Ch. 2: Cell Structure & Function

in Concepts & Challenges: The Basis of Life

2-1: What is a microscope?

Objective:	*Students will be able to DESCRIBE the microscope and its parts.*

KEY TERMS

Microscope: tool that makes things look larger than they really are

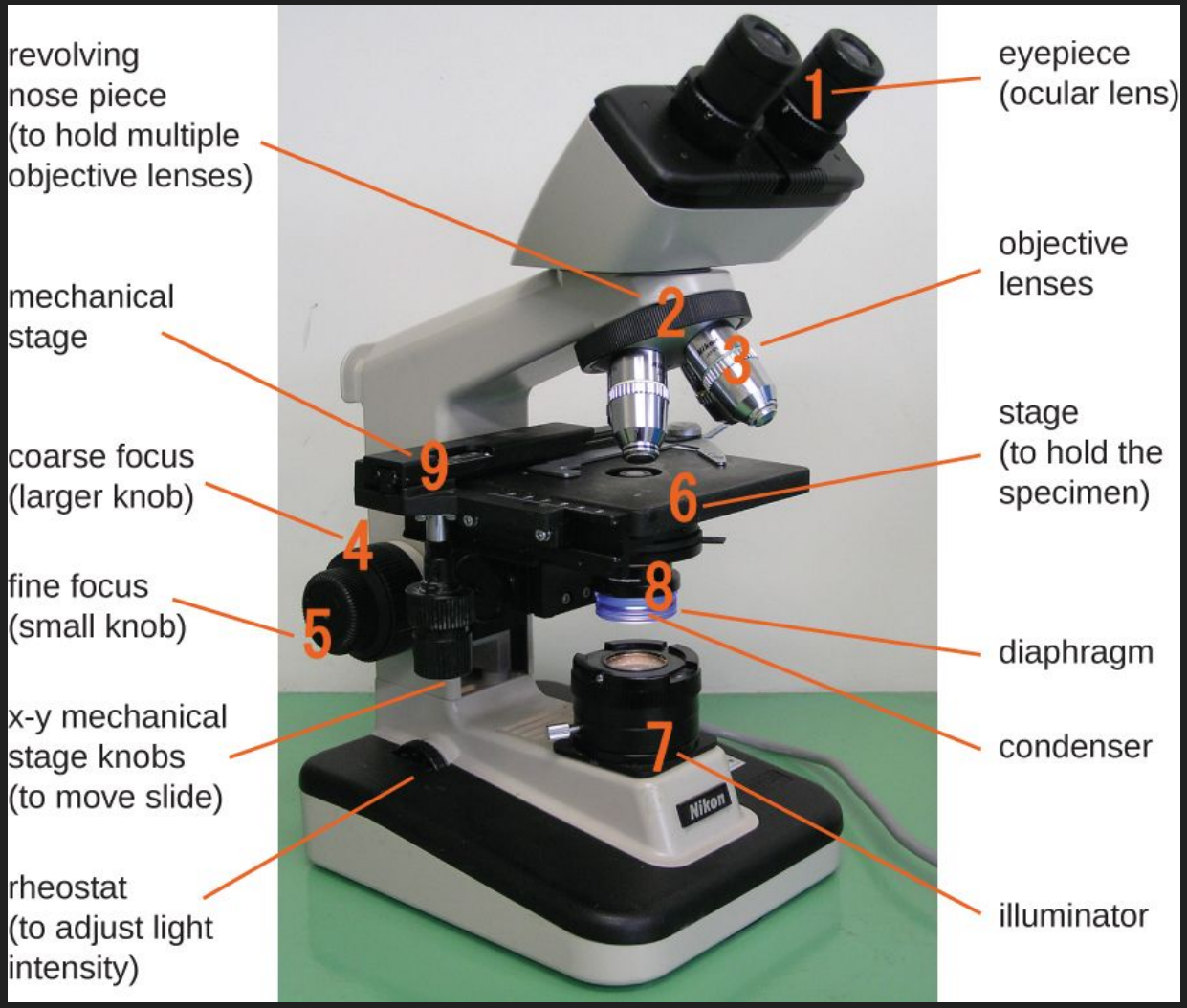
Lens: piece of curved glass or other key material that causes light rays to come together or spread apart as they pass through

Microscopes

- One of the most important tools used to study living things
- Micro- = “very small”
- Scope = “to look at”

Lenses

- Some lenses have one curved surface and one flat surface
- Others have two curved surfaces
- Brings light rays together or spreads them apart
- Light that passes through a lens is bent, causing the object to look larger or smaller


revolving nose piece (to hold multiple objective lenses)
mechanical stage
coarse focus (larger knob)
fine focus (small knob)
x-y mechanical stage knobs (to move slide)
rheostat (to adjust light intensity)
eyepiece (ocular lens)
objective lenses
stage (to hold the specimen)
diaphragm
condenser
illuminator
1
2
3
4
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6
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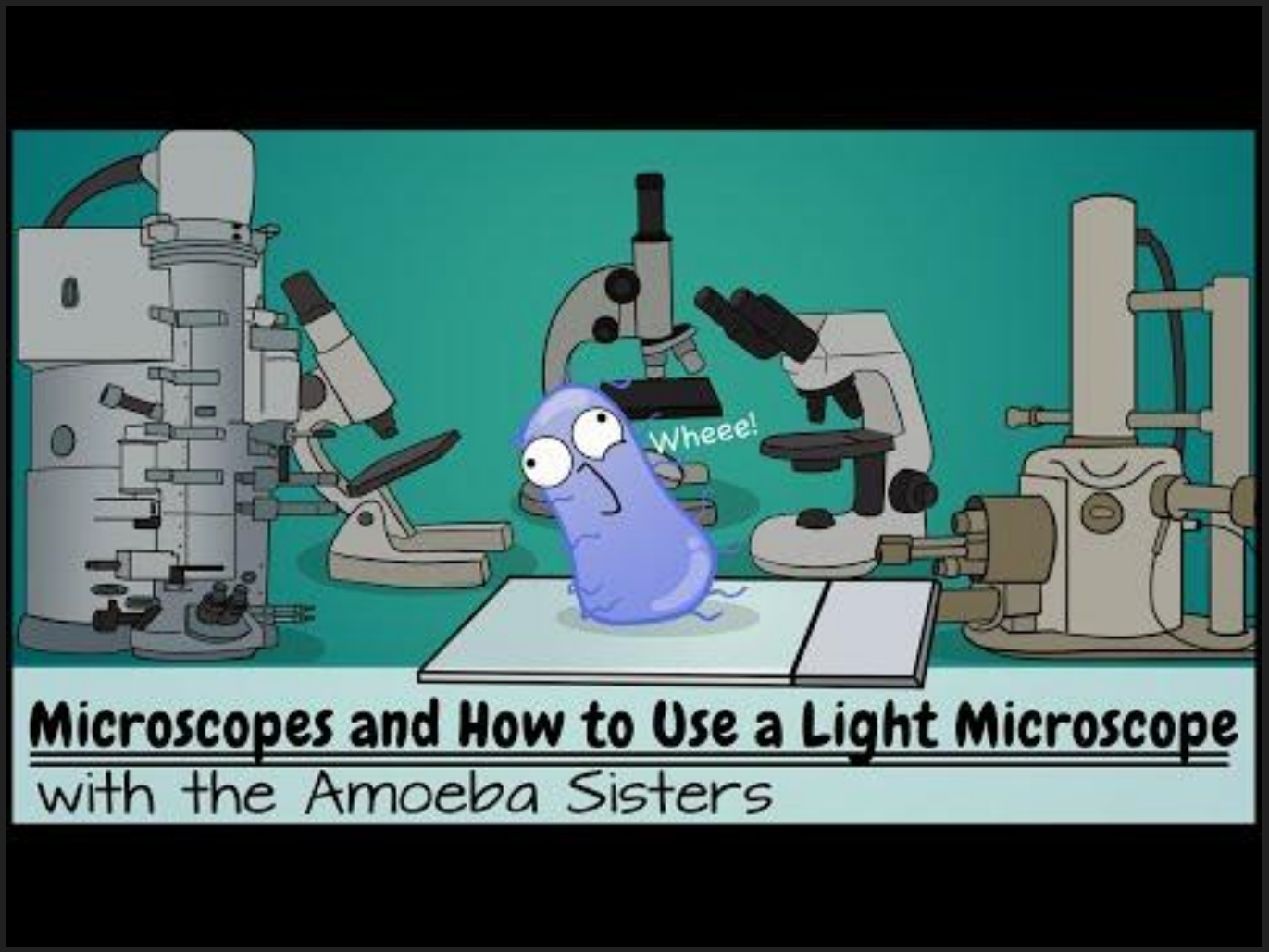
8
9
Nikon


Wheee!
Microscopes and How to Use a Light Microscope
with the Amoeba Sisters

Parts of a Microscope

- All microscopes have the same basic parts
- Parts are fragile
- Use only lens cleaner to clean the lens and slides
- Be careful not to break a slide by zooming in too far
- Carrying a microscope: one hand holding the arm, one hand under the base

Types of Light Microscopes

- 1590: 1st compound microscope created by two Dutch eyeglass makers, Hans & Zacharias Janssen
- Much of what is known about living things would not be known without microscopes
- Magnifying glass = very simple microscope (only one lens)
- Compound microscope has two or more lenses
  - Using two lenses makes things even larger than using one lens

In-Class Today

- Notes on Chapter 2, Section 2

2-2: What is a cell?

Objective:	*Students will be able to EXPLAIN the cell theory.*

KEY TERMS

Cell: basic unit of structure and function in living things

Cells

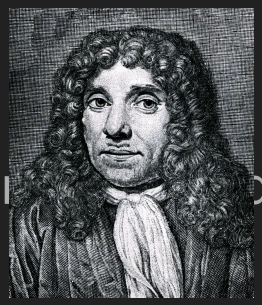
- All living things are made up of one or more cells
- Cells carry out all life processes
  - Cell takes in and breaks down glucose to produce energy —- cellular respiration

Discovery of Cells

Robert Hooke, English scientist

- used a light microscope to look at thin slices of cork
- Cork looked to be made up of small boxes
- Named the structures that made up the cork, “cells”
- 1665: published his drawings of cork cells in his book, “*Micrographia*”
- Only saw dead plant cells in the cork

Anton van Leeuwenhoek, Dutch lensmaker



- First person to observe and describe living cells
- 1674: saw single-celled organisms swimming in a d[illegible]d water

Cell Theory

By 1800, microscopes were becoming more advanced and allowed scientists to see plants and animals in more detail. Scientists developed more ideas about cells.

Matthias Schleiden, German botanist

- 1838: studied many plants in order to learn more about living things
- stated that all plants are made up of cells

Cell Theory

Theodor Schwann, German zoologist

- studied cells
- 1839: stated that the cell is the basic unit of structure in animals

Rudolph Virchow, German doctor

- studied cells
- 1855: stated that new cells come from cells that already exist

Cell Theory

In the mid-1800s, ideas were put together as a theory:

- All living things are made up of one or more cells.
- Cells are the basic unit of structure in living things.
- Cells carry on all life processes.
- Cells come only from other living cells.

(supported by observations and data again and again)

2-3: What are the main cell parts?

Objective:	*Students will be able to IDENTIFY the main parts of a cell and describe their functions.*

KEY TERMS

Cell Membrane: thin structure that surrounds a cell

Cytoplasm: gel-like substance inside the cell where most of the cell's activities take place

Nucleus: control center of the cell

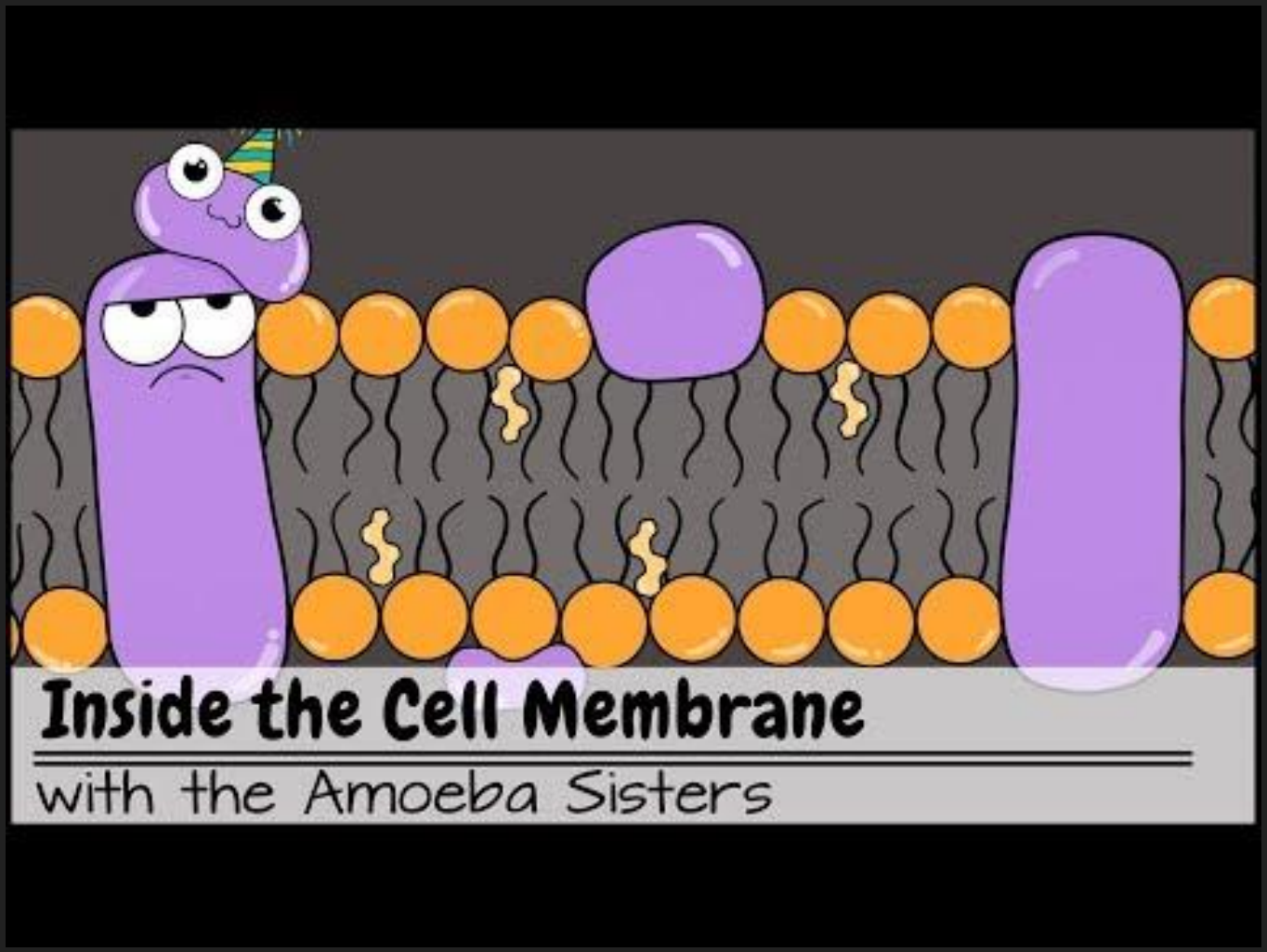
Nuclear Membrane: thin structure that surrounds and protects the nucleus

Three Main Parts

1. Cell Membrane
2. Cytoplasm
3. Nucleus

Cell Membrane

- Sometimes called the plasma membrane
- Has three important jobs:
  1. Protects the inside of the cell
  2. Supports and gives a cell its shape
  3. Controls the movement of materials into and out of a cell
     - In: Food, water, oxygen
     - Out: Waste


Inside the Cell Membrane
with the Amoeba Sisters

Cytoplasm

- Where most cell parts are located
- Where most cell activity takes place

Nucleus

- Round or egg-shaped
- Controls all life processes of a cell
- Controls cell reproduction
- Separated from the cytoplasm by nuclear membrane
  - Controls movement of materials into and out of the nucleus
- Contains blueprints called DNA (deoxyribose nucleic acid)
  - Instructions for how the cell is supposed to function

2-4: What are other cell parts?

Objective:	*Students will be able to DESCRIBE the functions of the parts of a cell.*

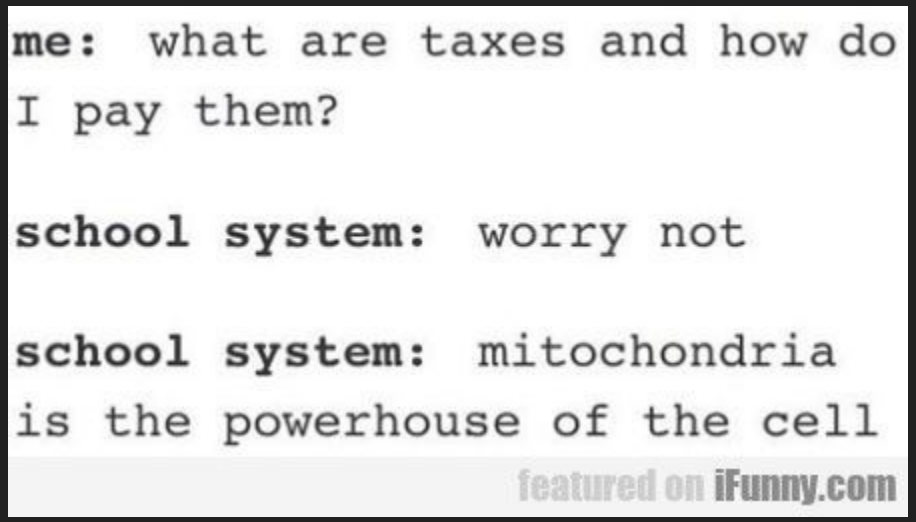
Organelles

- A cell is like a factory
  - Each machine has its own special job
  - Machines work together to keep the factory working
  - “Machines” = Organelles
- **Organelle**: a small structure that is suspended in the cytoplasm
  - So small that they can only be seen with an electron microscope
  - Each one has a special job
    - Produce energy
    - Transport materials
    - Get rid of waste
  - Keep cell working properly

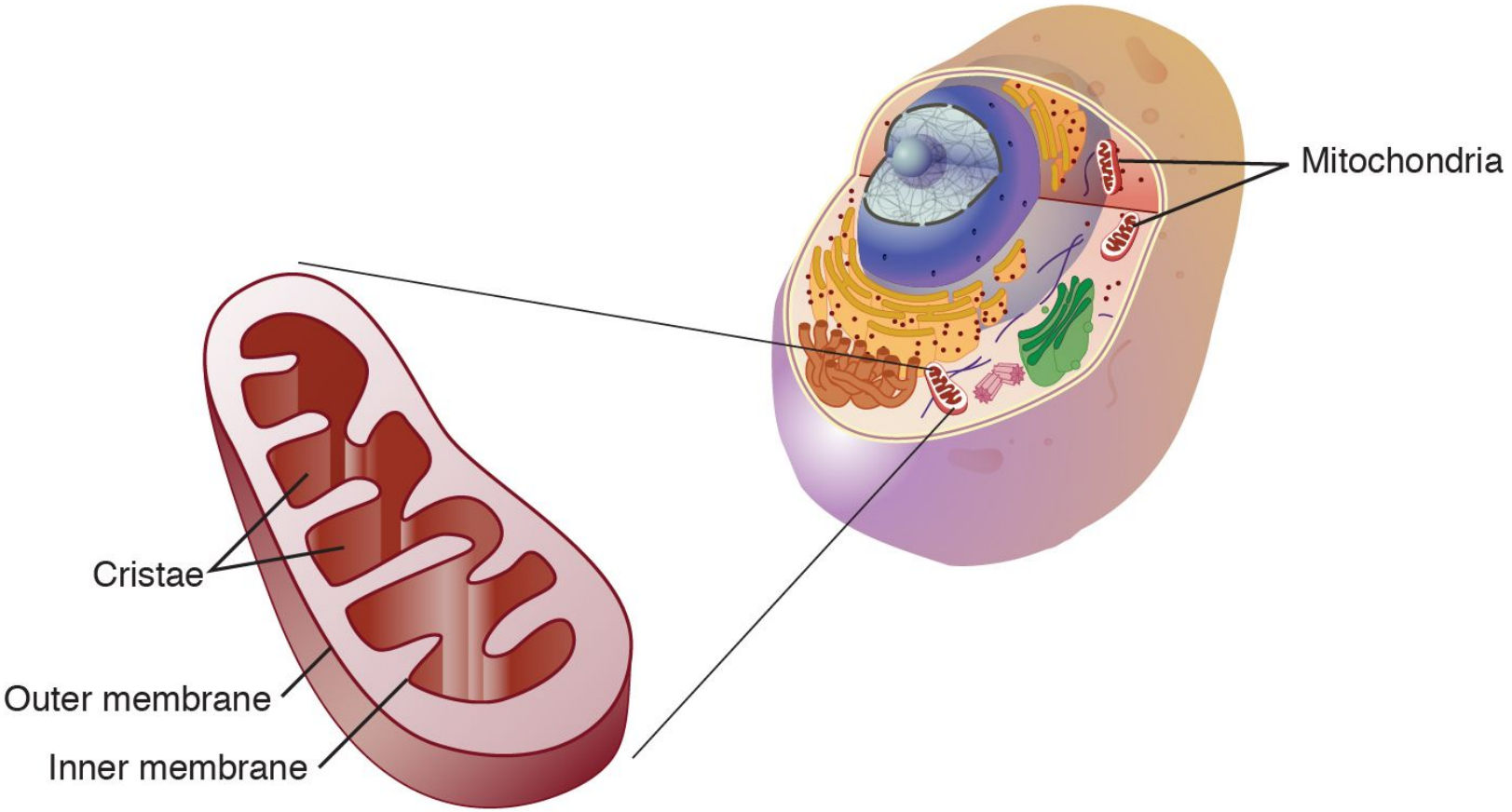
1. Mitochondria

- “POWERHOUSE” of the cell
- release energy that the cell can use to carry out its life processes
- Cells that have a lot of mitochondria: liver, muscles, brain, kidney


Heraa Hashmi
@caveheraa
Mitochondria is the powerhouse of the cell?
FALSE.
Mitochondria *are* the powerhouses of the cell. Mitochondria is plural. The singular is mitochondrion.
If that's the only thing you learned from school, I'm sorry to say you messed that up too.


me: what are taxes and how do I pay them?
school system: worry not
school system: mitochondria is the powerhouse of the cell
featured on iFunny.com


MITOCHONDRIA IS
inhales
THE POWERHOUSE OF THE CELL !

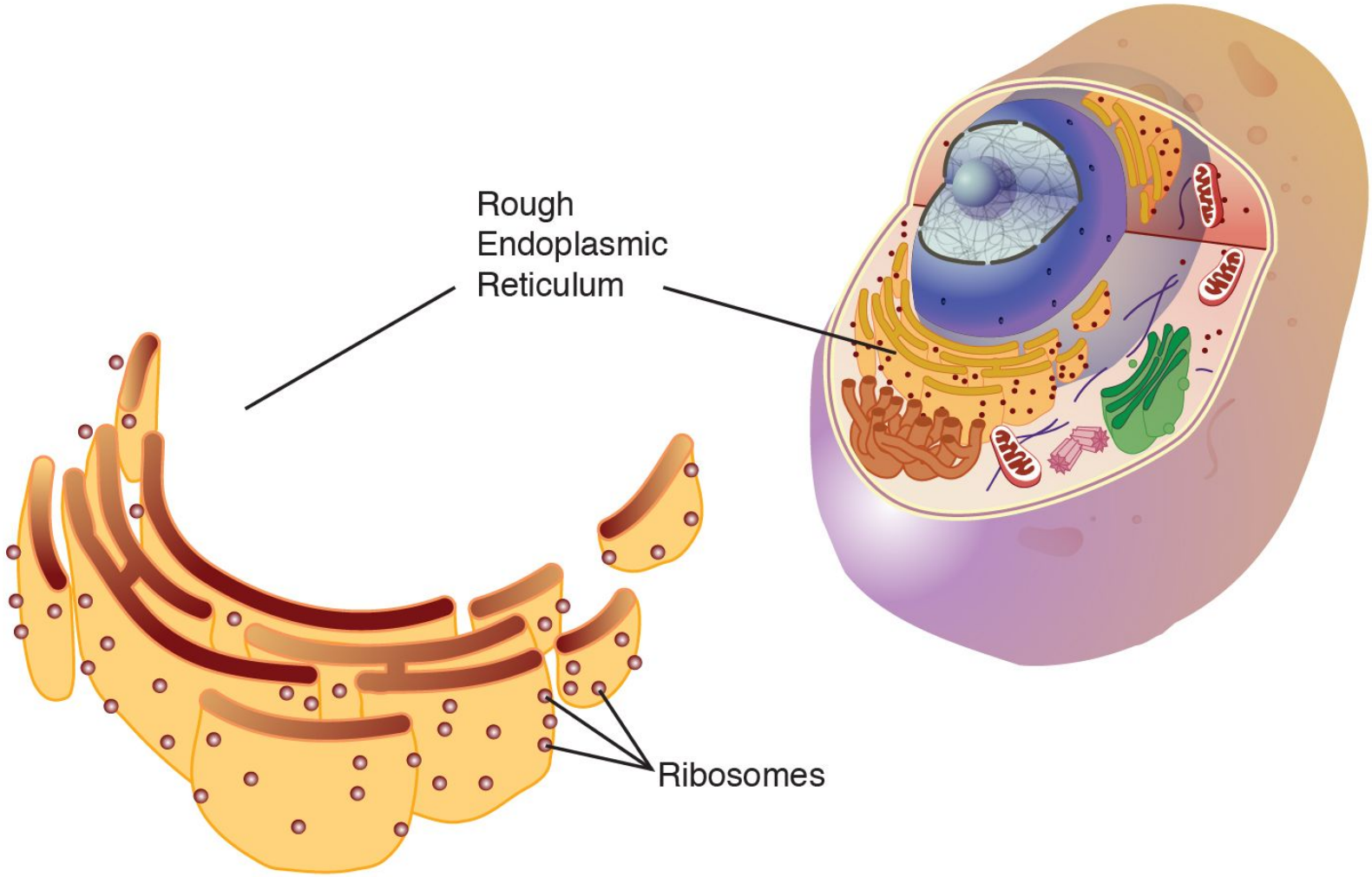

Mitochondria
Cristae
Outer membrane
Inner membrane

2. Endoplasmic Reticulum

- Very small network of tubes inside the cell
  - Like a highway system within the cell
- Substances move along these tubes from one organelle to another
- Also known as the “ER”

3. Ribosomes

- Small, rounded structures located within the cell
- Make proteins
  - Needed for growth and are involved in all cell processes
- Appear as small bumps on the ER, or scattered throughout the cytoplasm


Rough
Endoplasmic
Reticulum
Ribosomes

4. Golgi Bodies

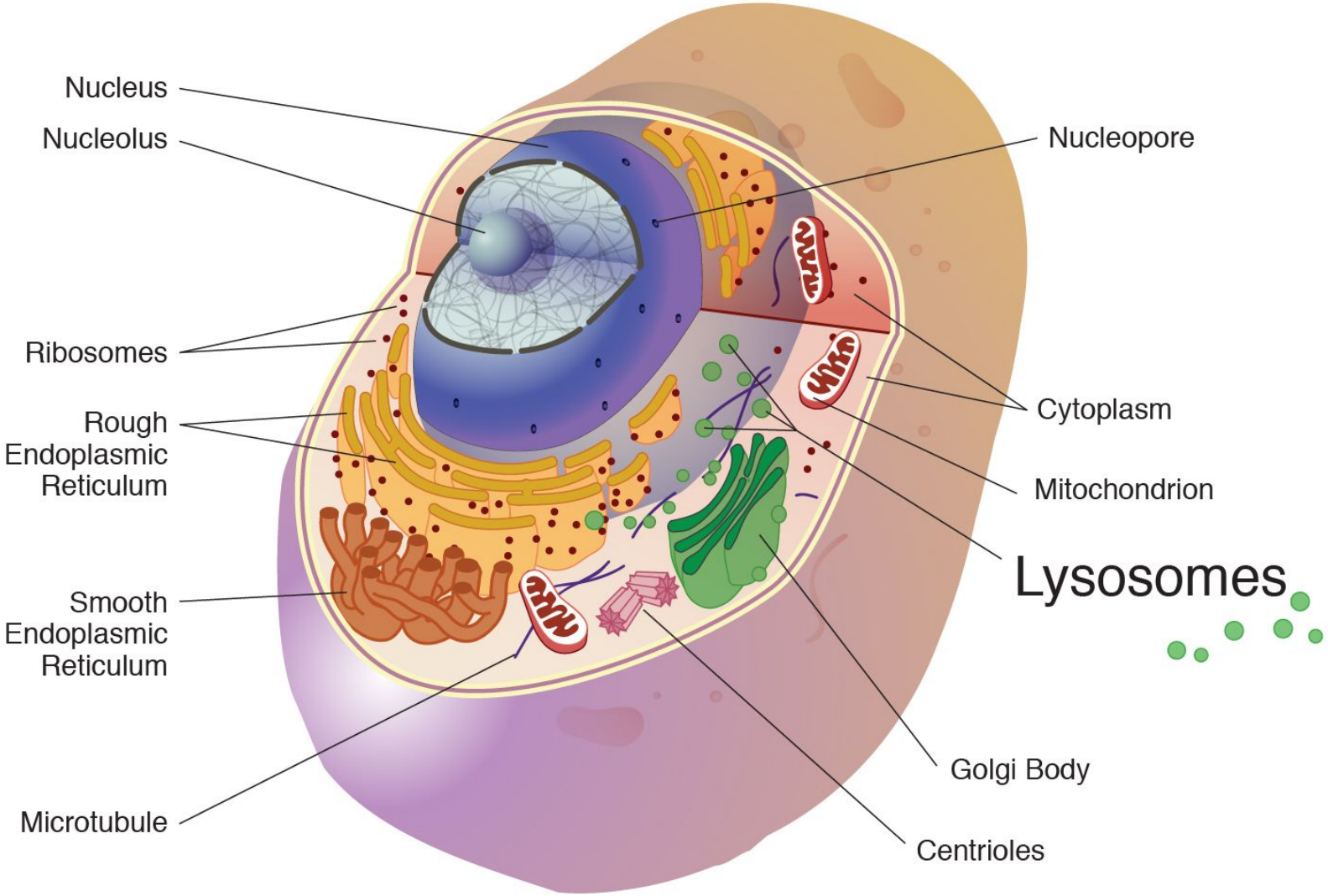
- Flattened, folded pockets
- “Post Office” of the cell
  - Proteins and other materials are sent to GB through the ER
  - Package and distribute the materials to other parts of the cell
  - Send materials to the outside of the cell

5. Vacuoles

- Small storage spaces in the cytoplasm
- surrounded by a membrane
- “Storage bins”
  - Store food, waste, extra water
- Pump extra water out of the cell
- Plant cells: one large vacuole
- Animal cells: many large vacuoles

6. Lysosomes

- Small, round
- “Clean-up Crew” of the cell
- Contain powerful chemicals that digest nutrient molecules
- When other organelles stop working properly, the lysosomes break down and recycle old cell parts so they can be used again
  - Chemicals only break down unhealthy cell parts
- Healthy cell: membrane surrounds lysosomes, preventing them from destroying the entire healthy cell


Nucleus
Nucleolus
Ribosomes
Rough Endoplasmic Reticulum
Smooth Endoplasmic Reticulum
Microtubule
Nucleopore
Cytoplasm
Mitochondrion
Lysosomes
Golgi Body
Centrioles

2-5: How do plant and animal cells differ?

Objective:	*Students will be able to COMPARE plant and animal cells.*

Cell Wall

- All plant cells have a cell wall. Animal cells do not have a cell wall.
- Cell wall surrounds the cell membrane
- Made up of hard material called cellulose
  - Wood is made up of cellulose
- Jobs:
  - Protect the plant cell
  - Give the cell shape
  - Gives the plant cell support

Vacuoles

- Plant cells have only one or two very large vacuoles. Animal cells have many small vacuoles.
- In a plant cell, most of the water is stored here.
  - When it rains, cells store water to use later
  - Plant is healthy when there is a lot of water
  - Plant wilts when there is not enough water

Chloroplasts

- Roundish organelles found in plant cells
- Contain a material called chlorophyll, which gives plants its green color
  - Plants use chlorophyll to make food
- Animal cells do not have chloroplasts

PLANT CELLS	ANIMAL CELLS
• Cell wall • One or two large vacuoles • Chloroplasts	• No cell wall • Many smaller vacuoles • No chloroplasts

2-6: Why do cells have different shapes?

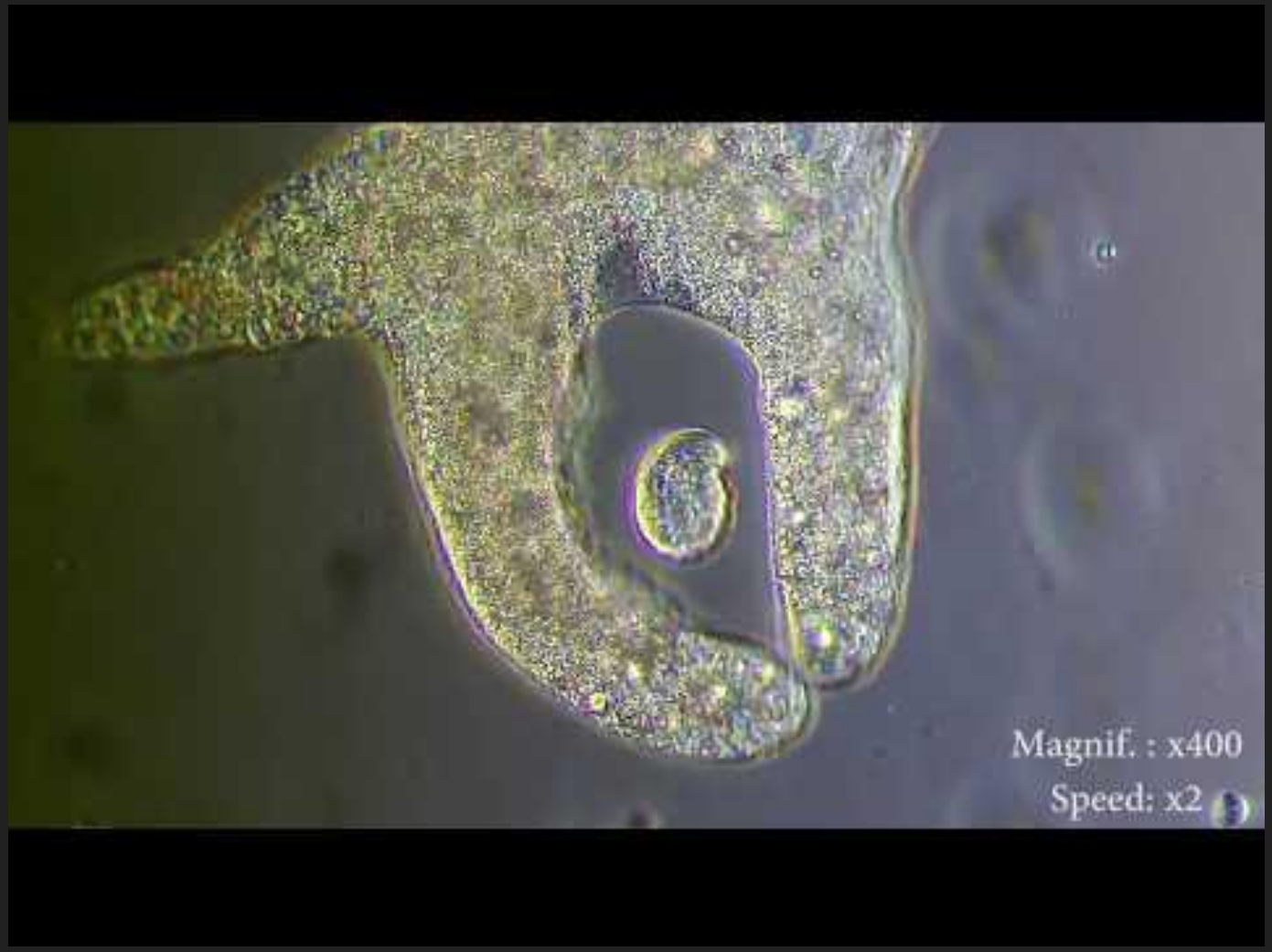
Objective:	*Students will be able to DESCRIBE and RELATE the structures and functions of different kinds of cells.*

Cell Size & Shape

- **Unicellular**: used to describe organisms made up of only one cell
  - All life processes are carried out by the same cell
- **Multicellular**: used to describe organisms made up of more than one cell
  - Cells in a multicellular organism are not all the same - different shapes and sizes
  - Different cells have different jobs
  - Shapes of most cells help them do their job

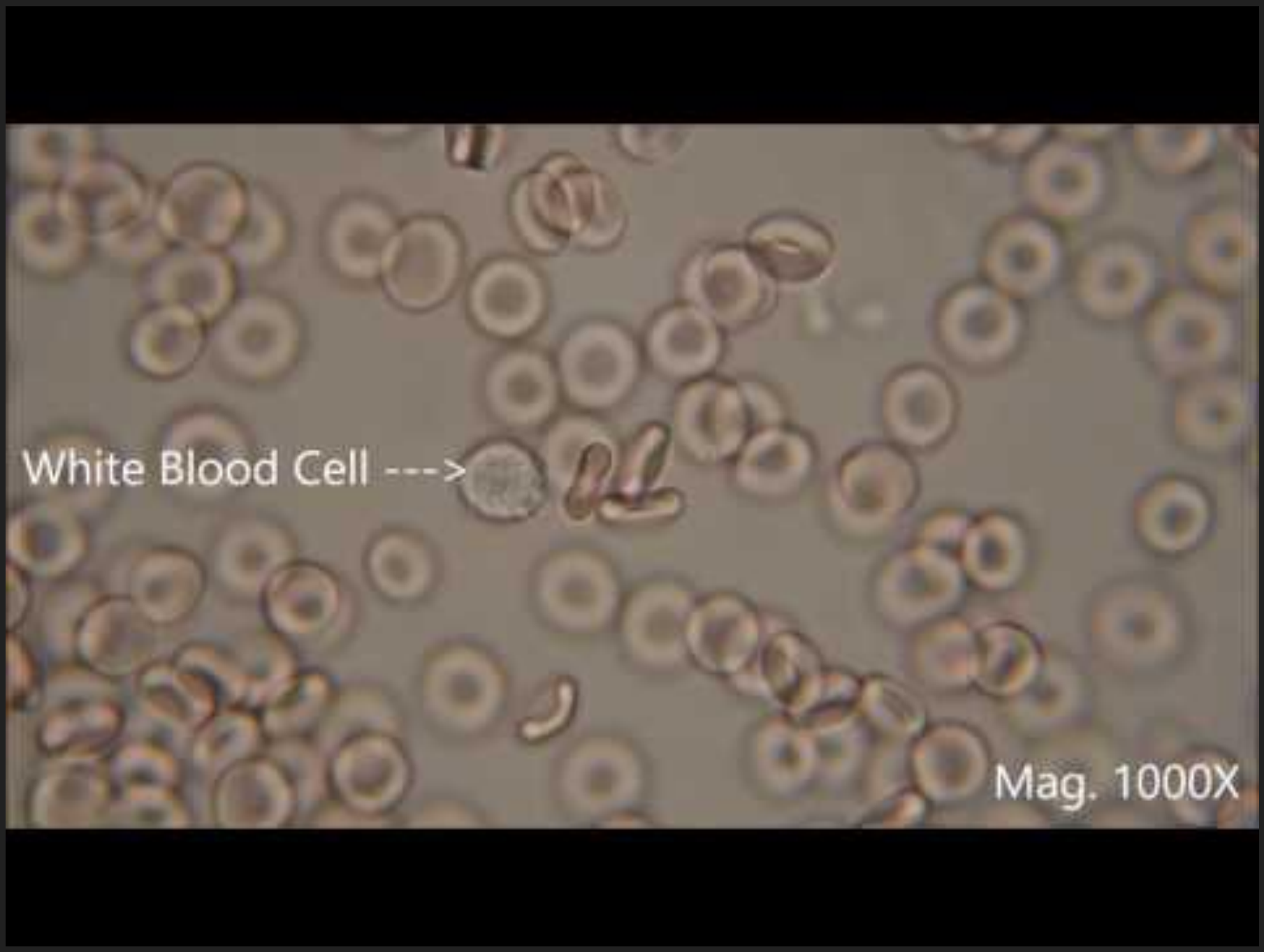
Amoeba

- A unicellular organism that lives in water
- Have ability to change shape
- Use temporary, fingerlike extensions of the cytoplasm (**pseudopods**) to move and get food
  - Surround food particles with pseudopod
  - Closes around the food particle and digests it


Magnif. : x400
Speed: x2

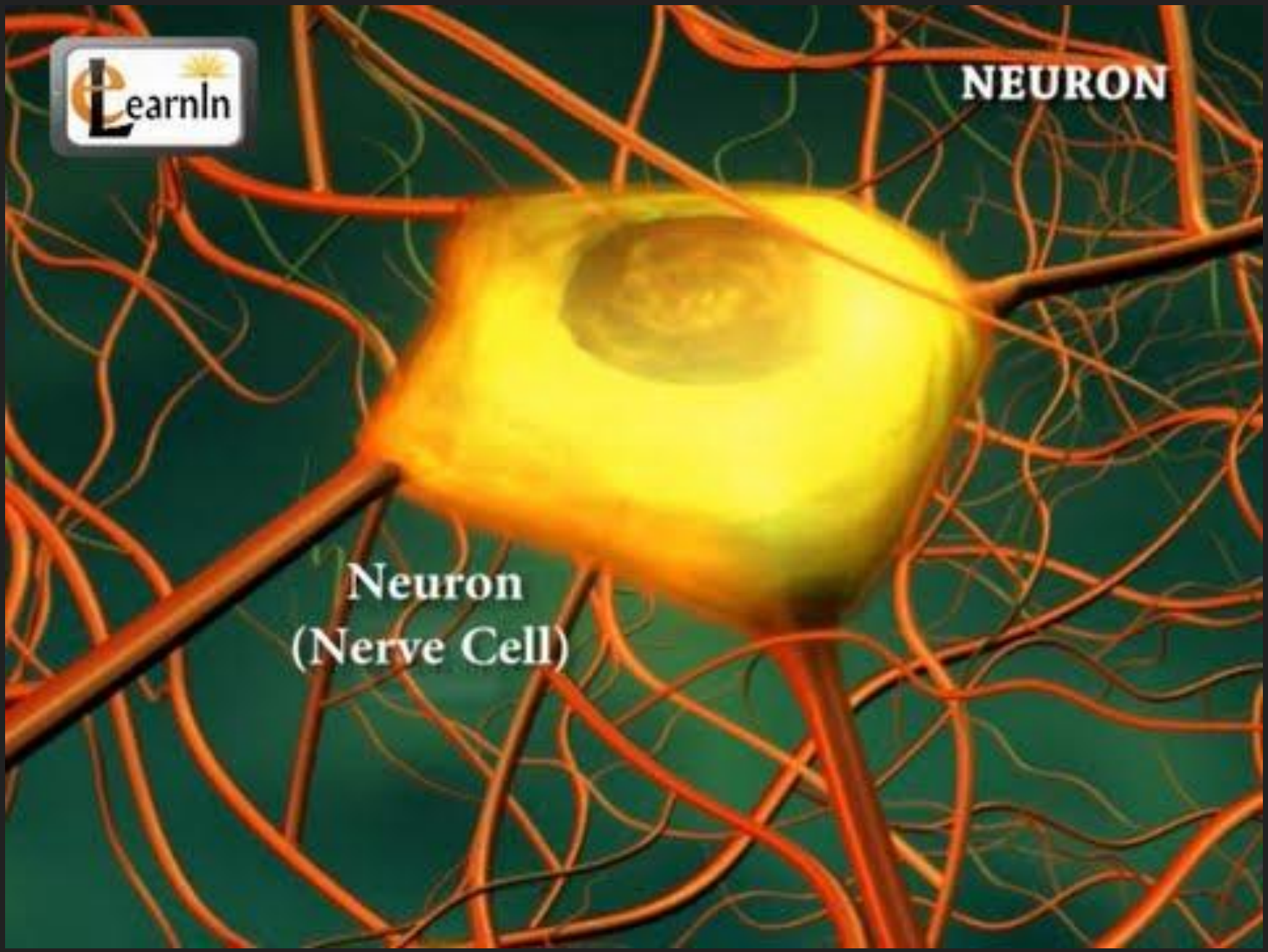
Red Blood Cells

- Round, flexible cells
- No nucleus
- Can easily bend and fold - can fit through very small tubes in your body (capillaries)
- Job: To carry oxygen


White Blood Cell --->
Mag. 1000X

Nerve Cells

- Store or transfer information
- Different types:
  - In the brain - store information
  - Carry messages from one part of the body to the other (impulses)
- Usually long and thin (some of the longest in your body)

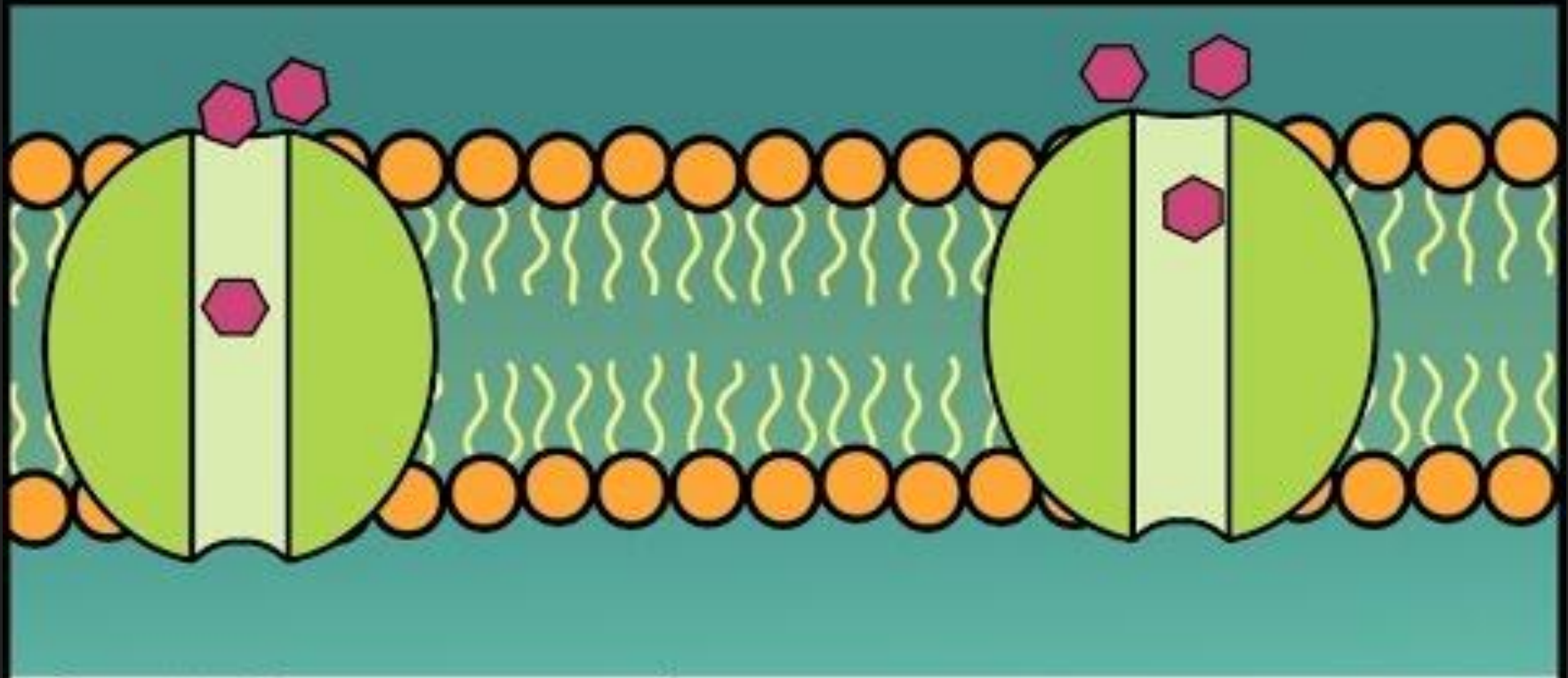

LearnIn
NEURON
Neuron
(Nerve Cell)

Guard Cells

- Surround a tiny opening on the outer surface of a plant leaf (called the **stoma**)
  - Stoma lets carbon dioxide into the leaf, and releases oxygen and water into the air
- Control the size of the stoma
  - Swell to open the stoma
  - Shrink, stoma closes

2-7: How do materials move in and out of the cell?

Objective:	*Students will be able to DESCRIBE how materials can move in and out of cells.*



Cell Transport

with the Amoeba Sisters

Diffusion: the movement of material from an area where molecules are crowded to an area where they are less crowded

Passive Transport : movement of materials through a membrane without use of energy

- Cell membranes have very tiny holes through which some molecules can move
- Molecules will continue to move through the cell membrane until the number of molecules is the same on both sides of the membrane

Osmosis: movement of water through a membrane

- Special kind of diffusion
- Many substances dissolve in water
- Molecules of water usually move across a membrane toward areas with more dissolved substances

Active Transport : movement of materials through a membrane using energy

- Usually, a cell needs to have more molecules of a certain substance inside of it than outside of it
  - Molecules have to move toward an area where they would be more crowded --- Opposite direction of the way molecules naturally move

2-8: How do cells obtain energy?

Objective:	*Students will be able to DESCRIBE the processes that cells use to get energy.*

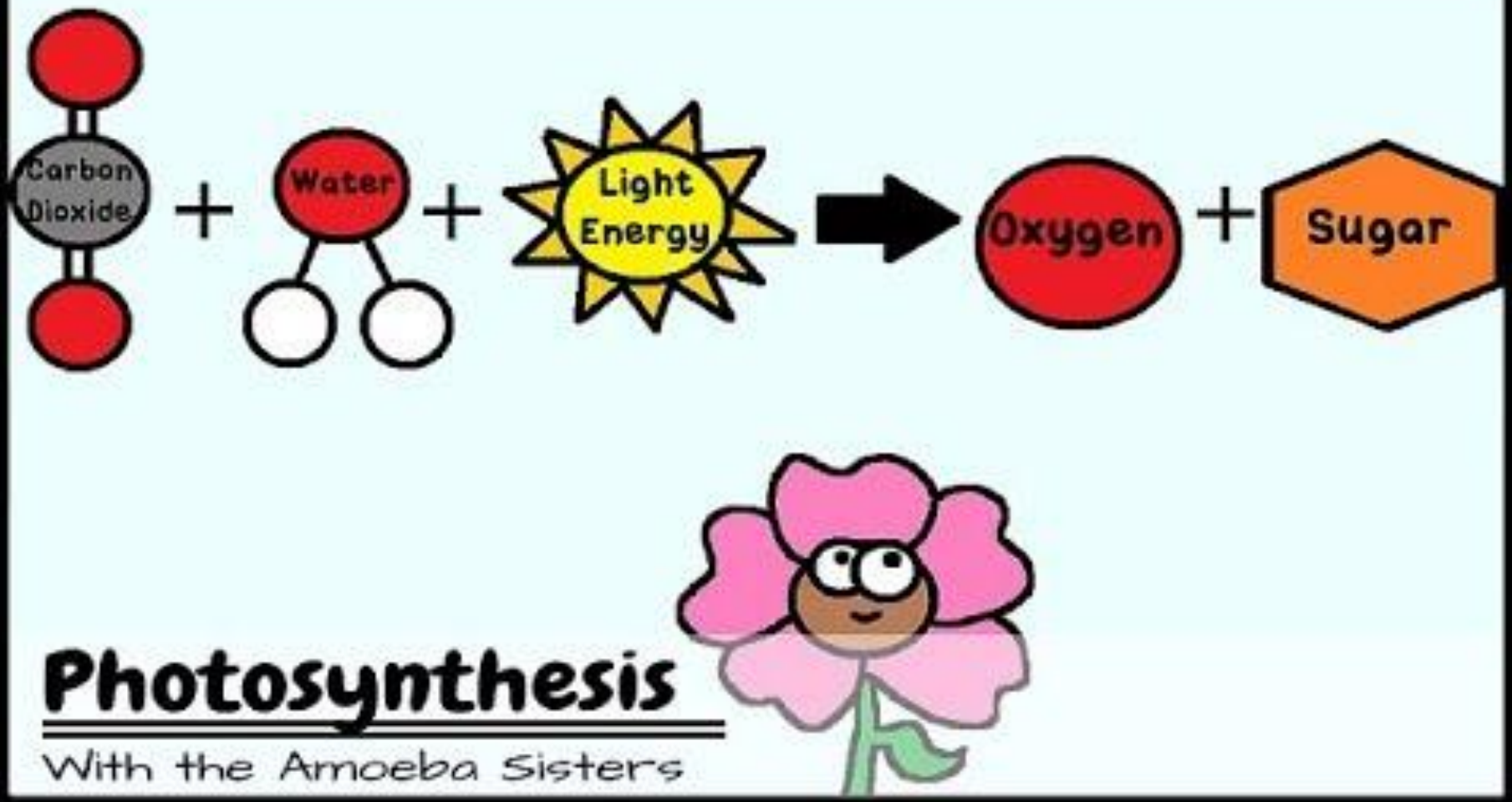
Cells and Energy

- Cells perform many important activities
  - Growing
  - Repairing structures
  - Creating new cell parts
  - Reproducing
- All activities require energy
  - ENERGY: the ability to do work and cause change
    - Found in many forms
    - Sun provides light energy
    - Food provides energy in the form of nutrients

Photosynthesis:

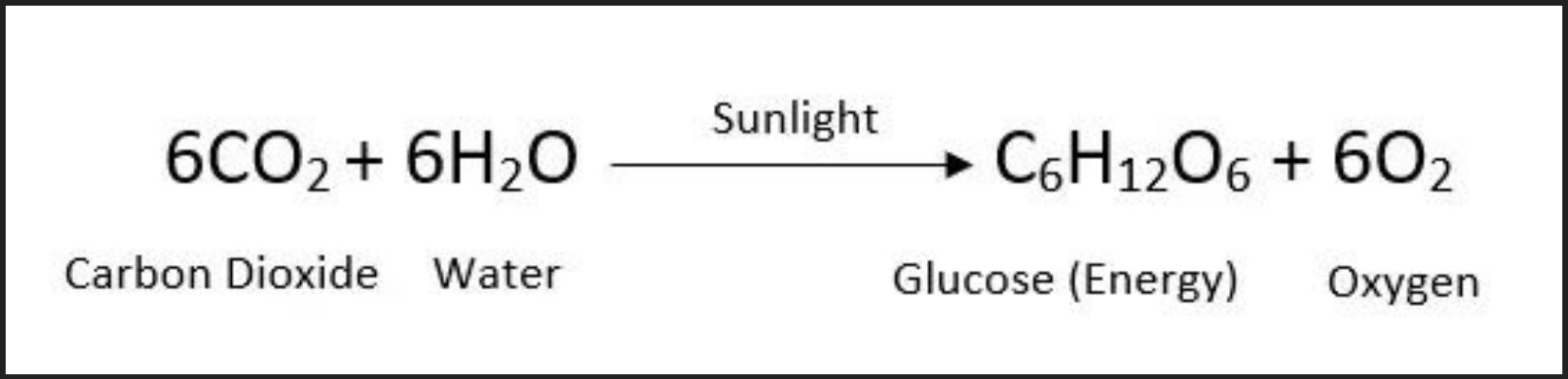
food-making process in plants and other organisms that uses sunlight

- Plant cells have the ability to use the energy from the sun to make food
- Occurs in chloroplasts
  - Only organisms with chloroplasts can perform photosynthesis


Carbon Dioxide
+
Water
+
Light Energy
Oxygen
+
Sugar
Photosynthesis
With the Amoeba Sisters

Steps for Photosynthesis

1. Plants take in carbon dioxide and water
2. Use sun's energy to change molecules into food (sugar) and oxygen
3. Food is used immediately OR stored for later use as a source of nutrients



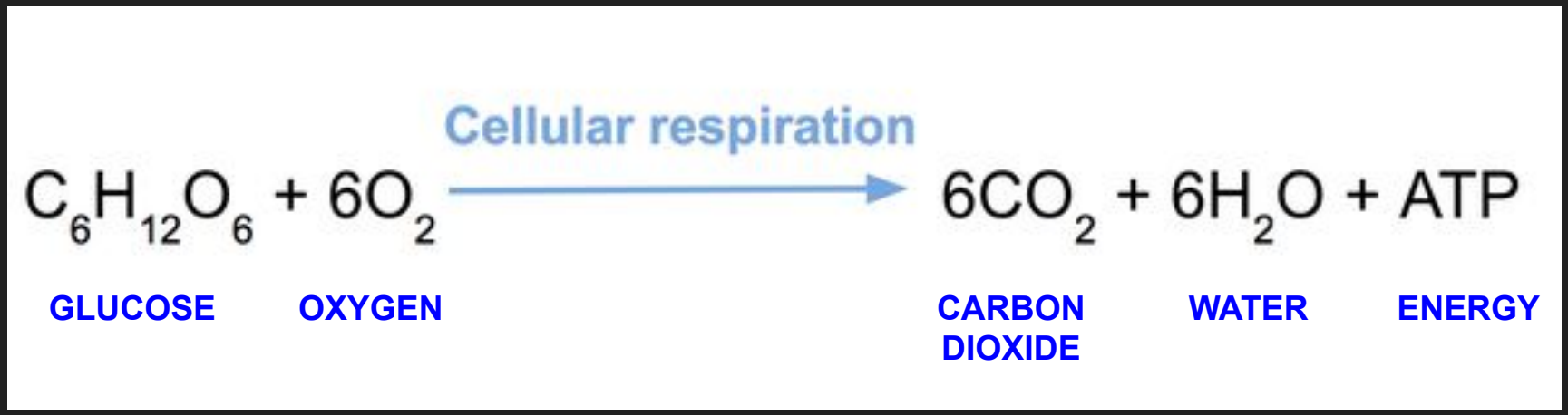
Cellular Respiration

- When a plant needs to use some of its stored sugar, it breaks it down into glucose (a simple type of sugar)
- Glucose is used in cellular respiration, which takes place in the mitochondria of the cell
- Cells without chloroplasts (animal cells) can’t make their own food
  - Must take in energy from their environment

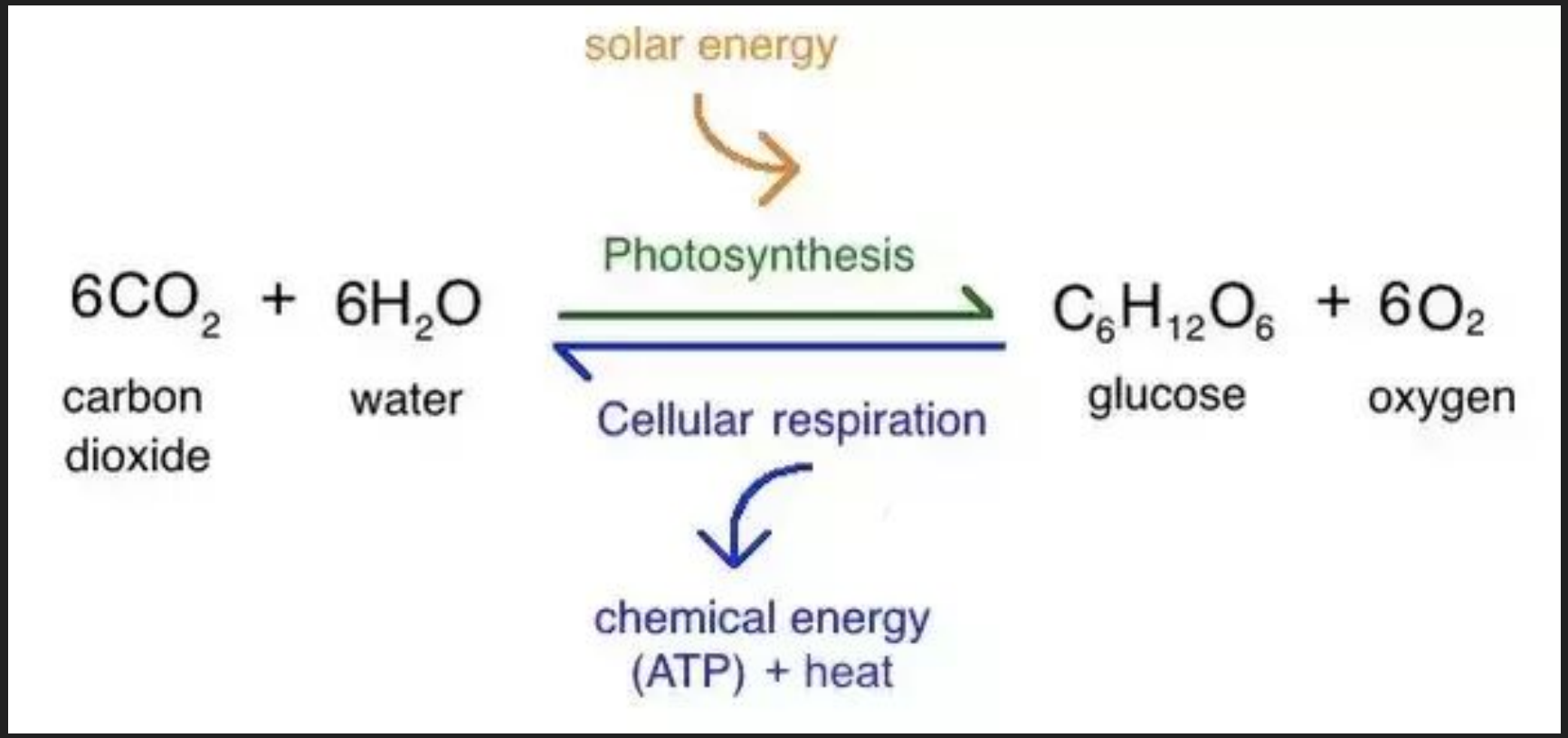
Steps for Cellular Respiration

1. Organism takes in food and digests it
2. After food is digested, nutrient molecules enter the cell and are sent to the mitochondria
3. Glucose is broken down into hydrogen and carbon molecules
4. Hydrogen and carbon molecules combine with oxygen to form carbon dioxide and water
5. Energy is released for use by the cell

Cellular Respiration



Photosynthesis
&
Cellular Respiration



Fermentation:

process by which a cell releases energy from food without using oxygen

- Sometimes respiration must take place when there is no oxygen available
- Some organisms can do this, like yeast
- Cells break down sugar and give off carbon dioxide and alcohol molecules
- Used in baking to help bread rise
  - Yeast cells are mixed with the dough
  - Bubbles of carbon dioxide are produced, and force dough to expand, or “rise”


KIDS TRY
FERMENTED FOODS

Fermentation

with the Amoeba Sisters

2-9: How do cells produce new cells?

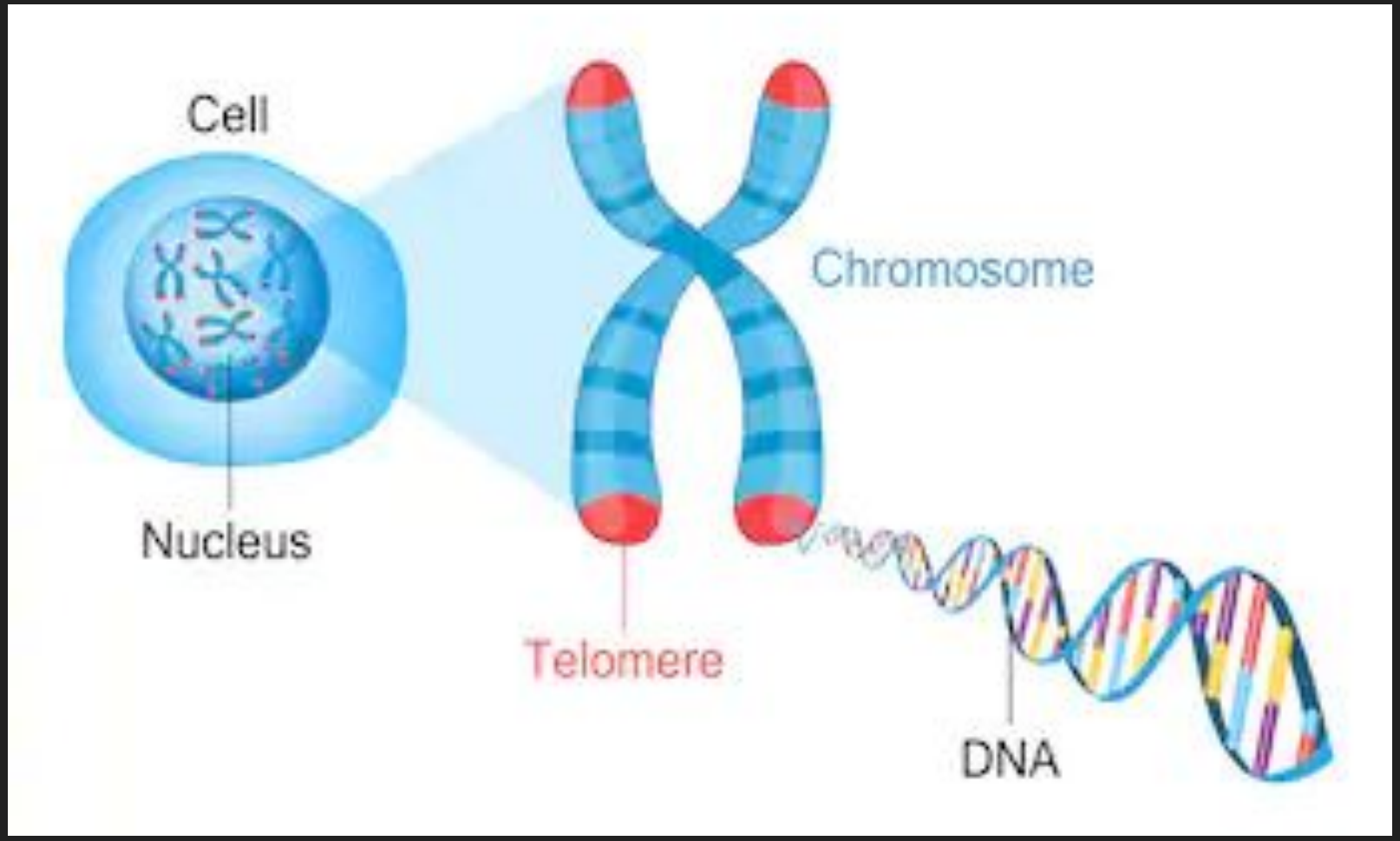
Objective:	*Students will be able to DESCRIBE how cells reproduce.*

Cell Division

- Growth = number of cells increasing (NOT cells getting bigger)
- Cells of most organisms are able to reproduce and make new cells

Chromosomes

- The nucleus controls cell division
- **Chromosomes**: cell part that determines what traits a living thing will have
  - Chromosomes are made up of **chromatin** (thread-like material that make up chromosomes)
  - Control cell processes
  - Determine traits of the entire organism
  - During cell division, each chromosome makes a copy of itself

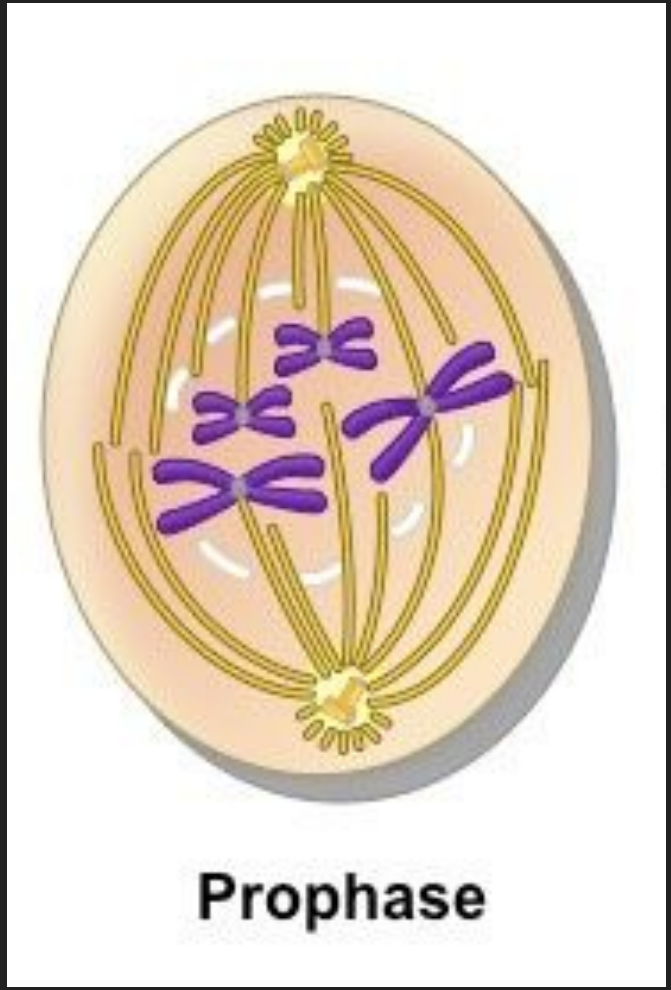

Cell
Nucleus
Chromosome
Telomere
DNA

Mitosis

- After chromosomes make copies of themselves, the nucleus divides (**mitosis**)
- Four phases of mitosis:
  1. Prophase
  2. Metaphase
  3. Anaphase
  4. Telophase

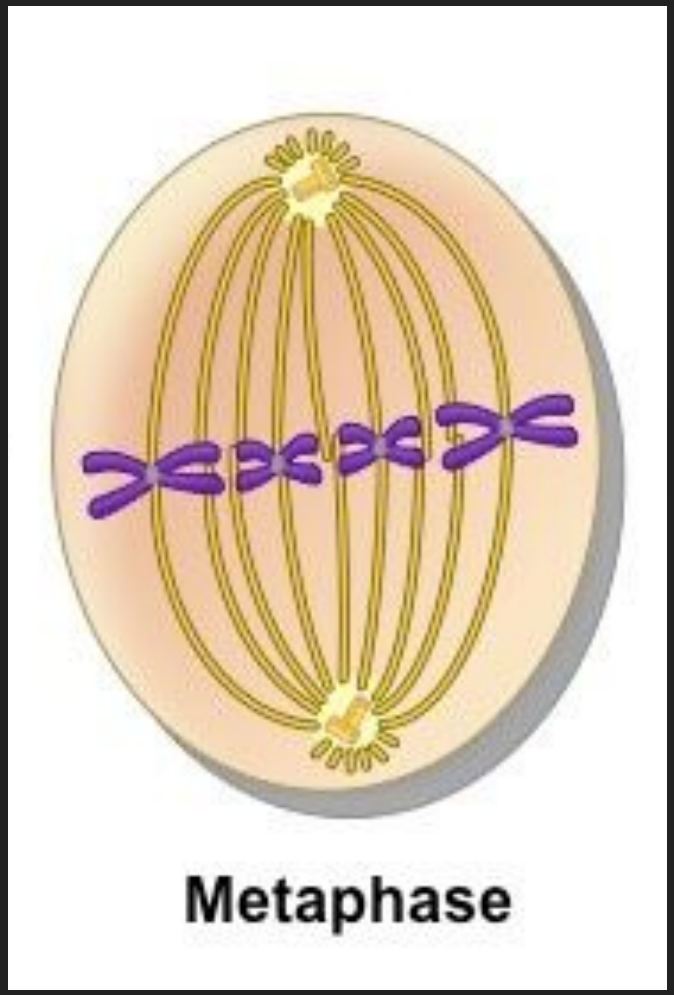
Mitosis, Step 1: Prophase

The chromosomes group tightly together and the nuclear membrane disappears



Mitosis, Step 2: Metaphase

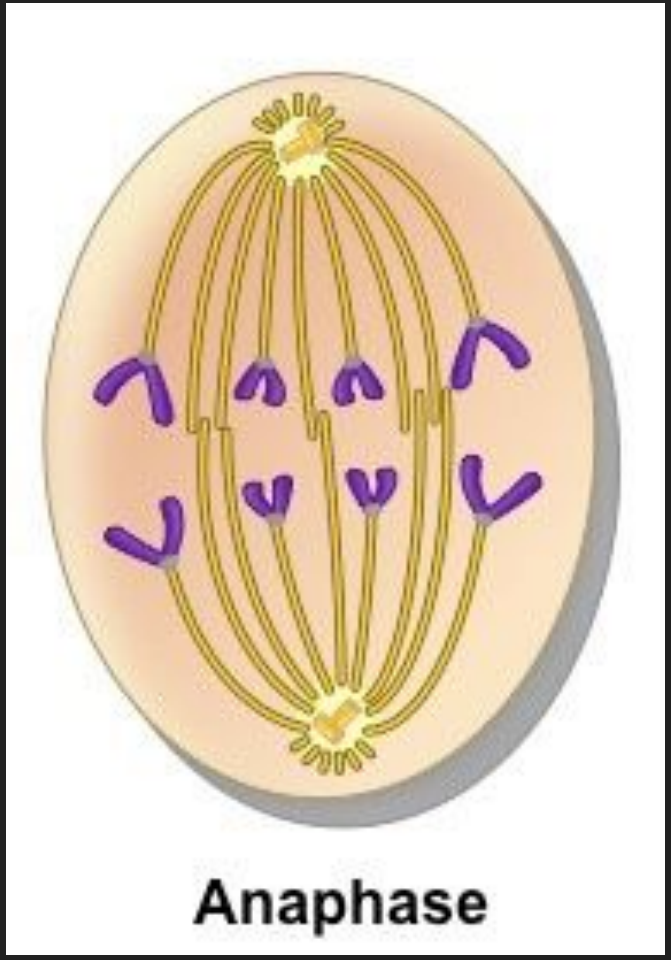
All copied chromosomes line up across the center of the cell.



Mitosis, Step 3: Anaphase

The chromosome copies separate and move to opposite ends of the cell.

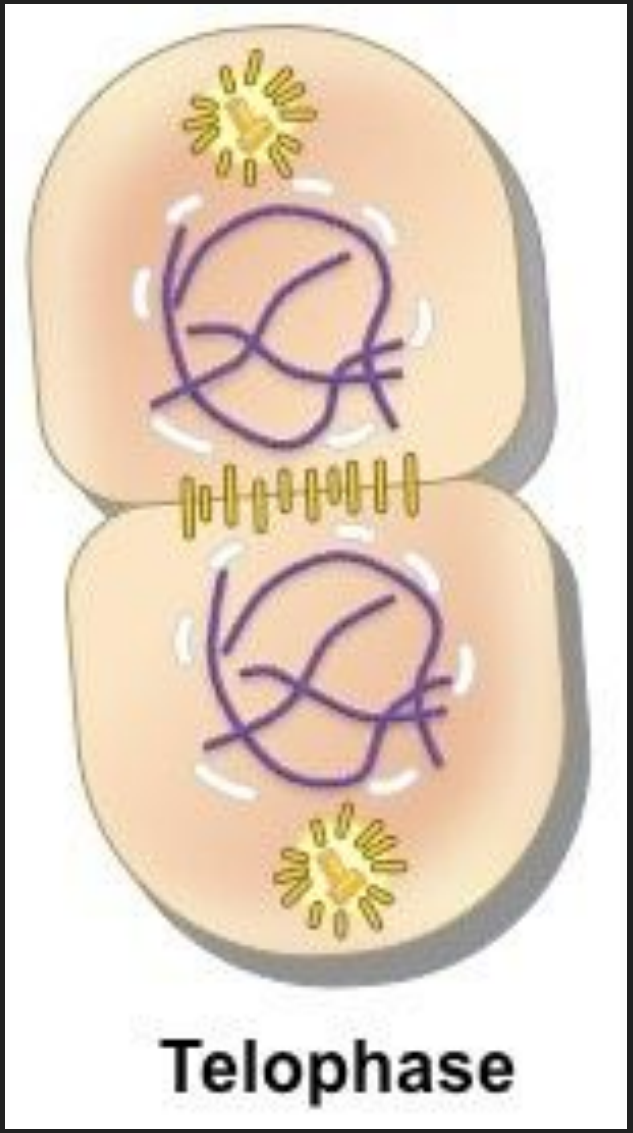
Special organelles called centrioles and spindle fibers help with this process.



Mitosis, Step 4: Telophase

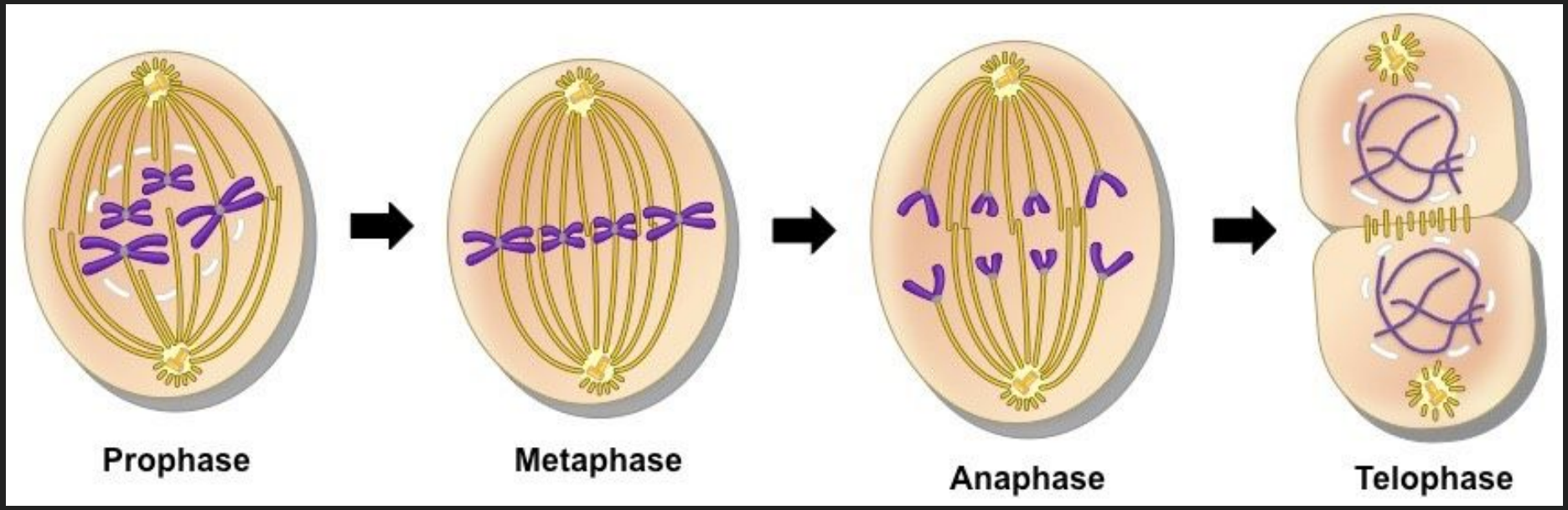
The cell membrane pinches together in between the two nuclei.

Nuclear membrane re-forms.



Mitosis, Step 5

- The cell splits apart.
- Two identical cells form (“daughter cells”)
  - Have the exact same nuclei
  - Half the size of the original cell
  - In time, the daughter cells will grow and divide to form more daughter cells of their own


Prophase
Metaphase
Anaphase
Telophase

Cell Division in Plants

- Plant cells also reproduce by cell division
  - Make copies of their chromosomes and carry out mitosis
- **DIFFERENCE**: Cell membrane DOES NOT pinch together to form daughter cells.
  - Instead, a new cell wall and new cell membrane form down the middle of the cell.
  - Two daughter cells are formed, one on each side of the new cell wall