CELLS AND HEREDITY

Mrs. Minghettino

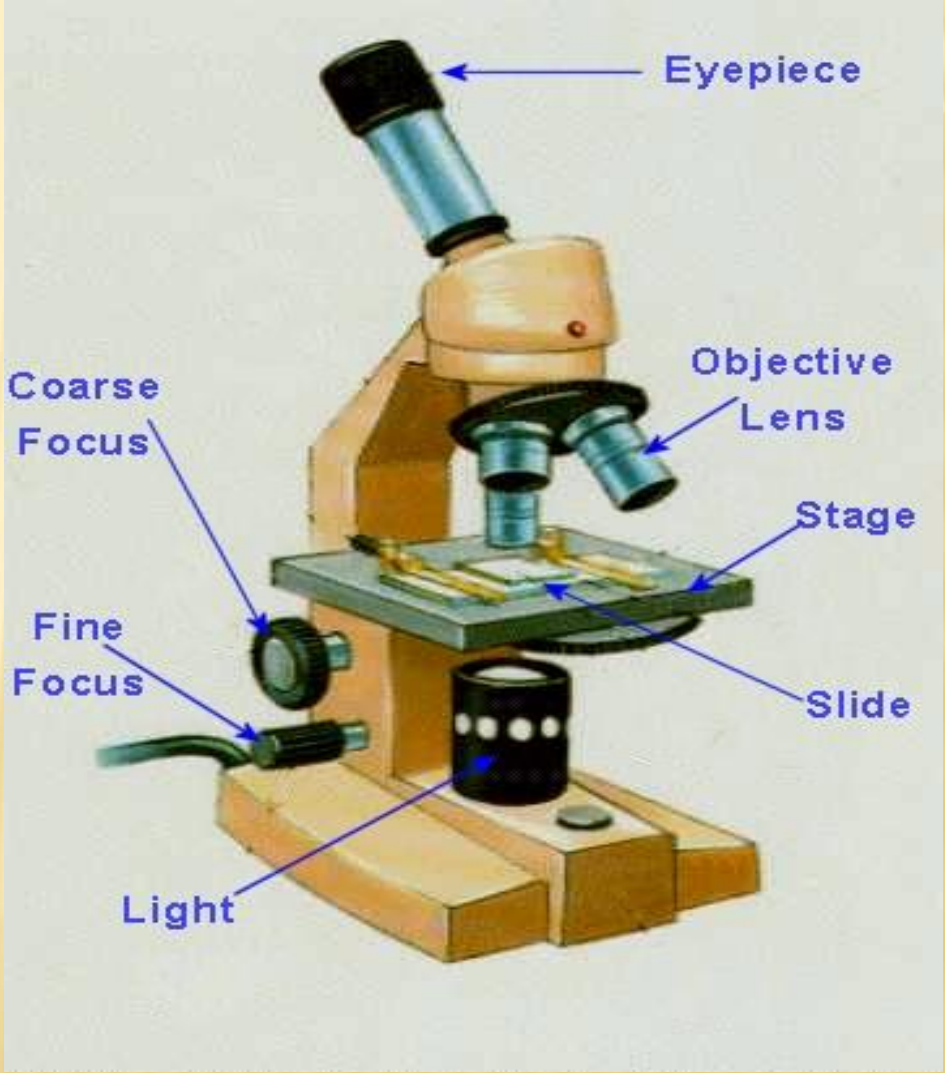
Period 3

VOCABULARY (1.1)

IMPORTANT TOOL:

MICROSCOPE

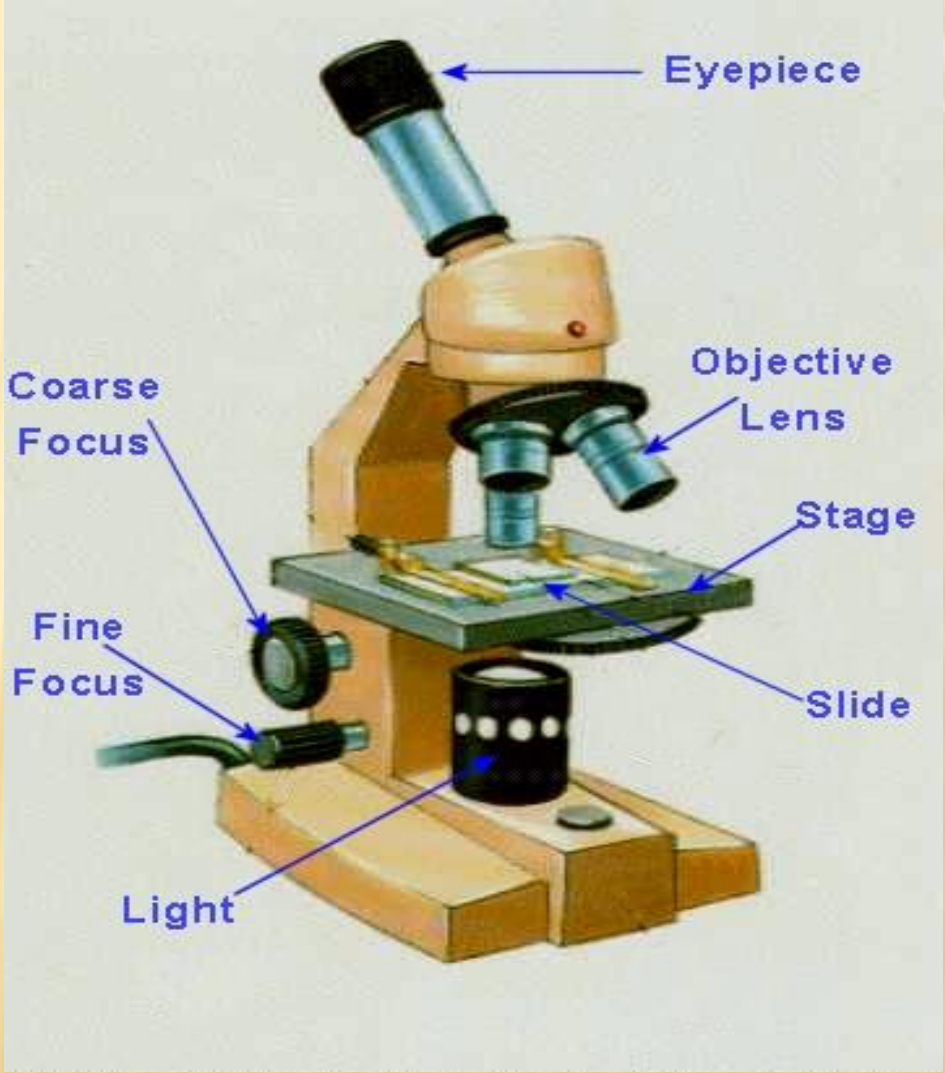
- focuses light or beams of electrons through a lens to produce a larger image



VOCABULARY (1.1)

magnification: condition of things appearing larger than they are

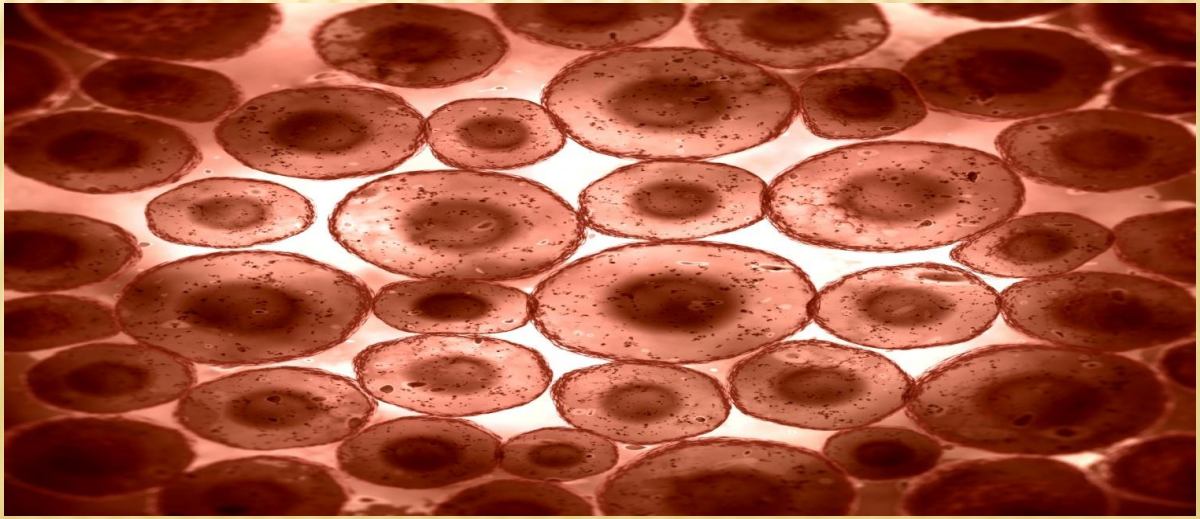
resolution: shows clear details of an object to separate it from another structure next to it



VOCABULARY (1.1)

What are **cells**?

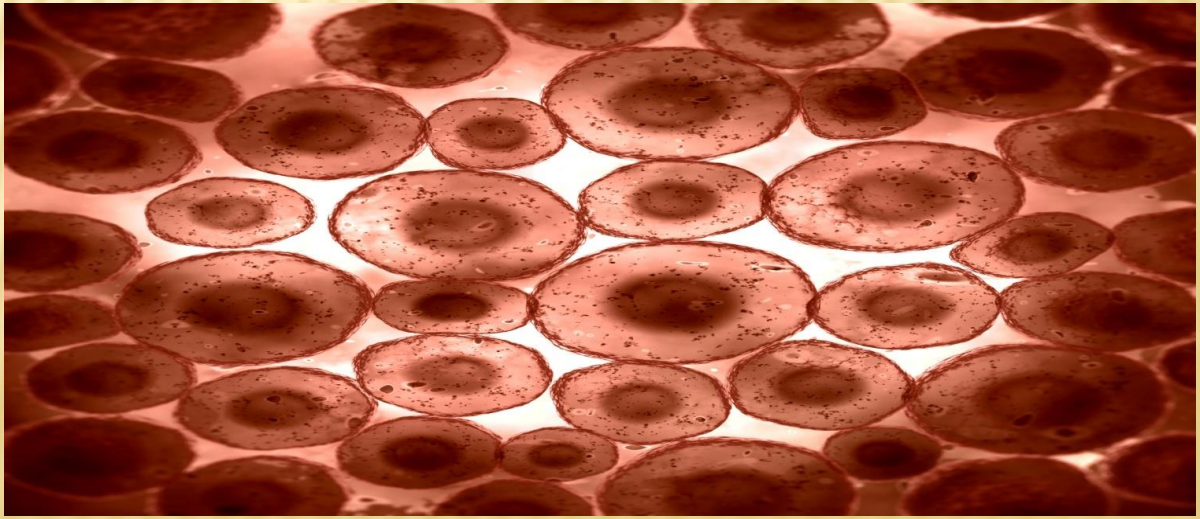
- form parts of an organism/living things
- carry out its functions
- basic units of structure and function in living things



VOCABULARY (1.1)

What are **functions**?

- processes that allow an organism to live, grow and reproduce (make more)
- Examples: getting oxygen, food and water; getting rid of waste



VOCABULARY (1.1)

CELL THEORY

- All living things are composed of **cells** (the basic units of structure and function in living things)
- All cells are produced from other cells
- Cells can provide **clues** about functions that living things perform
- Scientists can study cells to learn about growth and production

VOCABULARY (1.1)

CELL THEORY

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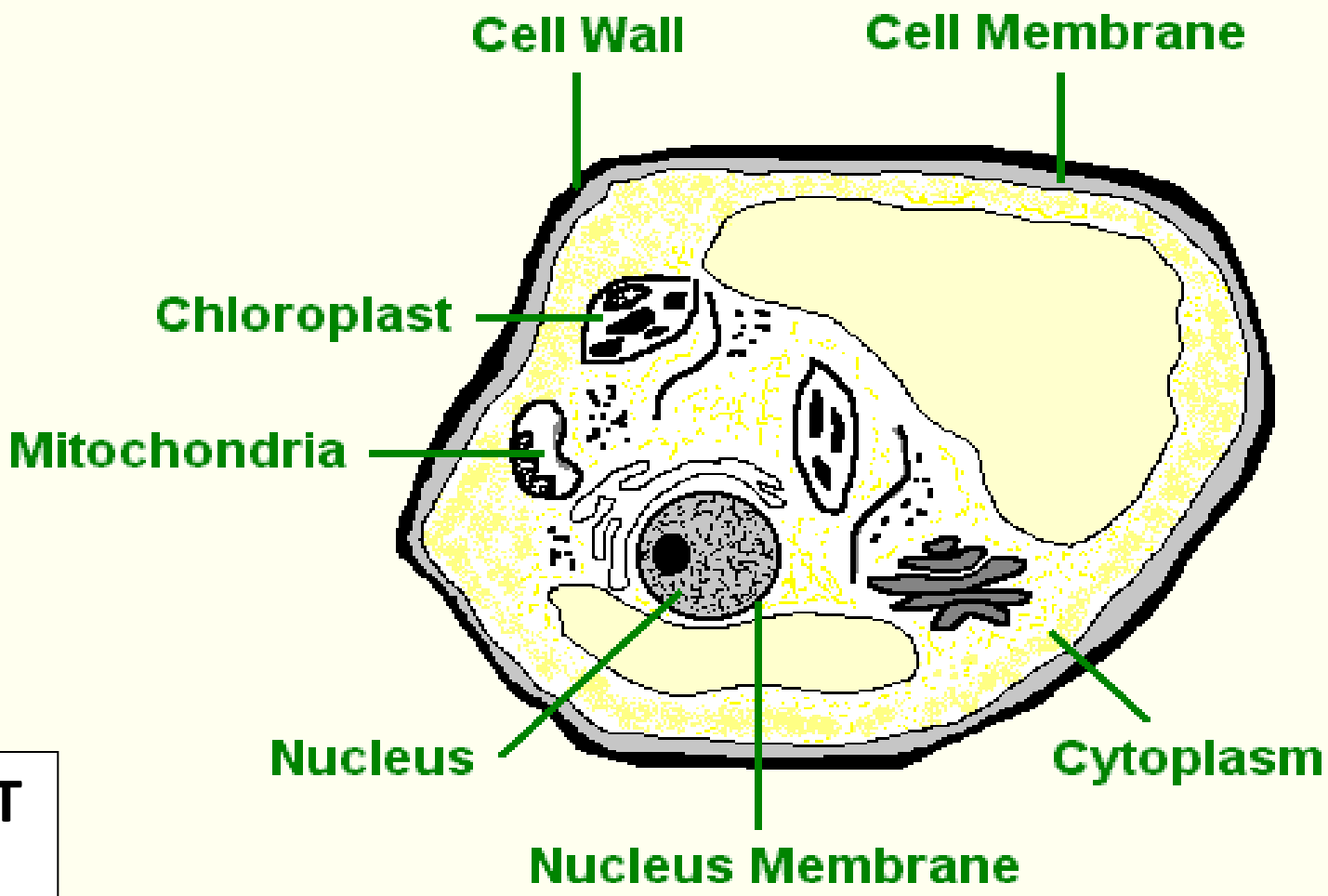
VOCABULARY (1.2)

Each kind of cell structure has a different function/job within the cell

- **cell wall:** a rigid/strong/stiff layer that surrounds the cells of plants and other organisms (animal cells do not have cell walls)
- **cell membrane:** controls which substances pass in and out of a cell
- **nucleus:** large oval structure controls the cell, directs all of the cell's activities

VOCABULARY (1.2)

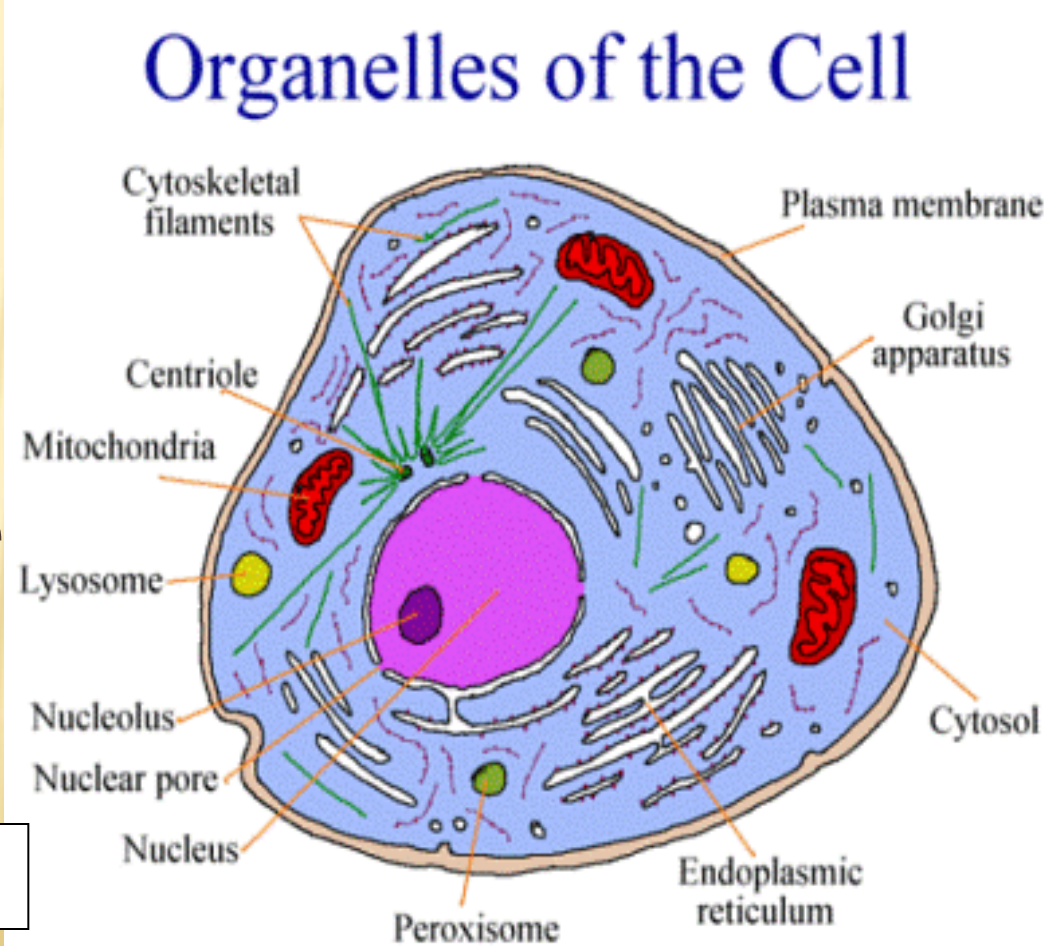


PLANT CELL

VOCABULARY (1.2)

- **organelles:**
  tiny cell structures that have specific functions in a cell

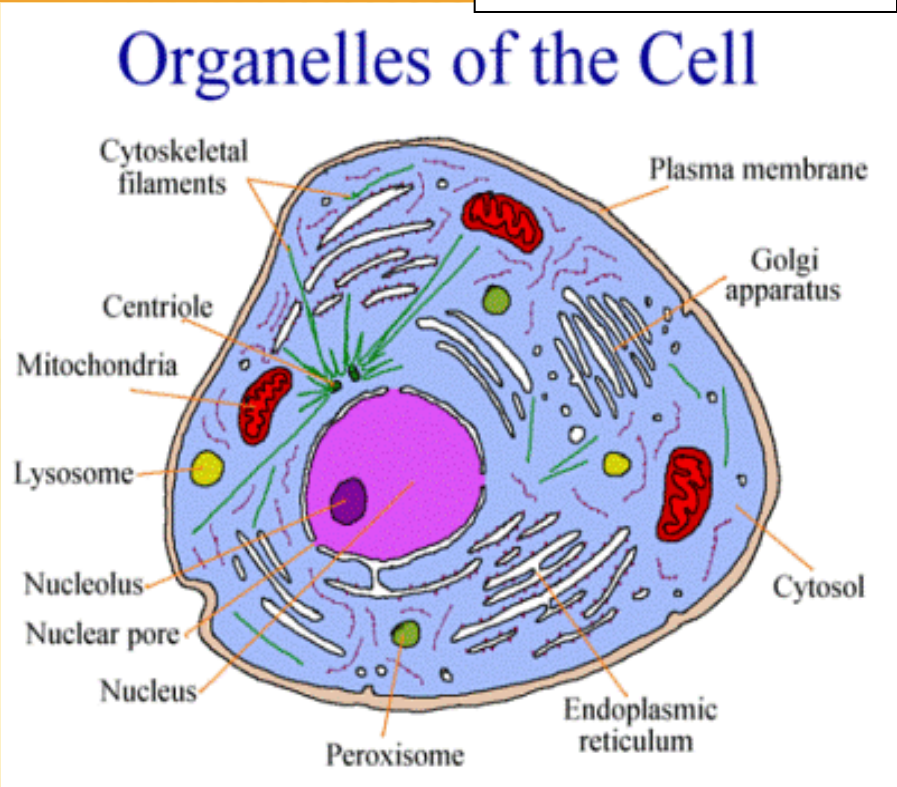
- The nucleus is the largest of these.



Animal Cell

VOCABULARY (1.2)

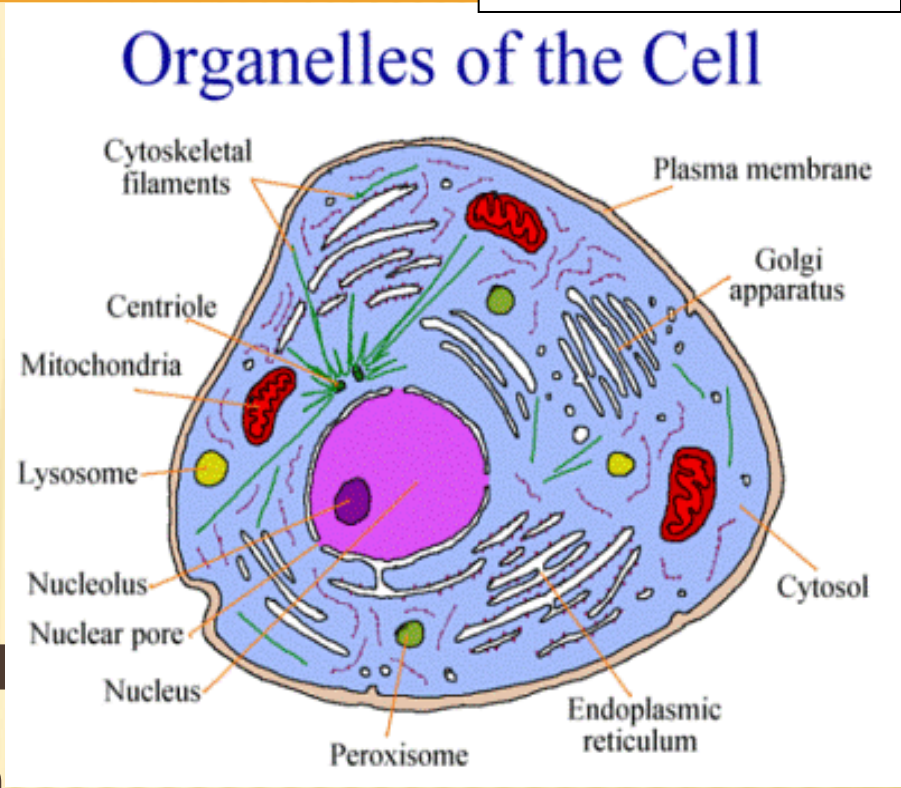
Animal Cell



- **ribosomes**:
  found in the **nucleolus** (in the nucleus);
  <u>produce proteins</u>
- **cytoplasm** – fills the space between cell membrane & nucleus; fluid moves constantly & carries other parts

VOCABULARY (1.2)

Animal Cell

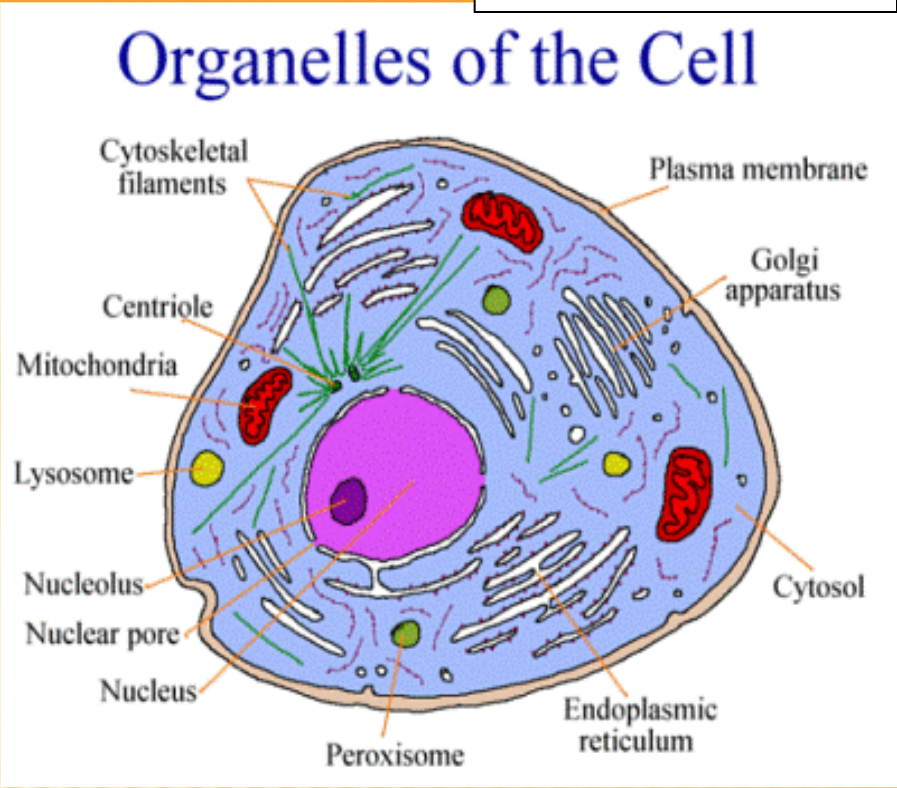


- **mitochondria**: convert energy stored in food to energy the cell can use to live
- **endoplasmic reticulu**
  (ER)- an organelle with membranes that connect to produce many substances

VOCABULARY (1.2)

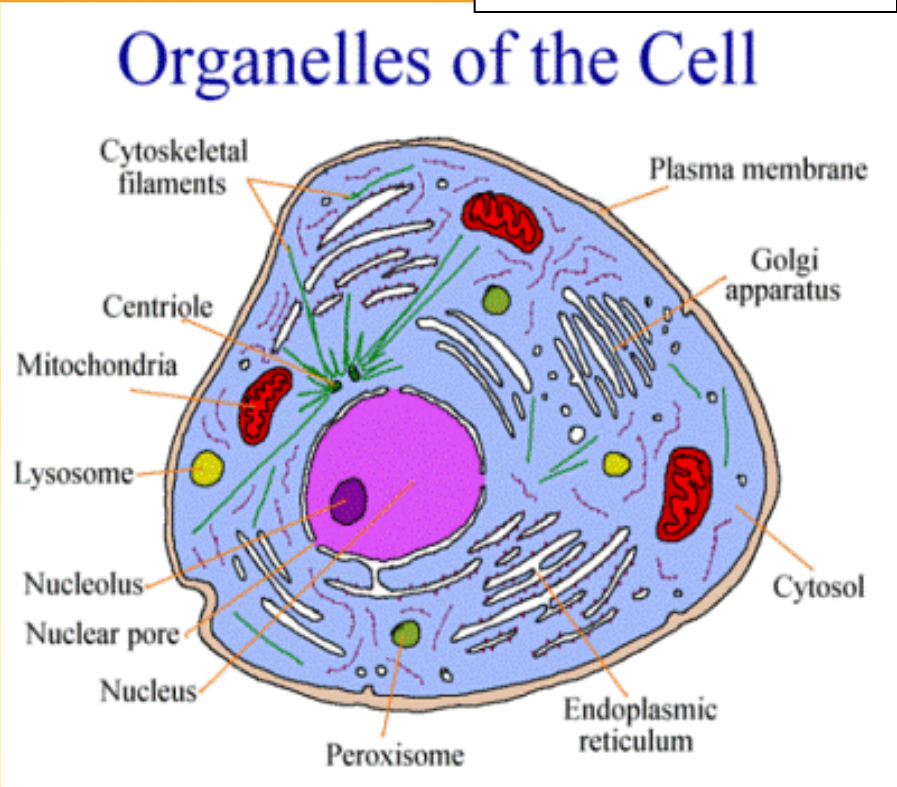
- **Golgi apparatus**: receives proteins and other new material from the ER, packages them and distributes them to other parts of the cell or out of it

Animal Cell



VOCABULARY (1.2)

Animal Cell

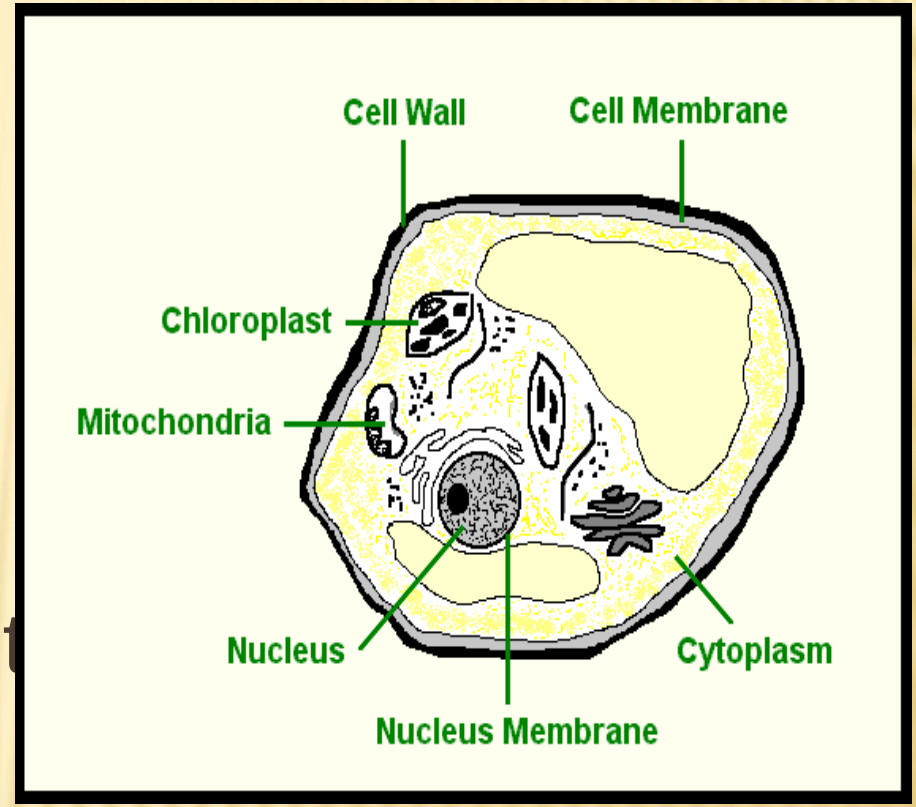


- **vacuole**:
  stores water, food, or other materials needed by the cell
- **lyosomes**: organelle sacs that contain substances that recycles cell parts in animal cells

VOCABULARY (1.2)

- **chloroplast**: green structures in a plant cell's cytoplasm; captures energy from the sun and changes it into energy the plant uses to make food (why leaves are green)

Plant Cell



VOCABULARY (1.2)

unicellular
(uni = one)
single-cell organism

multicellular
(multi = many)
made of many cells

SPECIALIZED CELLS
have specific functions
to help the whole organism

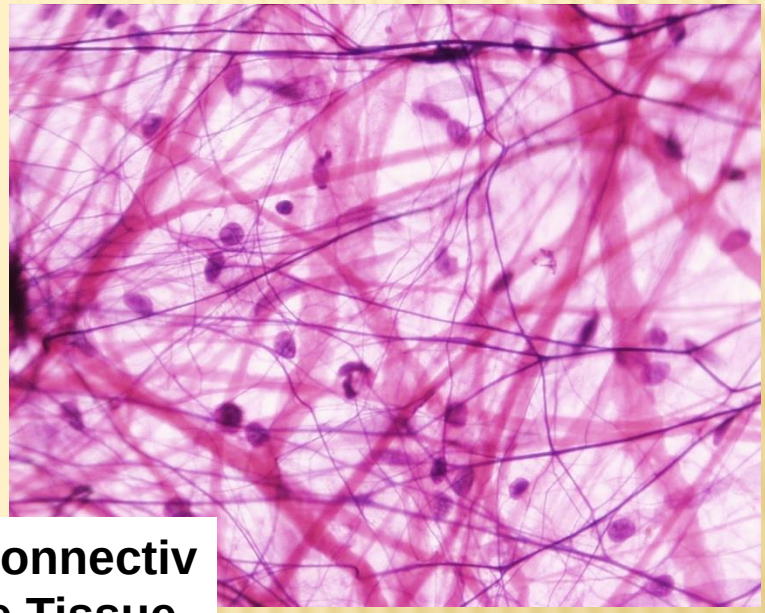
VOCABULARY (1.2)

- **tissue**:

  group of similar cells

  that work together for

  a specific function



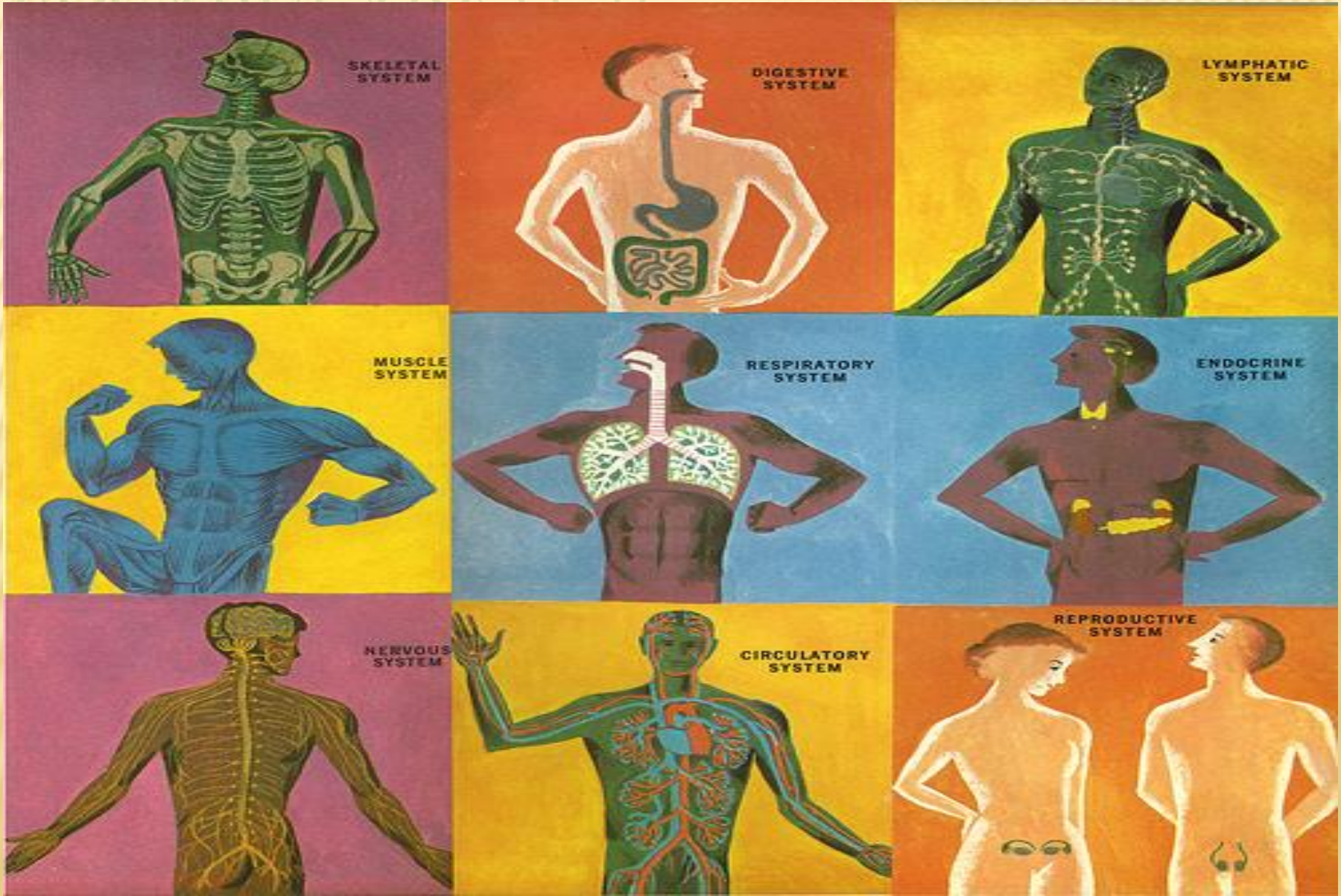
Connectiv e Tissue

- **organ**:

  different tissues that work together

  organ system: a group of organs that work for one major function

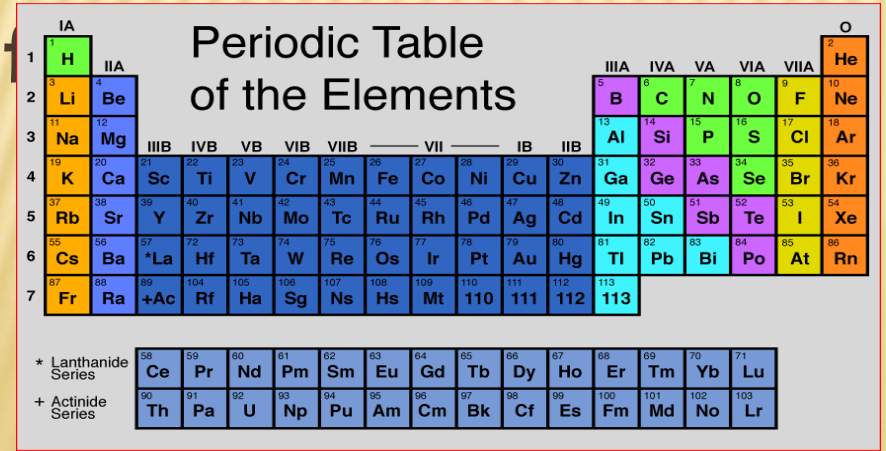
VOCABULARY (1.2)



VOCABULARY (1.3)

REVIEW:

- **Elements** are the simplest substances, and can't be broken down; they have specific physical and chemical properties
- **Compounds** are substances made of 2 or more elements represented by a **chemical**



VOCABULARY (1.3)

WE ARE WHAT WE EAT

CARBOHYDRATES

- energy-rich organic compounds made of carbon, hydrogen & oxy
- the body breaks down the starch into **glucose** (sugar cells use to get energy)
- found in cell walls and

VOCABULARY (1.3)

WE ARE WHAT WE EAT **LIPIDS**

- compounds made mostly of carbon & hydrogen, and some oxygen
- found in the cell membrane
- cells store this energy for later use

VOCABULARY (1.3)

WE ARE WHAT WE EAT **PROTEINS**

- large organic molecules made of carbon, hydrogen, oxygen, nitrogen & sometimes sulfur
- forms part of the cell membrane and organelles in a cell
- **enzymes** a group of proteins) speed up chemical reactions in organisms

VOCABULARY (1.4)

Why is the <u>cell membrane</u> important?

- made up of **two layers of lipids**
  - some **proteins** are within the layers of lipids
  - **chains of carbohydrates** are attached
    - > other carbohydrate chains sit on the surface

- the cell membrane is **selectively permeable**
  - some substances can pass through freely while
    - others cannot

VOCABULARY (1.4)

Substances that move in and out of the cell can do it in one of 2 processes:

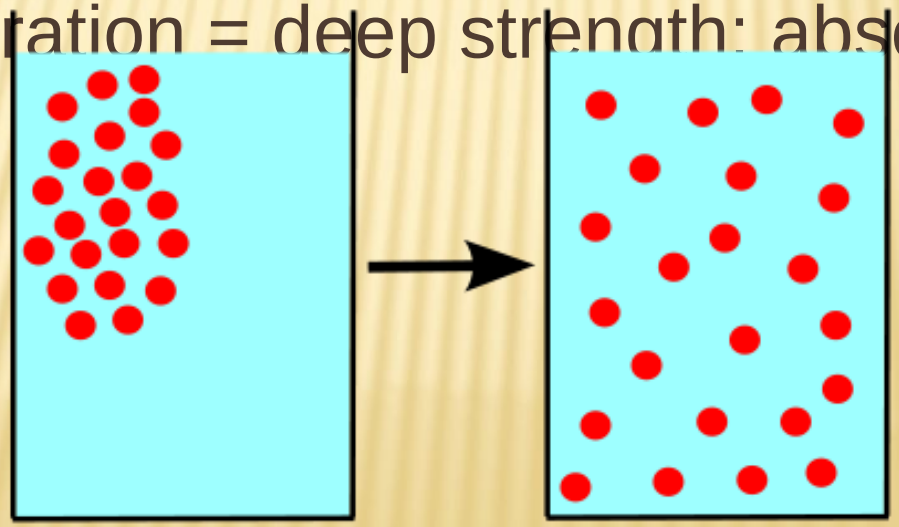
- **PASSIVE TRANSPORT**
  – movement of dissolved materials across the cell membrane without using the cell's energy

- **ACTIVE TRANSPORT**
  – movement of materials across the cell membrane using the cell's energy

VOCABULARY (1.4)

PASSIVE TRANSPORT

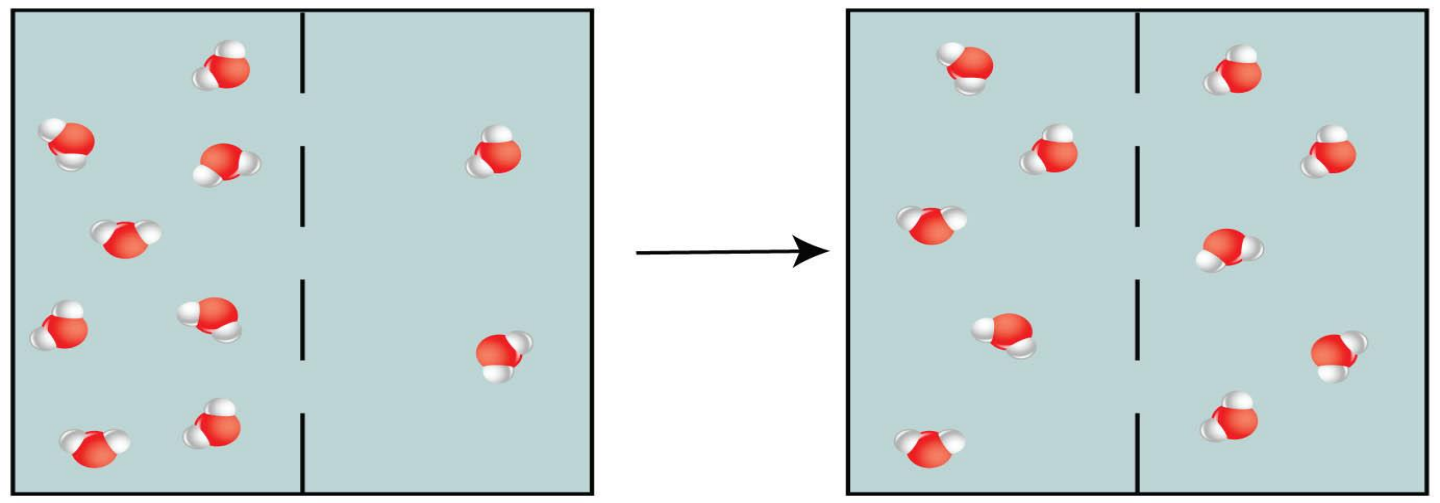
- **diffusion** – process where molecules move from an area of higher concentration to lower concentration
  (concentration = deep strength; absorption)



VOCABULARY (1.4)

PASSIVE TRANSPORT

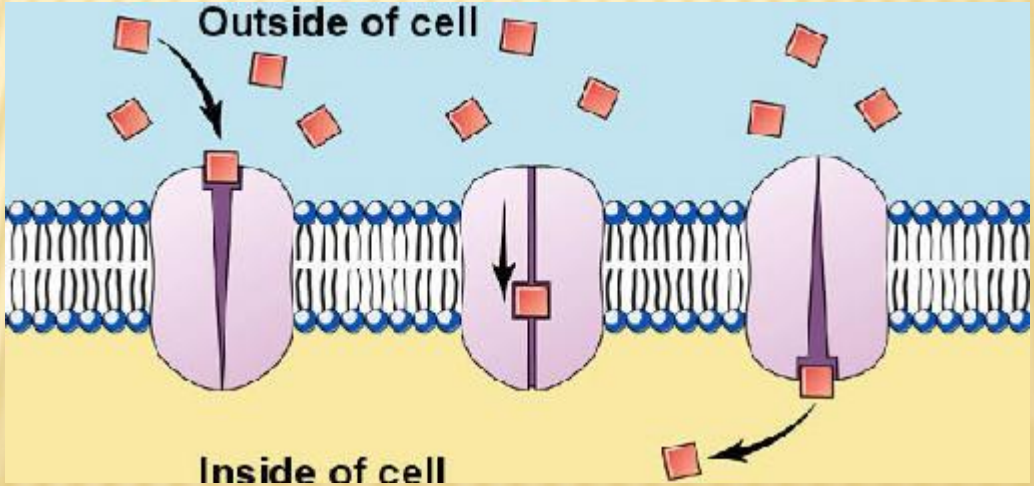
- **osmosis** – diffusion/scattering of water molecules across a selectively permeable membrane



VOCABULARY (1.4)

PASSIVE TRANSPORT

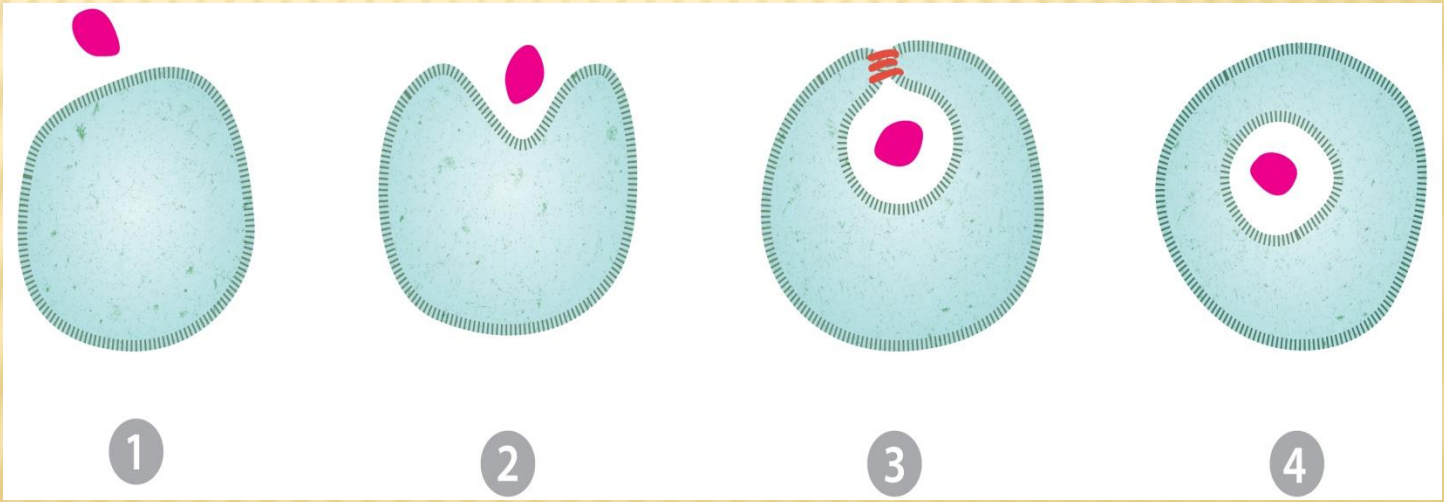
- **facilitated diffusion** – proteins in the cell membrane make channels/passages where sugars can pass/flow through easily



VOCABULARY (1.4)

ACTIVE TRANSPORT

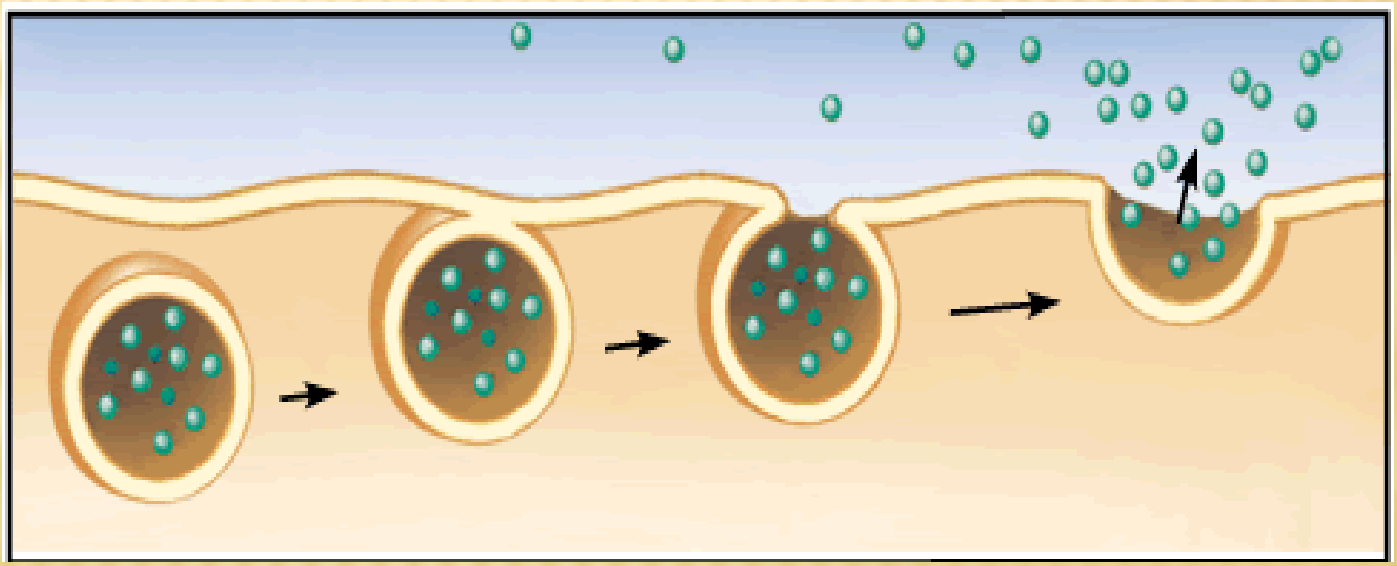
- **endocytosis** – process where the cell membrane changes shape and surrounds a particle



VOCABULARY (1.4)

ACTIVE TRANSPORT

- **exocytosis** – process that allows large particles to leave the cell



VOCABULARY (2.1 AND 2.2)

ENERGY FROM THE SUN

- energy used by living things comes from their environment

  (example: grass is the energy for cows)
- plants and other organisms obtain/get energy from sunlight to make their own food

Nearly all living things obtain energy directly or

indirectly from the energy of sunlight

VOCABULARY (2.1 AND 2.2)

ENERGY FROM THE SUN

- **autotroph** (producers)

  an organism that can **make** its own food

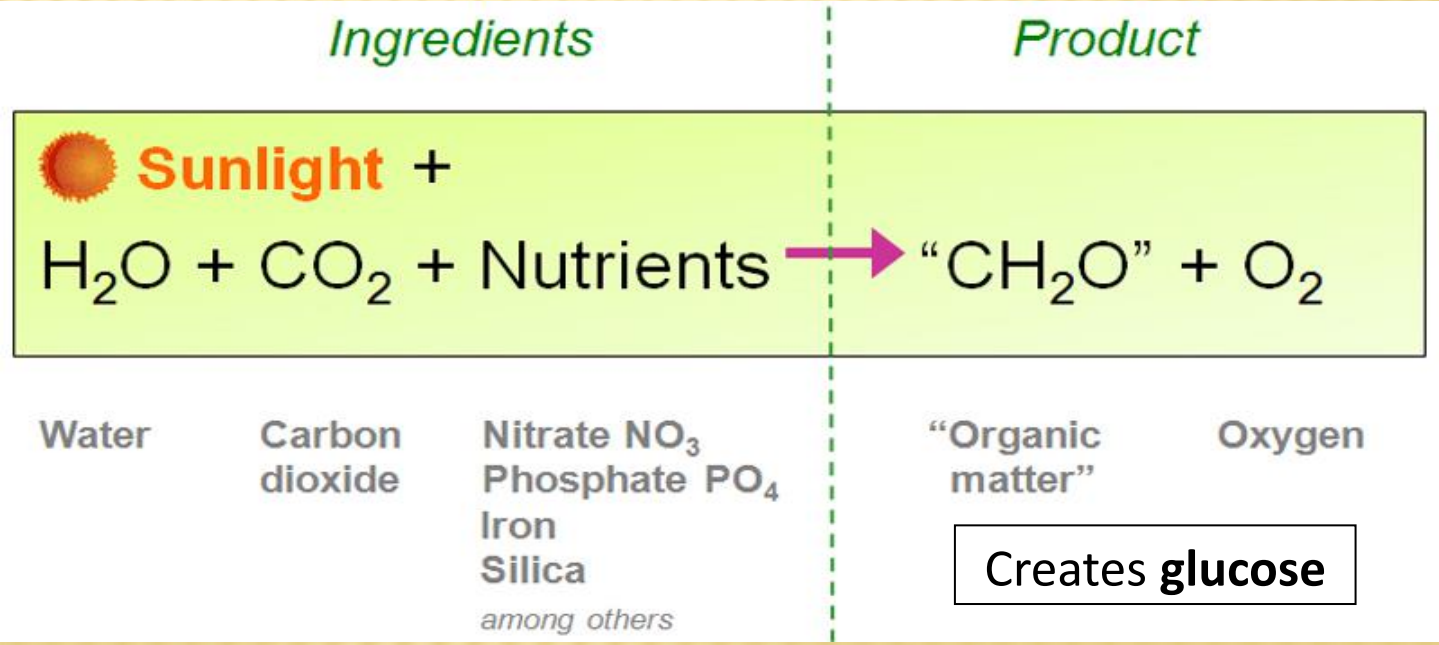
- **heterotroph** (consumers)

  an organism that cannot make its own food; obtain/get their food by **consuming/eating** other organisms

VOCABULARY (2.1 AND 2.2)

PHOTOSYNTHESIS

- (light + putting together)
- process where a cell captures energy in sunlight & uses it to make food

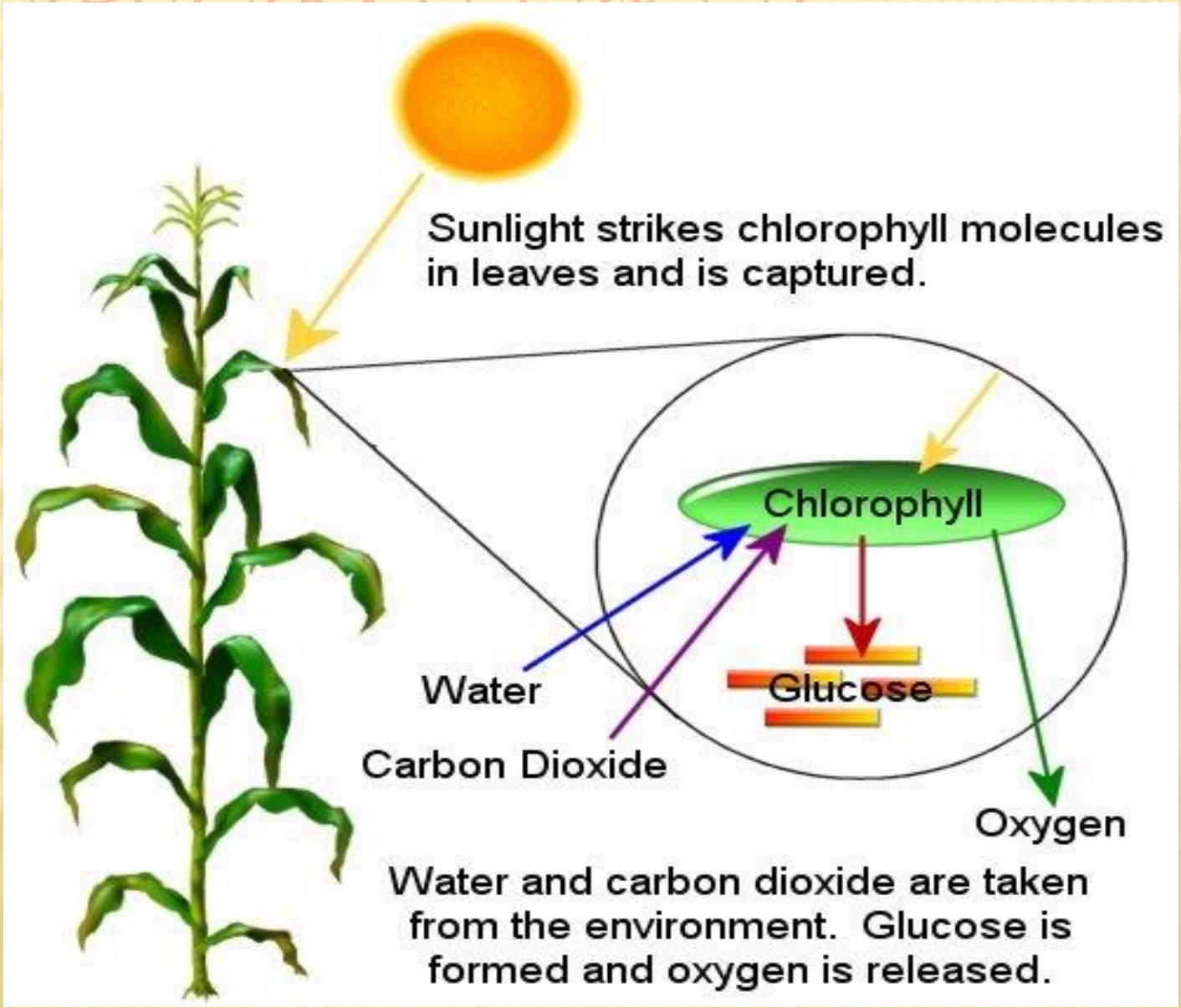


VOCABULARY (2.1 AND 2.2)

PHOTOSYNTHESIS

- **chlorophyll -** captures light energy and converts it to a form used in the second part of photosynthesis (making food)
  - found in chloroplasts
  - provides color

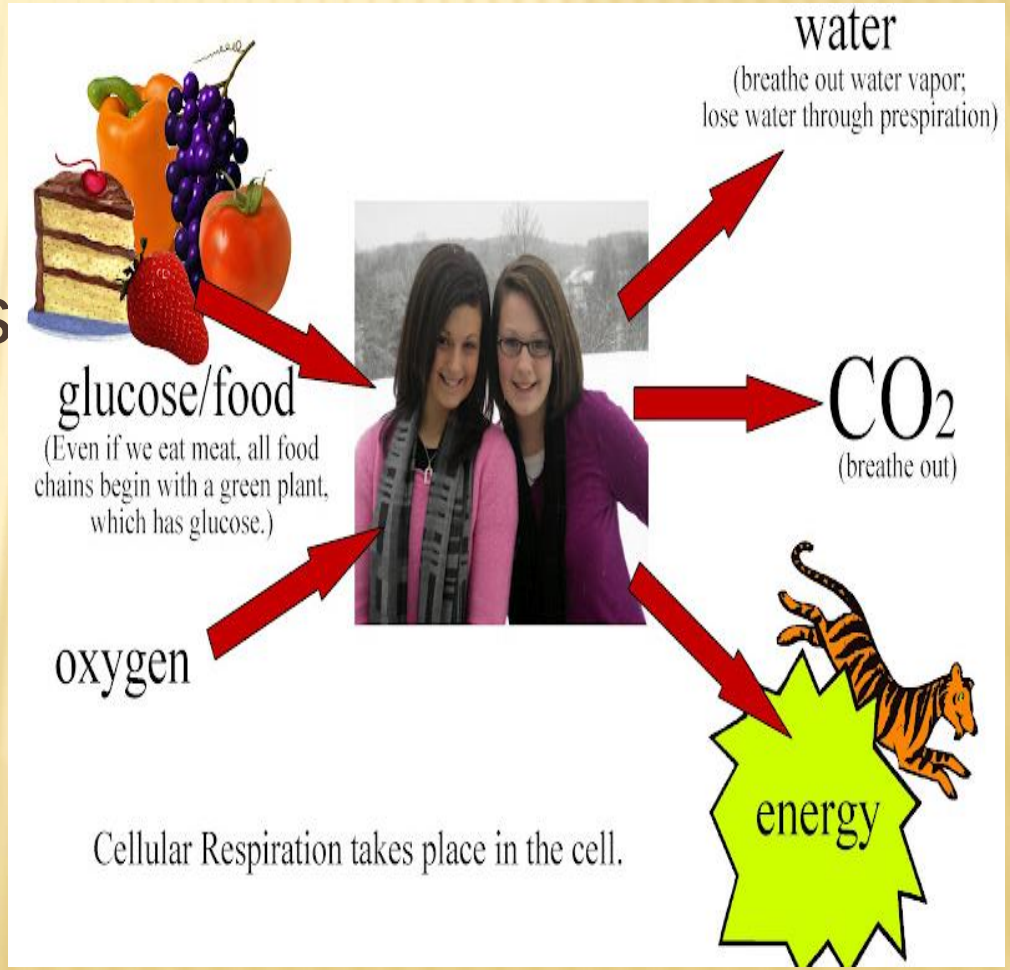
VOCABULARY (2.1 AND 2.2)



VOCABULARY (2.1 AND 2.2)

CELLULAR RESPIRATION

- process where cells get energy from glucose, then releas energy by breaking down glucose and other molecules with oxygen



VOCABULARY (2.1 AND 2.2)

CELLULAR RESPIRATION

- Cells of living things (organisms) carry out cellular respiration continuously (all the time)
  - When cells need energy they take it from glucose
  - Breathing removes waste products from your body

VOCABULARY (2.1 AND 2.2)

CELLULAR RESPIRATION

- It is a two-stage process

1.) -occurs in the cytoplasm of the cell

-molecules of glucose are broken down

-oxygen is not involved

-only a small amount of energy is released

VOCABULARY (2.1 AND 2.2)

CELLULAR RESPIRATION

- It is a two-stage process

2.) –takes places in the mitochondria

-small molecules are broken down more

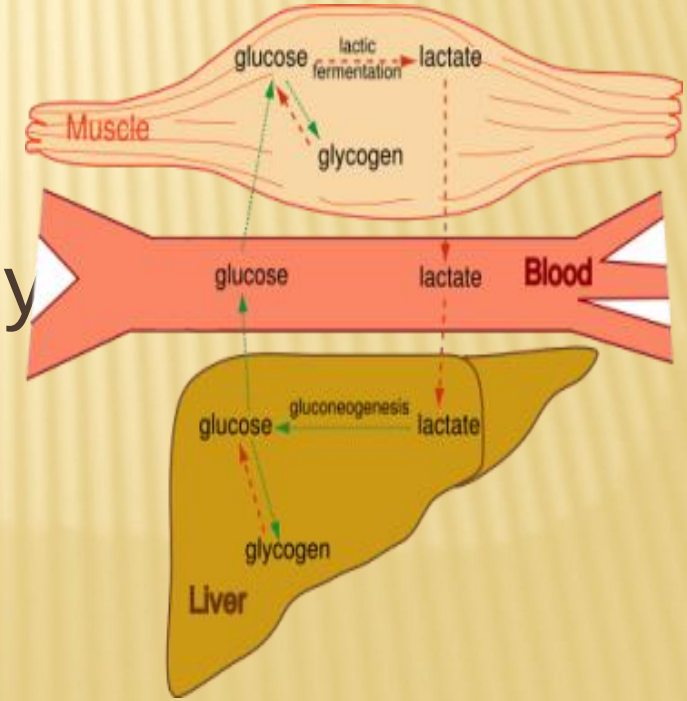
-requires oxygen

-releases a lot of energy

VOCABULARY (2.1 AND 2.2)

FERMENTATION

- cells release energy from food, not oxygen
- process used by organisms that don't have enough oxygen to carry out cellular respiration (it releases a lot less energy than cellular respiration)



VOCABULARY (2.3)

CELL DIVISION

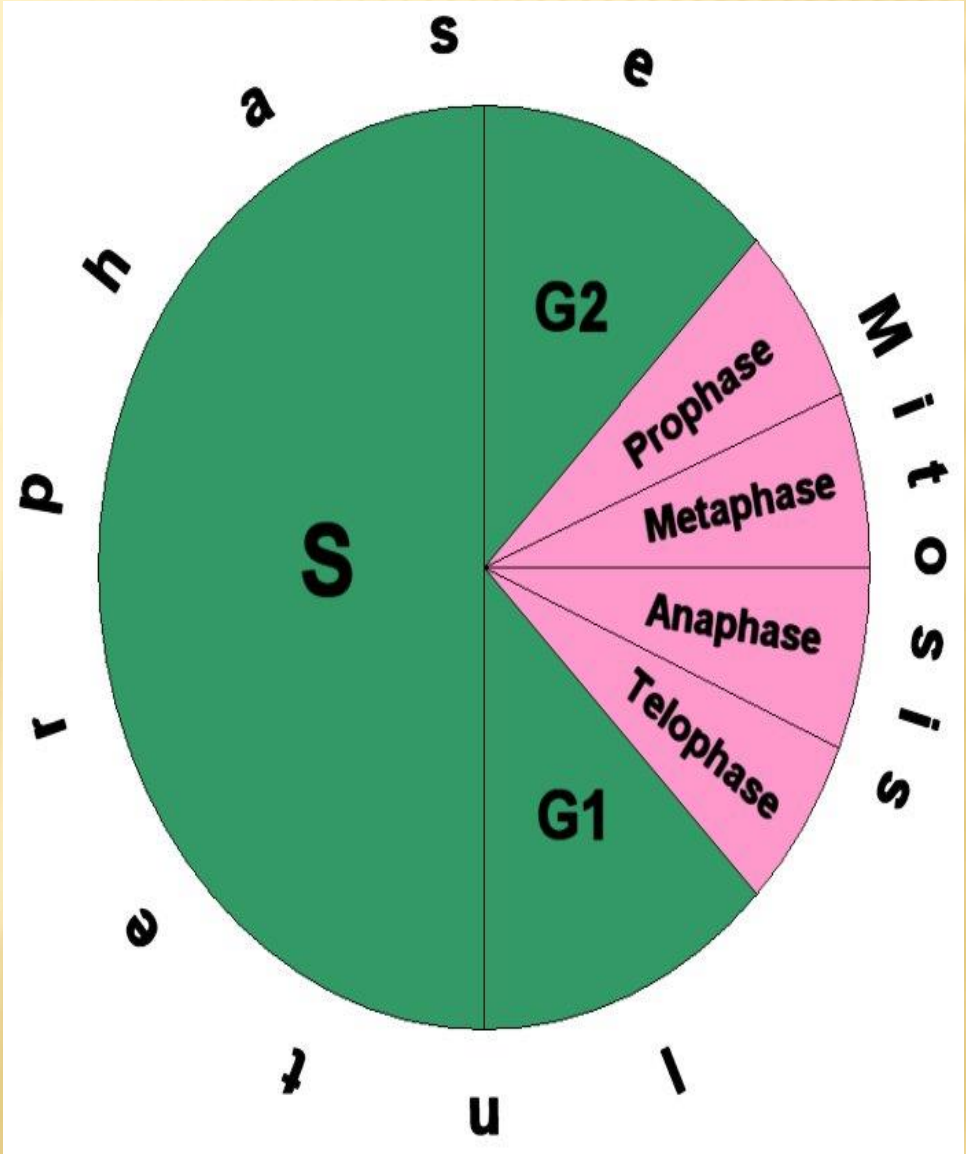
- allows organisms to grow, repair damaged structures and reproduce
- **single-cell organisms:** reproduce/make more of their kind when one cell divides itself
- **multi-cell organisms:** can reproduce when special cells from two "parents" combine to make a new cell
  - this new cell keeps dividing and a new organism/living thing is formed

VOCABULARY (2.3)

CELL CYCLE

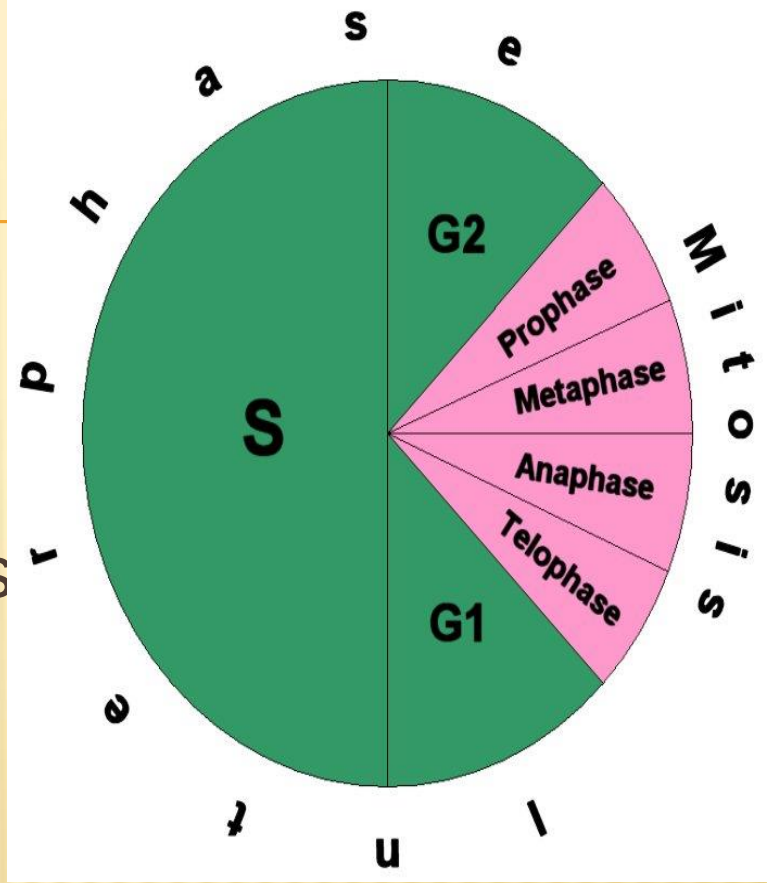
- when a cell grows, prepares to be divided, and then divides into **2** new "daughter" cells
  - each "daughter" then begins the cell cycle again

There are THREE (3) STAGES….



VOCABULARY (2.3)

STAGE 1: INTERPHASE

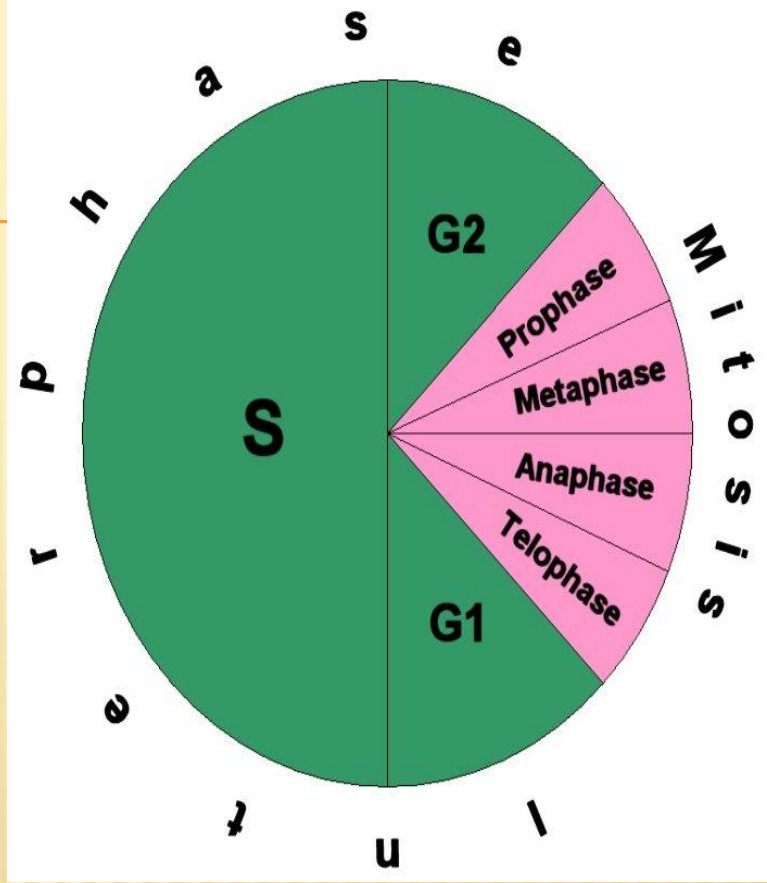


- **growing:** the cell grows to its full size; it produces organelles ribosomes, mitochondria and enzymes it needs
- **replication:** the cell makes a copy of its DNA; DNA and proteins form **chromosomes** (threadlike structures)
  - **At the end of replication, the cell contains TWO (2) identical sets of chromosomes**

VOCABULARY (2.3)

STAGE 1: INTERPHASE

- **division:** the cell produces/ makes structures that will help divide into two new cells
  - in animal cells only, a pair (2) of centrioles is duplicated (for a total of 4 2x2)

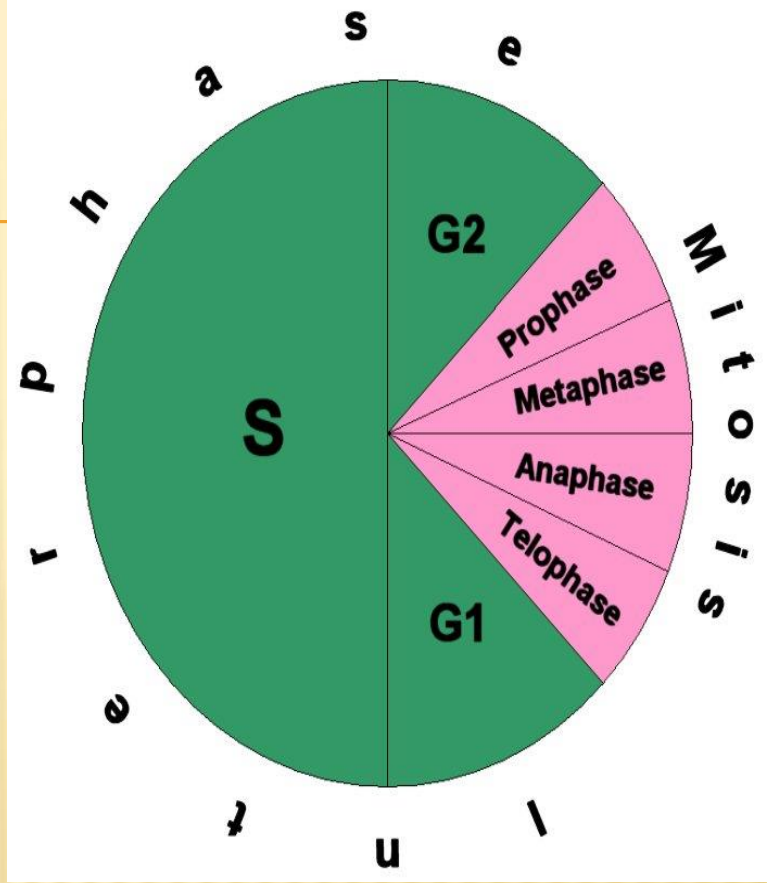


At the end of Stage 1 (Interphase), the cell is ready to divide.

VOCABULARY (2.3)

STAGE 2: MITOSIS

- the cell's nucleus divides into two (2) new nuclei
- one set of DNA is given to each daughter cell

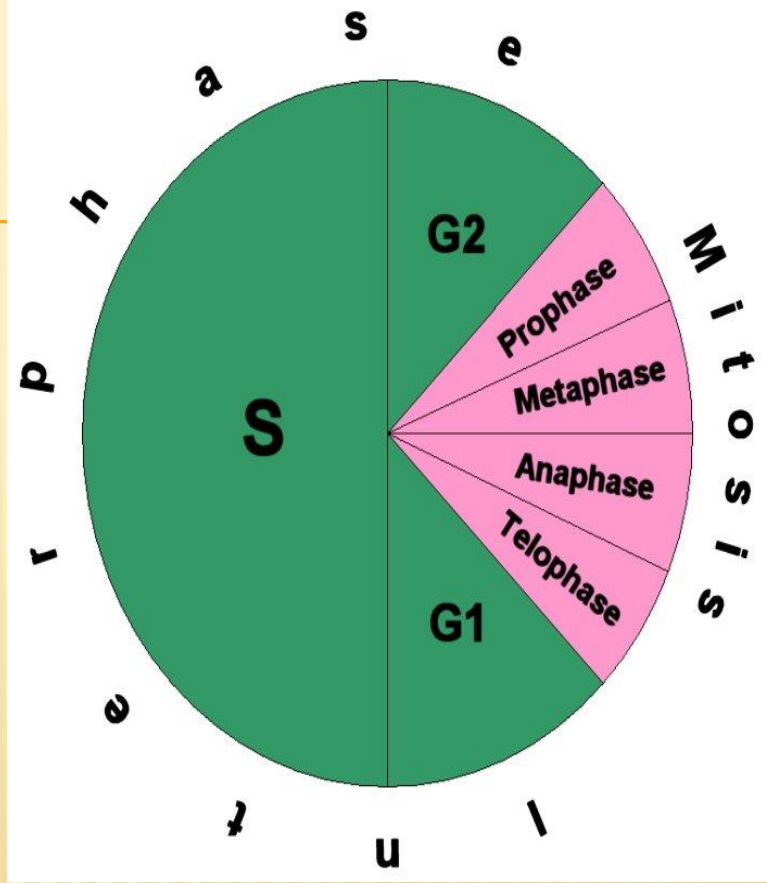


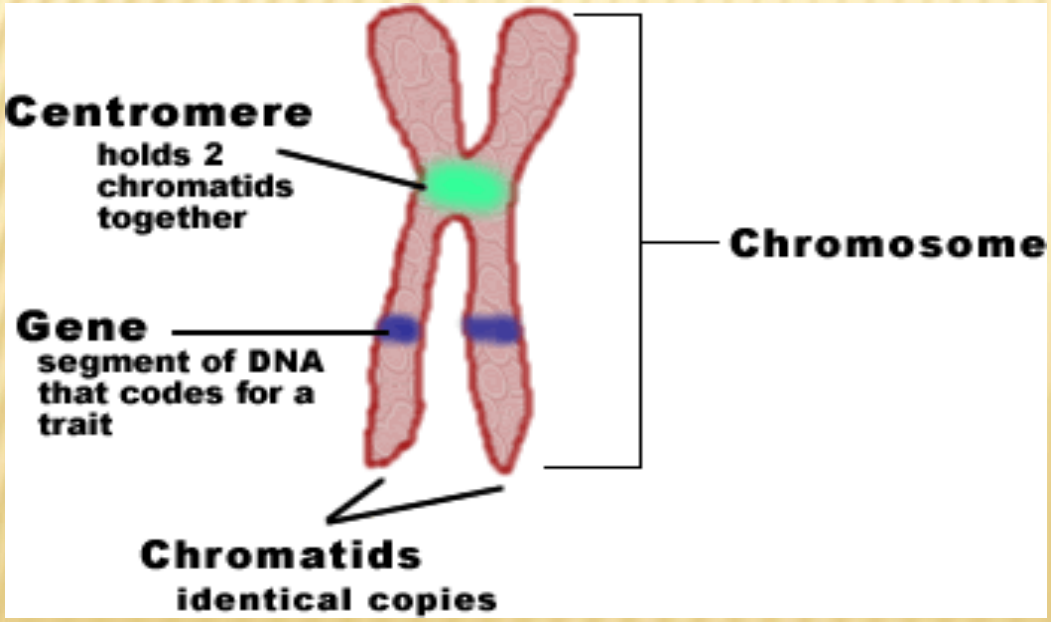
There are FOUR (4) PHASES….

VOCABULARY (2.3)

STAGE 2: MITOSIS

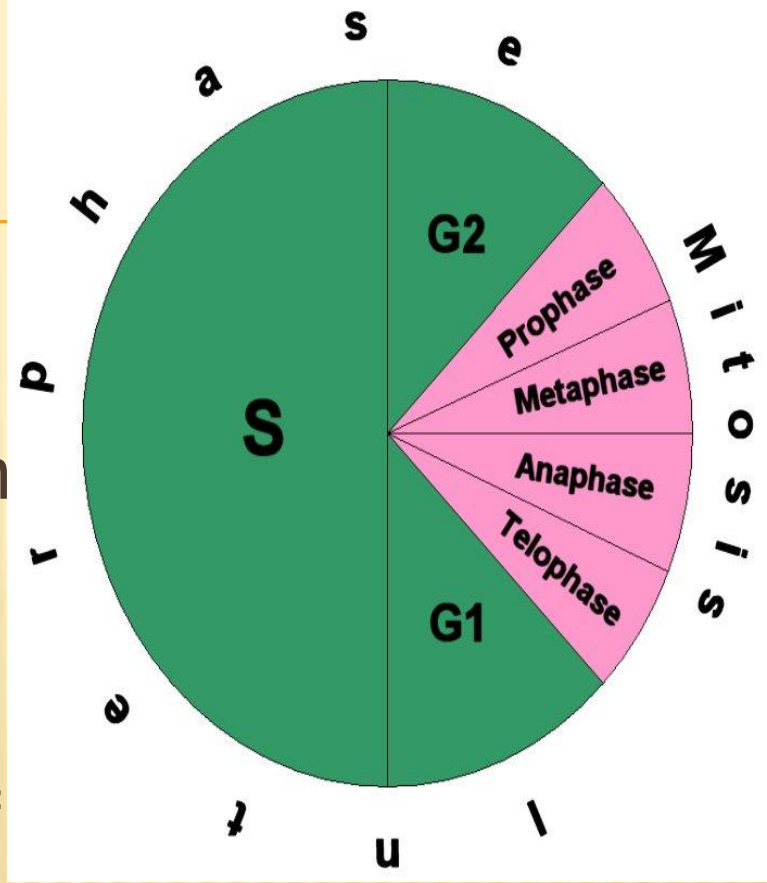
- **prophase:** chromosomes condense/become smaller and turn into shapes that you can see under a microscope





- One copy of each chromatid will move into the daughter cell in the last phase of mitosis
- When the chromatids separate, they are chromosomes again
- Each cell then has a complete copy of DNA.

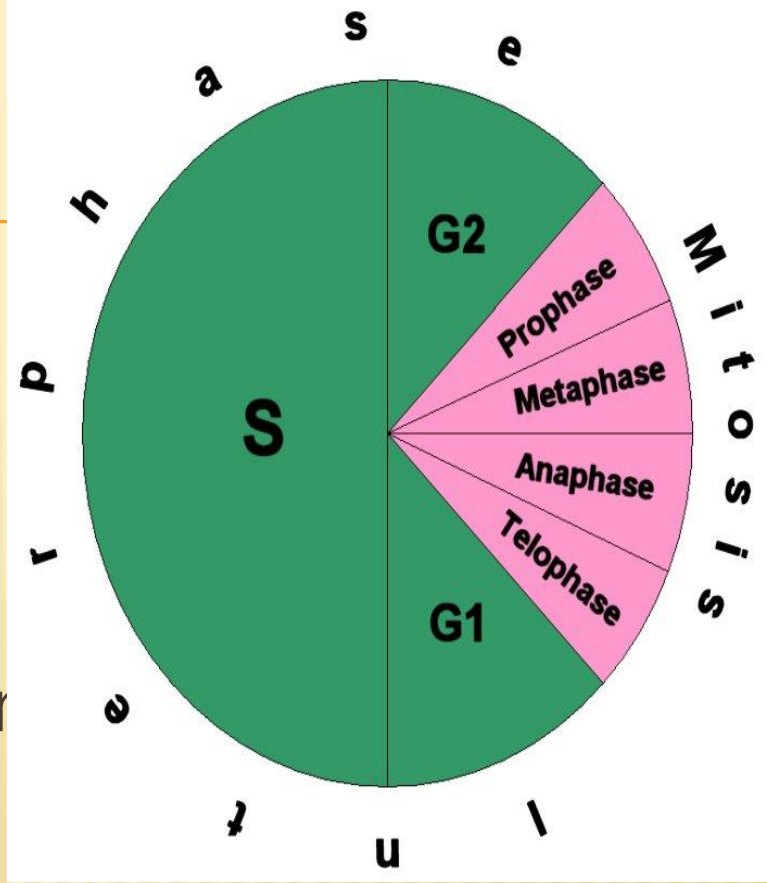
VOCABULARY (2.3)



STAGE 2: MITOSIS

- **metaphase:** each chromosom attaches/sticks to a spindle fiber at its centromere
- **anaphase:** the centromere of each chromosome splits, pulling chromatids apart; each chromatid is now a chromosome; the cell stretches out
- **telophase:** nuclei are formed; the spindle fibers disappear; the cell is tied together in the middle

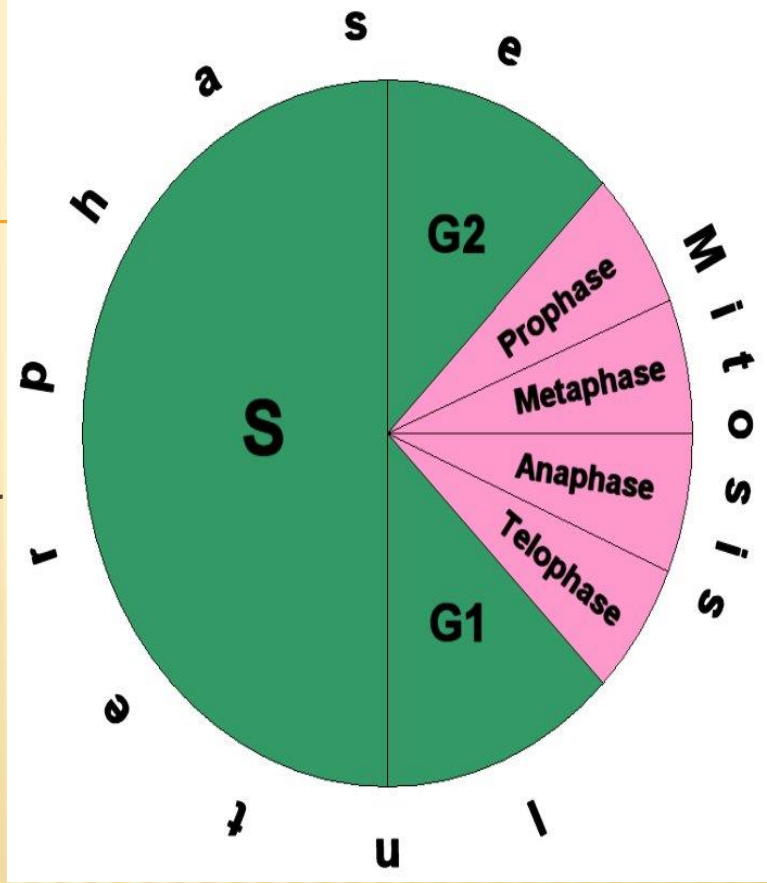
VOCABULARY (2.3)



STAGE 3: CYTOKINESIS

- completes the process of cell division
- cytoplasm divides, and is given to two new cells
- starts at about the same time as the telophase
- when complete, each daughter cell has the same number of chomosomes as the parent cell
- at the end of cytokinesis, each cell begins the cell cycle process again

VOCABULARY (2.3)



STAGE 3: CYTOKINESIS

- **animal cells:** the cell membra
  together around the middle
  of the cell; the cytoplasm
  gets tied into two cells; each
  daughter cell gets about half
  of the organelles from its parent cell

- **plant cells:** a *cell plate* forms across the middle of the cell, and begins to form new cell membranes between the two daughter cells; new cell walls form

VOCABULARY (3.1)

GREGOR MENDEL

The Father of Genetics

(1822-1884)

- priest who performed experiments in his garden
- his study of why plants grew differently than others led him to discover **genetics**
- his discovery of **genes** and **alleles** changed scientists' ideas about **heredity**

VOCABULARY (3.1)

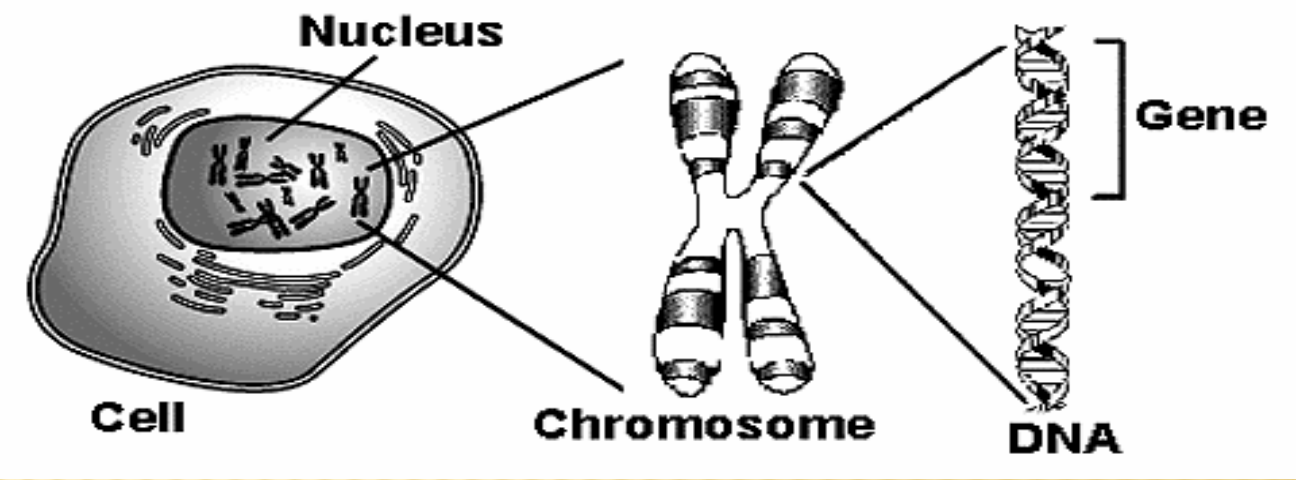
WHAT IS HEREDITY?

- passing of physical traits from parents to offspring (children)
  - **trait:** specific characteristics
- **genetics:** the scientific study of heredity

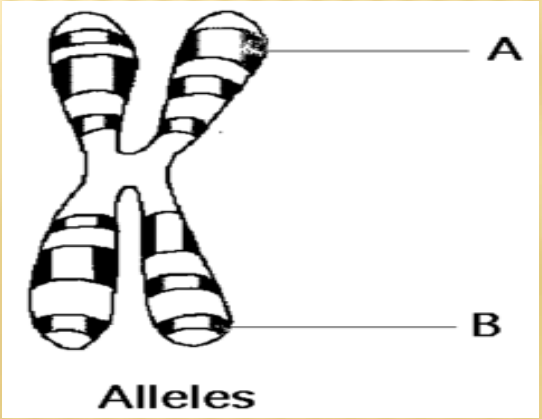
VOCABULARY (3.1)

WHAT IS HEREDITY?

- **gene:** factors that control a trait



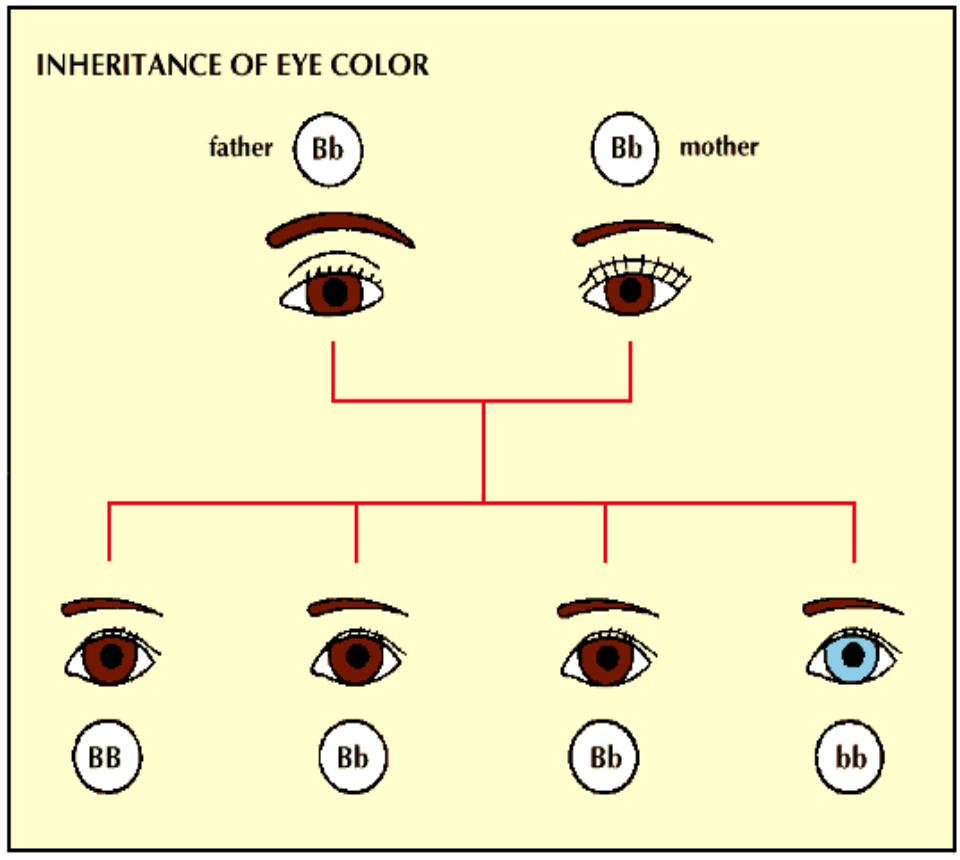
- **alleles:** different forms of a gene



VOCABULARY (3.1)

WHAT IS HEREDITY?

- **alleles:** different forms of a gene
  - **DOMINANT**
    always shows up
  - **RECESSIVE**
    stays hidden when the dominant allele is present



Dominant Gene	Recessive Gene
Cleft Chin 	No Cleft 
Widow's Peak 	No Widow's Peak 
Dimples 	No Dimples 
Brown/Black Hair 	Blonde Hair 
Freckles 	No Freckles 
Brown Eyes 	Gray/Blue Eyes 
Free Earlobe 	Attached Earlobe 

VOCABULARY (3.1)

WHAT IS HEREDITY?

- **fertilization:** process when egg and sperm cells join together to form a new organism
- **purebred:**

  the offspring of many generations that have the same form of a trait

VOCABULARY (3.1)

WHAT IS HEREDITY?

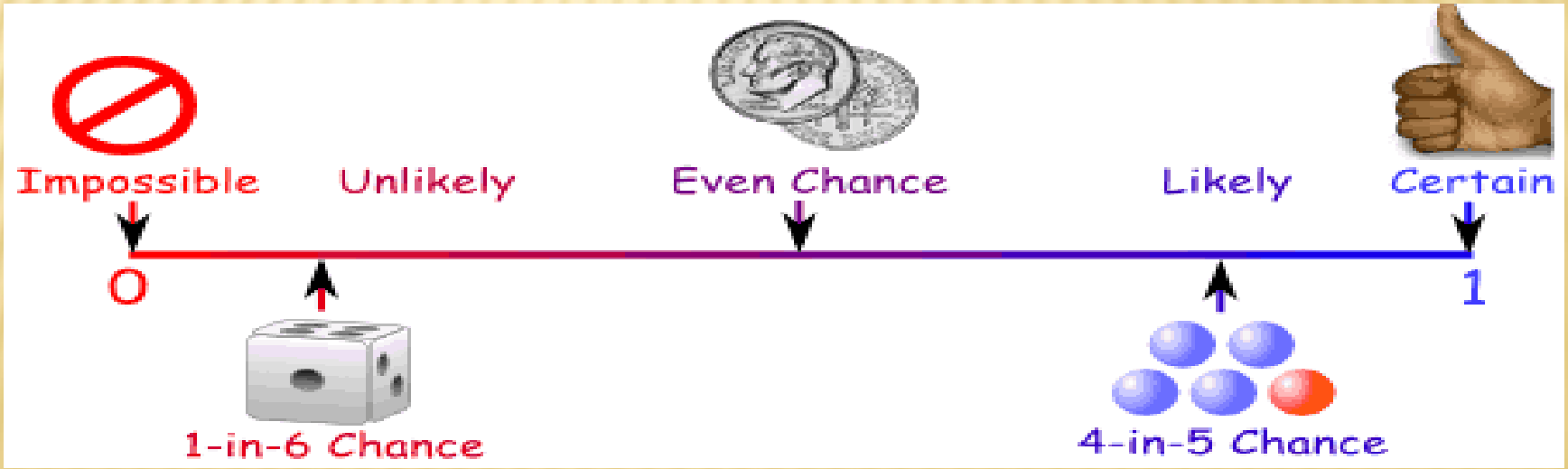
- **hybrid:** has **2** different alleles for a trait

Genetic studies have shown that wolves in the eastern U.S. and Canada are actually hybrids of gray wolves and coyotes.

VOCABULARY (3.2)

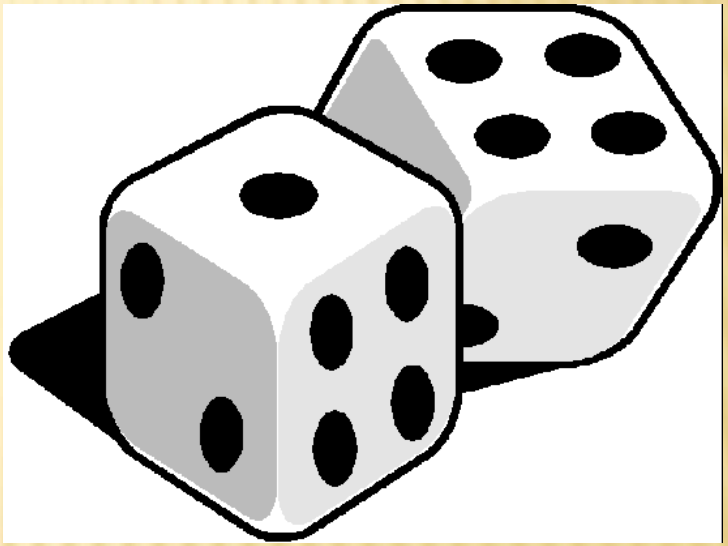
PROBABILITY **(Yes! Just like Math!)**

- a number that describes how likely it is that an event will happen/occur
- *laws of probability* predict what is **likely** to



VOCABULARY (3.2)

PROBABILITY (Yes! Just like Math!)



STOP!!! Let's roll the dice!

How many sides/numbers are on a die?

What are the chances I will roll a 3?

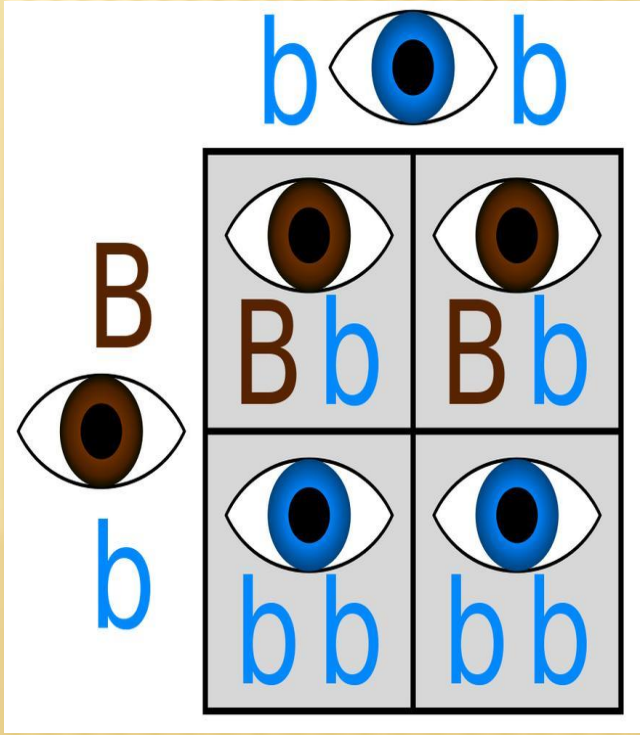
Roll your die 10 times – how many times did you get a 3? (keep track in your notebook)

VOCABULARY (3.2)

How is PROBABILITY related to GENETICS?

- skills of probability can help predict how genetics will work (how do genes ***cross*** ?)

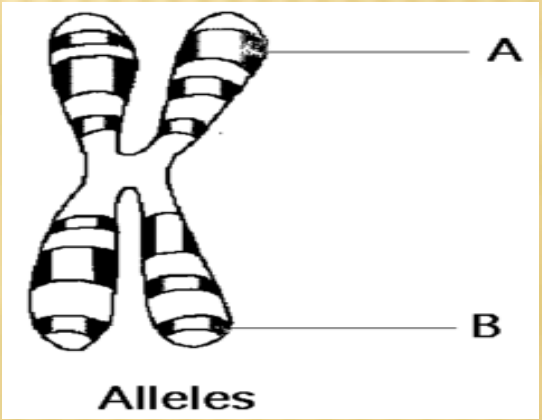
- **Punnet Square:** a chart that shows all the possible ways alleles can combine in a genetic cross



VOCABULARY (3.2)

- **phenotype [**OUTSIDE**]**
  physical appearance (visible traits) of an organism

- **genotype [**INSIDE**]**
  an organism's genetic make up (alleles)

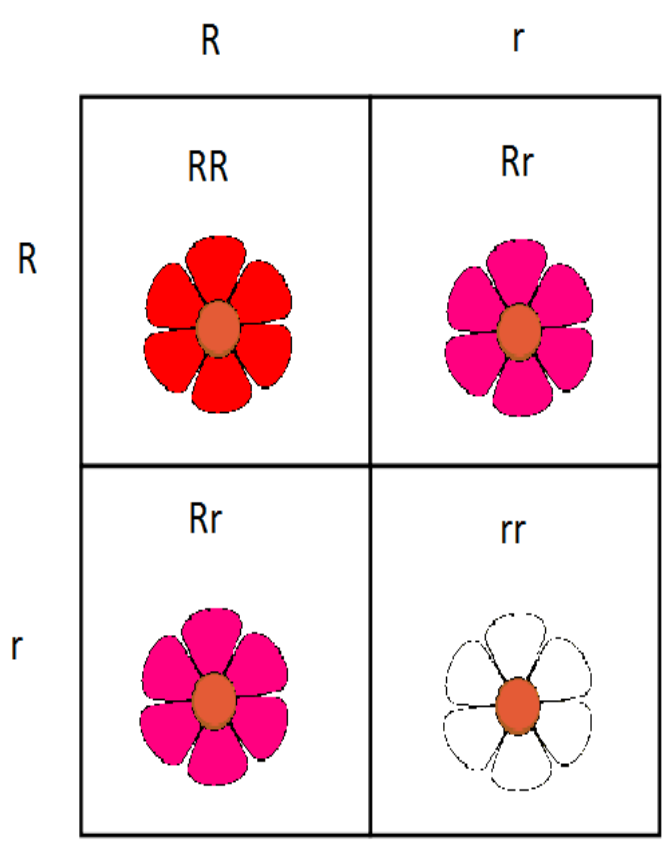


VOCABULARY (3.2)

2 other ideas describe an organism's *genotype:*

- **homozygous:** when an organism has **2 identical/same** alleles for a trait
- **heterozygous:** when an organism has **2 different** alleles for a trait

VOCABULARY (3.2)



Red is **dominant**; **RR** is the **homozygous** organism

White is **recessive**; **rr** is the **homozygous** organism

Rr are the **heterozygous** organisms made up of **R** (red) and **r** (white)

VOCABULARY (3.2)

How do *genetics* and the environment work together?

- **inherited traits:** physical traits an organism is born with (like vocal chords and tongues)

- **acquired traits:** skills organisms learn to do, or physical traits that are developed (like speaking another language, or getting a blister from too much walking)

VOCABULARY (3.2)

How do *genetics* and the <u>environment</u> work together?

- Environmental factors/issues can affect the way genes turn out
  - Example: do you have a <u>chance/opportunity</u> to take music in school? Then you can develop a "musical gene".
  - Example: smoking can create lung cancer
  - Example: plants are native to some parts of the world but not others because of the weather

VOCABULARY (3.4)

CHROMOSOME PAIRS

- fertilized eggs that form when a sperm cell and egg cell meet has 24 chromosomes
  - this is the same number that the parent has
  - the chromosomes are together in pairs (12)
  - one chromosome comes from the father; one chromosome comes from the mother

VOCABULARY (3.4)

CHROMOSOME THEORY OF INHERITANCE

- **Remember:** alleles are different forms of a gene (example: eye color is the gene we carry; blue, brown or green is the allele)
- alleles come in pairs, just like chromosomes
  - genes pass from parents to their offspring on chromosomes

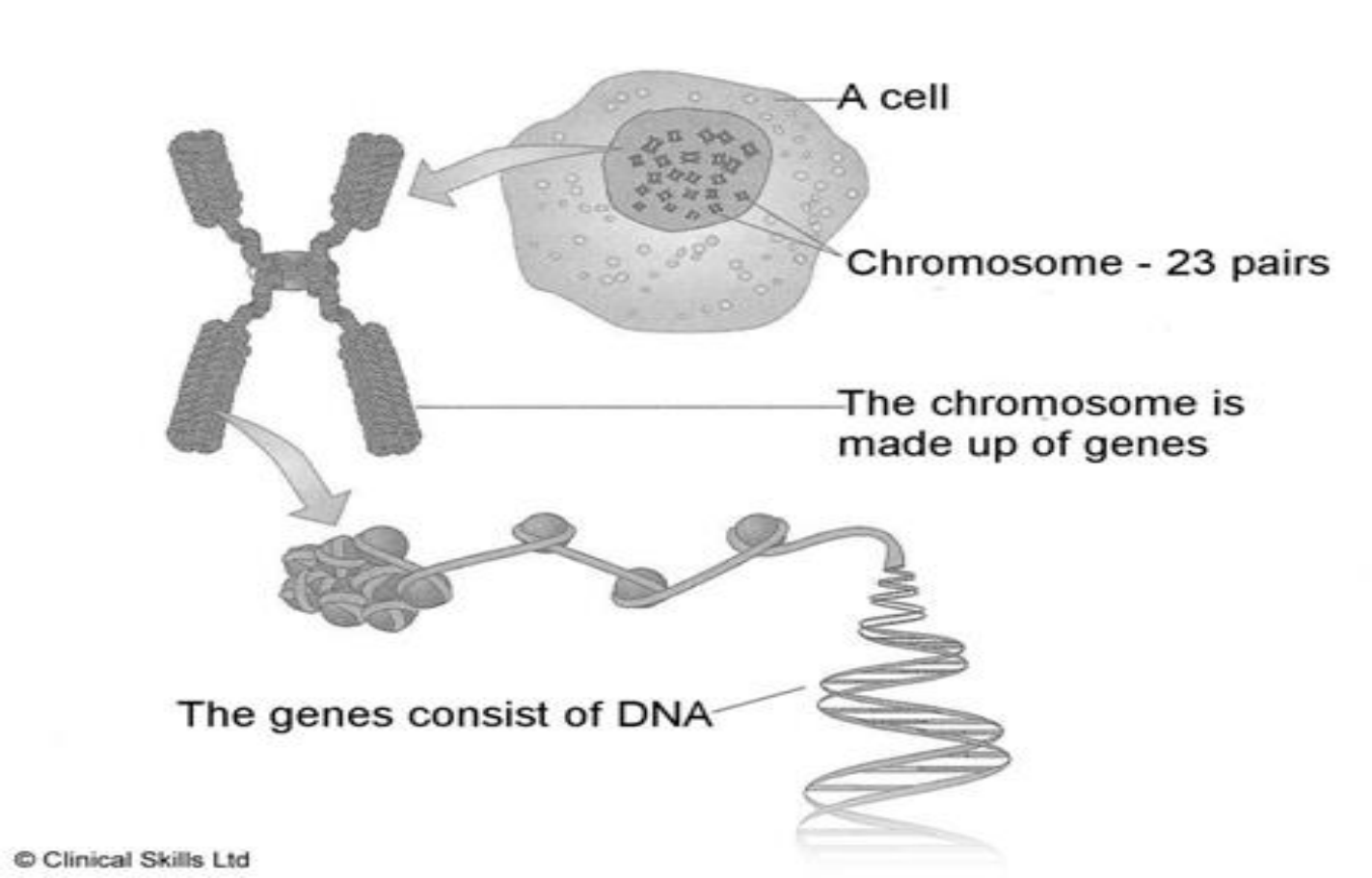
VOCABULARY (3.4)

GENES and CHROMOSOMES

- the body cells of humans contain 46 chromosomes (23 pairs)
- chromosomes are made up of genes joined together, like beads on a string
- body cells each contain 20,000-25,000 genes

VOCABULARY (3.4)

GENES and CHROMOSOMES



VOCABULARY (3.4)

MEIOSIS

- process of cell division where the number of chromosomes is reduced [made less] by half
  - chromosome pairs separate into 2 different cells, then divide again (total of four cells)
  - chromosomes duplicate (make a copy) before the first cell division

VOCABULARY (3.4)

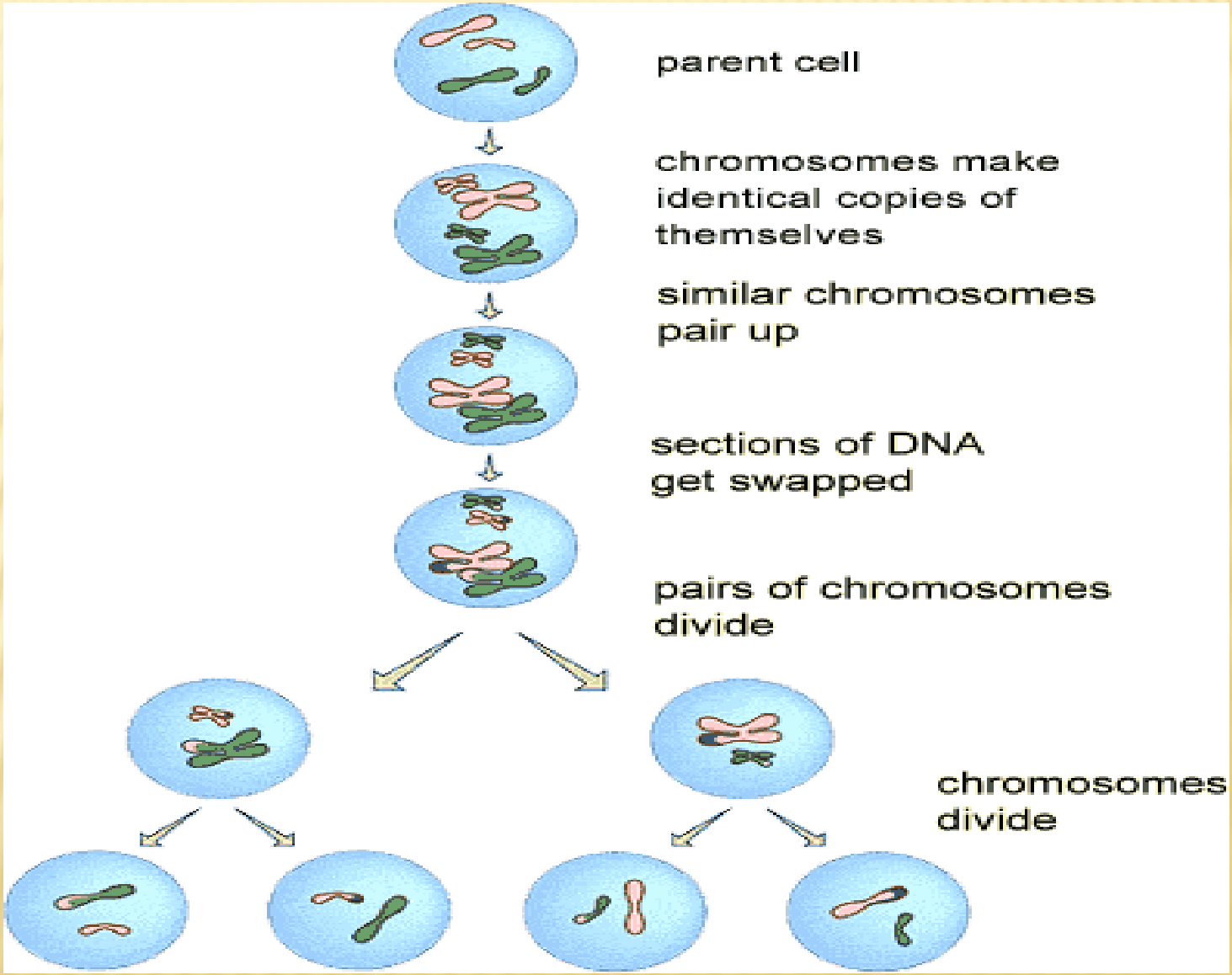
MEIOSIS

- sex cells form during this process
  - only have half as many chromosomes as other cells in the organism
  - when 2 sex cells join during fertilization, the new cell has the full number of chromosomes

VOCABULARY (3.4)

More to come…

MEIOSIS



VOCABULARY (4.3 **and** 5.3)

MUTATIONS

- any change in DNA of a gene or chromosome

The violet eyes of actress Elizabeth Taylor were a genetic mutation of dominant **B**rown alleles and recessive **b**lue alleles.

Red hair is a genetic mutation of dominant **B**rown alleles and recessive **b**londe alleles.

VOCABULARY (4.3 **and** 5.3)

MUTATIONS

- any change in DNA of a gene or chromosome

There are physical mutations that can happen, causing physical **deformities** and **illnesses.**

VOCABULARY (4.3 **and** 5.3)

MUTATIONS

- **size:** it could be a small block of DNA or a large part of a chromosome
- **it can happen 2 ways**: inherited from a parent, or developed during a person's life
  - Mutations can either be something that changed in a cell, or environmental factors that affect you (e.g. rays from the sun, which can cause cancer)

VOCABULARY (4.3 **and** 5.3)

OTHER CHANGES

- **selective breeding:** process of selecting organisms with specific traits to be parents of the next generation
- **inbreeding:** a technique that crosses **2** individuals that have similar characteristics
- **hybridization:** when **2** genetically different individuals are crossed; the result is to have the best traits of both parents

VOCABULARY (4.3 **and** 5.3)

OTHER CHANGES

- **clone:** an organism that has exactly the same genes as the organism it was produced from
- **genetic engineering:** process when genes from one organism are transferred into the DNA of another organism

VOCABULARY (4.3 **and** 5.3)

What is <u>NATURAL SELECTION?</u>

"survival of the fittest"

- process when individuals that have adapted well to their environment (are able to live well) are more likely to survive and reproduce than other members of the same species

VOCABULARY (4.3 **and** 5.3)

Causes of natural selection:

- **overproduction:** in some species so many offspring are born that there are sometimes not enough resources (e.g. food, water)
- **variation:** any difference between individuals of the same species (e.g. “weak” runners)
- **competition:** can be *direct* (e.g. fighting) or *indirect* (e.g. not enough food to eat)

VOCABULARY (4.3 **and** 5.3)

Causes of natural selection:

- **selection:** certain characteristics/traits get stronger with each generation, while weak traits begin to disappear
- **environmental change:** genetic variations allow new traits to develop (e.g. flowers that can now grow in places they couldn't before)

VOCABULARY (4.3 **and** 5.3)

Causes of natural selection:

- **gene changes:** variations can happen when genes are changed or have different forms at the time that the egg cell and sperm cell meet
  - only inherited traits (passed from parent to offspring) can be acted on by natural selection (e.g. height can create mutated genes that affect survival)