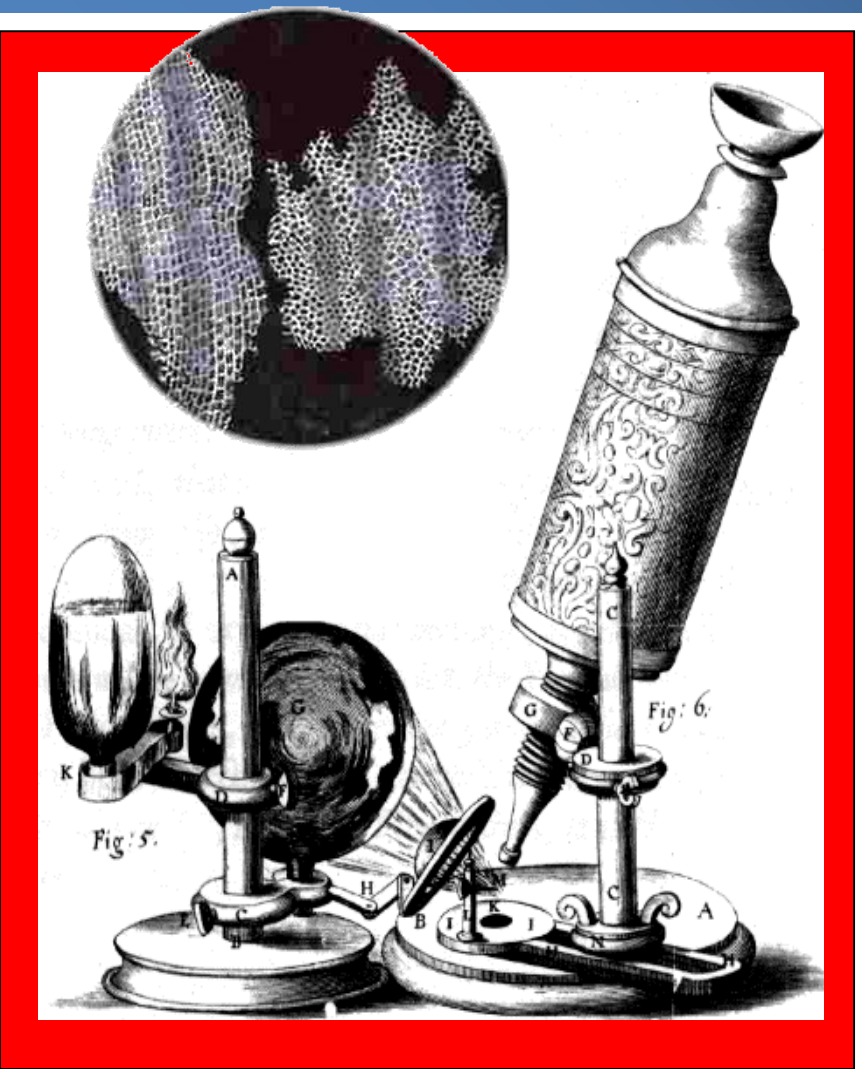
What in the Cell is Going On?

Robert Hooke

naturalist, philosopher, inventor, architect....
(July 18, 1635 - March 3, 1703)



In 1665 Robert Hooke publishes his book, *Micrographia*, which contains his drawings of sections of cork as seen through one of the first microscopes (shown at right).

He was the first person to use the term “cells”.

Cell Theory

Matthias Schleiden concluded that all plants are made of cells (1838)

Theodore Schwann concluded that all animals are made of cells (1839)

Rudolf Virchow concluded that all cells came from pre-existing cells (1855)

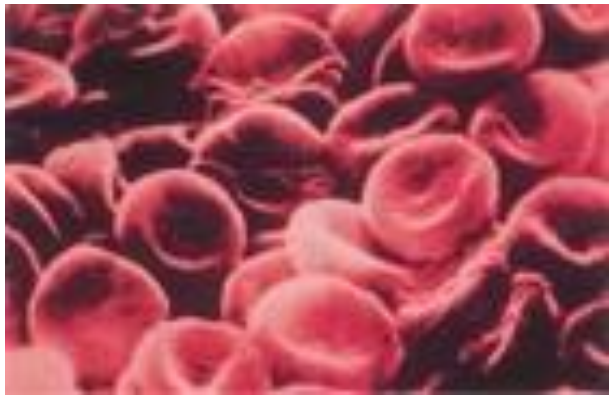
Cell Theory

- all living things are made up of cells
- cells are the basic units of structure and function in an organism
- new cells are produced from existing cells

Cell Specialization (differentiation)

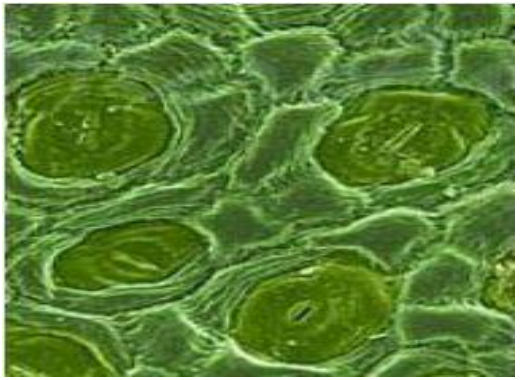
Cells in organisms are specialized to perform different tasks.

Stem cells



Red Blood Cells

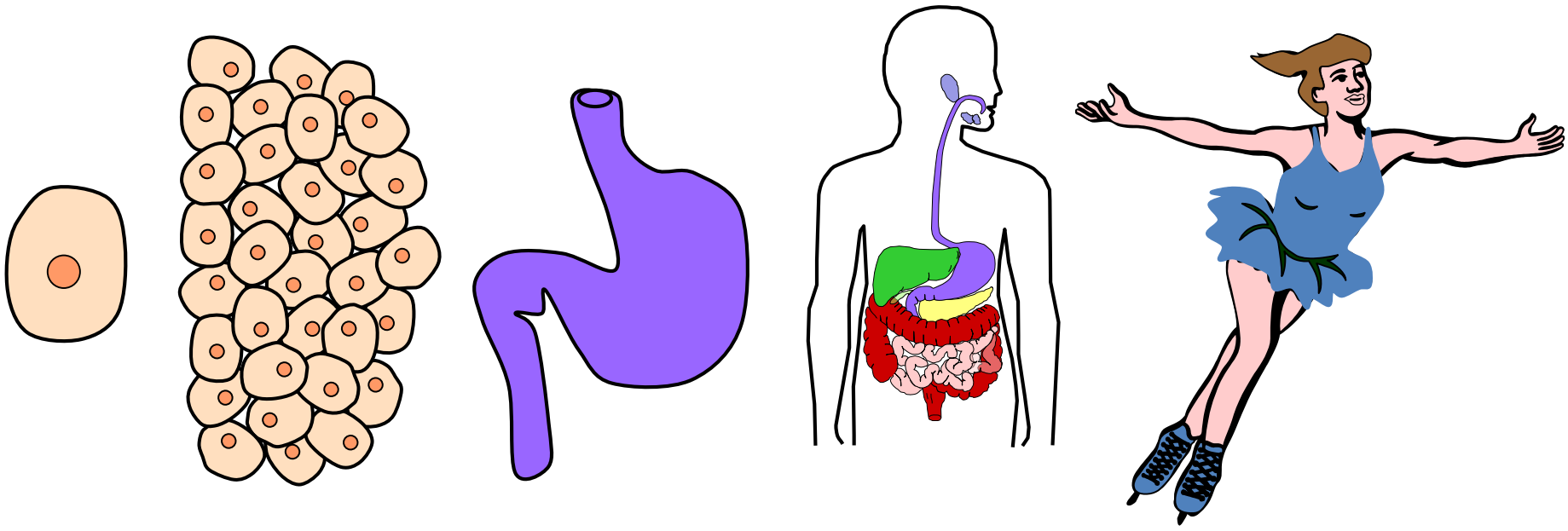
Muscle Cells



Stomata

The Levels of Organization

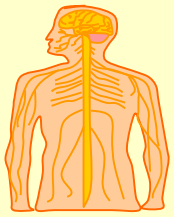
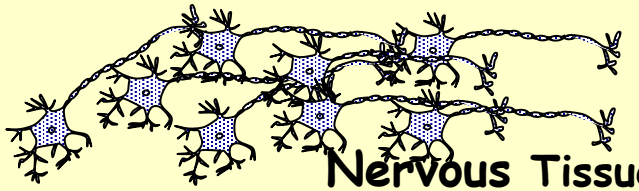
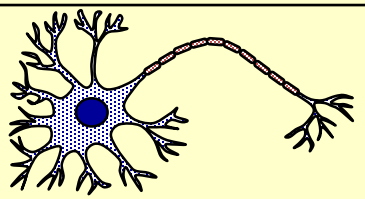
Multicellular organisms are arranged from simple to complex according to their level of cellular grouping.



cell tissue organ organ system organism

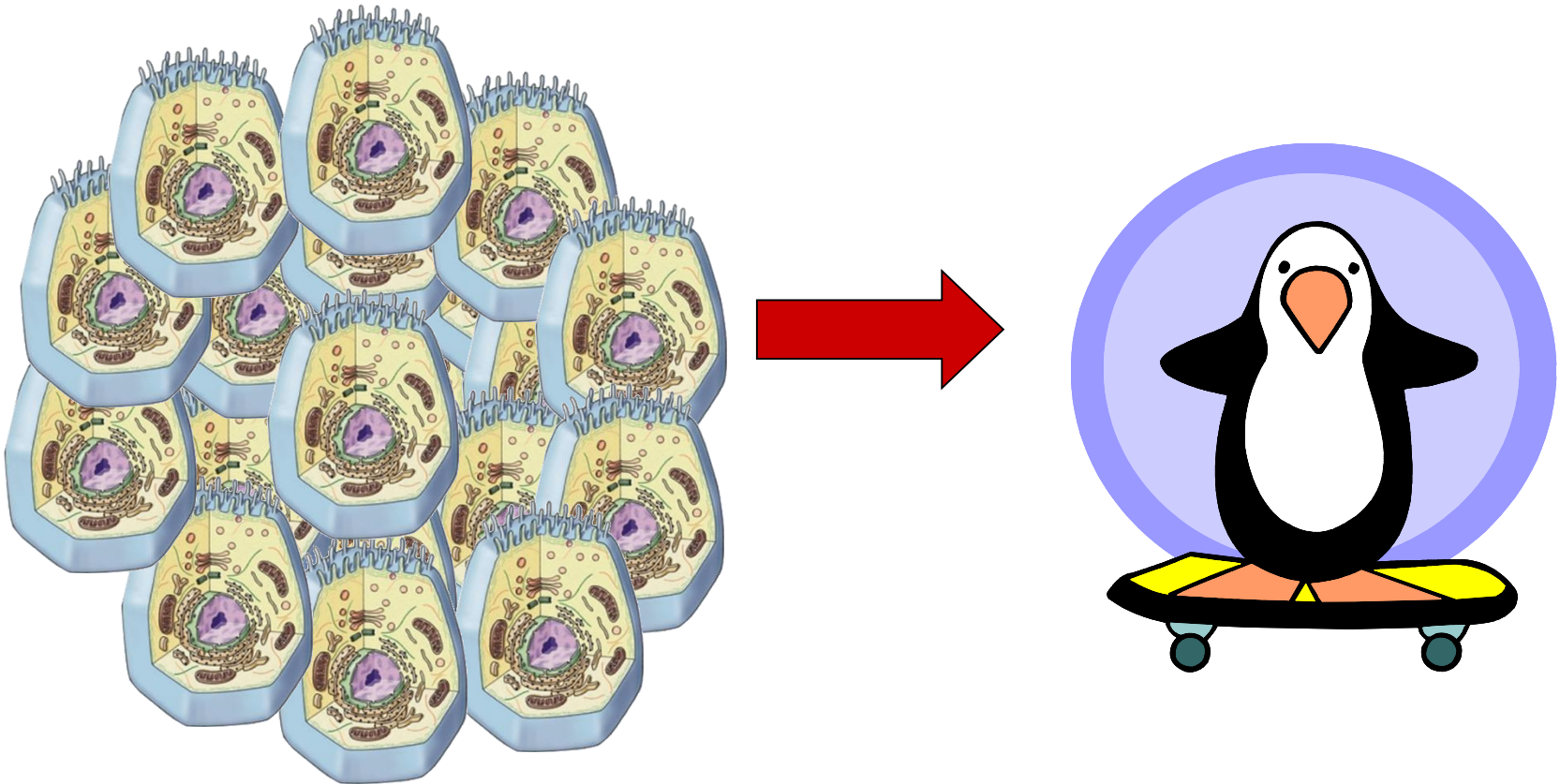
Levels of Organization

- What is the benefit of being made of all of these cells?

Level	Function	Example
Organ system	Different organs function together	 Nervous System
Organ	Different tissues function together	 Brain
Tissues	Similar cells function together	 Nervous Tissue
Cells	Cells can perform special jobs	 Neuron

Why study cells?

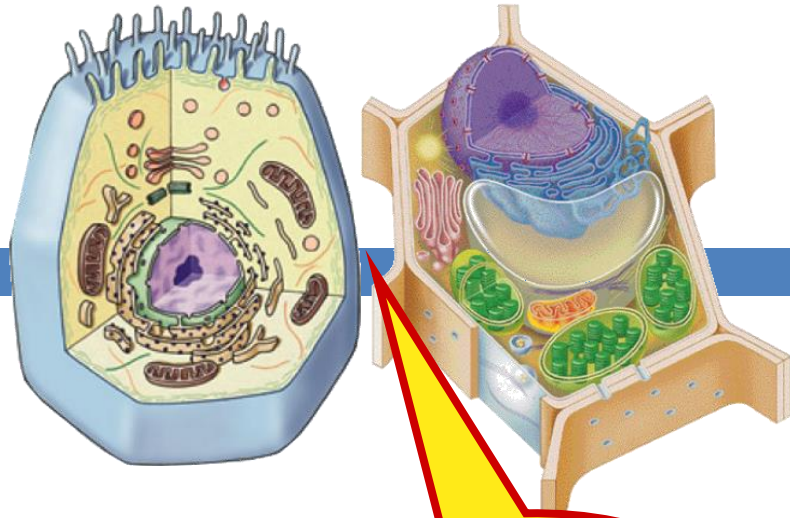
- Cells → Tissues → Organs → Bodies
  - **bodies are made up of cells**
  - **cells do all the work of life!**



The Work of Life

- What jobs do cells have to do for an organism to live…
  - "breathe"
    - gas exchange: O_2 in vs. CO_2 out
  - eat
    - take in & digest food
  - make energy
    - ATP
  - build molecules
    - proteins, carbohydrates, fats, nucleic acids
  - remove wastes
  - control internal conditions
    - homeostasis
  - respond to external environment
  - build more cells
    - growth, repair, reproduction & development

The Jobs of Cells



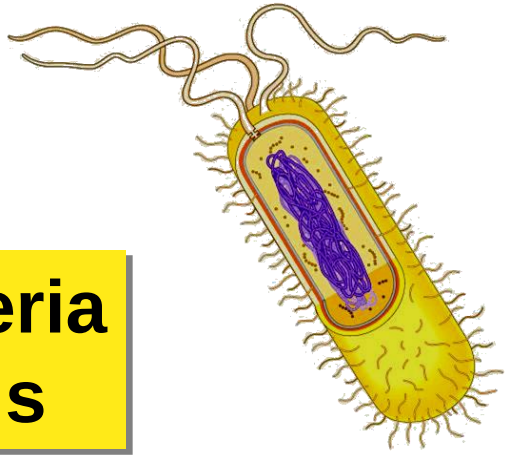
Our organelles do all these jobs!

- Cells have 3 main jobs
  - make energy
    - need energy for all activities
    - need to clean up waste produced while making energy
  - make proteins
    - proteins do all the work in a cell, so we need lots of them
  - make more cells
    - for growth
    - to replace damaged or diseased cells

Two Types of Cells

Prokaryote

- no organelles

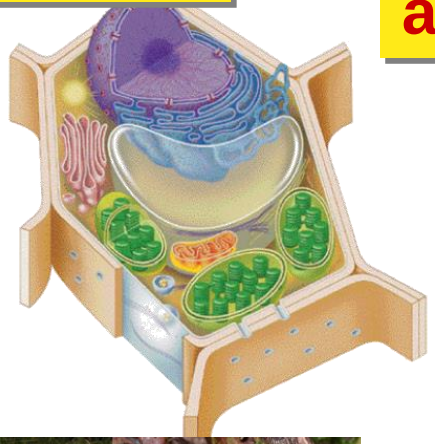


bacteria cells

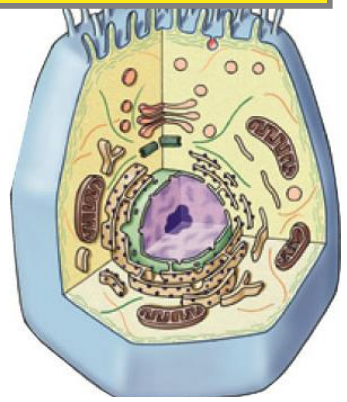
Eukaryotes

- organelles

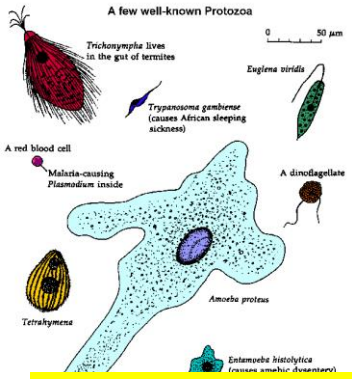
plant cells



animal cells



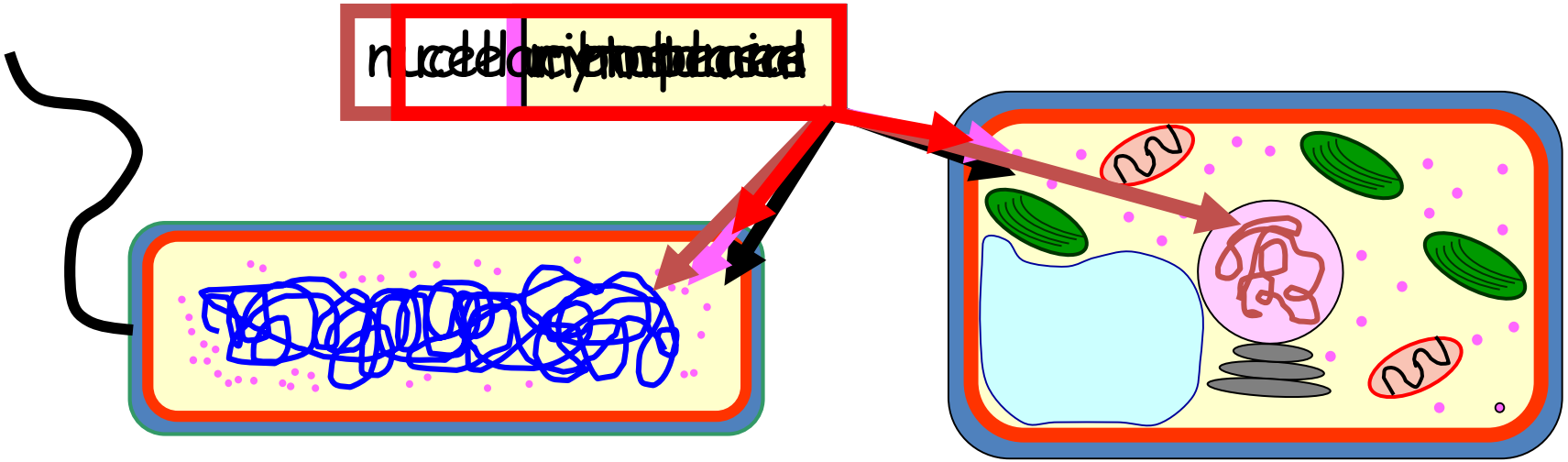
fungus cells



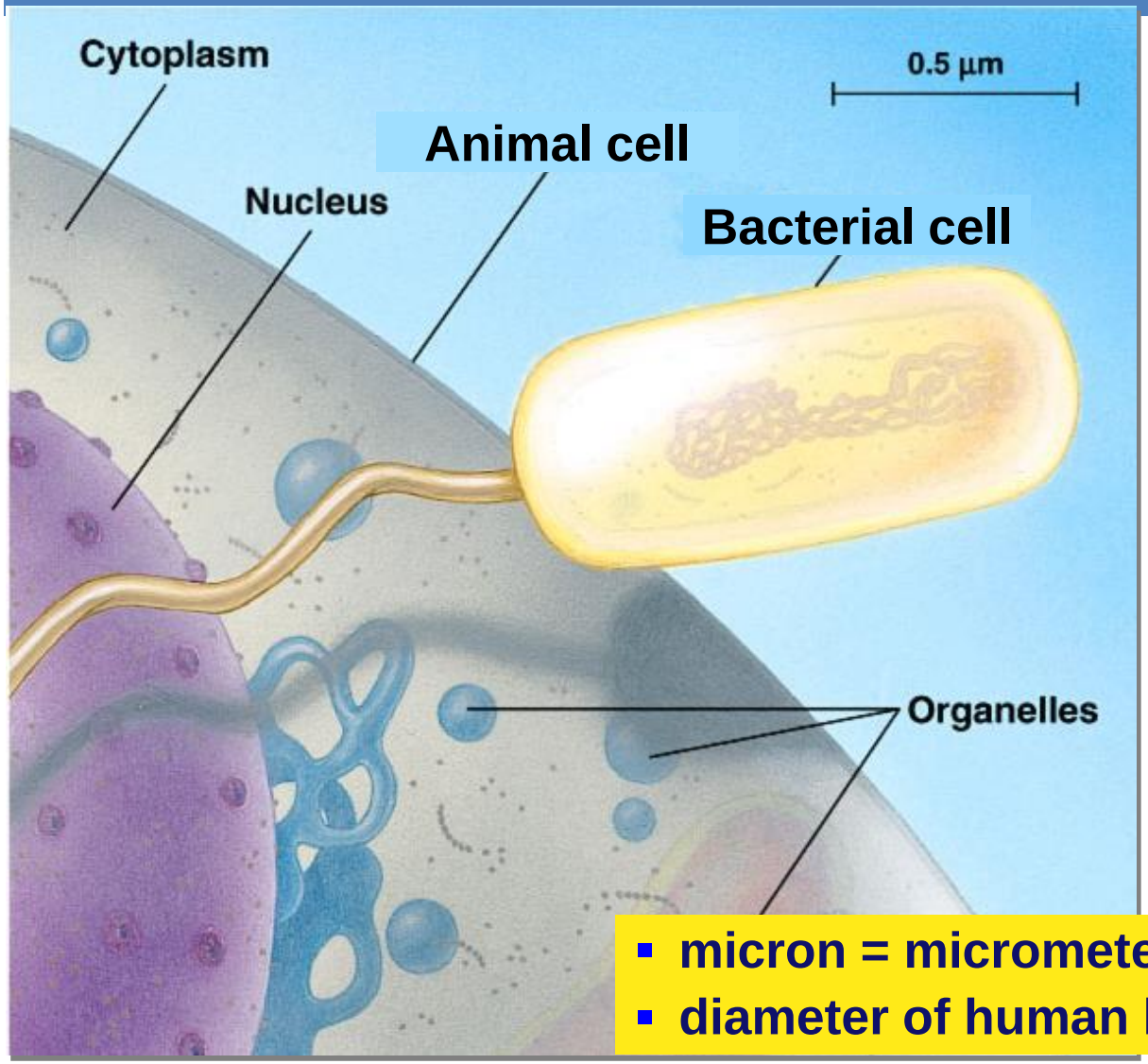
protist cells

4 characteristics of ALL cells (prokaryotes & eukaryotes)

- All cells have
  - cell membrane
  - cytoplasm
  - ribosomes
  - nuclear material



Cell size comparison



most bacteria

- **1-10 microns**

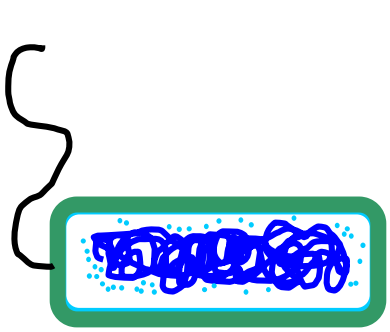
eukaryotic cells

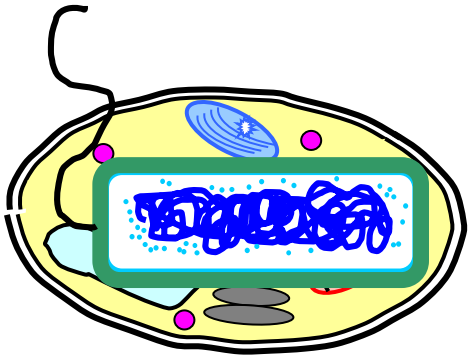
- **10-100 microns**

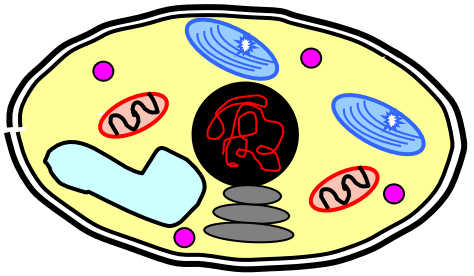
- **micron = micrometer = 1/1,000,000 meter**
- **diameter of human hair = ~20 microns**

Different Types of Cells

- Prokaryotic
  - no nucleus
  - small ribosomes
  - no organelles
  - very small 1-10Tm
  - only in bacteria
- Eukaryotic
  - nucleus
  - larger ribosomes
  - organelles
  - small 2-1000Tm
  - protists, fungi, plants, animals

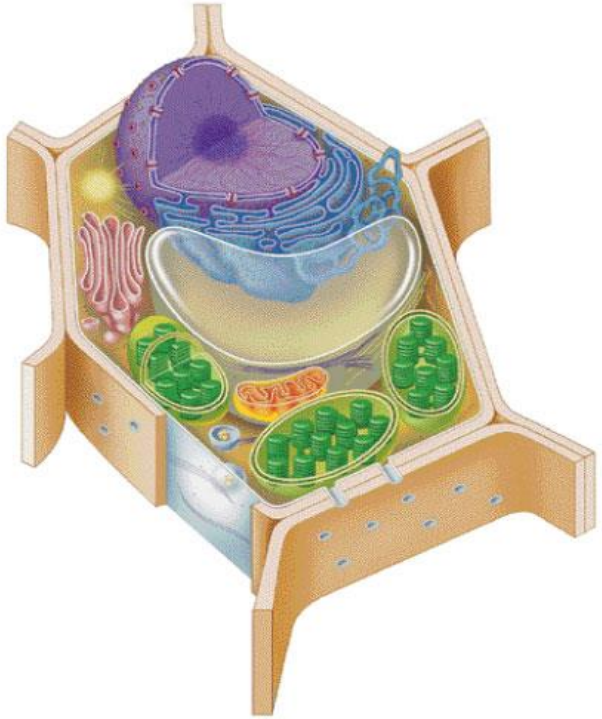




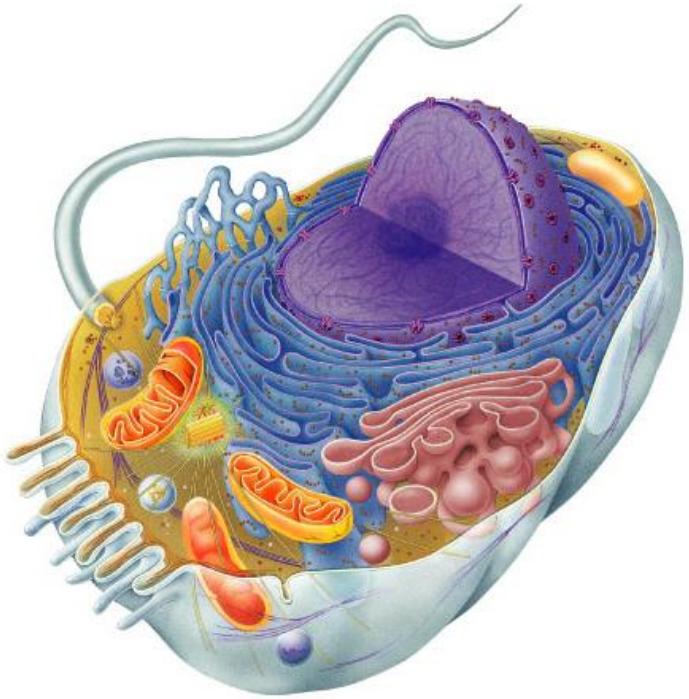


2 famous Eukaryotes

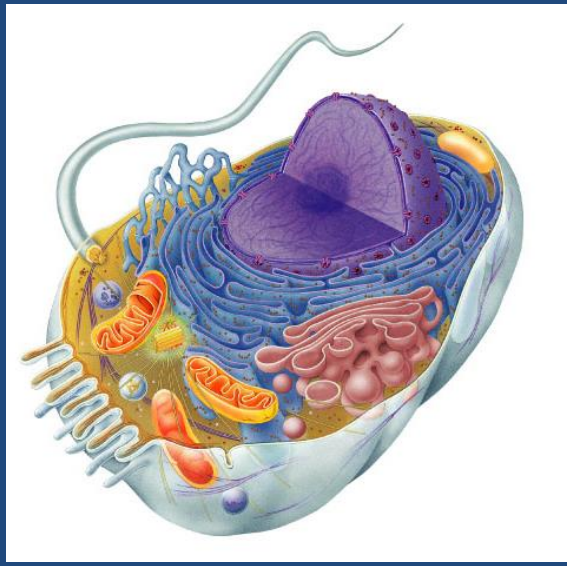
Plant cell



Animal cell

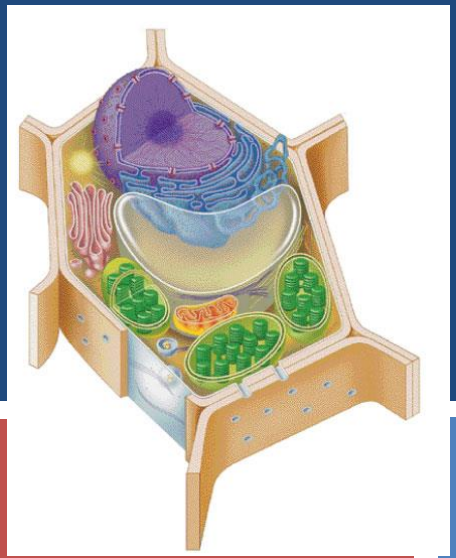


Microscopes - review



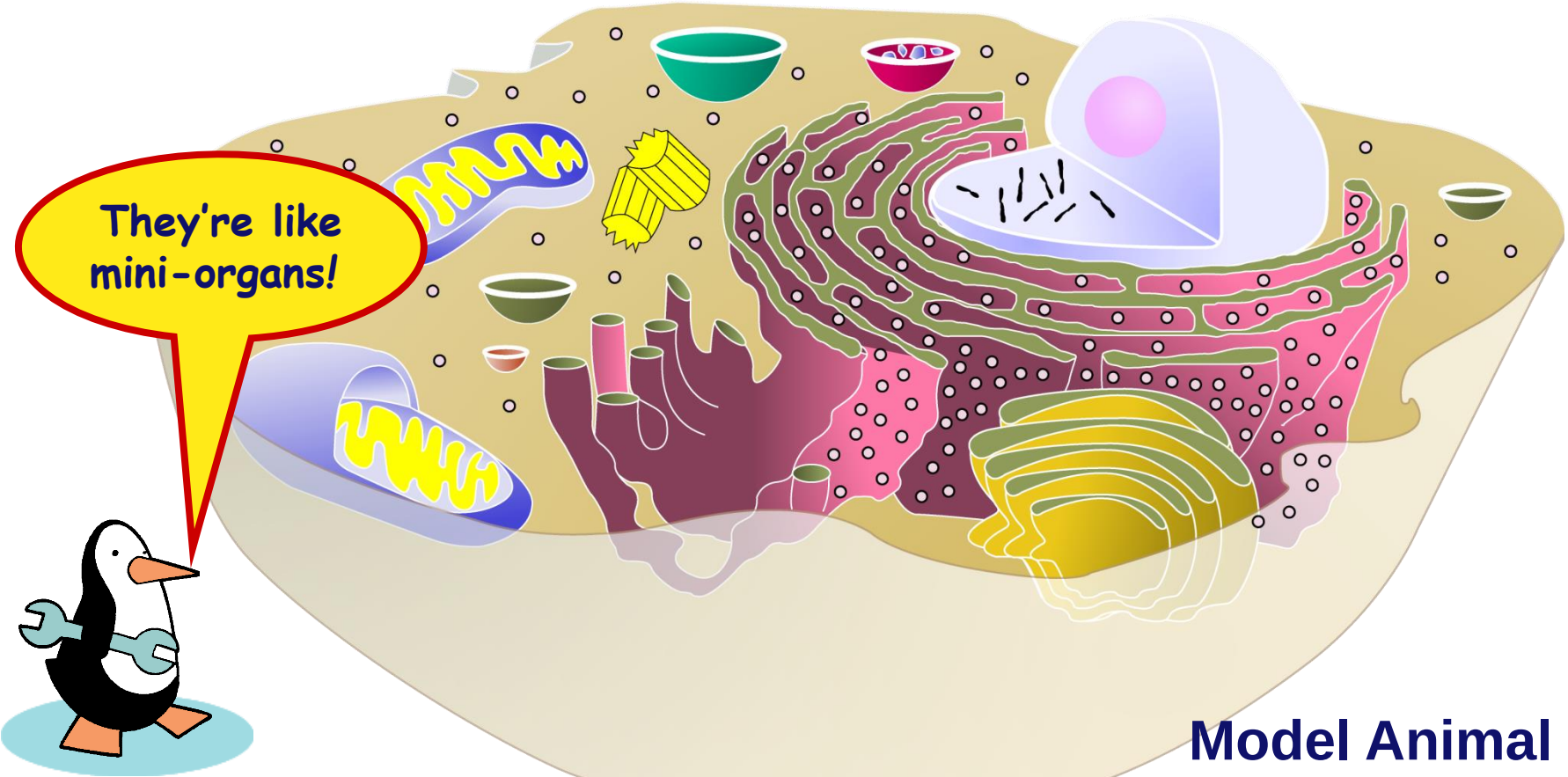
Cells & Cell Organelles

Doing Life's Work



Organelles

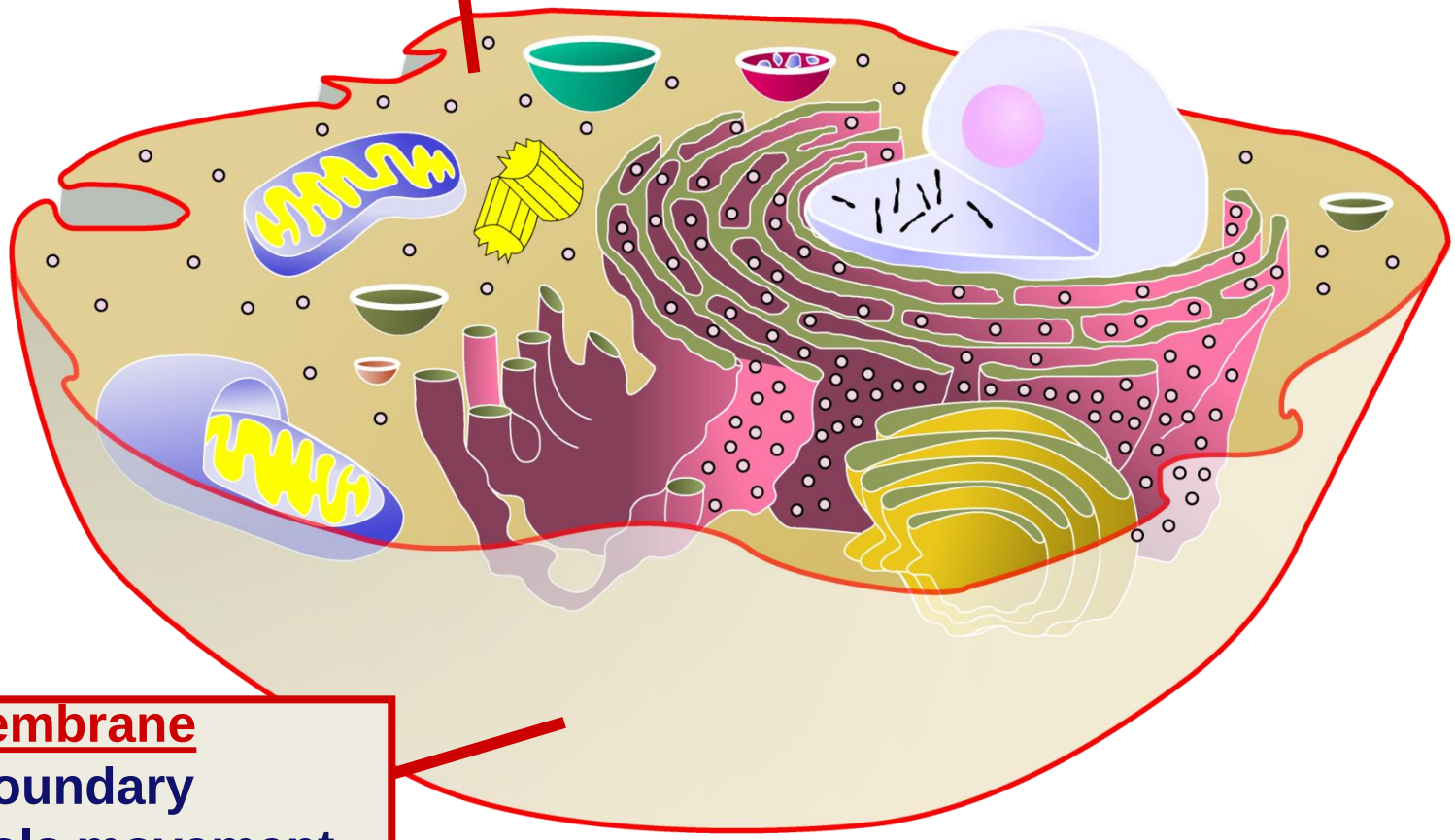
- Organelles do the work of cells
  - each structure has a job to do
    - keeps the cell alive; keeps you alive



Model Animal Cell

cytoplasm

- jelly-like material holding organelles in place

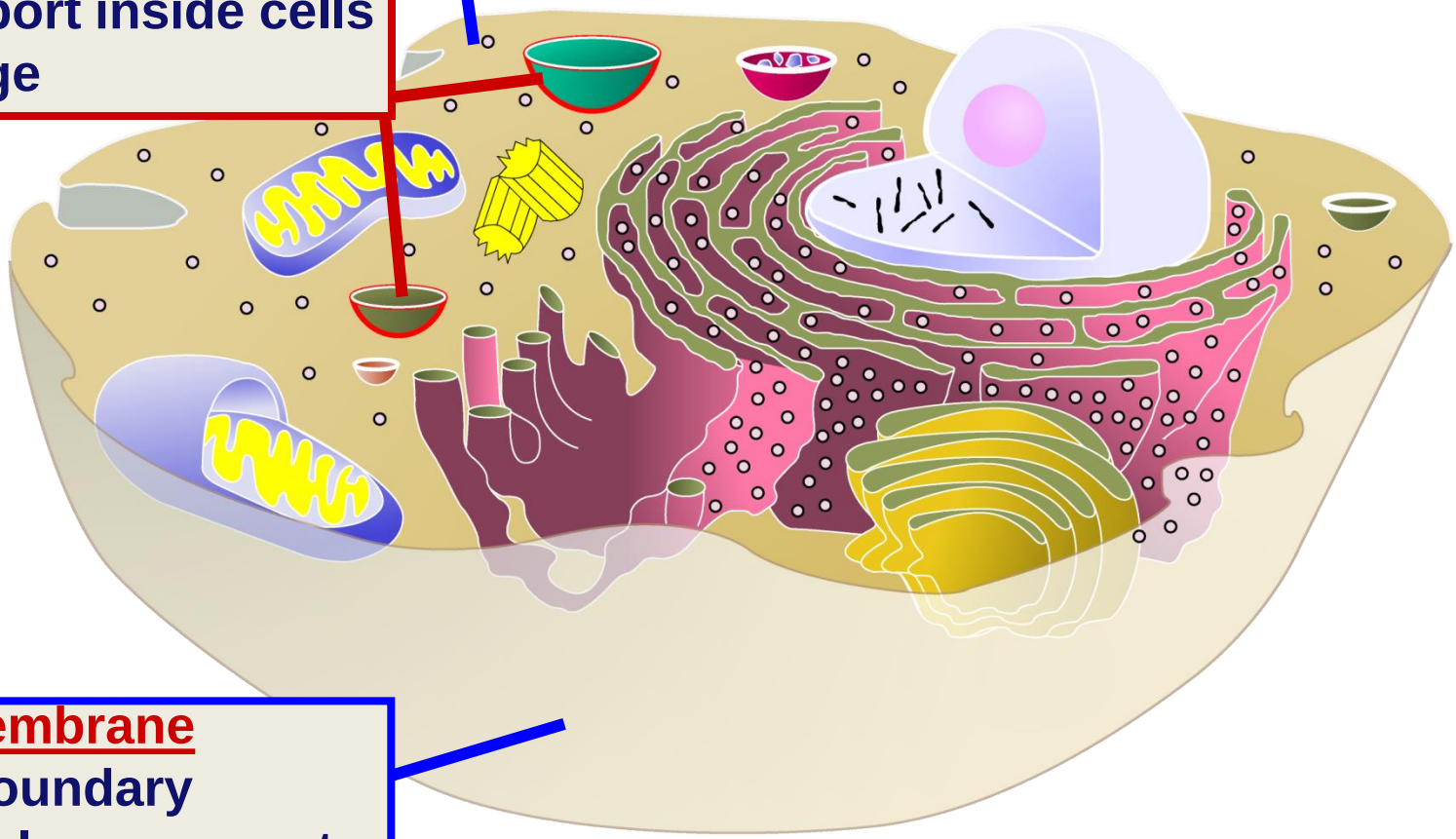


cell membrane

- cell boundary
- controls movement of materials in & out
- recognizes signals

cytoplasm
- jelly-like material holding organelles in place

vacuole & vesicles
- transport inside cells
- storage

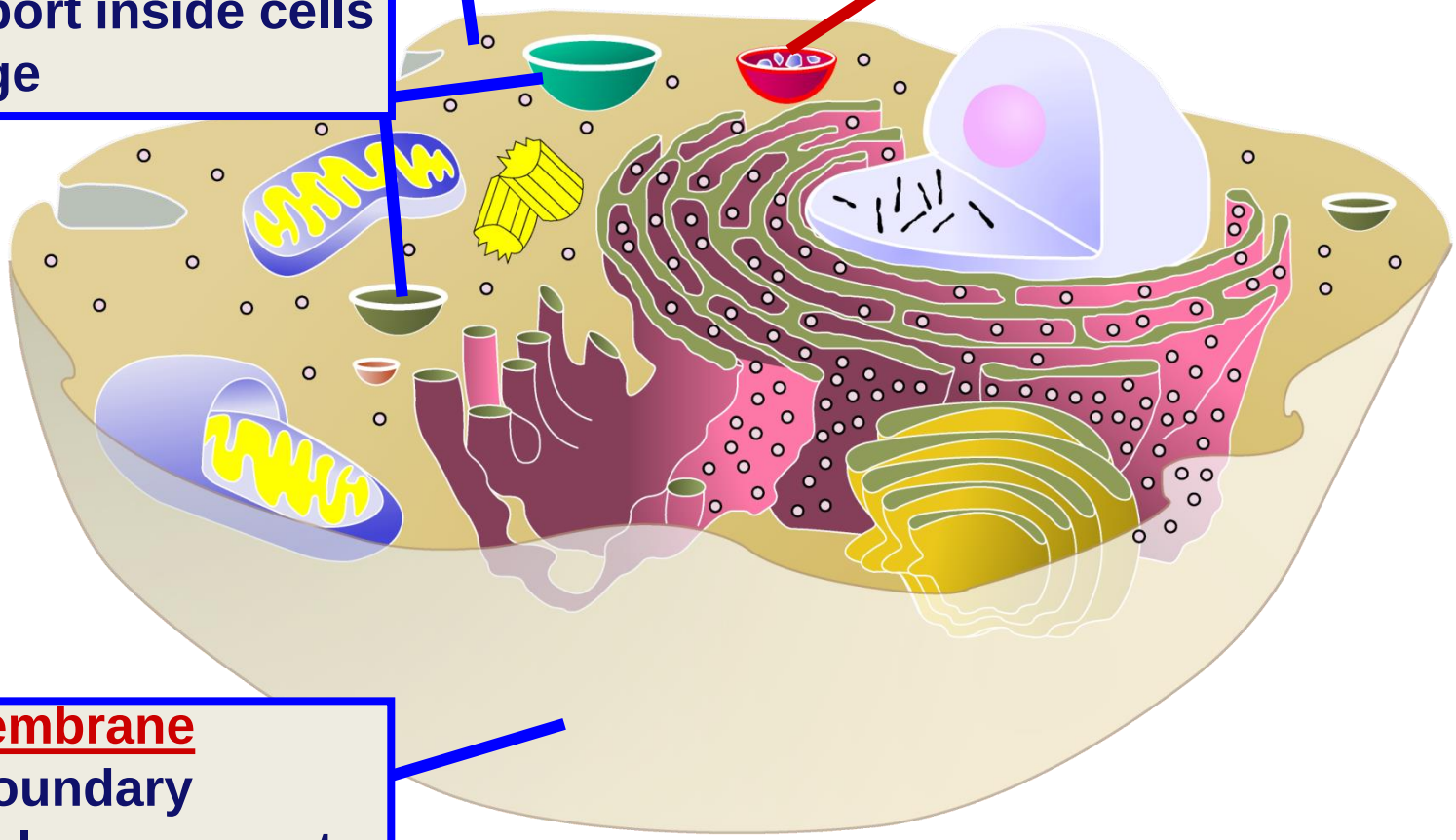


cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

vacuole & vesicles
- transport inside cells
- storage

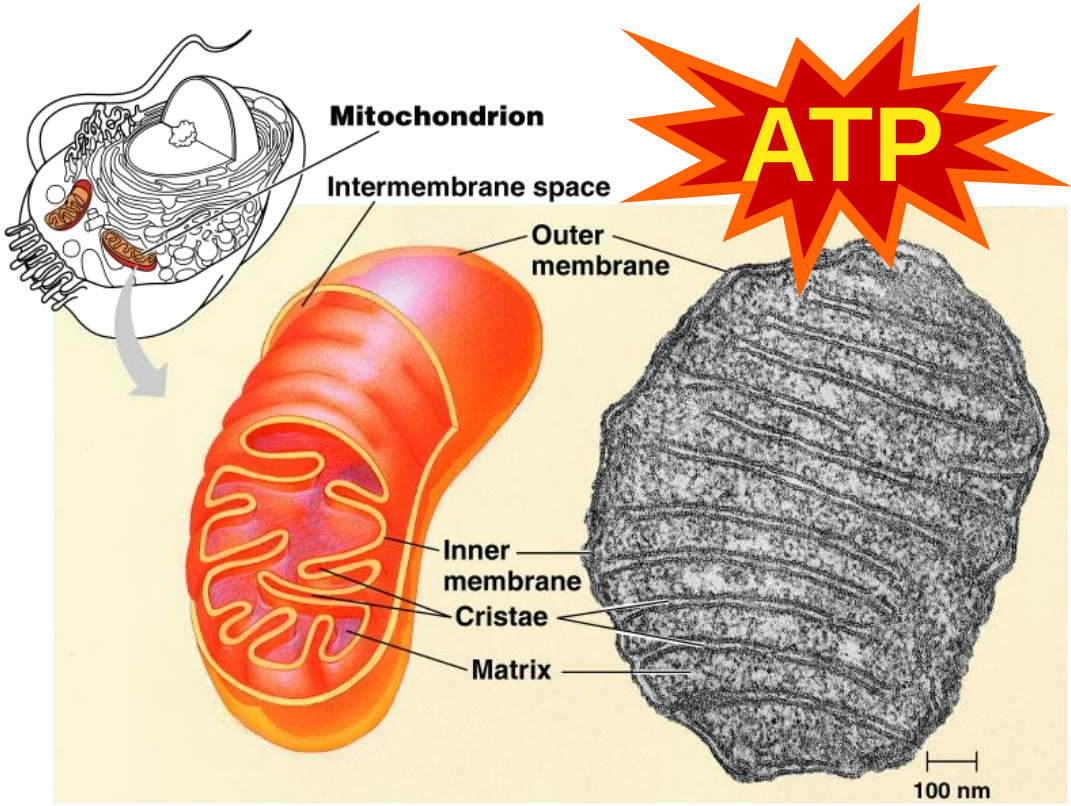


cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

Mitochondria

- Function
  - make ATP energy from cellular respiration
    - sugar + O_2 → ATP
    - fuels the work of life
- Structure
  - double membrane

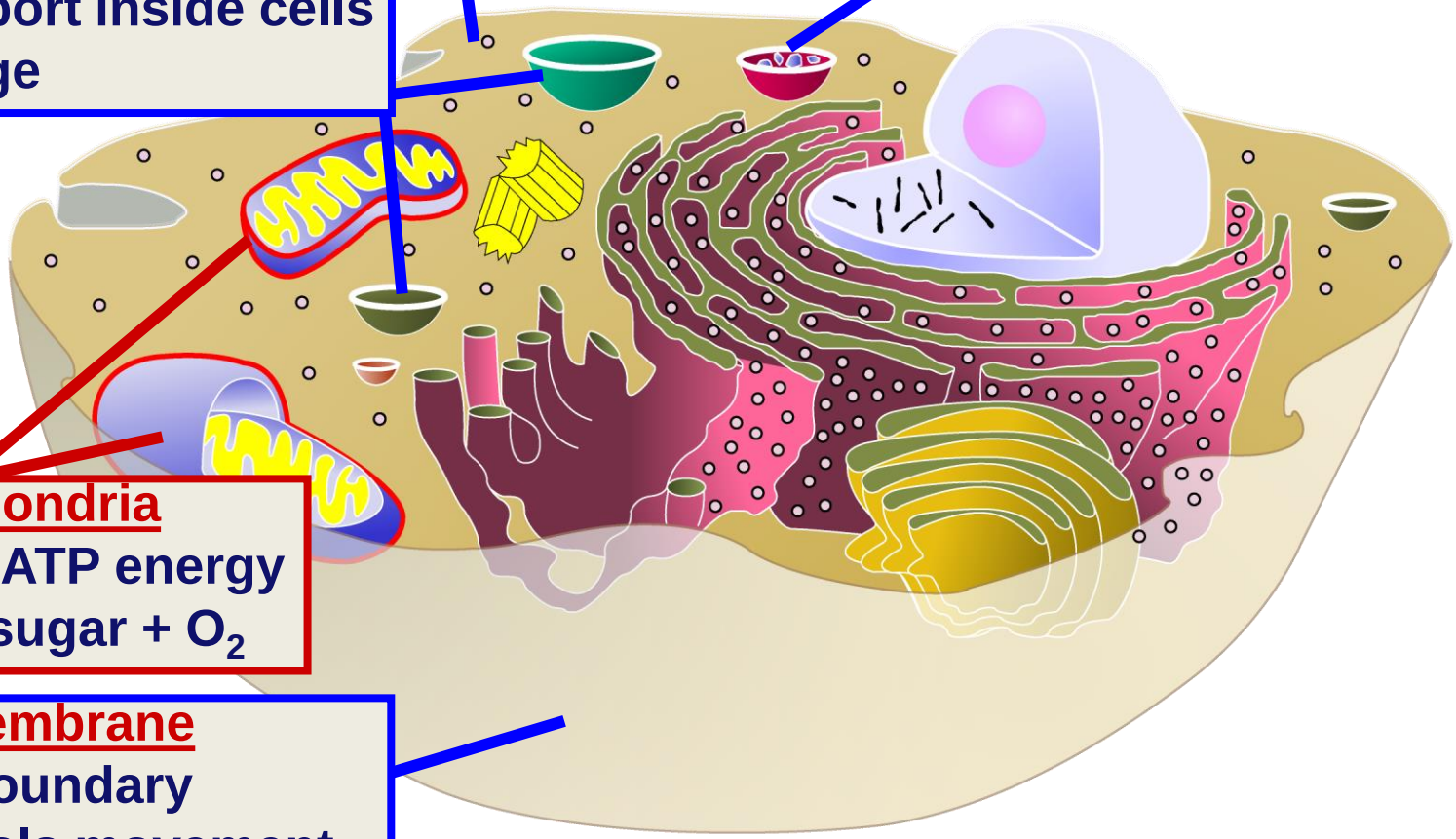
in both animal & plant cells



cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

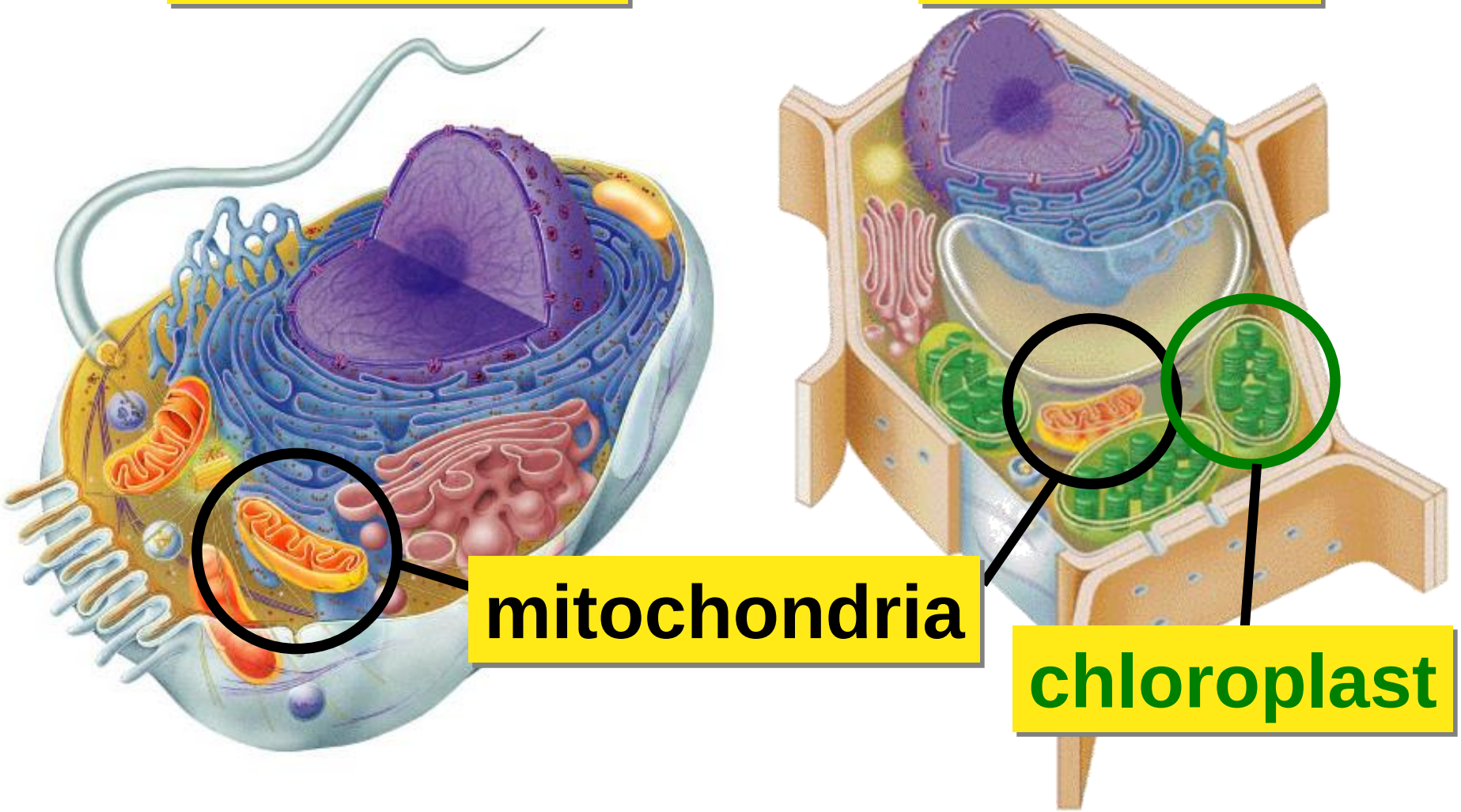
vacuole & vesicles
- transport inside cells
- storage

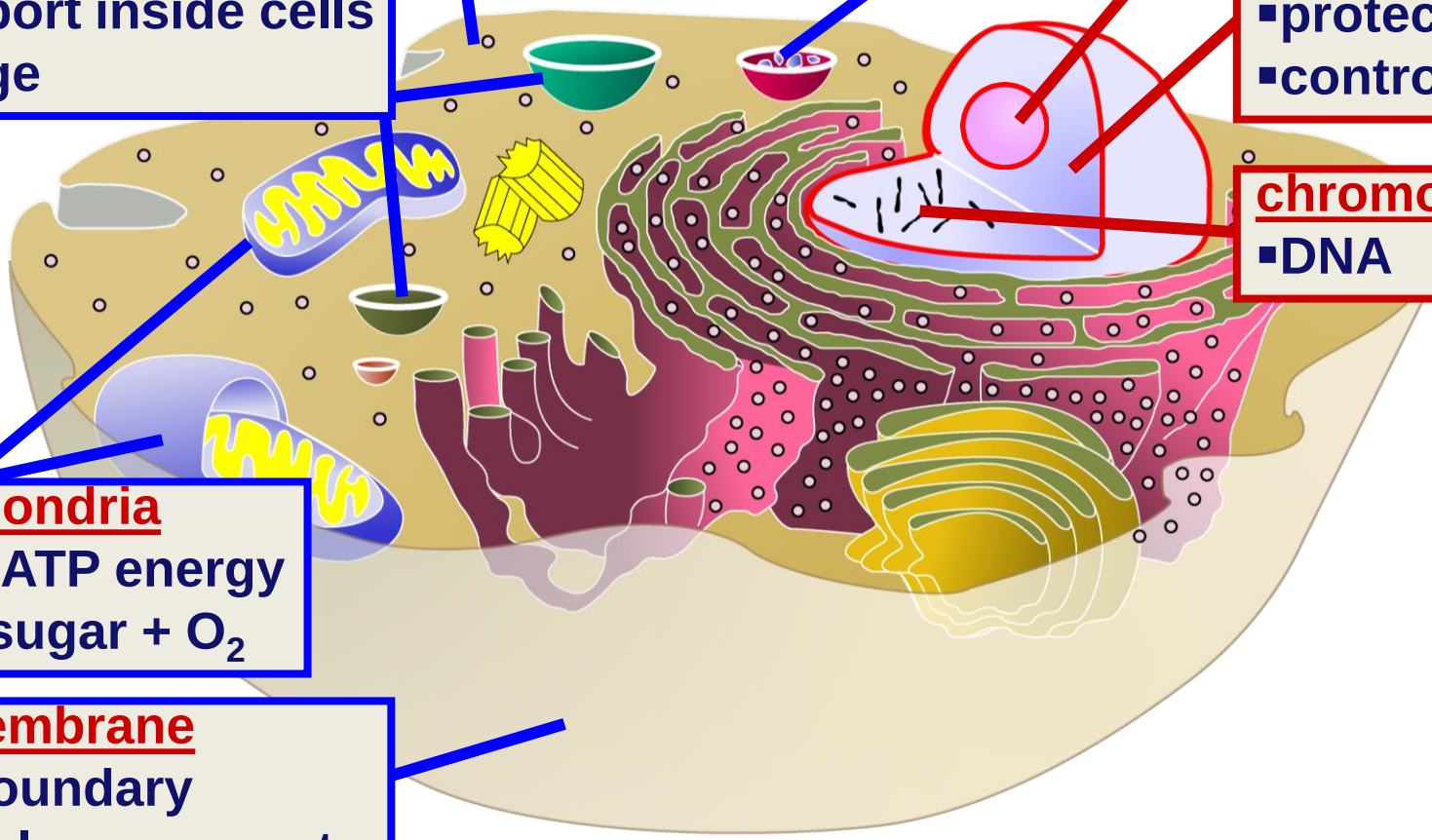


mitochondria
- make ATP energy from sugar + O_2

cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

Mitochondria are in both cells*!!*





cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

nucleolus
- produces ribosomes

vacuole & vesicles
- transport inside cells
- storage

nucleus
- protects DNA
- controls cell

chromosomes
- DNA

mitochondria
- make ATP energy from sugar + O_2

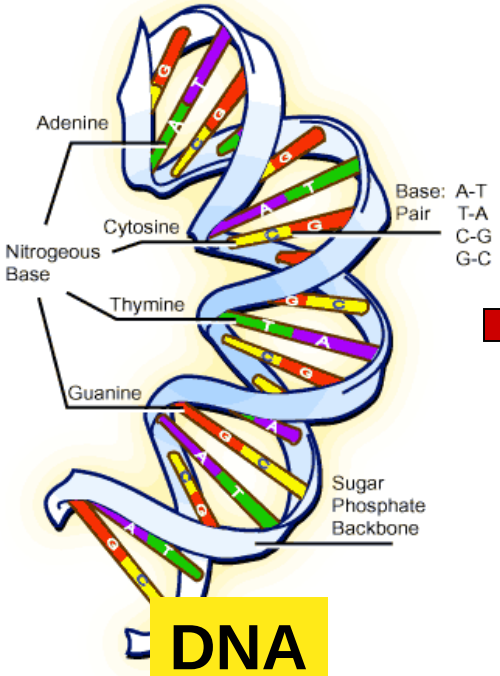
cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

2. Cells need workers = proteins!

- Making proteins
  - to run daily life & growth, the cell must…
    - read genes (DNA)
    - build proteins
      - structural proteins (muscle fibers, hair, skin, claws)
      - enzymes (speed up chemical reactions)
      - signals (hormones) & receptors
  - organelles that do this work…
    - nucleus
    - ribosomes
    - endoplasmic reticulum (ER)
    - Golgi apparatus

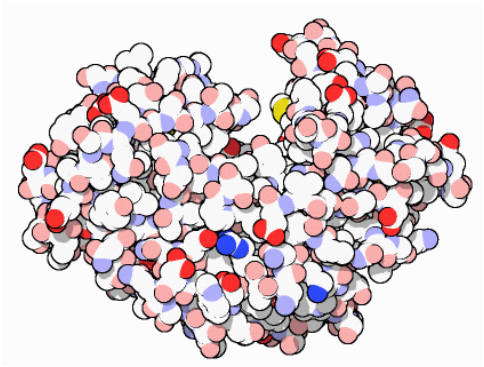
Proteins do all the work!

one of the major job of cells is to make proteins, because…



DNA

proteins do all the work!



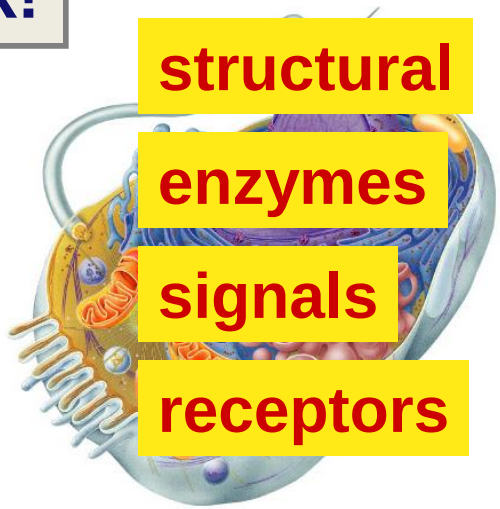
proteins

structural

enzymes

signals

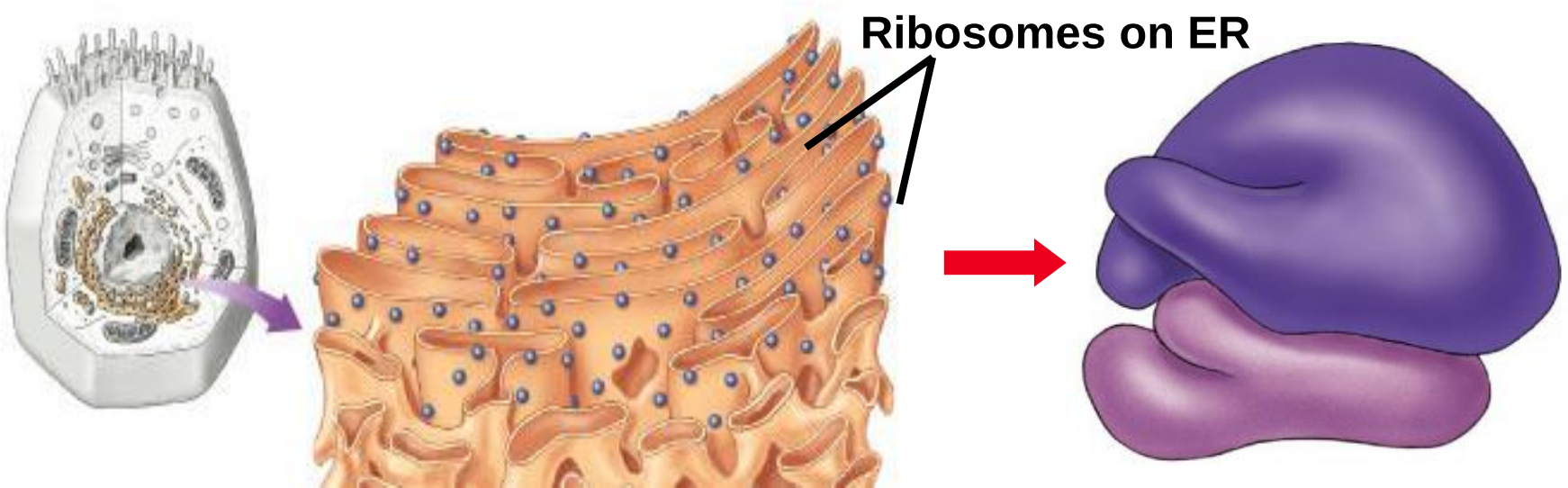
receptors



cells

Ribosomes

- Function
  - protein factories
  - read instructions to build proteins from DNA
- Structure
  - some free in cytoplasm
  - some attached to ER

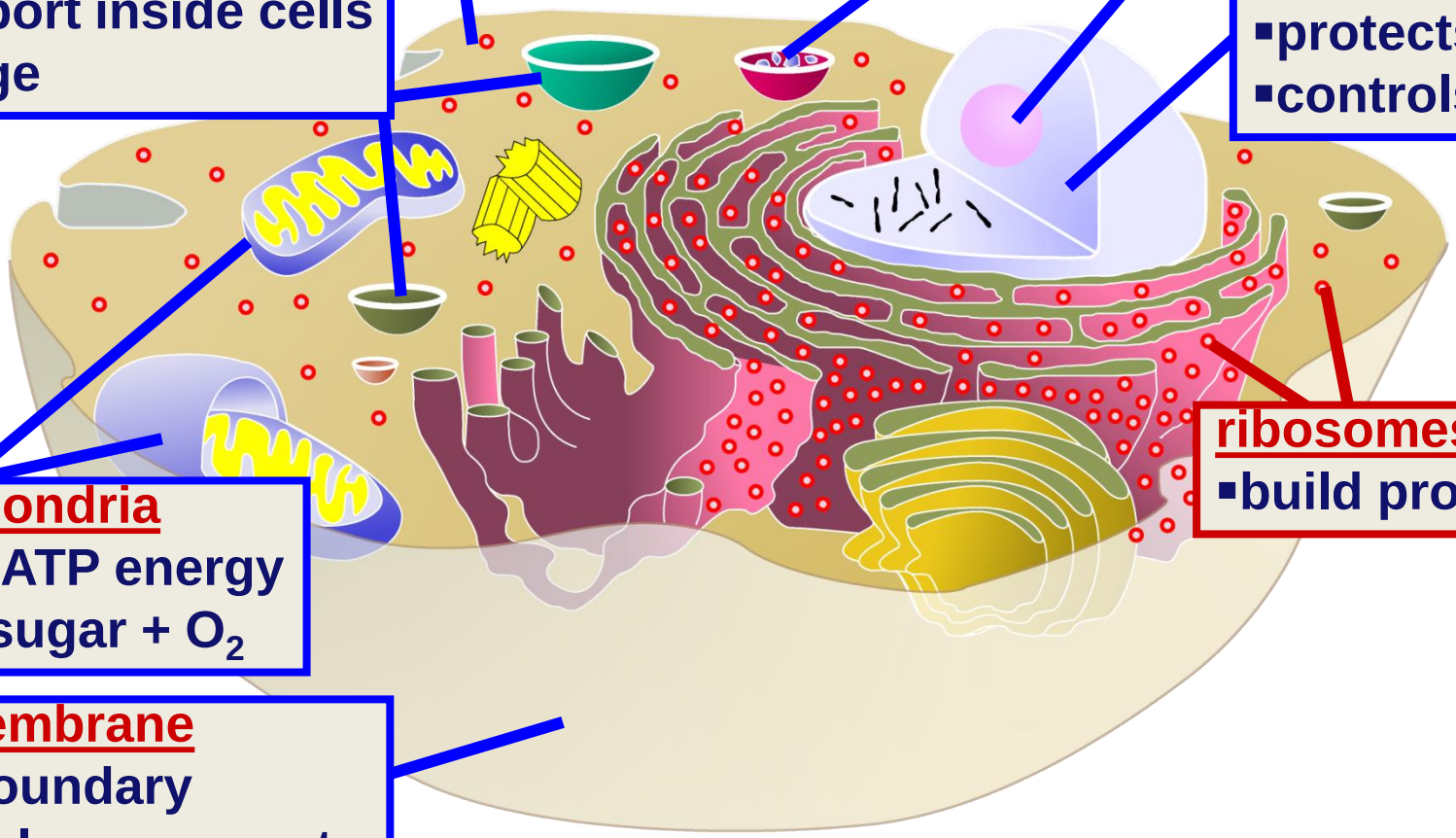


cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

nucleolus
- produces ribosomes

vacuole & vesicles
- transport inside cells
- storage

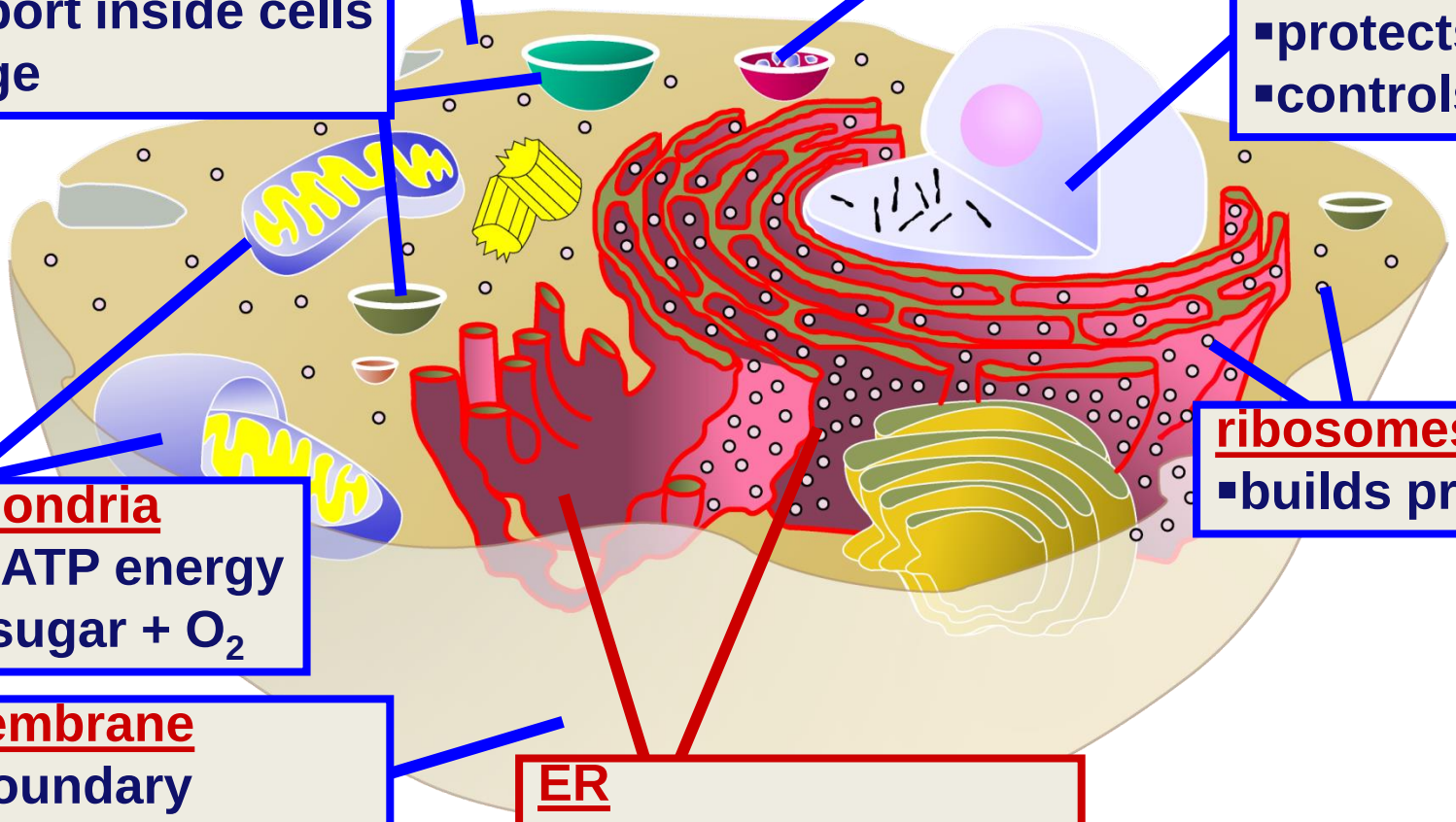


nucleus
- protects DNA
- controls cell

ribosomes
- build proteins

mitochondria
- make ATP energy from sugar + O_2

cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals



cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

vacuole & vesicles
- transport inside cells
- storage

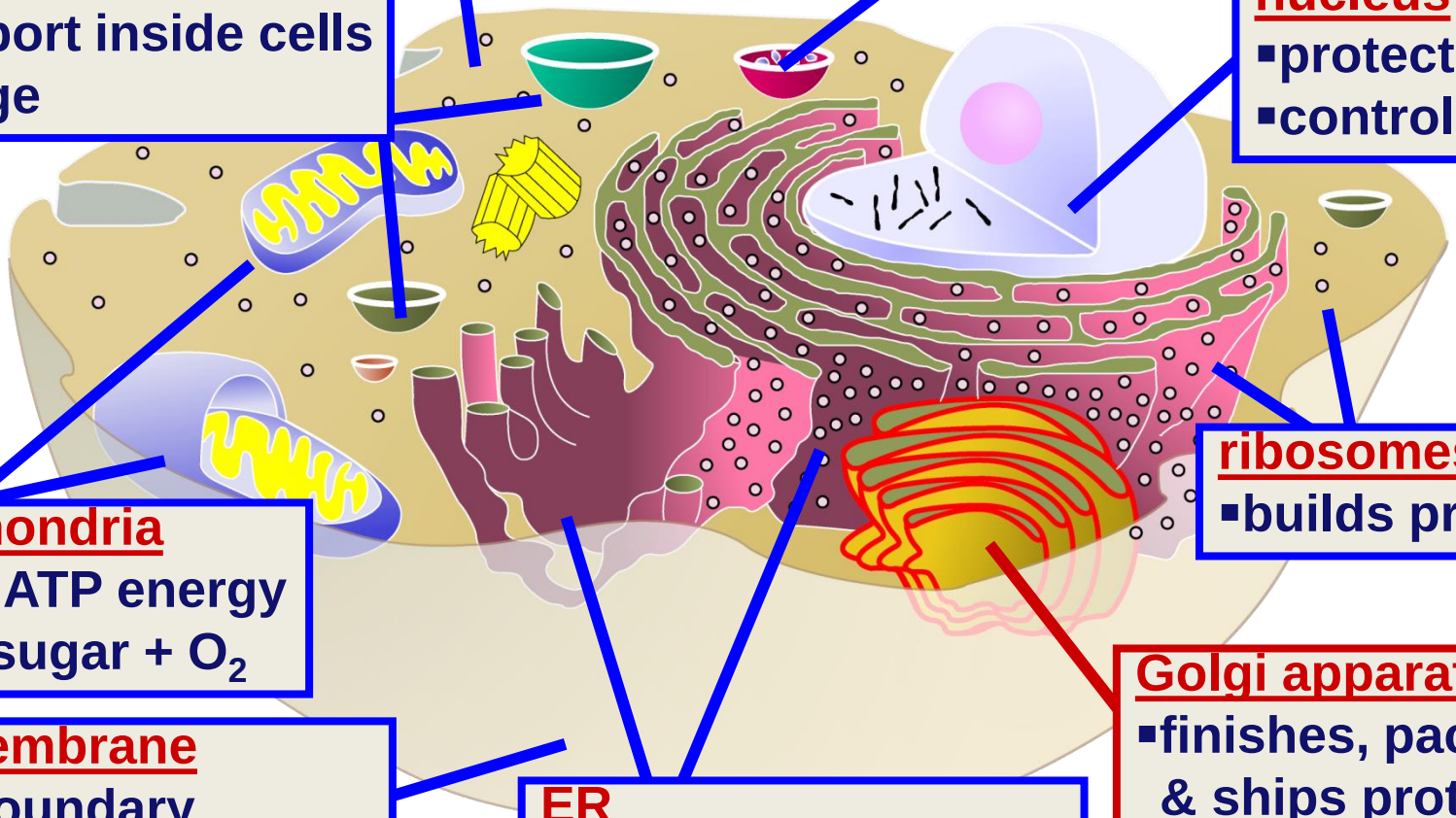
nucleus
- protects DNA
- controls cell

ribosomes
- builds proteins

mitochondria
- make ATP energy from sugar + O_2

cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

ER
- works on proteins
- makes membranes



cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

vacuole & vesicles
- transport inside cells
- storage

nucleus
- protects DNA
- controls cell

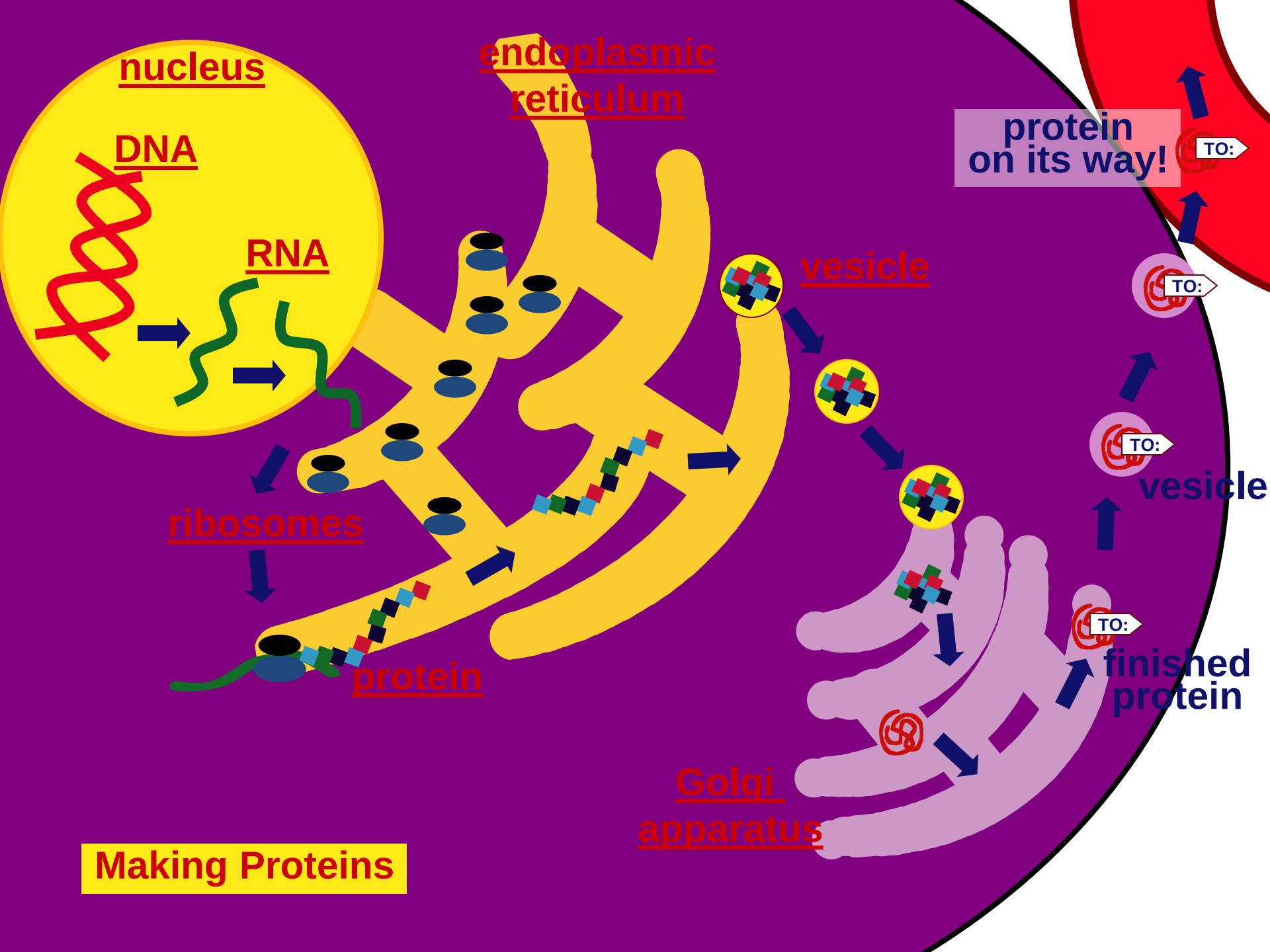
ribosomes
- builds proteins

mitochondria
- make ATP energy from sugar + O_2

Golgi apparatus
- finishes, packages & ships proteins

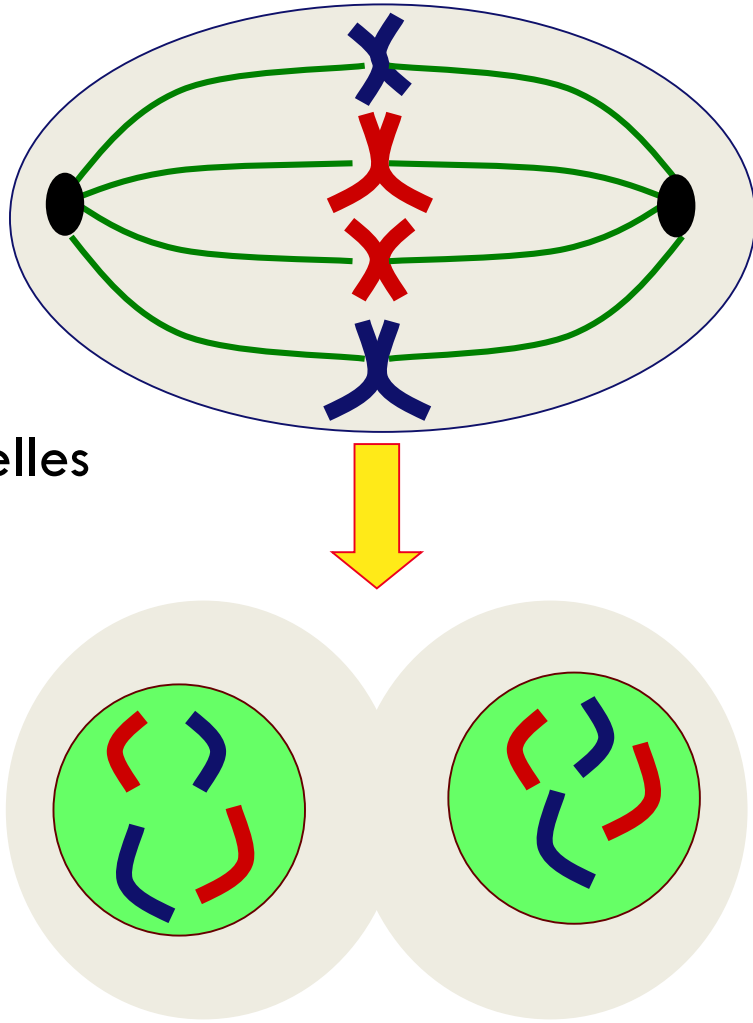
cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

ER
- helps finish proteins
- makes membranes


nucleus
DNA
RNA
endoplasmic reticulum
ribosomes
protein
vesicle
Golgi apparatus
protein on its way!
TO:
TO:
TO:
vesicle
TO:
finished protein
Making Proteins

3. Cells need to make more cells!

- Making more cells
  - to replace, repair & grow, the cell must…
    - copy their DNA
    - make extra organelles
    - divide the new DNA & new organelles between 2 new "daughter" cells
  - organelles that do this work…
    - nucleus
    - centrioles

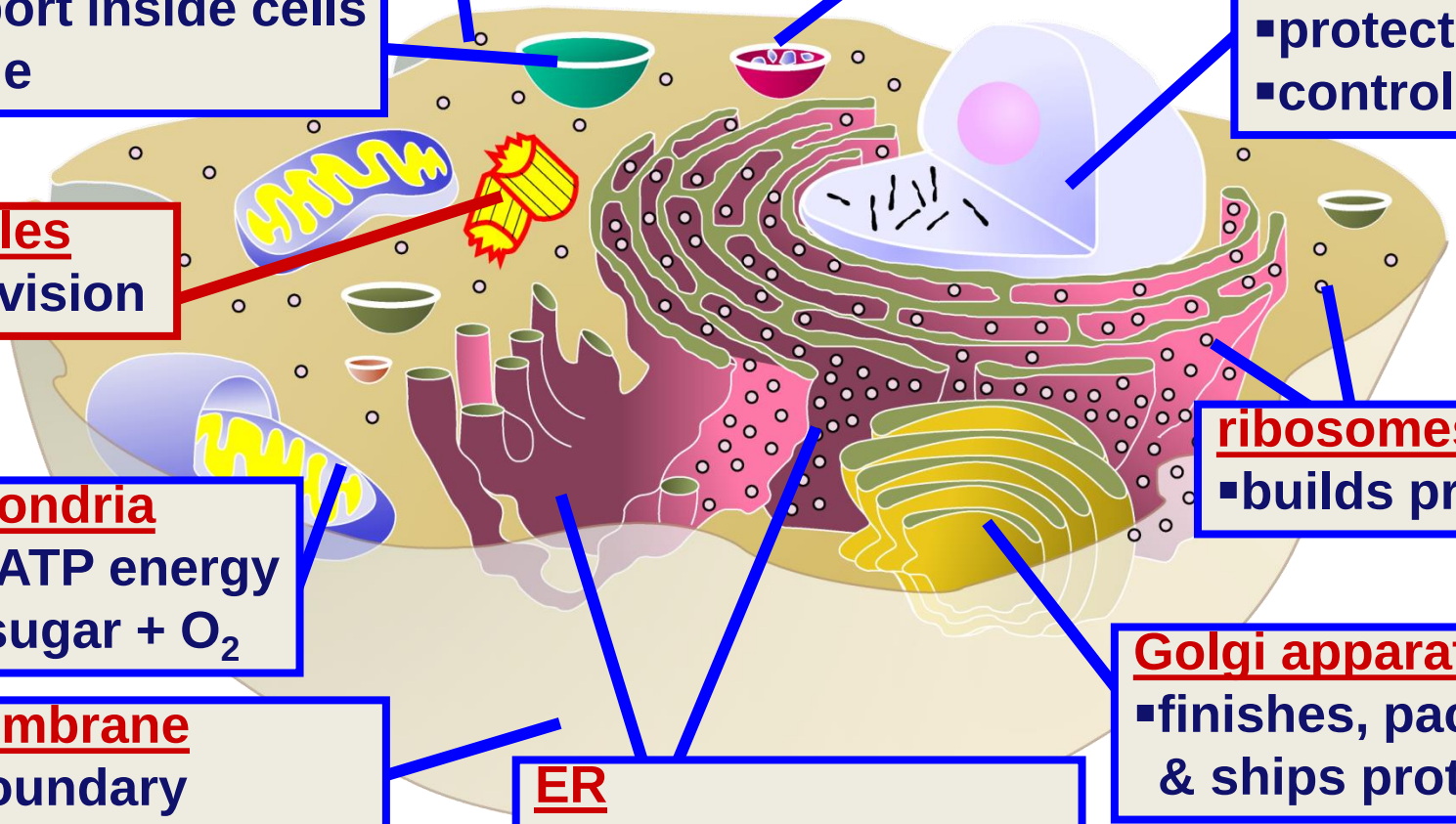


cytoplasm
- jelly-like material holding organelles in place

lysosome
- food digestion
- garbage disposal & recycling

vacuole & vesicles
- transport inside cells
- storage

nucleus
- protects DNA
- controls cell



centrioles
- cell division

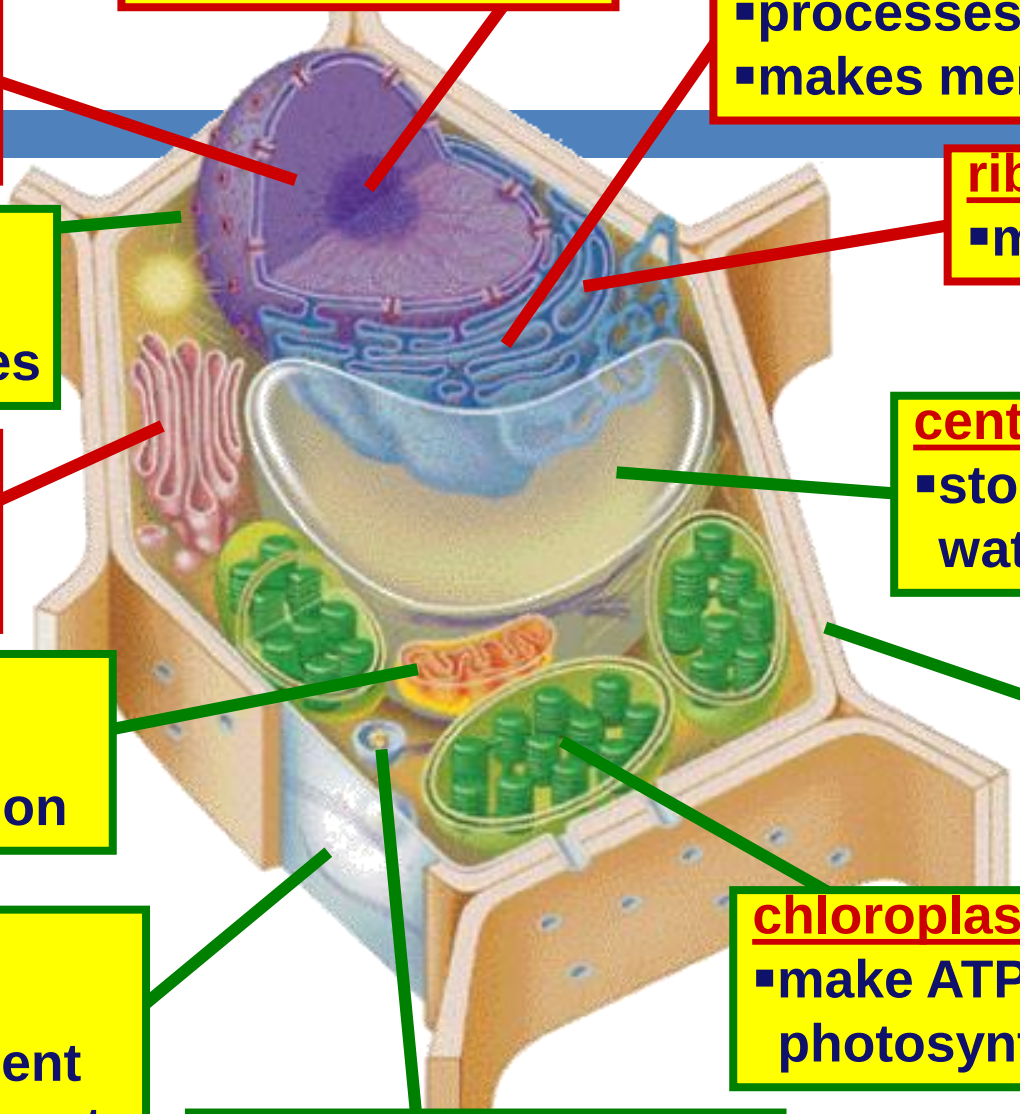
ribosomes
- builds proteins

mitochondria
- make ATP energy from sugar + O_2

Golgi apparatus
- finishes, packages & ships proteins

cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

ER
- helps finish proteins
- makes membranes



nucleolus
- make ribosomes

endoplasmic reticulum
- processes proteins
- makes membranes

nucleus
- control cell
- protects DNA

ribosomes
- make proteins

cytoplasm
- jelly-like material around organelles

central vacuole
- storage: food, water or waste

Golgi apparatus
- finish & ship proteins

cell wall
- support

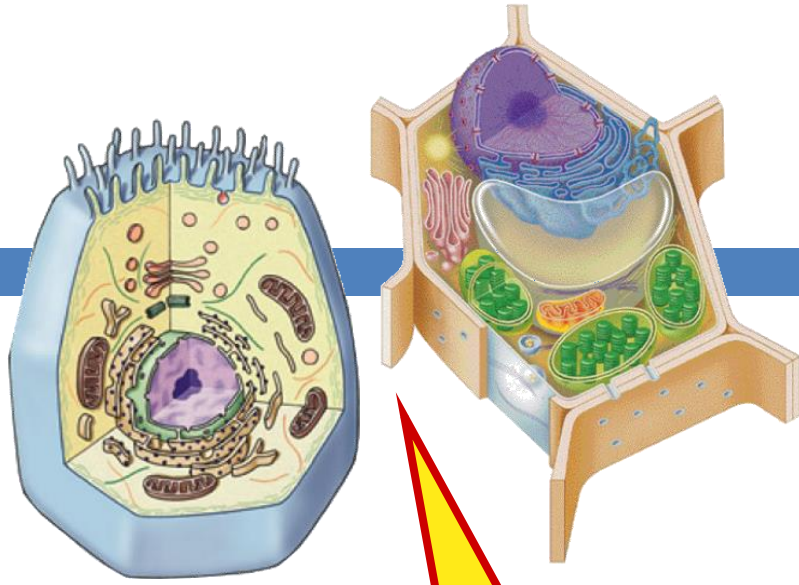
mitochondria
- make ATP in cellular respiration

chloroplast
- make ATP & sugars in photosynthesis

cell membrane
- cell boundary
- controls movement of materials in & out
- recognizes signals

lysosome
- digestion & clean up

Cell Summary



- Cells have 3 main jobs
  - make energy
    - need food + O_2
    - cellular respiration & photosynthesis
    - need to remove wastes
  - make proteins
    - need instructions from DNA
    - need to chain together amino acids & "finish" & "ship" the protein
  - make more cells
    - need to copy DNA & divide it up to daughter cells