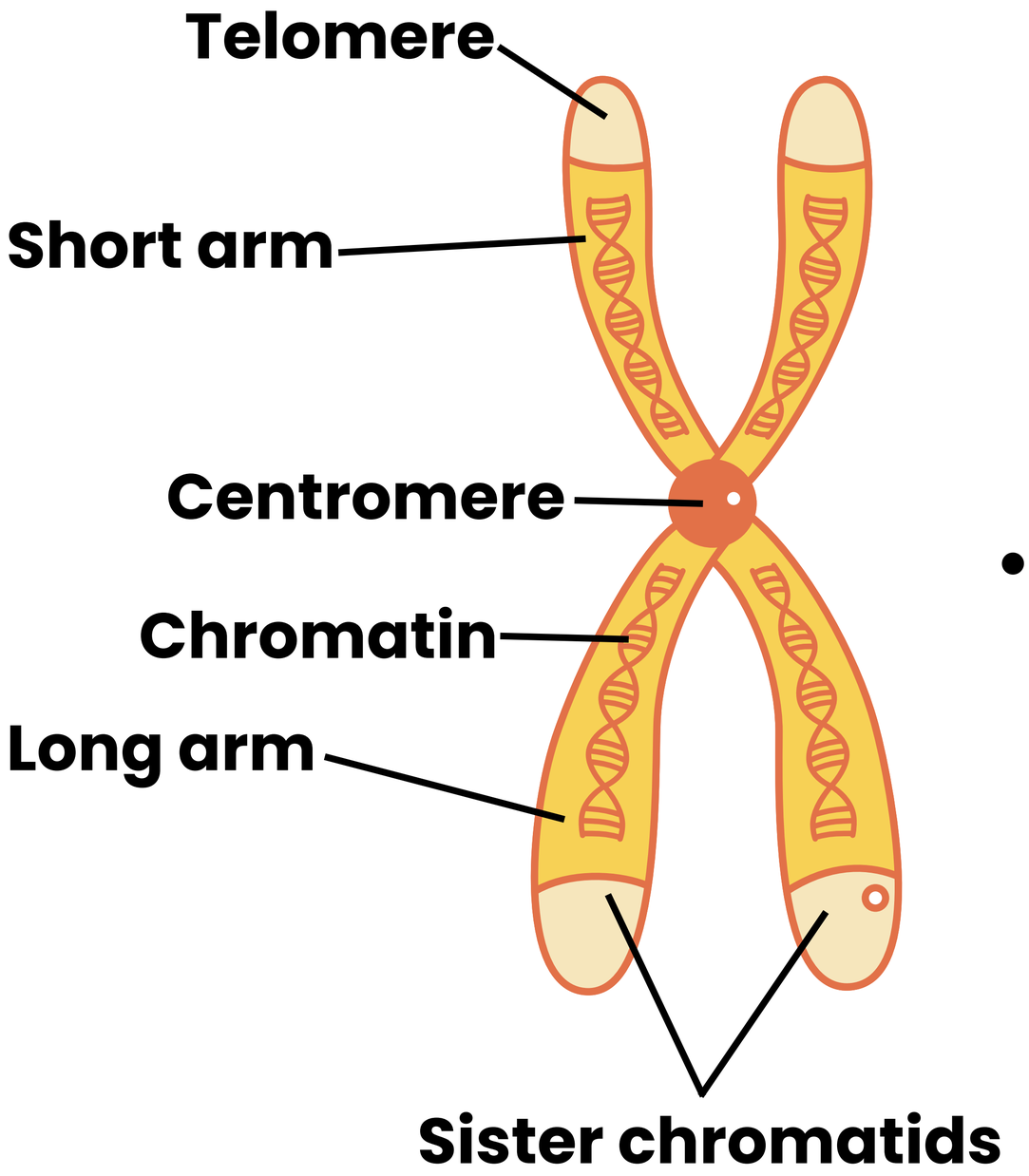
Cell Structure

Nucleus of a Cell

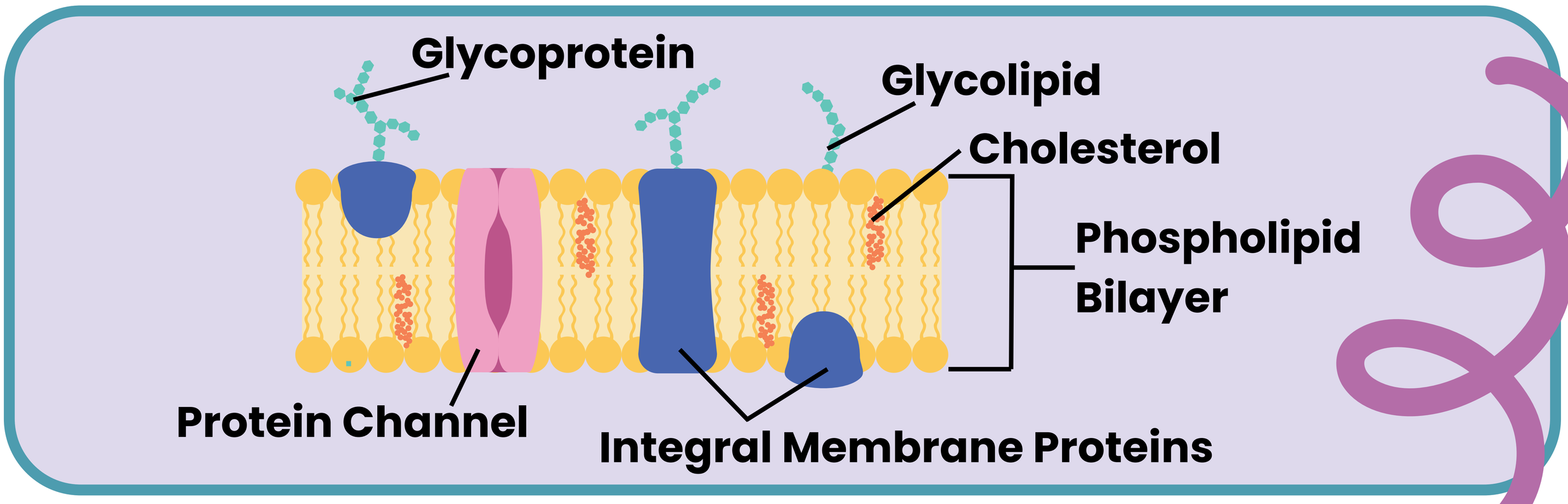


- The nucleus is the command center of the cell.
- It is a membrane-bound organelle surrounded by a nuclear envelope with nuclear pores that allow chemical communication.
- The perinuclear space is the region between the inner and outer membranes of the nuclear envelope.
- It contains the body's DNA.
  - DNA wrapped around histone proteins is called chromatin.
    - When chromatin condenses during cell division, it creates chromosomes.
- The nucleus contains the nucleolus, which is a spherical organelle that produces ribosomes and transcribes ribosomal RNA (rRNA).



Cell Membrane

- The cell membrane, or plasma membrane, is the structure that surrounds the entire cell.
- This structure is in charge of regulating what goes in and out of the cell.
  - It also serves to protect the cell from toxins and other bad things.
  - The cell membrane acts as the “skin” of the cell.
- The plasma membrane is made up of glycerophospholipids, which are molecules made up of glycerol, two fatty acid chains, and a phosphate group.

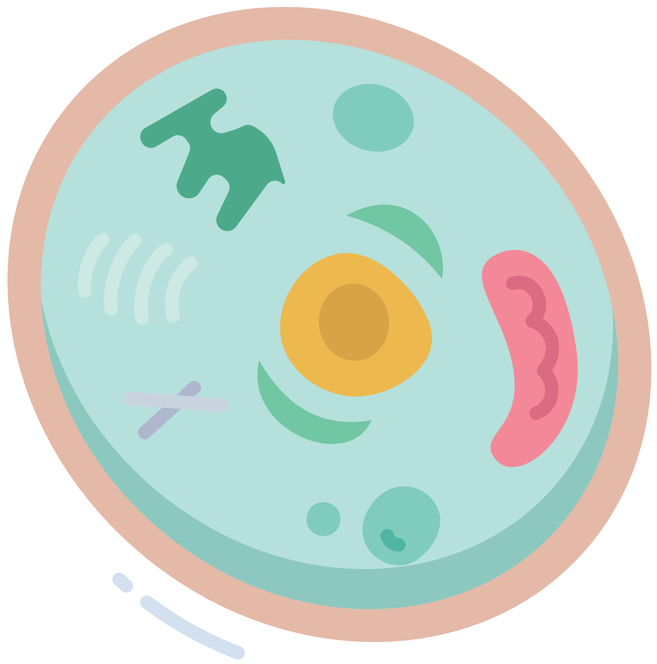


Cytoskeleton

- The cytoskeleton is a network of protein filaments that link up and create a shell-like structure around the cell.
  - This maintains the cell’s shape.
- The way this structure is built allows the cell to split during replication.

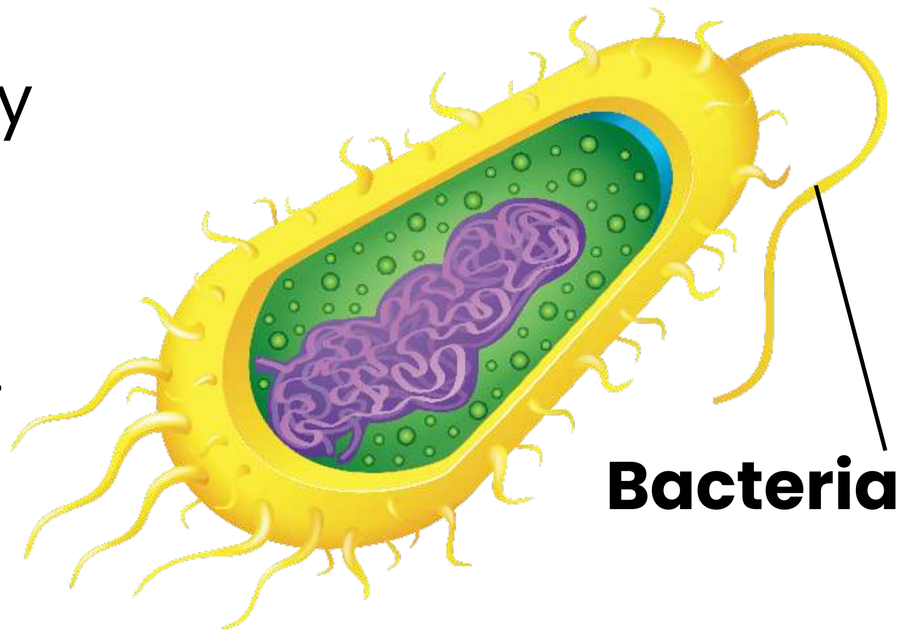
Cytoplasm

- The cytoplasm is both the liquid and solid parts of a cell.
  - (i.e., both the gelatin-like liquid and the organelles that are floating in the liquid)
- The only thing that isn't part of the cytoplasm is the nucleus, which has its own nuclear membrane.
- *Cyto* means *cell,* and *plasm* means *stuff*, so cytoplasm is basically everything that's inside the cell.
  - Cytoplasm is the site for photosynthesis (in plants), glycolysis, cellular respiration, protein synthesis, and cell division.



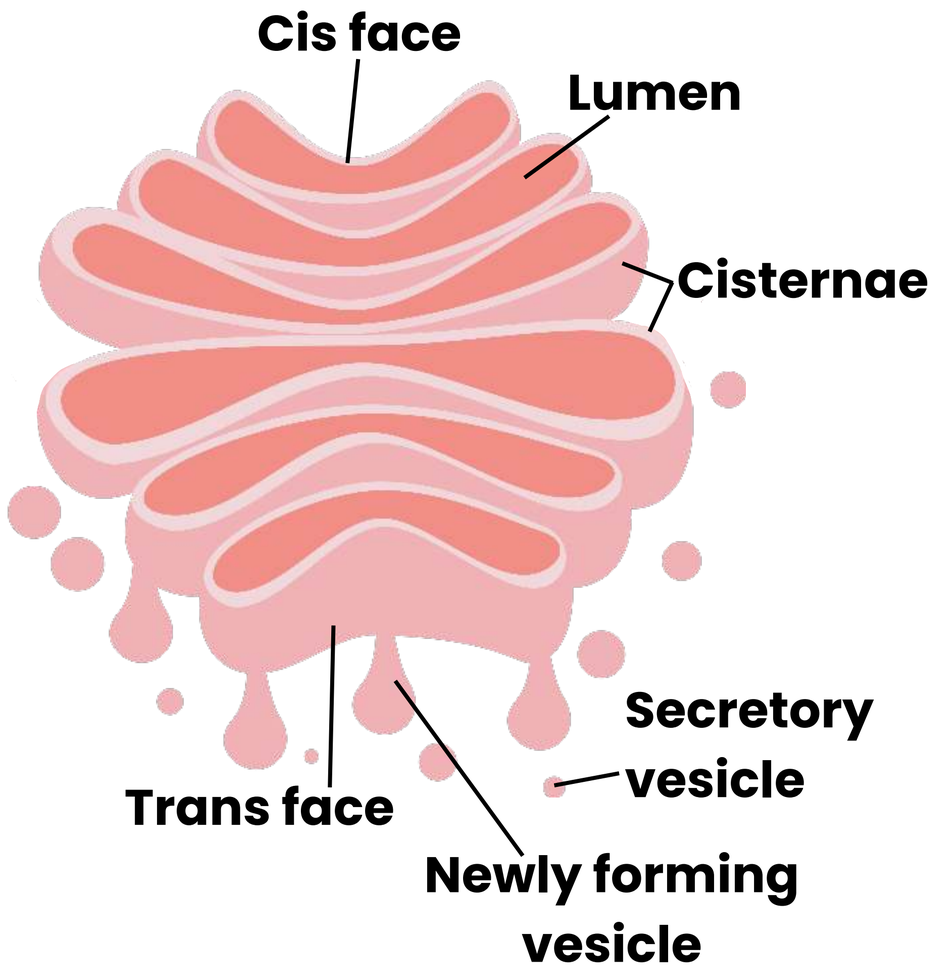
Flagellum

- A flagellum is a little tail that is attached to the plasma membrane of the cell.
  - These provide mobility for the cell.
  - They work similarly to the flagella on sperm.
  - They propel the cell forward with a circular motion.
    - The bacterial flagellum is made up of a protein called flagellin, which is shaped like a cylinder.



Golgi Apparatus

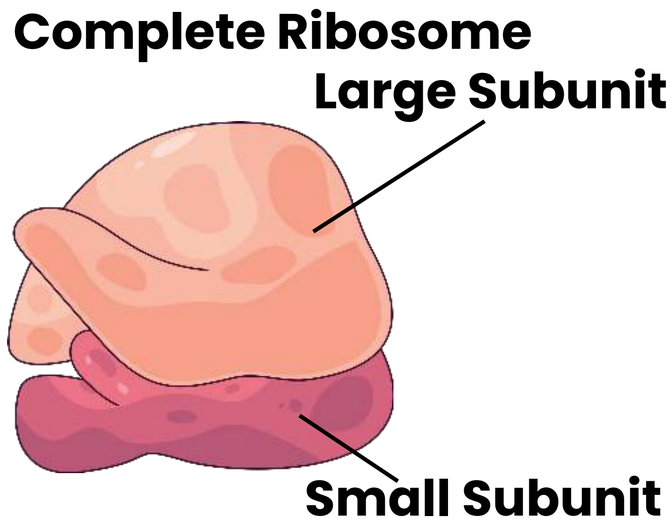
- The Golgi apparatus is an organelle made up of folded membranes and vesicles.



  - Vesicles are small cellular containers that can carry substances outside the cell.
    - This process is called exocytosis.
      - The exact definition of exocytosis is when the contents of a cell are allowed to leave the cell through a fusion of the vesicle's membrane and the cell membrane.
- The Golgi apparatus preps proteins and lipids for proper use. So it’s essentially the mailing service of the cell.
  - This includes inside and outside the cell.
    - One of the main functions of this organelle is to package the proteins and lipids into vesicles.
  - Glycolipids and sphingomyelin are made in this organelle.

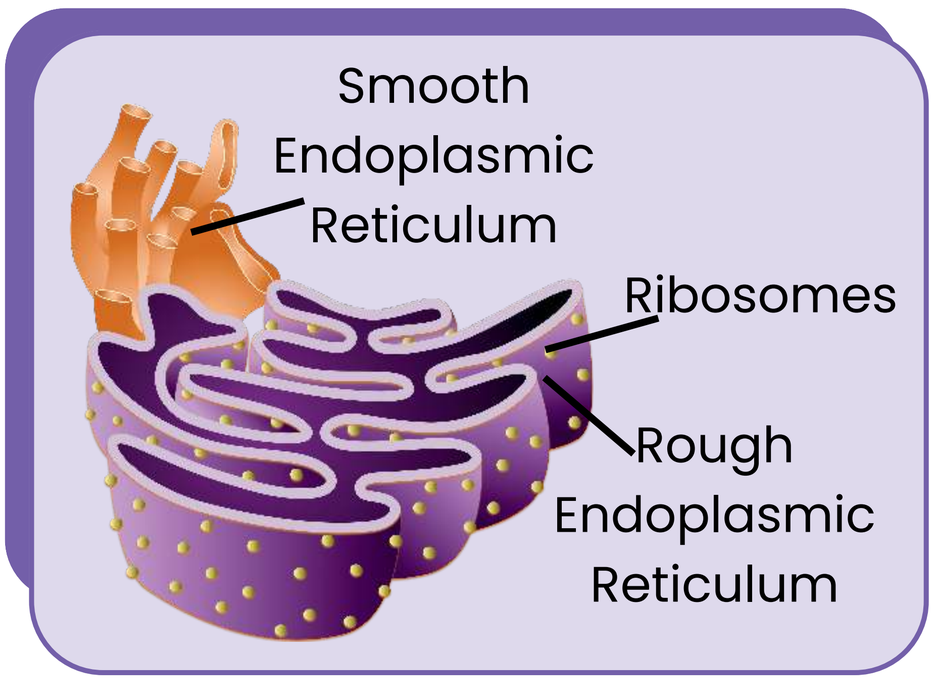
Ribosomes

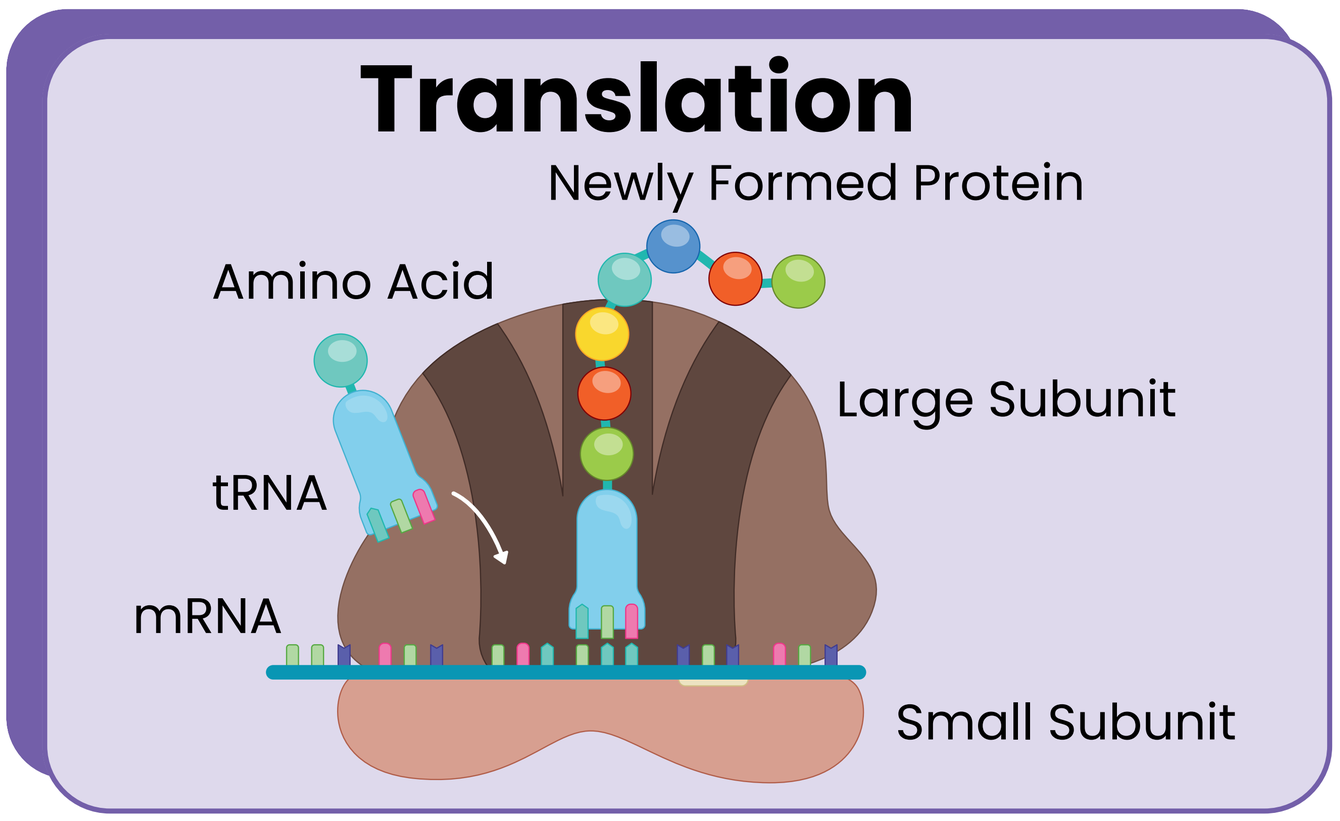
- Ribosomes are essential to life and are made with proteins and nucleic acids.
- They are the site for protein synthesis.
- They are small, ball-like structures that translate the amino acids into a protein chain.
- Ribosomes can be found throughout the entire cytoplasm, but they are heavily concentrated in and around the rough endoplasmic reticulum (RER).



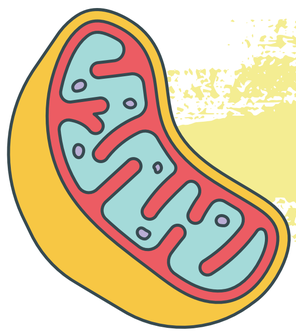
Endoplasmic Reticulum

- **Rough Endoplasmic Reticulum (RER):**
  - The reason that it is called “rough” ER is because this organelle is covered in ribosomes.
  - RER is involved in protein synthesis because of the ribosomes in and around the organelle.
  - The part of protein synthesis called “translation” occurs in this organelle.
    - Translation is when a protein is made and assembled from RNA. RER is typically closer to the nucleus and looks like a stack of pancakes.





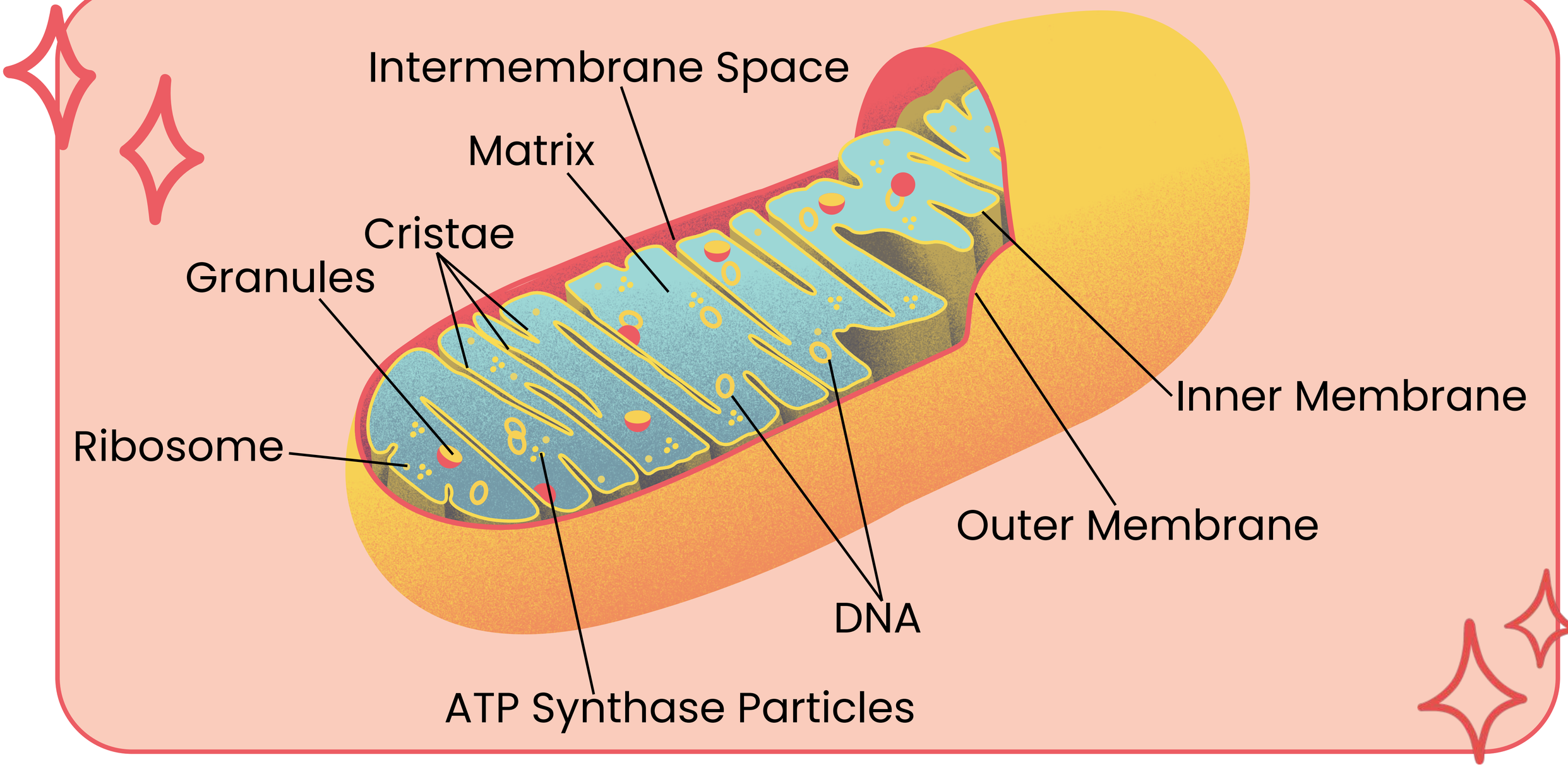
- **Smooth Endoplasmic Reticulum (SER):**
  - Though it is very similar to RER, it is farther from the nucleus and doesn’t have any ribosomes.
  - SER is more like a tube than a pancake.
  - The SER has a role in detoxification.
  - In the liver, it filters through drugs, alcohol, and waste.
  - One of the main roles of SER is that it synthesizes lipids and phospholipids.
  - SER does not have anything to do with protein synthesis because it doesn’t have any ribosomes.



Mitochondria

- Mitochondria are membrane-bound organelles that produce the needed energy for the cell.
  - These are called the powerhouse of the cell.
  - Muscle cells often have a lot of mitochondria because they need power in order to contract.
- They are rod-shaped structures with folds in the inner membrane, which are called cristae.
  - These provide a lot of surface area for the chemical reactions to occur and help them produce more energy.
    - Mitochondria produce energy through a process called oxidative phosphorylation.

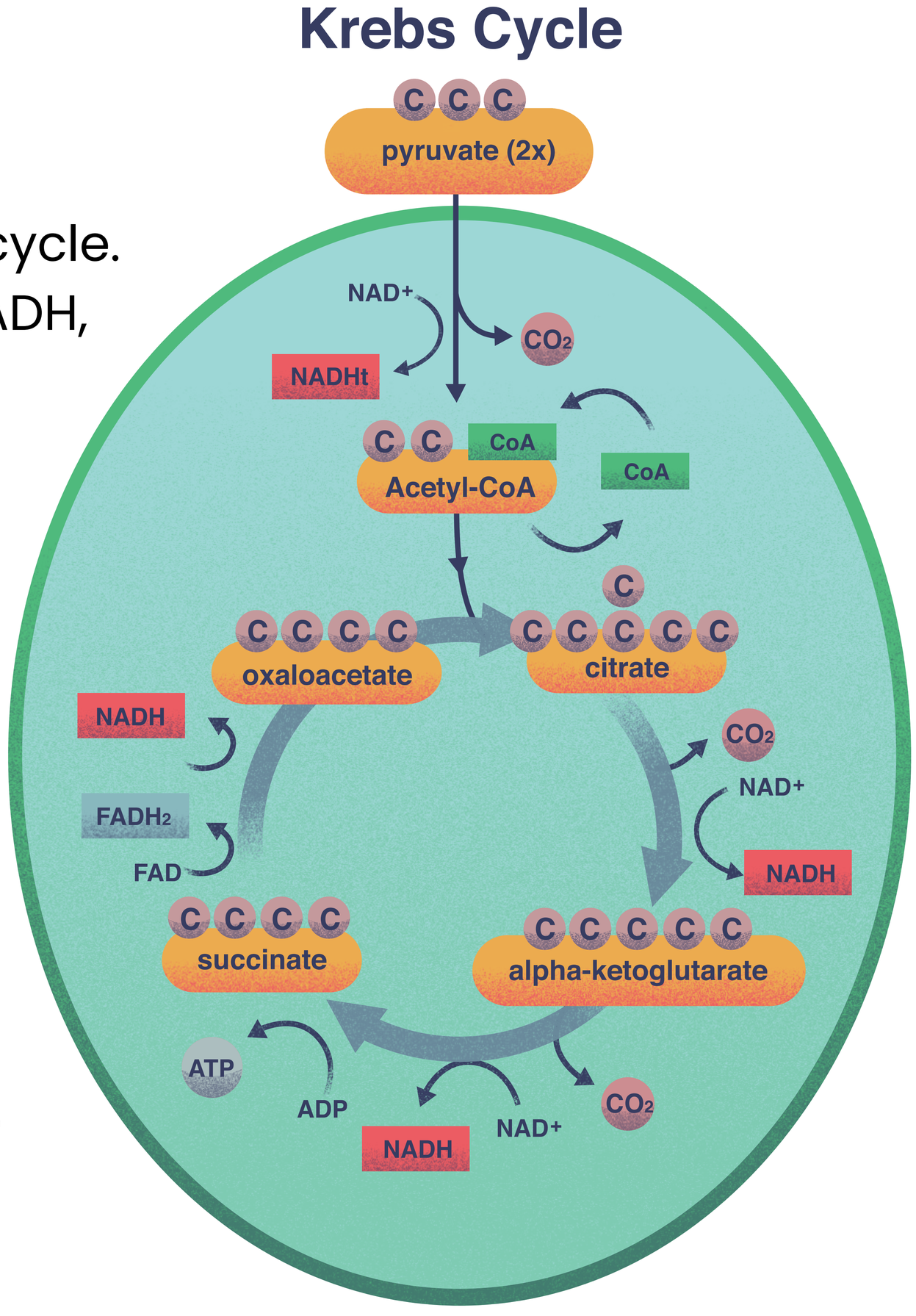
The more mitochondria, the more energy

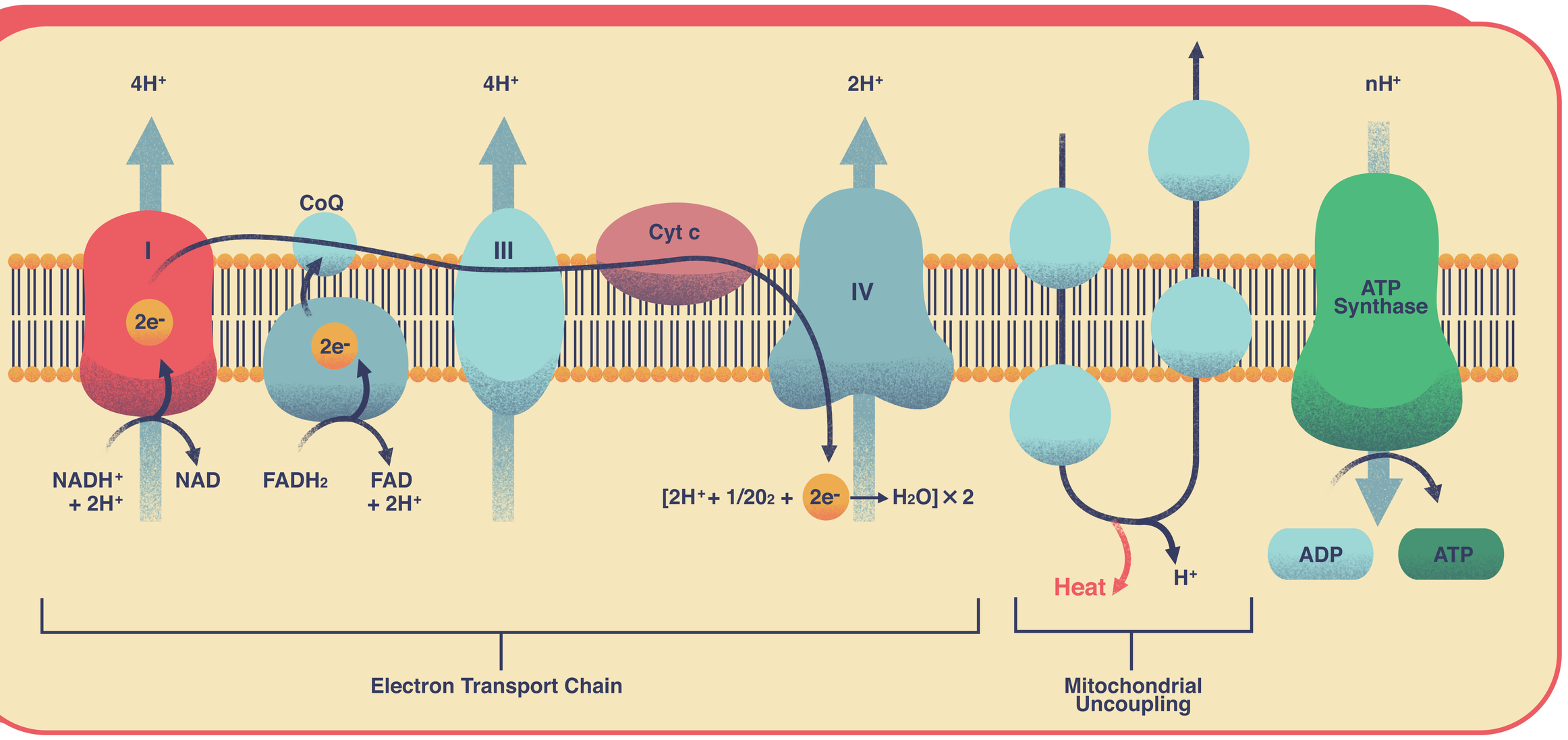


Mitochondria

Cellular Respiration:
This process has three steps.

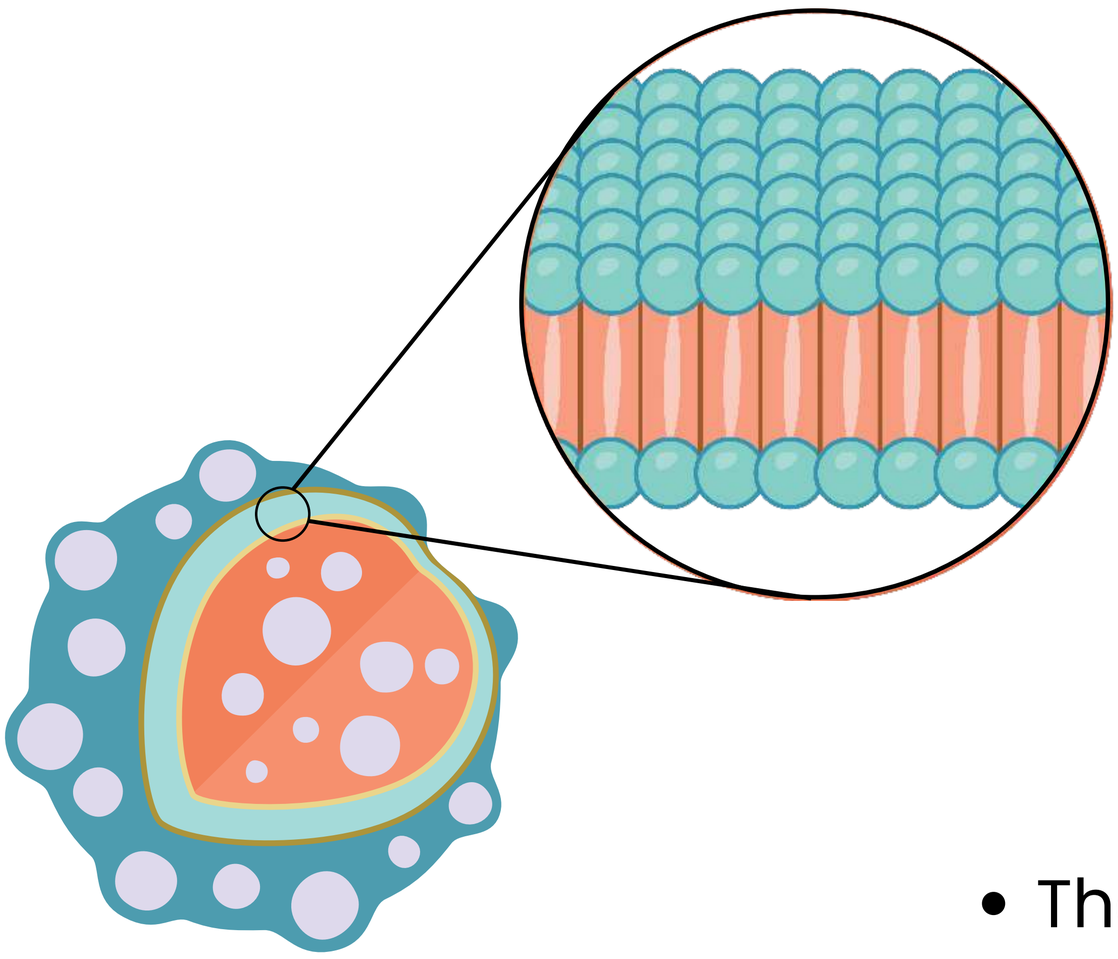
- Citric acid cycle
  - This is known as the Krebs cycle. This cycle produces ATP, NADH, and $FADH_2$.
- Electron transportation chain
  - This is when protons cross the inner mitochondrial membrane to create an electrochemical proton gradient.
- Adenosine diphosphate (ADP) is converted to adenosine triphosphate (ATP)
  - The protein ATP synthase moves protons through the cristae to the matrix. This allows the ADP to turn into ATP.





Lysosomes

- Lysosomes are spherical digestive enzymes bound in a membrane (similar to a vesicle).
  - They are larger than the normal vesicles that are used for exocytosis.
- They eat away and discard old cell parts that aren't useful anymore.
  - They also attack and destroy any bacteria that gets into the cell.
    - Lysosomes are like garbage trucks.
    - They are bound with a phospholipid bilayer that separates the digestive enzymes from the gel-like portion of the cytoplasm.
- The enzymes are made in the ER and packaged in the Golgi apparatus.



Centriole

- Centrioles organize the microtubules of the cytoskeleton.
  - They determine where all the organelles go in the cell.
  - They decide everything about the structure of the cell.
- They are shaped like a barrel.
- They are the structures that go to opposite sides of the cell during division.
  - They are also the base of the spindles that build the next exoskeleton.