Biology TAKS Quick Review

Biology – the study of life

SCIENTIFIC METHOD:

1.) Observation 2.) Asking Questions

3.) Collecting Data: Observing, Measuring, Sampling & Organizing Data

4.) Hypothesizing: Forming Hypothesis & Predicting

5.) Experimenting: Conducting Controlled Experiment & Analyzing Data

Independent Variable – the one factor that is changing between the control group and the experimental group.

Dependent Variable – a factor that changes during the experiment; driven by the independent variable.

6.) Drawing Conclusions: Modeling, Inferring, Forming a Theory

Theory – a broad and comprehensive statement of what is thought to be true.

Characteristics of Life: metabolism, reproduction, growth, movement, responsiveness, complex organization

Branches of Biology: *Zoology* – study of animals; *Botany* – study of plants; *Microbiology* – bacteria & protests; *Biochemistry* – study of chemical nature of life; *Ecology* – study of the interactions among organisms in ecosystems; *Entomology* – study of insects

EVOLUTION – all organisms are related by common ancestry.

Natural Selection – a mechanism for how evolution occurs.

1. Survival of those offspring best adapted to the conditions in which they live:
   a. There is genetic variation in every population.
   b. Organisms (individuals) compete for limited resources.
   c. Organisms (individuals) produce more offspring than can survive.
   d. Organisms (individuals) pass genetic traits on to their offspring.
   e. Organisms (individuals) with the most beneficial traits (i.e. adaptations), are more likely to survive to the age of reproduction and thus pass their genes on to the next generation.
   This is called NATURAL SELECTION.
   Thus, nature is selecting offspring and shaping the evolution of species.

2. **Charles Darwin** and **Alfred Wallace**, 19th century biologists, formulated the concept of natural selection independent of each other (although Darwin was first).

3. IN SOME CASES THE BENEFICIAL TRAIT IS BEHAVIORAL: This is true for both instinctive and learned behaviors. In the case of humans, as a result of the evolution of our brains, learning and behavior -- and thus culture -- are particularly important to the survival of our species.

Artificial Selection – humans select traits in offspring (e.g. domesticated animals, farm crops)

Speciation – the development of a new species from another species.

Phylogeny – the evolutionary history of a species or group of related species. (e.g. dogs, foxes, coyotes, wolves)

Adaptation – inherited characteristics that enhance an organism's survival & reproduction in specific environments.

Behavior – what an animal does and how it does it.

Homologous structures – animal structures with a common structural theme (e.g. forelegs, wings, flippers & arms in mammals).

Molecular homologies – organism sharing molecular characterisitics (e.g. DNA & RNA found in all life forms; universal genetic code).

BIOCHEMISTRY

Organic molecules – molecules, in living things, which contain carbon.

A. The use of repeating units:
   1.) Monomer – single repeating unit in a larger molecule (polymer)
   2.) Polymer – large molecule made of monomers
      a.) Four Types
         1. **Carbohydrates** – used for energy storage (glucose, starch, cellulose)
         2. **Proteins** – used as enzymes, hormones & structural molecules; made of chains of amino acids
            a.) **Enzymes -** organic catalysts which speed up chemical reactions by lowering activation energy of the reaction, thus allowing organisms to survive at lower body temperatures.
         3. **Lipids** – used as energy storage, and as hormones (fats, oils, waxes, & steroids)
         4. **Nucleic Acids** – the genetic material of the cell (DNA & RNA)

CELL: Cytology – study of cells.

Cell Theory – ***1.)*** All living things are composed of cells. ***2.)*** Cells are the basic unit of life. ***3.)*** All cells come from preexisting cells.

Cell Size: small to maximize surface area to volume ratio (SA/V) for regulating internal cell environment. As a cell's volumes increases, the SA/V decreases.

Cell (plasma) membrane – composed of fluid-like phospholipid bilayer, proteins, and glycoproteins.

Cell Wall – outside of cell membrane in some organisms. Composed of carbohydrate (e.g. cellulose, in plants; or chitin, in fungi) or carbohydrate derivative (e.g. peptidoglycan, in bacteria).

Cytoplasm – material outside the nucleus.
1. Site for metabolic activity.
2. **Cytosol**: solutions with dissolved substances such as glucose, CO_2, O_2, etc.
3. **Organelles**: membrane-bound subunits of cells with specialized functions)

Eukaryotic cells – complex cellular organization, larger than prokaryotics, and have membrane-bound organelles:
1.) **Nucleus** – contains DNA, chromosomes control cellular activities via genes)
2.) **Chloroplast** – site of photosynthesis (light reaction & Calvin cycle)
3.) **Mitochondrion** – site of respiration (ATP production: Kreb's cycle & electron transport chain).
4.) **Vacuole** – general storage and space filling structure.
5.) **Ribosome** (no membrane) – site of protein synthesis.
6.) **Smooth endoplasmic reticulum (ER) –** free of ribosomes; synthesis of lipids, metabolism of carbohydrates & detoxification of drugs poisons.
7.) **Rough ER –** covered with ribosomes; making secretory proteins (glycoproteins).
8.) **Golgi body –** modifies, stores & ships products of the ER to other areas of the cell.
9.) **Lysosome –** vesicles of hydrolytic enzymes that the cell uses to digest macromolecules, dead organelles and dead cells.

Prokaryotic cells – bacteria; simpler cellular organization with no nucleus or other membrane-bound organelles (they do have ribosomes).

ENERGY & LIFE

Sun: organisms use the sun's energy (directly or indirectly) to become and remain in an organized state.

Metabolism – series of chemical reactions involved in storing (anabolism) or releasing (catabolism) energy, much of this through the use of enzymes.

Adenosine triphosphate (ATP) – a high-energy molecule that is used by cells. Energy is released by the breaking phosphate bonds in ATP.

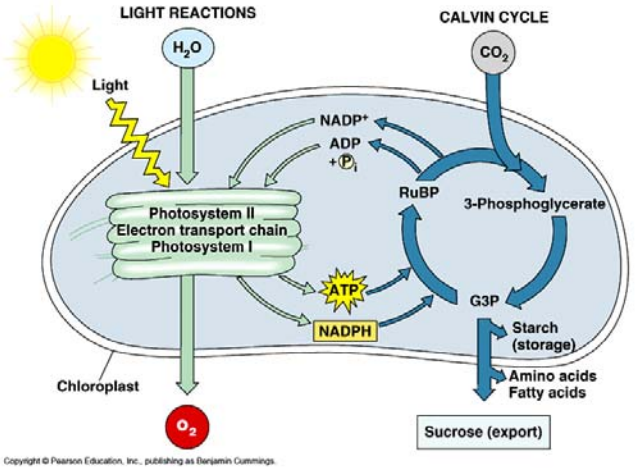
Photosynthesis – sunlight or radiant energy is captured by chlorophyll and carotenoid pigments (found in cytoplasm in prokaryotes and chloroplasts in eukaryotes) and converted into sugars (e.g. glucose).

Formula: $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

Light Reaction: 1. Carried out by molecules in the thylakoid membrane.
2. Convert light energy to the chemical energy of ATP & NADPH.
3. Splits H_2O for electrons & releases O_2 into atmosphere.

***Calvin Cycle*:** 1. Takes place in stroma.
2. Use ATP & NADPH to convert CO_2 to the sugar G3P.
3. Returns ADP & $NADP^+$ to light rxn

Photosynthesis

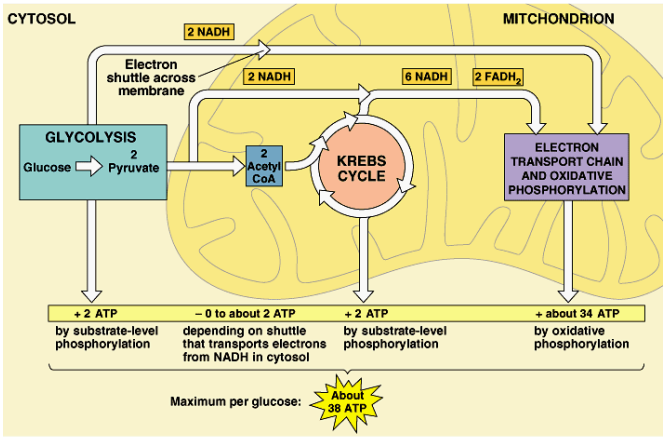


Cell Respiration – glucose is broken down in the mitochondria of eukaryotic cells, and cytoplasm of prokaryotes, to produce ATP.

Formula: $C_6H_{12}O_6 + 6O_2 + 6H_2O \rightarrow 6CO_2 + 12H_2O$

A. With O_2 the energy yield from one molecule of glucose is about 36 ATP; without O_2 the energy yield from one glucose is 2 ATP (via glycolysis).

B. In the absence of O_2 a cell needs to perform a process known as fermentation, despite the fact that there is no net gain of energy.
1. **Lactic Acid Fermentation:** produces 2 lactic acid molecules (in yogurt, and anaerobic muscle use)
2. **Alcoholic Fermentation:** produces 2 molecules of ethanol & 2 molecules of CO_2 (carried out in yeast to make beer, wine)



CELL TRANSPORT

Passive Transport – no energy to move substances.

1. **Diffusion** – movement from an area of high to low concentration.
2. **Osmosis** – diffusion of water across a semi-permeable membrane; from high to low concentration.

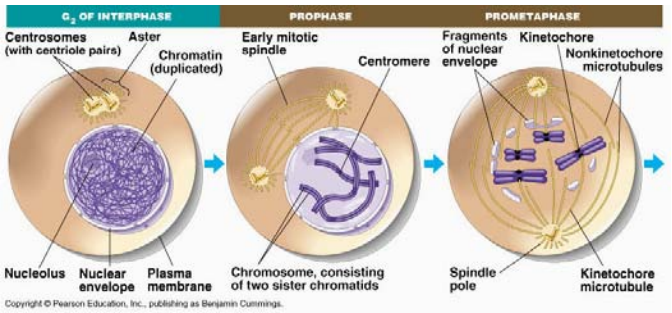
Active Transport – energy (ATP) is used to move substances from low to high concentration; moves against concentration gradient (e.g. sodium-potassium pump, proton pumps)

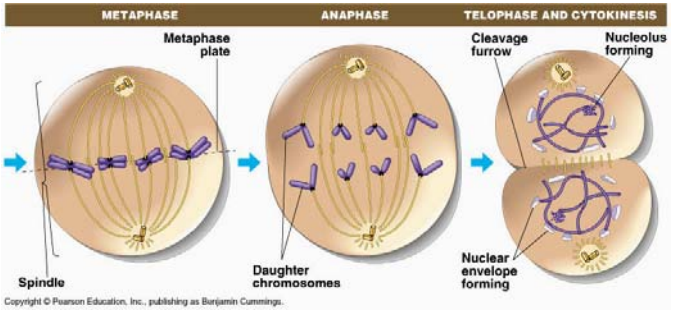
CELL REPRODUCTION

Mitosis – division of nuclear material.

Cell Cycle:

1. ***Interphase*** (G_1 –growth, S – DNA copied, G_2 – prep for mitosis) – main part of cell's life; 3 phases.
2. ***Prophase*** – chromosomes condense and organize; nuclear membrane & nucleoli disappear, spindle fibers assembled and attach to centromeres of duplicated chromosomes.
3. ***Metaphase*** – spindles line up duplicated chromosomes along equator of cell (metaphase plate); one spindle to each half or chromatid of duplicated chromosome.
4. ***Anaphase*** – centromere of each duplicated chromosome is separated and sister chromatids are pulled apart.
5. ***Telophase*** – chromosomes uncoil, nucleoli reappear, cytokinesis occurs and two genetically identical daughter cells are produced.
6. ***Cytokinesis*** – division of remaining cellular contents of the cytoplasm.





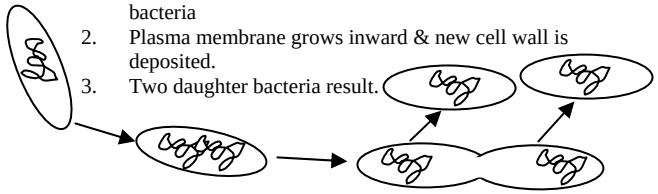
ORGANISMAL REPRODUCTION & MEIOSIS

Sexual reproduction – the union of gametes from two parents; results in greater genetic variation.

Meiosis – reduces chromosome number by half and results in new genetic combinations in gametes (which is enhanced further by crossing over). To insure proper chromosomal numbers in the **zygote (fertilized egg)**, each gamete must have half or **haploid (n)** of the original **diploid (2n)** amount of DNA.

Binary Fission – bacterial cell division.

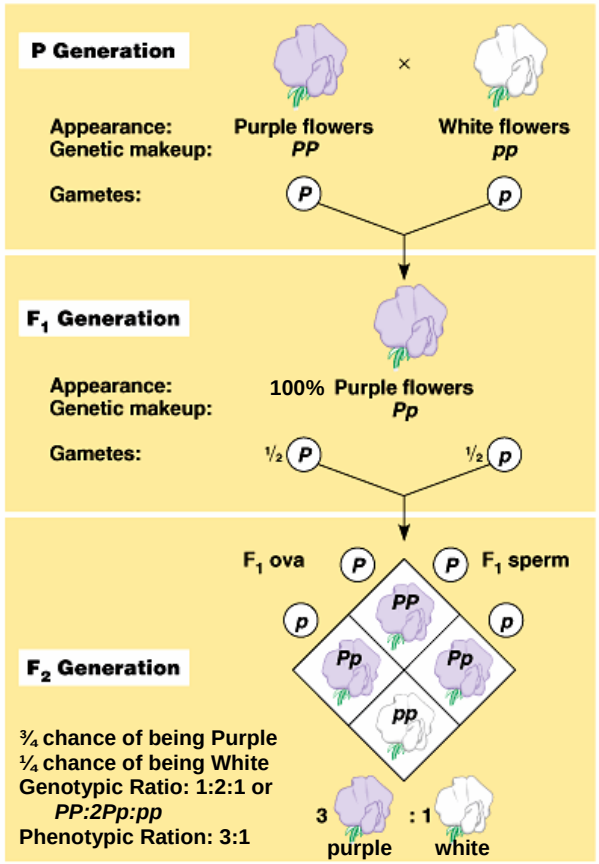
1. Chromosome replicates & moves to opposite ends of bacteria
2. Plasma membrane grows inward & new cell wall is deposited.
3. Two daughter bacteria result.



GENETICS – the study of traits and their inheritance.

Gregor Mendel – discovered basic principles of heredity by breeding garden peas in carefully planned experiments. Developed two laws using statistics to analyze results of crosses involving distinguishing traits of garden peas.

1.) Law of Segregation – the two alleles for a character are packaged into separate gametes. Developed by Mendel using single-trait crosses.

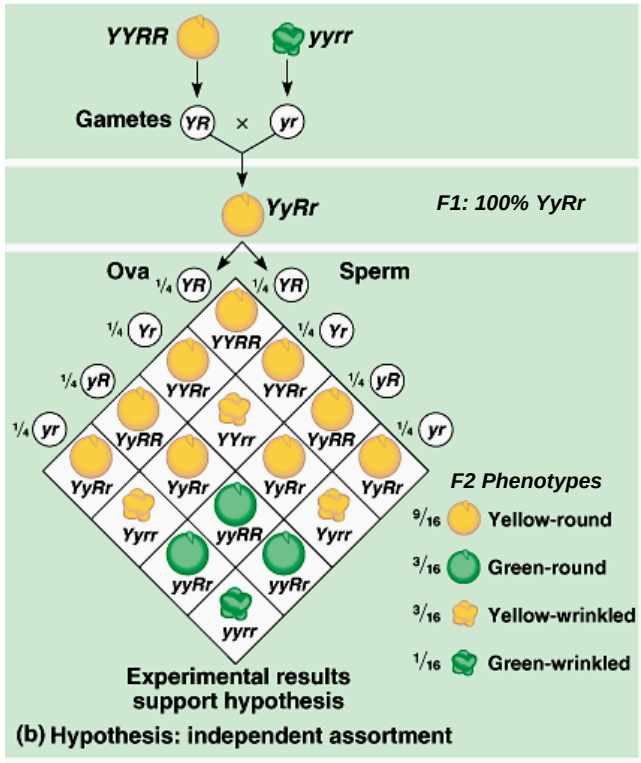


Mendel's 1st Conclusions: Discrete factors (now known as genes) were responsible for the traits and these factors (genes) were paired, separated (which occurs during meiosis) and recombined (during fertilization). Alternate forms of genes exist called alleles. The F1 individuals had two alleles, their genotypes consisted of a dominant & recessive allele (e.g., *Pp* with *P* for purple and *p* for white flowers). Thus the F1 offspring were hybrids. Their phenotype (physical appearance) was similar to only one of the original parents, the one with the dominant trait (purple flowers).

2. Law of Independent Assortment – each pair of alleles segregates into gametes independently. Alleles for one trait or gene did not effect the inheritance of alleles for another trait.

Mendel Updated:

A. Genes are found on chromosomes, and thus multiple traits assort independently as long as they are located on different chromsomes. Mendel studied traits in peas that were each on separate chromsomes. Genes on the same chromosome are linked and thus will not normally assort independently.

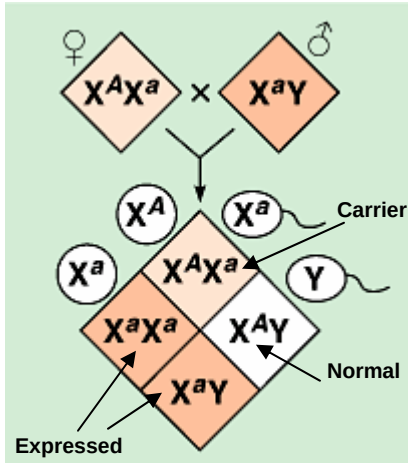


B. Interactions Between Alleles

1. **Complete dominance –** one allele dominates another allele.
   a.) **R** – this trait is called **dominant** and shows up with either two alleles **RR (homozygous dominant)** or one allele Rr heterozygous.
   b.) **r** – this trait is called **recessive** and is expressed with one allele **rr (homozygous recessive)**
   c.) **Human Disorders:** *1.) Huntington's Chorea:* Dominant allele; *2.) Dwarfism:* Dominant allele; *3.) Sickle Cell Anemia:* Recessive allele; *4.) Cystic Fibrosis:* Recessive allele
2. **Incomplete Dominance** – neither allele is expressed fully.
3. **Codominance** – both alleles are expressed fully.
4. **Multiple Alleles** – more than two alleles for a gene are found with a population (e.g. blood type)
5. **Epistasis** – one gene alters the affect of another gene.
6. **Polygenic Inheritance** – many genes contribute to a phenotype.

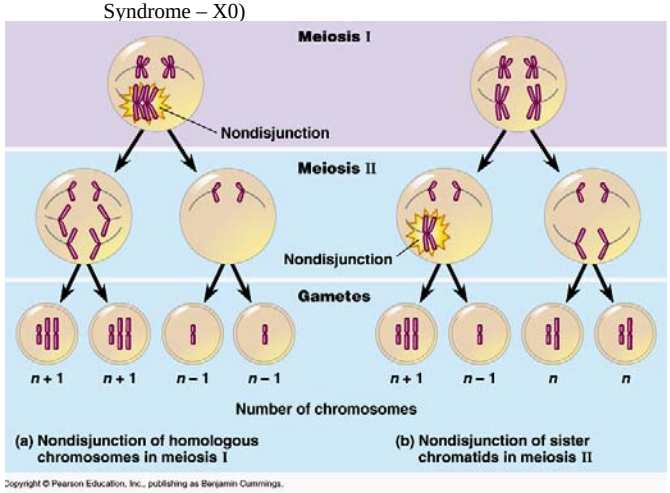
7. **Pleiotropy** – one gene can affect several phenotypes.
8. **Environment Influences** – genotype and environment interact to form a phenotype (e.g. diet and genotype affects body heighth)

Sex determination – controlled by sex chromosomes X & Y
Autosomes – non-sex chromosomes. (44 in humans +2 sex chromosomes)
Sex-linked traits – genes located on the sex chromosomes
Sex-linked Traits: In humans, the Y chromosome contains the determinant for maleness, the X contains many genes. If a male gets a recessive (or dominant) allele on the X chromosome from his mother, he will express the trait. Therefore males are frequently afflicted with X-linked disorders. A female must inherit a recessive allele from both parents in order to express a recessive X-linked disorder.
Sexlinked Human Disorders: 1.) Colorblindness & hemophilia; both are recessive alleles on the X chromosome.

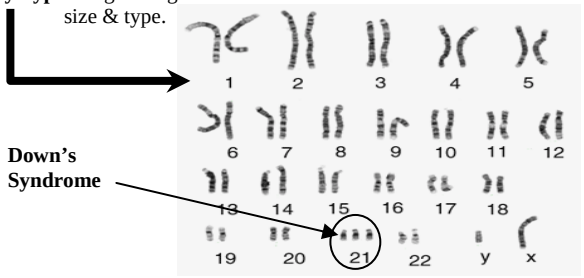


Sex-linked on the X chromosome

Nondisjunction – an accident of meiosis or mitosis, in which the members of a pair of homologous chromosomes or sister chromatids fail to move apart properly (e.g. trisomy 21 or Down's Syndrome, Klinefelter Syndrome – XXY, Turner Syndrome – X0)



Karyotype – organizing the chromosomes of a cell in relation to number, size & type.



MOLECULAR GENETICS

Gene Functions: 1.) To be preserved and transmitted. 2.) To control various biological functions through the production of proteins (e.g., large, complex sequences of amino acids) and RNA.

Nucleic Acids:

1.) Deoxyribonucleic acid (DNA).
- -nucleic acid of chromosomes (contains genes in base sequence)
- -made of nucleotides that have 3 subunits: Sugar (deoxyribose in DNA; ribose in RNA), Phosphate & a Nitrogen base
- -contains 4 nitrogen bases: *Adenine (A), Thymine (T), Guanine (G) & Cytosine (C)*
- -double helix (spiral staircase)
- -sides formed by repeating sugar-phosphate groups from each nucleotide
- -horizontal portions (e.i. steps) formed by bonds involving **A with T, or C with G**
- -Hydrogen bonds connect nitrogen bases together on the horizontal portions of DNA

2.) Ribonucleic acid (RNA) – made in the nucleolus of nucleus
- -single strand of nucleotides
- -consists of A, C, G, and **Uracil (U)**
- -Uracil (U) replaces Thymine (T) in RNA
- -3 types: **1.) mRNA (messenger RNA)–** contains instructions for building proteins
  - **2.) tRNA (transfer RNA)** – connects amino acids together during translation.
  - **3.) rRNA (ribosomal RNA)** – makes up a ribosome

Replication – DNA is copied from other DNA, *Helicase* enzyme unzips the hydrogen bonds holding the two sides of the helix, and *DNA Polymerase* enzyme pairs new nucleotides with the proper bases (e.g. A to T & G to C) on each separated side of the original DNA. *Proof Reading* enzymes then check for sequence mistakes.

Transcription – messenger RNA (mRNA) is copied from DNA, by unzipping a portion of the DNA, *and RNA Polymerase* enzyme adds nucleotides of RNA with the proper bases (A with U and C with G).

Translation – proteins are synthesized from mRNA by ribosomes which read from a universal triplet code (i.e. 3 bases = codon), and instruct tRNA (transfer RNA) to bring specific amino acids, which are linked together to make the protein. Occurs in the cytoplasm.

Mutation – any random, permanent change in the DNA molecule. Many are harmful, some have no effect and a few actually benefit the organism. Mutations provide the raw material for the evolution by adding to the variation in every population. Nature selects those mutations that are beneficial or adaptive in organisms to help shape the course of evolution.

LEVELS OF CLASSIFICATION:

Domain – broadest, consist of Bacteria, Archaea and the Eukarya domains. Bacteria domain contains Eubacteria kingdom. Archaea domain contains archeabacteria kingdom & Eukarya domain contains the kingdoms Protista, Plantae, Fungi & Animalia

Kingdom – at present 6 kingdoms; Eubacteria, Archaebacteria, Animalia, Plantae, Fungi, & Protista

Phylum - Phyla (plural). Each kingdom is subdivided into more specific groups called phyla. These organisms organisms contain all the kingdom characteristics plus some other specific ones that set each phylum apart from the others in the kingdoms.

Class - Each phylum is subdivided into classes.

Order - Each class is subdivided into orders.

Family – Each order is subdivided into families.

Genus - Each family is subdivided into smaller groups called genera.

Species - Each genus is divided into species. Species is the most specific taxon in the system.

Scientific Name of an Organism: Used to avoid confusion between scientists all over the world by establishing a universal name for every organism. A scientific name of an organism contains two parts. The first part is the genus name and the second part is the species name. There are rules to writing a scientific name:

1.) The first letter of the ***Genus*** name **must be** capitalized.
2.) The first letter of the ***species*** name is **not** capitalized.
3.) Both names must be underlined or italicized.

Kingdom Characteristics:

Animalia - motile, multicellular, eukaryotic consumers (heterotrophic), no cell wall, nucleus & membrane bound organelles (e.g. man, dogs, insects worms).

Plantae - sessile, multicellular, eukaryotic producers (autotrophic), cell wall containing cellulose, nucleus & membrane bound organelles (e.g. ferns, grasses, mosses)

Fungi - sessile, multicellular, eukaryotic decomposer (saprophytic), cell wall made of chitin, nucleus & membrane bound organelles (e.g. mushrooms, yeast, mold)

Protista – unicellular eukaryotes, may be producers (e.g. euglena, algae) or consumers (e.g. paramecium & amoeba)

Eubacteria – prokaryotic, cell wall containing peptidoglycan & single chromosome, unicellular, heterotrophic & autotrophic (photosynthetic & chemosynthetic), (e.g. *E. coli*, Anthrax, *Salmonella*)

Archeabacteria – prokaryotic, cell wall does NOT contain peptidoglycan, single chromosome, unicellular, unicellular, heterotrophic & autotrophic (photosynthetic & chemosynthetic), RNA sequences similar to eukaryotes, live in extreme environments: thermal vents, salt lakes & animal intestines, (e.g. methanogens, extreme halophiles, thermoacidophiles)

ECOLOGY

Producers – called autotrophs, produce their own food through either photosynthesis or chemosynthesis.

Consumers – called heterotrophs, eat material that is made by producers, or other consumers.

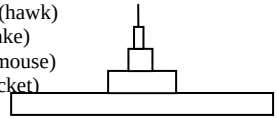
Decomposers – called saprophytes, break down dead organisms and return nutrients to the soil, thus recycling the elements necessary for life. (e.g. bacteria, fungi)

Food Chain – illustrates the fact that smaller organisms are eaten by larger organisms, who in turn are eaten by even larger organisms (e.g. grass → mouse → snake → hawk).

Food Web – a more accurate view that accounts for the fact that many organisms will eat a large variety of other organisms, forming an interconnected web (intertwined food chains).

Trophic Levels – based upon what an organism does for food ("feeding level"). An organisms place is determined by the highest level that it eats.

5. **Quaternary Consumers** (hawk)
4. **Tertiary Consumers** (snake)
3. **Secondary Consumers** (mouse)
2. **Primary Consumers** (cricket)
1. **Producers** (plant)



Energy & Biomass Pyramids: In both, the producers are the largest group, and they appear as the base of the pyramid. The **Energy Pyramid** is used to illustrate that each organism is able to harvest **only 10%** of the energy of the organism it eats (thus an organism must eat 10 kg of meat to harvest the same amount of energy from 1 kg of grain). The **Biomass Pyramid** is used to illustrate the size of each of the groups of organisms in an ecosystem.

Water Cycle: Water enters the atmosphere through **evaporation**, and transpiration (evaporation through the leaves in plants); **condensation** of the water molecules forms clouds; water then returns to earth as **precipitation** (rain, sleet, snow, etc.); water is then absorbed into the groundwater, enters lakes, rivers and oceans – cycles starts over.

Carbon Cycle: Carbon in the atmosphere (as CO_2) is absorbed by plants & algae for photosynthesis; the carbon becomes a part of these producers, as well as the consumers who eat them; when all these organisms die they are broken down by decomposers who release CO_2 into the atmosphere. Cellular respiration also releases CO_2 into the atmosphere.

Nitrogen Cycle: N_2 gas in the atmosphere is absorbed by nitrogen-fixing bacteria in the soil (in the roots of legumes) where the triple covalent bond is broken – the nitrogen becomes part of producers, as well as the consumers who eat them – consumers release nitrogenous wastes which are broken down by bacteria in the soil – when all these organisms die they are broken down by decomposers who release nitrogen into the soil – some soil bacteria (denitrifying bacteria) ultimately release N_2 from these processes back into the atmosphere.

Populations – all of the organisms of a single species in a given area.

Community – all of the organisms of all the different species in a given area. This is an important ecological concept in that organisms have an effect on other organisms in their environment in both the large scale and the small (e.g. intestinal bacteria, parasites).

Ecosystem – All of living (biotic) and non-living (abiotic) things in a given area. Organisms also have an effect on the non-living parts of their environment (e.g. plants greatly increase the amount of O_2 gas in the atmosphere), and vice versa.

Predation – an interaction between species in which one species, the predator (e.g. coyote), eats the other, the prey (e.g. rabbit).

Parasitism – a symbiotic relationship in which the symbiont (parasite) benefits at the expense of the host by living either within the host (as an endoparasite) or outside the host (as an ectoparasite).

Commensalism – symbiotic relationship in which one organism (the symbiont) benefits but the host is neither helped or harmed.

Mutualism – a symbiotic relationship in which both organisms benefit.

Biosphere: is the planet as a whole. It is made up of several biomes (regions with characteristic types of ecosystems: desert, rain forest, tundra, deciduous forest, savanna, coniferous forest, etc.). It is so called because the effect of organisms on their environment can have global consequences (e.g., plants on O_2 levels in the atmosphere).

Global Warming (The Greenhouse Effect): One of the reasons life can survive at all on Earth has to do with the way gasses in the atmosphere retain some of the heat energy from the sun. Certain gasses, such as CO_2, released from the burning of fossil fuels, build up in the atmosphere trapping more heat energy than can be released. This is resulting in a rise in the average global temperature. This may ultimately result in the melting of the polar ice caps, and severe climate changes, which can ultimately have social & political consequences as agricultural regions lose their ability to harvest crops.

Ozone Layer: This is a different phenomenon in which O_3 gas, known as ozone, absorbs energy from UV (ultra violet light) radiation and is converted into O_2 gas. O_2 gas is then transformed into O_3 gas (ozone) by UV radiation. This recycling process protects organisms from the harmful mutagenic effects of UV radiation. CFC's (chloroflurocarbons, such as freon in air conditioners) destroy the ozone layer, thus increasing the risk of skin cancer.

<u>BODY SYSTEMS</u>:

Skeletal System:
- -206 bones
- *1. Axial skeleton* – skull, spine & ribcage
- *2. Appendicular skeleton* – shoulders, arms, & hands, hips, legs & feet
- -provides support, & mineral storage
- -provides organ protection and site for muscle attachment
- -produces blood cells in the marrow
- <u>EQUIVALENTS</u>: cell walls of monerans & plants, shells of mollusks, hydrostatic skeletons of cnidarians, exoskeletons of arthropods

Immune (Lymphatic) System:
- -fluids & nutrients released by diffusion from the bloodstream are returned to the blood via the tubes of this system.
- -these fluids are then filtered through lymph nodes where pathogens (disease-causing agents) are removed and destroyed.
- -white blood cells destroy pathogens
- -skin and mucous membranes serve as the first line of defense in trapping pathogens
- <u>EQUIVALENTS</u>: xylem & phloem of plants, open circulatory systems of arthropods

Integumentary System:
- -Skin, hair & finger nails
- -barrier for pathogens
- -regulates body temperature through sweating & blood flow
- -production of vitamin D
- <u>EQUIVALENTS</u>: cell walls of monerans, & plants, bark of trees

Circulatory System:
- -Heart & blood vessels (Aorta, arteries, artioles, capillaries, venules, veins, Vena Cave)
- -blood carries many essential materials throughout the body: H_2O, O_2, CO_2, nutrients, hormones, etc.
- -arteries carry blood away from heart, veins carry blood to heart
- -the action of the heart pumps the blood through the blood vessels.
- -4 chambered heart separates the oxygenated blood (from the lungs) and the deoxygenated blood (on the way to the lungs), thus maximizing the amount of O_2 that reaches the body tissues.
- -veins have valves to prevent back-flow of blood
- <u>EQUIVALENTS</u>: xylem & phloem of plants, open circulatory systems of arthropods

Muscular System:
- -over 600 muscles
- -many arranged in antagonistic pairs: muscles that work opposite of each other (e.g., flexor = bicep & extensor = tricep)
- -skeletal muscle contraction is controlled by the nervous system
- -moves the body, maintains body position and organ volume, and generates body heat
- -muscle contraction increases blood flow
- -3 types of muscle tissue:
  1.) Cardiac muscle (heart)
  2.) Smooth muscle (organ linings)
  3.) Skeletal (attached to bone)
- <u>EQUIVALENTS</u>: cilia & flagella of protests & monerans, mollusk shell-closing muscles

Endocrine System:
- -Hypothalamus (master gland), pituitary, thyroid, parathyroid, thymus, adrenal, ovaries, testes, pancreas
- -Slow control of the body's functions through chemical means (via hormones). These hormones travel through the blood stream, and control everything from growth & development to blood-sugar levels.
- <u>EQUIVALENTS</u>: plant growth hormones & insect hormones (used in metamorphosis)

Nervous System:
- -Central Nervous System (CNS): brain & spinal cord
- -Peripheral Nervous System (PNS): cranial, spinal & other peripheral nerves
- -Controls body movement, peristalsis & digestion of food, interpretation of sensory input, heartbeat, breathing
- -Sympathetic nerves: controls body reactions to stress
- -Parasympathetic nerves: slows down the body in the absence of stress
- <u>EQUIVALENTS</u>: nerve nets of cnidarians, ganglia of worms

Respiratory System:
- -Epiglottis: closes off trachea when swallowing, larynx (voice box), trachea, bronchi, lungs (bronchioles & alveoli)
- -Controls the intake of O_2 and the release of CO_2 (which is a waste) from the blood.
- -Breathing rate increases during exercise ddue to a greater need for O_2, which is used to convert glucose into ATP
- -Pons and Medulla in brain stem are control centers for breathing.
- EQUIVALENTS: cell membranes of monerans & protist, skin of worms, plant leaf stoma, gills of fish, trachea system in insects & book lungs in scorpions & spiders

Excretory System:
- -Kidneys, ureters, urinary bladder, urethra
- -Blood is filtered of wastes in the kidneys. A balance of solutes and body fluids is thus regulated by the production and release of urine.

-Nephron: tubular excretory unit of a kidney
EQUIVALENT: cell membrane of monerans & protests, nephridia of annelids, green glands of arthropods

Reproductive System:
-Females: ovaries, fallopian tubes, uterus, vagina
-Males: testes, vas deferens, prostate & cowpers glands, urethra, penis
-Haploid (n) gametes are produced in the ovaries (ovum), and testes (sperm)
-Fertilization of the ovum by the sperm (thus producing the diploid [2n] zygote) occurs in the fallopian tubes.
-Implantation and development of the zygote (now a blastocyst) into an embryo and then a fetus, occurs in the uterus over a period of nine months (divided into 3 trimesters).
-The greatest period of development occurs in the 1st trimester, during which the embryo/fetus is the most vulnerable to birth defects by chemicals (teratogens). The 3rd trimester is largely one of growth in the fetus, although some development still occurs (especially in the lungs).
EQUIVLAENTS: binary fission of monerans & protests, budding in yeast, flower pollination.

Digestive System:
-Primary Organs (through which food passes): mouth, pharynx (throat), esophagus, stomach, small intestine, large intestine, rectum, anus.
-Accessory Organs (provides digestive enzymes and, in the case of the liver, processes some of the food absorbed): salivary glands, liver, gall bladder, pancreas.
-Mechanical Digestion (mouth & stomach) the food gets broken into smaller pieces, but actual organic molecules remain the same.
-Chemical Digestion breaks down organic molecules (polymers) into monomers (subunits).
-Saliva: breaks down starches
-Pepsin: starts break down of proteins in stomach
-Bile: aids in digestion & absorption of fats
-Absorption of nutrients occurs in small intestines
-Water is absorbed from large intestines
EQUIVALENTS: cell membranes of monerans & protests, phagocytosis of amoeba, two-way digestive tract of cnidarians & flatworms, one-way digestive tracts of insects & vertebrates

INVERTEBRATES:

Porifera: sponges
Circulatory: none
Respiratory: none
Digestive: collar cells, & amebocytes
Reproductive: budding (regeneration) & gemmules (sexual)
Excretory: none
Nervous: none
Skeletal: spicules
Muscular: none

Cnidaria: jellyfish, hydra, sea anemone & coral
Circulatory: none
Respiratory: none
Digestive: gastrovascular cavity
Reproductive: budding, regeneration & sperm & eggs
Excretory: none
Nervous: nerve net found in mesoglea
Skeletal: none
Muscular: muscle cells

Platyhelminthes: flatworms: planaria, blood fluke, tapeworm
Circulatory: none
Respiratory: none
Digestive: mouth, pharynx & gastrovascular cavity
Reproductive: regeneration & hermaphroditic
Excretory: flame cells
Nervous: ladder-like nervous system
Skeletal: none
Muscular: muscle cells

Nematoda: parasitic roundworms
Circulatory: none
Respiratory: none
Digestive: mouth, intestine & anus
Reproductive: separate sexes
Excretory: excretory tubules & excretory pores
Nervous: circular brain & several longitudinal nerve cords
Skeletal: none
Muscular: longitudinal muscles

Annelida: segmented worms: earthworm
Circulatory: closed circulatory system, Aortic arches, dorsal & ventral blood vessel
Respiratory: skin
Digestive: mouth, pharynx, esophagus, crop, gizzard, intestine & anus
Reproductive: hermaphroditic
Excretory: nephridia (2 per segment)
Nervous: ventral nerve cord with a small anterior brain
Skeletal: none
Muscular: longitudinal & circular muscles

Mollusca: clams, snails, oysters, squid, octopus
Circulatory: open circulatory system with dorsal heart & sinuses
Respiratory: gills
Digestive: mouth, gut & anus
Reproductive: sexual
Excretory: nephridia
Nervous: brain & ventral nerve cord
Skeletal: some contain shells
Muscular: Anterior & Posterior adductor muscles

Arthropoda: insects, arachnids, shrimp, crayfish, barnacles
Circulatory: open circulatory system with dorsal heart & sinuses
Respiratory: gills, tracheal system, book lungs
Digestive: mouth, esophagus, crop, gastric ceca (grasshoppers), intestine, rectum & anus
Reproductive: sexual, some hermaphroditic, some parthenogenic
Excretory: malpighian tubules & green glands
Nervous: anterior brain & a ventral nerve cord
Skeletal: exoskeleton made of chitin
Muscular: complex muscular system

Echinodermata: starfish, sea urchins, sand dollars
Radial symmetry
Bilateral larval stage
Water vascular system controls tube feet
True coelomates
No brain & simple nervous system
Deuterostomes
Separate sexes
Skin gills for respiration

VERTEBRATE CLASSES:

Agnatha: lamprey & hagfish
Jawless
Cartilaginous skeleton
Notocord present
Lacks paired fins
2 chambered heart

Chondrichthyes: sharks, skates, rays, chimearas
Cartilaginous skeleton
Jaws
Paired fins
Gills
No operculum (gill covering)
No swim bladder
Internal fertilization
Placoid scales
2 chambered heart

Osteichthyes: bass, trout, perch, tuna
Bony skeleton
Jaws
External fertilization
Swim bladder
Operculum
Ctenoid scales
2 chambered heart

Amphibia: salamanders, newts, frogs, toads
Appendages adapted for land use
Larval stage
Respiration through lung & skins
Smooth moist skin
3 chambered heart

Reptilia: snakes, lizards, turtles, crocodiles
Dry, scaly skin
Respiration via lungs
Lay amniotic egg
Partially divided septum in heart

Aves: Owls sparrow, penguins, eagles, chickens
Feathers
Forelimbs modified as wings
Respiration through lungs
Air sacs aid in respiration
Endothermic
4 chambered heart
amniotic egg

Mammals: monotremes (egg laying), marsupial (pouch animals) & placental
Young nourished by mammary glands
Diaphragm
4 chambered heart
Hair
Endothermic
Single jaw bone
Specialized teeth
Evolution: Synapsids → Therapsids → Mammals

PLANTS:

Roots: -1st structure to grow
-anchor plant
-absorb water & nutrients
-root elongates at tips for growth
-root caps: protects and covers tip of root
-root hair: small hair like projections of root (increase surface area of root)

Specialized Roots
1. *storage roots:* stores large amounts of carbohydrates (sweet potatoes, carrot)
2. *prop roots:*extra sturdy & gives support, may be exposed at ground surface
3. *aerial roots:* fasten plants to trees, also absorb water/minerals from surface and air

Shoots: -above portion of plant
-consists of leaves, stems, flowers, fruits, etc.
-Stems: support leaves & flowers
contains vascular tissue xylem & phloem
-Leaves: primary site of photosynthesis (in **mesophyll** layer)
covered with **cuticle** (waxy outer covering to prevent water loss)
stomata (stoma): 1.) regulate water loss from plant
2.) composed of 2 guard cells
3.) Closed: guard cells deflated (not full of water), no water released
4.) Open: guard cells swell with water, water released
5.) Usually open during day, closed at night

Plant Tissues (how nutrients move through plants):

Xylem: -transports water & minerals
-forms long, narrow tubes
-water is absorbed through roots, pulled through plant and released through the stomata in leaves (transpiration)
-water moves into roots by osmosis; water is attracted to walls of tubes, as water evaporates out of the top of plant, water molecules get pulled up
-capillary action: describes the action of water moving through a plant

Phloem: -transports sugar and other organic molecules
-translocation: sugar made in leaves during photosynthesis is transported to other parts of plant
1.) usually to actively grow part of a plant
2.) sugar moves from high to low concentration

Ground Tissue: -surrounds vascular tissue (xylem & phloem)
-cells store carbohydrates
-cells have thick walls to support plant

Epidermis: outer layer of flattened cells that secrete protective waxy layer (cuticle)

Growth: **Meristem:** region of actively growing cells, grow in length
Primary growth: lengthening growth of roots & shoots (annuals…growth of one season)
Secondary growth: body stem thickens by producing new xylem & phloem
*Wood consists of mainly secondary xylem, secondary phloem forms inner part of the bark.

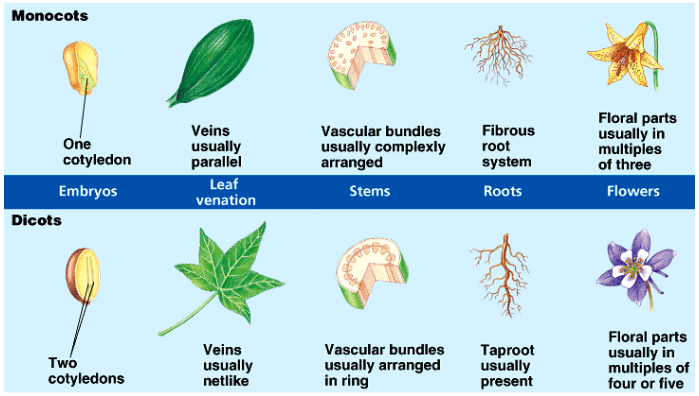
Growth Hormones:

Auxin: -stimulates elongation of plant cells
-causes cell walls to become more flexible, thus can grow longer.
-auxin hormone builds up on side of stem facing away from light, causing plant to bend and grow toward light.

Tropism: growth responses to different stimuli; such as gravity, light & touch.

Gibberellin: stimulates cell division and elongation of stem

Ethylene: stimulates fruit ripening & promotes dropping of leaves, fruit & flowers.



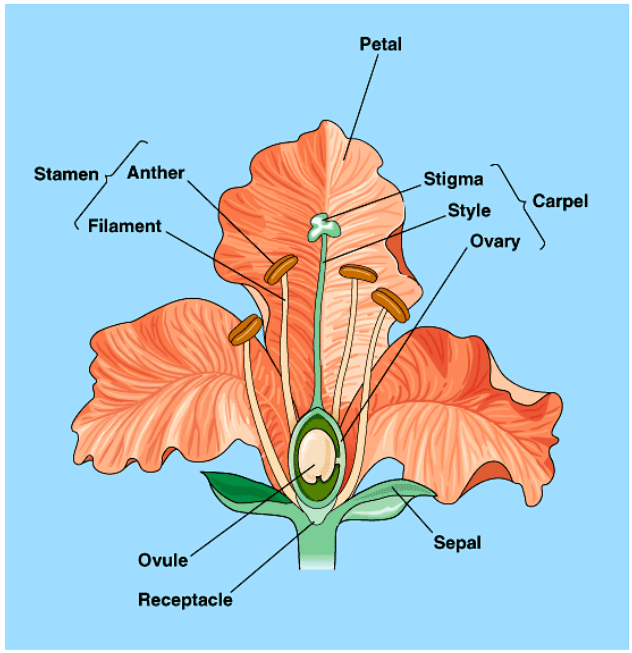
Reproduction: Pollen → lands on stigma → travels down to ovary → one sperm fertilizes ovum → other sperm fertilizes extra nuclei to form nutrition (endosperm) for embryo → fertilized ovule → develops into seed & ovary → develops into fruit

Pistil: female parts (contains stigma, style and ovary)

Stamen: males parts (composed of anther & filament)

Sepal: outside "petals", usually green & protect flower before it blooms

Petal: brightly colored to attract pollinators (insects, birds & bats)



BACTERIA:

Obligate aerobes – use O_2 for cellular respiration and cannot grow without it.

Facultative anaerobes – will use O_2 if it is present but can also grow by fermentation in an anaerobic environment.

Obligate anaerobe – cannot live in the presence of O_2

Table 27.1 Major Nutritional Modes

Mode of Nutrition	Energy Source	Carbon Source	Types of Organisms
Autotroph			
Photoautotroph	Light	CO_2	Photosynthetic prokaryotes, including cyanobacteria; plants; certain protists (algae)
Chemoautotroph	Inorganic chemicals	CO_2	Certain prokaryotes (for example, *Sulfolobus*)
Heterotroph			
Photoheterotroph	Light	Organic compounds	Certain prokaryotes
Chemoheterotroph	Organic compounds	Organic compounds	Many prokaryotes and protists; fungi; animals; some parasitic plants

Cocci – spherical shaped bacteria

Bacilli – rod shaped bacteria

Spirilla- spiral shaped bacteria

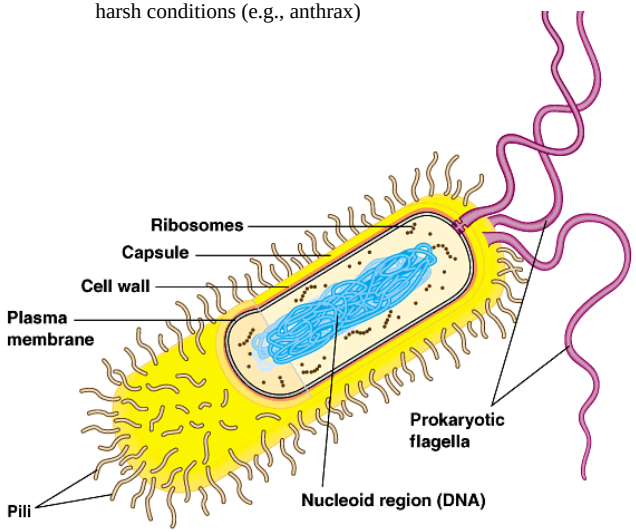
Pili – attachment structures on the surface of some bacteria

Nucleiod – region where the cell's DNA is located (not enclosed by membrane.

Capsule – jellylike outer coating of many bacteria

Flagella – locomotion organelles in some bacteria

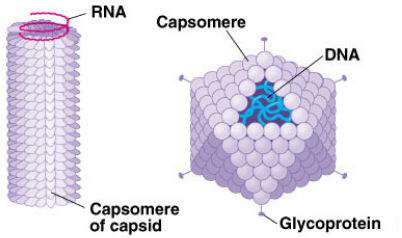
Endospores – some bacteria can form resistant cells that can withstand harsh conditions (e.g., anthrax)

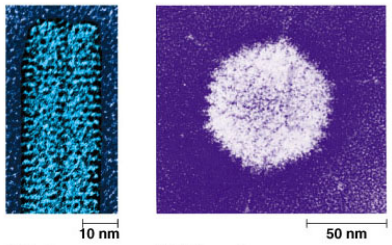


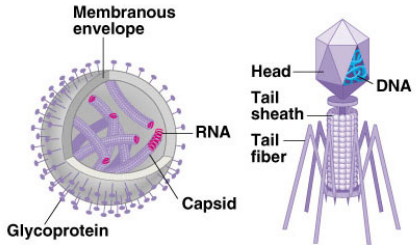
VIRUSES:

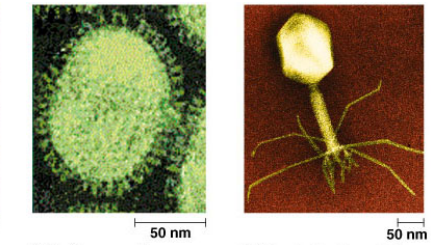
-a genome enclosed in a protective coat
-can only reproduce with a host cell
-bacteriophages (viruses that attack bacteria) reproduce using the lytic or lysogenic cycle
-animal viruses are diverse in their modes of infection & replication
-plant viruses are serious agricultural pests
-viruses are found in many different shapes & evolve easily

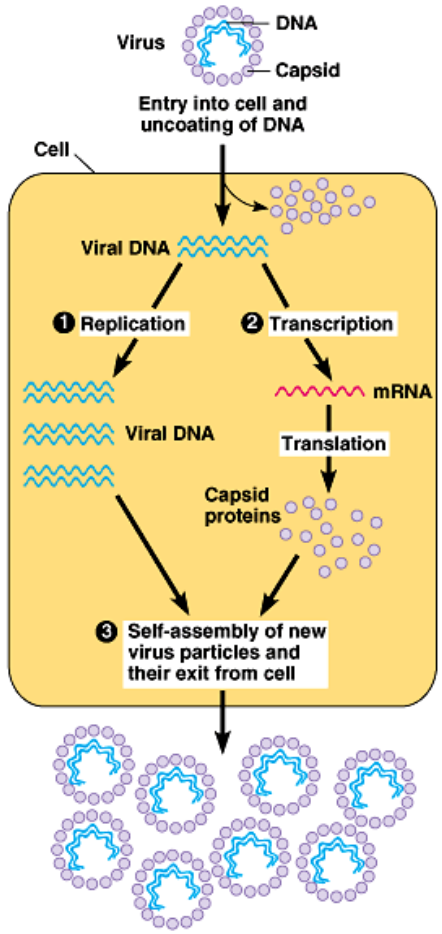
Viral Structure:

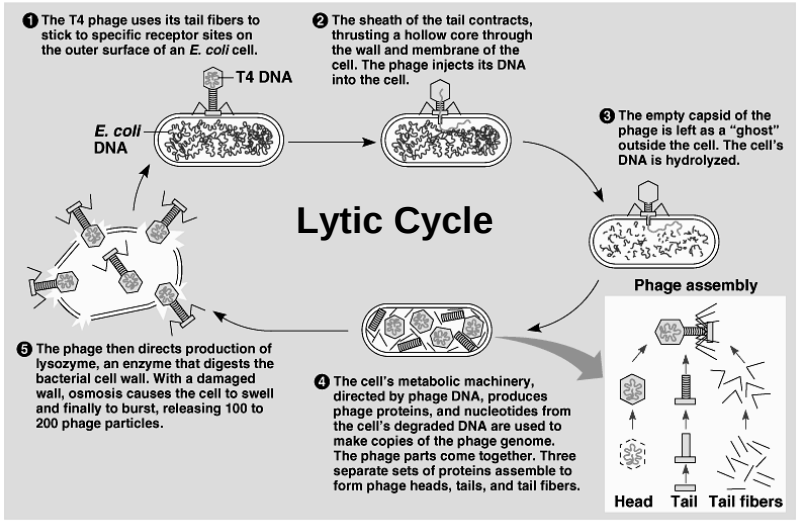


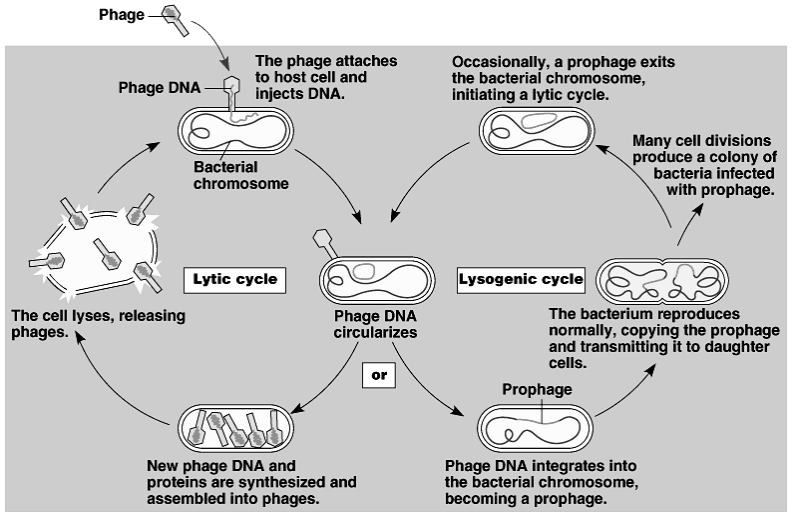


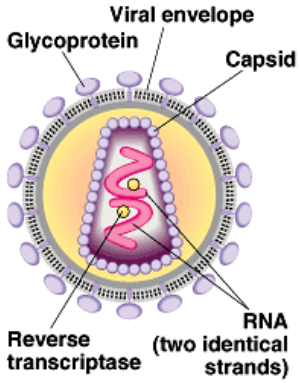




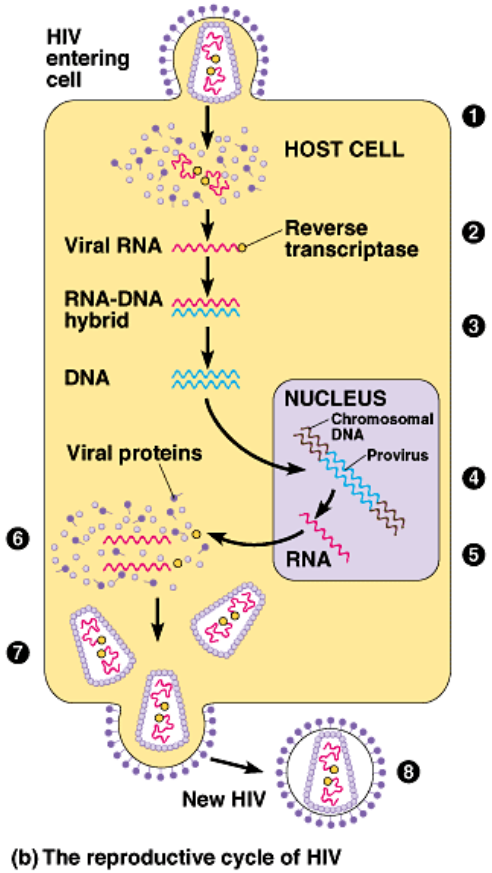








(a) The structure of HIV, the virus that causes AIDS



(b) The reproductive cycle of HIV

Retrovirus – a virus that contains RNA and reverse transcriptase, such as HIV