Study Guide for Biology End-of-Course Test (EOCT; short version)

- Characteristics of living things - 1. Respond to the environment 2. Metabolism 3. Homeostasis 4. Growth and Development 5. Genetic Material (DNA or RNA) 6. Made of cells 7. Reproduction

- Scientific Method – Problem , hypothesis, design an experiment, data, analyze data , conclusion

- What are the elements of an experiment?
  1. Independent variable (manipulating variable) – the variable that is changed in an experiment by the researcher.
  2. Dependent variable (responding variable) - the variable that responds to the independent variable. The variable that is measured.
  3. Experimental group- group that is changed
  4. control group - all variables are held constant. Used as a comparison for the experimental group.

- How to read a graph - Read the labels on both the horizontal axis and the vertical axis. Then look to see how they relate to the subject of the graph.

- Properties of water - 1. Polar molecule 2. Forms hydrogen bonds with other molecules 3. Adhesion – water sticks to non-water molecules and allows water to move up plants. 4. Cohesion (high surface tension) – water sticks to water. 5. Heat capacity – resists change to temperature 6. Expands when it freezes (less dense). 7. Heat of vaporization - cools substances as evaporates.

- Hydrogen Bonds - bonds between hydrogen and other elements. Usually weaker. Gives water its special properties.

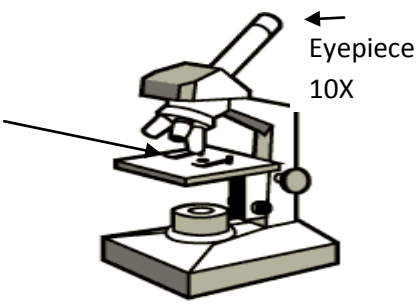
- Macromolecules - the 4 major polymers in living things

Polymer	Monomer	Elements	Examples	Function
Carbohydrate	glucose	C, H, O	glucose, cellulose, starch, fructose, glycogen	Short term energy storage
Protein	amino acids	C, H, O, N, S	enzymes, hormones	build muscle
Nucleic Acid	nucleotide	C, H, O, N, P	DNA, RNA	Storage of genetic information
Lipid	triglycerides	C, H, O, P, S	Fats, oils steroids, cholesterol	Insulation, long term energy storage (most energy/gram)

- Enzymes – proteins that lower activation energy for a reaction and speeds up the chemical reaction.

- Lock and Key Model - Substrate attaches to the active site on an enzyme.

- Light microscope- Used to view cells and other objects. There are magnifications. The total magnification is eyepiece X objective, so for this example total mag. = 40x



- Electron microscopes are used to study sub-cellular structure and viruses

- Prokaryotic Cells - smaller than eukaryotic cells, do **not** contain a true nucleus or membrane-bound organelles and can have pili or flagella to help with movement. Ex. Bacteria

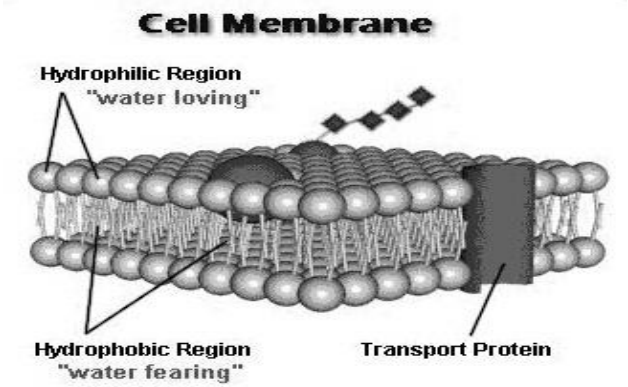
- Eukaryotic Cells - contains a true nucleus and membrane- bound organelles. Ex. All kingdoms except the two bacterial kingdoms

- Endosymbiosis Theory - One prokaryotic cell engulfed another prokaryotic cell and they began to work together. Evidence: both chloroplast and mitochondria have DNA , double membranes and make energy.

- Structures of cells –

Organelle	Function	Where found
Cell membrane/Plasma Membrane	Allows some things in or out (selectively permeable)	prokaryotic and eukaryotic cells (animal and plant)
Nucleus	controls cell activity and contains DNA	eukaryotic cells (animal and plant)
Mitochondria	Produces in energy (ATP) for the cell	eukaryotic cells (animal and plant)
Lysosomes	break down waste material in the cell using enzymes	eukaryotic cells (animal only)
Golgi apparatus (body)	Packages/modifies proteins for export	eukaryotic cells (animal and plant)
Smooth endoplasmic reticulum (no ribosomes on surface)	lipids are made	eukaryotic cells (animal and plant)
Rough endoplasmic reticulum (ribosomes on surface)	modifies and transports proteins within cell	eukaryotic cells (animal and plant)
Ribosomes	makes proteins	eukaryotic cells and prokaryotic cells
Vacuole	storage of materials	eukaryotic cells (animal and plant)
Cell wall	provides support and protection	eukaryotic cells (plant only)
Chloroplast	site of photosynthesis	eukaryotic cells (plant only)
Vesicle	Membrane bound sacs	Pinch off of Golgi and ER

- Structure of cell membrane - Selectively permeable phosphorous bi-lipid membrane with protein channels (allows some things in and out)



- Diffusion - movement of substances from an area of high concentration to an area of low concentration.

- Types of diffusion - 1. Facilitated diffusion – requires the help of transport proteins. 2. Osmosis - the diffusion of water, which moves to dilute. 3. Active Transport requires ATP energy and move low to high (endocytosis, exocytosis)

- Types of osmotic solutions -

  A simple rule to remember: Salt Sucks - Salt is a solute, when it is concentrated inside or outside the cell, it will draw the water in its direction. This is also why you get thirsty after eating something salty. Also remember water always moves to dilute. "Grow like a hippo in a hypo".

If the fluid on the outside of the cell has…	**Then the solution is…..**	**Water moves…..**	**Effect on cell**
More solute	hypertonic	out of cell	shrinks
Less solute	hypotonic	into cell	swells
same amount of solute	isotonic	into and out of cell at equal rates	stays the same

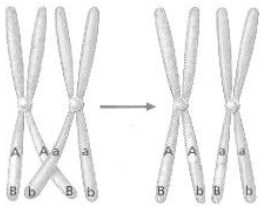
- Active Transport - requires energy (ATP) to move substances from an area of low concentration to high concentration. Example is the sodium (Na) potassium (K) ion pumps in humans (pg. 121)

- Types of active transport - 1. Endocytosis - material is taken into the cell. 2. Exocytosis - material is removed from the cell.

- Cell Reproduction
- Cell cycle: Interphase: G1 - cell grows, S- DNA replicates, G2- more growth and prepping for mitosis.

Characteristics	**Mitosis**	**Meiosis**
Number of daughter cells	2 diploid daughter cells (somatic cells)	4 haploid daughter cells (gametes)
Number of stages	1 (PMAT)	2 (PMAT PMAT)
Crossing over occurs	No	Yes
Purpose	cell growth, development and repair. Asexual reproduction (unicellular organisms)	Sexual reproduction= VARIATION= Mendel's Laws, random fert., mutations and crossing over

- Crossing over



- Cellular Energy

	Photosynthesis	**Cellular Respiration**
Reactants	Water, carbon dioxide, light energy	glucose and oxygen
Products	glucose and oxygen	water, carbon dioxide and ATP

		(energy)
Occurs in	plants chloroplasts	**ALL** organisms mitochondria
Purpose	produce glucose for energy	produce ATP

❖ ATP - stores energy. Adenosine Triphosphate.

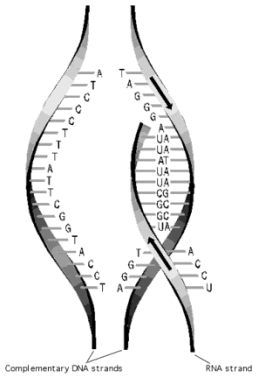
❖ DNA /RNA

	DNA	**RNA**
Nucleotide	deoxyribose sugar, nitrogen base(A,C,G,**T**), phosphate group	ribose sugar, nitrogen base(A,C,G,**U**), phosphate group
Structure	double helix	single strand
location	nucleus	nucleus and cytoplasm
Pairing of nitrogen bases	A-T C-G	A-U C-G

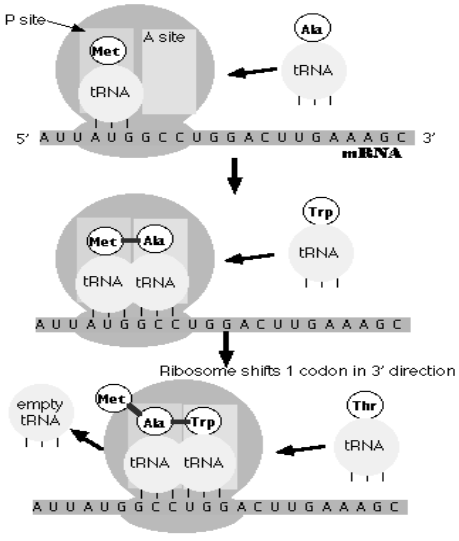
Protein Synthesis (R-T-T)

❖ Replication- DNA replicates and copies itself (Nucleus)

❖ Transcription- mRNA (messenger RNA) copies the code from DNA (Nucleus)



❖ Translation- converts mRNA code into a polypeptide (protein) with tRNA at the ribosomes

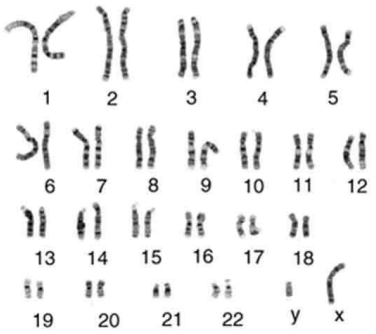


❖ Gene - segment of DNA that produces proteins

❖ Punnett Squares - a diagram used to show the probable outcome of a genetic cross.

	A	a
A	AA	Aa
a	Aa	aa

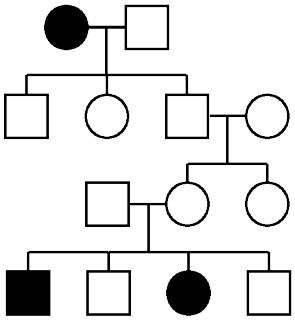
- Genotype - genetic makeup; Ex, BB
- Phenotype - physical makeup; Ex, Brown hair
- Mendel's 3 laws - Law of Segregation - Only one allele from each parent is passed to offspring, Law of Independent Assortment - genes for different traits are inherited independent of each other, Law of Dominance - one allele is dominant over the other allele.
- Patterns of inheritance-
  1. Co-dominance – both traits are expressed. Ex. Chik –fill –a cows and AB blood type
  2. Incomplete dominance - blending of traits. Ex. Red flowers and white flowers produce pink flowers.
  3. Multiple alleles – trait is controlled by more than 2 alleles. Ex. Blood types A,B,O
  4. Polygenic traits – trait is controlled by more than one gene which results in different combinations. Ex. Skin color and eye color
  5. Sex linked traits - trait is located on the X or Y chromosome Ex. Color blindness
- Karyotype - profile of a person's chromosomes



- How to read a karyotype- There should be 22 pairs of somatic chromosomes and one pair of sex chromosomes (#23) for a total of 46 chromosomes. If the number varies than there is a genetic disorder. Nondisjunction during meiosis leads to this chromosomal aberration. Down syndrome = 3 chromosomes at number 21 (trisomy 21)
- Gene Therapy – an absent or faulty gene is replaced by a normal working gene using transgenic technology
- Mutations - change in the DNA sequence
- Types of Mutations –
  1. Deletion - nucleotide is deleted or lost (frameshift mutation)
  2. Insertion - extra nucleotide is added to DNA (frameshift mutation)
  3. substitution - one nucleotide substituted for another (point mutation)
  4. Nondisjunction - chromosomes do not separate during meiosis= 1 extra or 1 missing

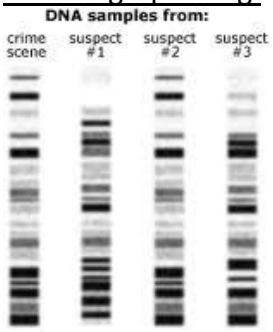
5. Inversions, duplications and translocations are when sections of chromosomes are changed.

- Pedigree - a chart that shows a family's inheritance for a given trait. Squares represent males and circles represent females. If the square/circle is shaded in the person has the trait. If the square/circle is half shaded in then they are a carrier for the trait.



- Genetic Engineering -
  Selective Breeding: Choosing organisms with the desired traits and breeding them together to produce offspring with the desired traits. GMOs!
  Cloning: producing a genetically identical copy
- Gel Electrophoresis: used to separate DNA fragments according to their size = DNA fingerprint

- DNA Fingerprinting:



- Recombinant DNA: genes from one organism are placed into another organism.

- Transgenic Organisms: An organism that contains genes that has been transferred from another organism.

- Darwin: developed the theory of Natural Selection= VSR explains how evolution occurs

- Lamarck: thought evolution was inheritance of acquired characters. Kangaroos grow and acquire large leg muscles and then pass those large muscles on to their offspring.

- Natural selection - The mechanism in which favorable heritable traits are passed from one generation to another (VSR). This allows organisms with the favorable trait to survive and reproduce.

- Antibiotic resistance- natural selection of bacteria. Bacteria that survive antibiotic treatments and pass resistance to next generation.

- Evidence of evidence
  1. Fossil record – shows how species have changed over time.
  2. Homologous structures - same structure different function

3. Analogous structures - different structure same function
4. Embryonic development – vertebrate embryos look very similar
5. Vestigial structures - structures that are useless for the function originally performed.
6. Biochemical & genetic analysis – similarities between proteins and DNA and genes.

❖ Speciation - formation of a new species
1. Reproductive isolation – when members of two populations cannot interbreed to produce fertile offspring.
2. Geographic isolation - two populations become isolated by geographical barriers.

- Convergent evolution: Distantly related organisms have evolved to resemble each other over time.

❖ Divergent evolution: (AKA – adaptive radiation) – Ancestral species evolve into lots of different species.

❖ Coevolution: One organism evolves in response to change in another organism. We see this with most symbiotic relationships. Co-evolution = mutualism

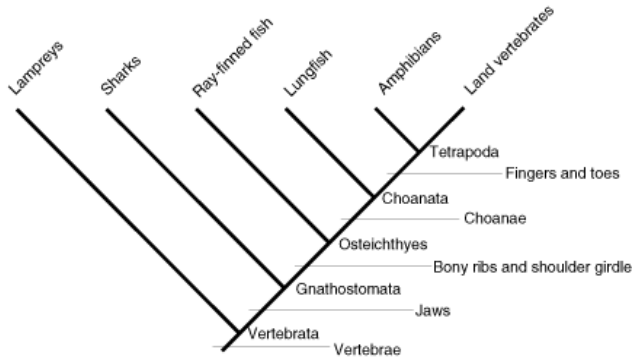
❖ Gradualism: Idea that evolution occurs slowly and gradually over time

❖ Punctuated Equilibrium: Long stable periods of equilibrium interrupted by brief periods of rapid evolution.

❖ Rate of Evolution: The higher the biodiversity and variation, the faster the rate of evolution

❖ Types of selection:
Stabilizing - individuals in the center curve have the advantage
Directional - individuals at one end of the curve have the advantage
Disruptive- individuals at both ends of curve are favorable

❖ Cladogram - a diagram depicting patterns of shared derived characteristics of various organisms



Remember that when you read the cladogram, that the characteristics are related to the organisms to the right of the characteristics. Ex. Organisms with fingers and toes are amphibians and land vertebrates

❖ Levels of classification- Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species
(broadest) → (smallest)

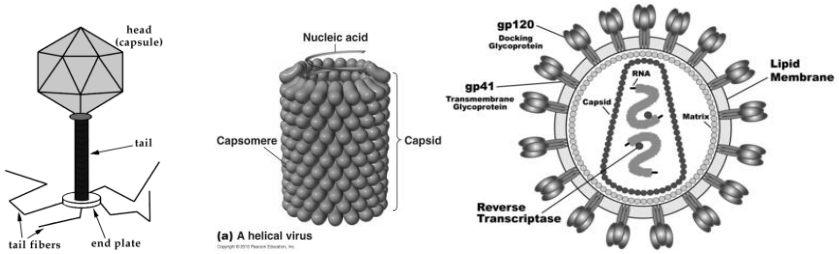
❖ Domains -

1. Achaea - ancient prokaryotes (archaebacteria)
2. Eubacteria - more advanced prokaryotes; "true" bacteria
3. Eukarya - eukaryotes

❖ Kingdoms- **Use your SB3b Matrix**

1. Archaebacteria - prokaryotes domain – archae
2. Eubacteria - prokaryotes domain – eubacteria
3. Protista - eukaryotes
4. Fungi – eukaryotes; ALL Heterotrophic
5. Plants – eukaryotes; ALL Autotrophic
6. Animals – eukaryotes

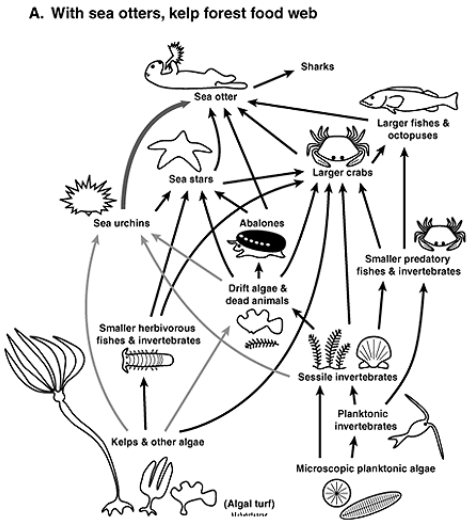
❖ Viruses - non-living but contain genetic material and protein layer. Cannot reproduce on their own and are NOT made of cells. Viruses are VERY SMALL = nanometers; (nm)



❖ Ecological levels of organization –

1. Biosphere – where life exists
2. Biome – a group of ecosystems that have the same climate and similar organisms
3. Ecosystem - all of the living things and nonliving parts of the environment.
4. Community – all the different species living together in a particular area.
5. Population – a group of individuals that belong to the same species in a particular area.
6. Organism – an individual living things.

❖ Food web - a series of different food chains



❖ Food chain - shows the flow of energy within an ecosystem. 10% of energy is passed onto each trophic, while 90% is lost as heat energy that is used for life processes.

- Trophic Levels -
  1. Producers (autotrophs) - make own food from the sun or chemicals.
  2. Herbivore (consumer) - eats only producers
  3. Carnivore (consumer) - eats only consumers
  4. Omnivore (consumer) - eats both producers and consumers
  5. Detrivores - feed off the remains of dead animals and plants Ex. Earthworm
  6. Decomposers – break down organic matter and release energy from it Ex. Bacteria and fungi

- Ecological pyramids –
  1. Energy pyramid - Rule of 10: Only 10% of energy transferred from one trophic level to another.
  2. Biomass pyramid – total amount of living material in a trophic level.
  3. Pyramids of number – The number of organisms in a trophic level.

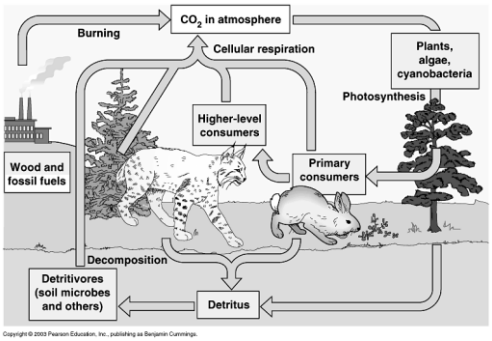
- Succession - the gradual and orderly process of change in an ecosystem
  1. Primary succession - No life has previously existed and there is no soil ex. New island formed by volcanic eruption. Pioneer species is usually lichens or mosses.
  2. Secondary succession – existing ecosystem is disturbed and a new ecosystem develops in the same place ex. Forest fire. Pioneer species is usually grasses or weeds.

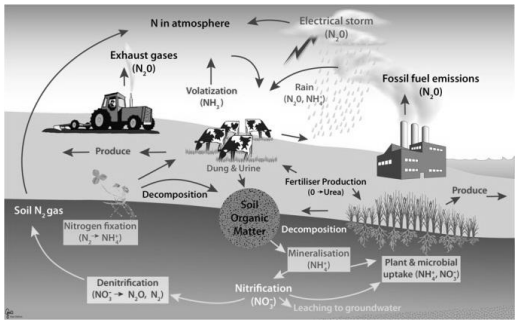
- Biomes

Biome Summary Chart

Biome	Location	Climate	Soil	Plants	Animals
Desert	midlatitudes	generally very hot days, cool nights; precipitation less than 10 inches a year	poor in animal and plant decay products but often rich in minerals	none to cacti, yuccas, bunch grasses, shrubs, and a few trees	rodents, snakes, lizards, tortoises, insects, and some birds. The Sahara in Africa is home to camels, gazelles, antelopes, small foxes, snakes, lizards, and gerbils
Tundra	high northern latitudes	very cold, harsh, and long winters; short and cool summers; 10-25 centimeters (4-10 inches) of precipitation a year	nutrient-poor, permafrost layer a few inches down	grasses, wildflowers, mosses, small shrubs	musk oxen, migrating caribuou, arctic foxes, weasels, snowshoe hares, owls, hawks, various rodents, occasional polar bears
Grassland	midlatitudes, interiors of continents	cool in winter, hot in summer; 25-75 centimeters of precipitation a year	rich topsoil	mostly grasses and small shrubs, some trees near sources of water	american grasslands include prairie dogs, foxes, small mammals, snakes, insects, varous birds. African grasslands includeelephants, lions, zebras, giraffes.
Deciduous Forest	midlatitudes	relatively mild summers and cold winters, 76-127 centimeters (30-50 inches) of precipitation a year	rich topsoil over clay	hardwoods such as oaks, beeches, hickories, maples	wolves, deer, bears, and a wide variety of small mammals, birds, amphibians, reptiles, and insects.
Taiga	mid- to high latitudes	very cold winters, cool summers,; about 50 centimeters (20 inches) of precipitation a year	acidic, mineral-poor, decayed pine and spruce needles on surface	mostly spruce, fir, and other evergreens	rodents, snowshoe hares, lynx, sables, ermine, caribout, bears, wolves, birds in summer
Tropical Rainforest	near the equator	hot all year round, 200-400 centuimeters (80-100 inches) of rain a year	nutrient-poor	greatest diversity of any biome; vines, orchids, ferns, and a wide variety of trees	more species of insects, reptiles, and amphibians than anyplace else; monkeys, other small and large mammals, including in some places elephants, all sorts of colorful birds

- Cycles of Nature



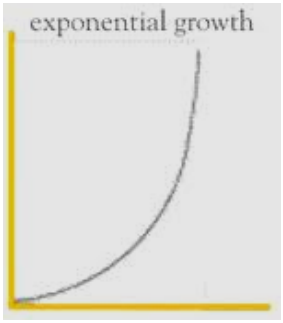


- Remember carbon cycle is basically cellular respiration cycling with photosynthesis. Also be sure to know process of Nitrogen fixation(conversion N gas to N solid), which is performed by nitrogen-fixing bacteria.

❖ Greenhouse effect - a buildup of carbon dioxide and other gases that traps the sun's rays, which can lead to global warming.

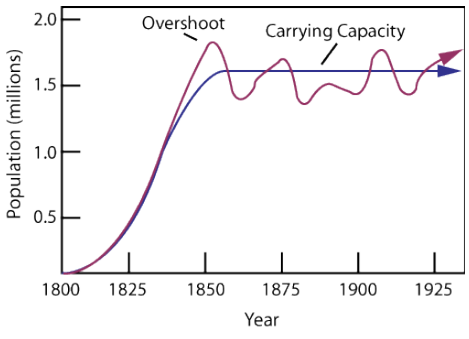
❖ Global warming - An increase in the average temperature of the biosphere caused from burning fossil fuels and deforestation, which increases CO_2 and other greenhouse gasses. These gasses are "like a blanket" covering the Earth.

❖ Types of Tropisms –
1. Gravitropism/Geotropism - movement of a plant due to gravity (plant up and roots down)
2. Thigmotropism - movement of a plant due to touch (like climbing vines)
3. Phototropism - movement of a plant due to sunlight
4. Hydrotropism- movement of plant due to water



❖ Types of behaviors –
1. Kinesis - movement in response to a stimulus
2. innate - behavior born with aka instinct
3. Classical conditioning (learned behaviors)
4. Mimicry, estivation, camouflage, hibernation, migration, etc.

❖ Symbiosis: Any relationship in which two species live closely together
Mutualism - both species benefit (often product of co-evolution)
Commensalism - one species benefits and the other species is unaffected
Parasitism - one species benefits and the other species is harmed



❖ Population density: the number of individuals in a defined area.

❖ Exponential Growth: population growth continues to get faster and faster until it is out of control. J-shaped.

❖ Logistic Growth: When population shows down after it reaches the carrying capacity. S-shaped
Carrying capacity - maximum population size an ecosystem can support. If population EXCEEDS carrying capacity, it may crash.