CORE CONCEPTS & TERMINOLOGY
SPRING 2011

CHAPTER 1: THE SCIENCE OF BIOLOGY

A] TERMINOLOGY:

1. **Metabolism** – the process by which all living things assimilate energy and use it to grow
2. **Homeostasis** – the maintaining of a relatively stable internal physiological environment in an organism
3. **Hypothesis** – a tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation
4. **Variable** – - a feature of an object or event that may differ over time or among the representatives of that object or event
5. **Theory** - a well-tested concept that can be used to explain causes of a broad range of related phenomena

B] CONCEPTS:

1. Properties of Life:
    a. What is life? What does it mean to "be alive"?
    b. Cellular organization; metabolism; homeostasis; growth and reproduction; & heredity
2. The Organization of Life – hierarchies of organization
    a. Cellular level: atoms, molecules, macromolecules, organelles, cells
    b. Organismal level: tissues, organs, organ systems, organism
    c. Population level: population, species, community, ecosystem
3. Stages of a Scientific Investigation (6 steps)
    a. Observation
    b. Hypothesis
    c. Predictions
    d. Testing
    e. Controls
    f. Conclusion
4. How to set up a controlled experiment

CHAPTER 2: THE CHEMISTRY OF LIFE

A] TERMINOLOGY:

1. **Atom** – the smallest particle into which a substance can be divided and still retain its chemical properties
2. **Proton** – major particle that makes up atoms that is found in the nucleus (center) of the atom and carries a positive electrical charge
3. **Neutron** – major particle that makes up atoms that is found in the nucleus (center) of the atom and carries no electrical charge

4. **Electron** – major particle that makes up atoms that is found orbiting the nucleus (center) of the atom and carries a negative electrical charge
5. **Element** – any substance that cannot be broken down into any other substance by ordinary chemical means
6. **Ion** –atoms in which the number of electrons does not equal the number of protons, causing them to have an electrical charge (+ or -)
7. **Isotope** – atoms that have the same number of protons but different numbers of neutrons
8. **Molecule** – a group of atoms held together by energy
9. **Hydrophilic** – molecules that form hydrogen bonds with water, allowing them to dissolve in water ("water loving" molecules)
10. **Hydrophobic** – molecules that do not form hydrogen bonds with water, making them insoluble in water ("water fearing" molecules)
11. **Solubility** – ability of a solid molecule to dissolve in a liquid
12. **pH** – a measure of the hydrogen ion (H+) concentration of a liquid, usually water
13. **Acid** – any substance that donates hydrogen ions to a solution (pH less than 7)
14. **Base** – any substance that removes hydrogen ions from a solution (pH greater than 7)

B] CONCEPTS:

1. The major subatomic particles (proton, electron, neutron) and their electrical charges
    a. The number of protons define the element
    b. The number of neutrons can vary somewhat (isotopes and radioactivity)
    c. The number of electrons can vary somewhat (ions)
    d. Opposite charges attract, like charges repel
    e. Bonding of atoms and molecules by sharing electrons (covalent bonds) vs. weak electrical bonding (hydrogen bonds)
    f. Some molecules have different electrical charges on different parts of the molecule (polar vs. non-polar molecules)
2. Water
    a. Hydrogen bonds give water unique properties
        i. water heats up slowly and holds its temperature for a long time when compared to other liquid molecules
        ii. ice is less dense than liquid water
        iii. when water vaporizes (turns from liquid to gas) it removes a lot of heat energy
        iv. water molecules want to "stick" to each other, causing such effects as the beading of water droplets and surface tension on the top surface of water
        v. substances that can make hydrogen bonds with water molecules (hydrophilic molecules) tend to dissolve in water while molecules that do not make hydrogen bonds (hydrophobic molecules) do not dissolve in water
    b. pH
        i. its relationship with hydrogen ions

ii. Scale goes from 0-14
iii. 7 is neutral
iv. below 7 is considered to be acid
v. above 7 is considered to be basic (or alkaline)
vi. the lower the pH, the more acidic the solution is
vii. the higher the pH, the more basic the solution is

CHAPTER 3: MOLECULES OF LIFE

A] TERMINOLOGY:

1. **Monomer** – relatively small or simple molecules that serve as the building blocks of longer and more complex molecules
2. **Polymer** – a molecule made up of long chains of similar subunits (monomers)
3. **Denaturation** – process that causes a protein molecule to unfold and lose its shape, thus destroying its ability to function

B] CONCEPTS:

1. Biological macromolecules and their building blocks
    a. concept of monomers and polymers
    b. 4 types = proteins, nucleic acids, carbohydrates, & lipids
2. Proteins
    a. Amino acids – the monomers (building blocks) for proteins
    b. Levels of protein structure – primary, secondary, tertiary, and quaternary structure
    c. The shape of a protein defines its biological activity
3. Nucleic Acids
    a. Nucleotides – the monomers (building blocks) of nucleic acids
    b. DNA and RNA basic structure as polymers of nucleotides
4. Carbohydrates
    a. Monosaccharides – the simplest carbohydrates and monomers (building blocks) for more complex carbohydrates (e.g. glucose & fructose)
    b. Disaccharides (e.g. sucrose & lactose)
    c. Polysaccharides
        i. Energy storage – starch (plants) & glycogen (animals)
        ii. Structural support – cellulose (plants) & chitin (animals)
5. Lipids
    a. Different types of lipids - fats & oils, phospholipids, and steroids
    b. Saturated vs. unsaturated fats & health implications

CHAPTER 4: CELLS

A] TERMINOLOGY:

1. **Cell** – the smallest unit of life
2. **Prokaryotic cell** – one of the 2 major kinds of cells. It lacks a nucleus and does not have an extensive system of interior membranes

3. **Eukaryotic cell** – one of the 2 major kinds of cells. It has an extensive system of interior membranes and membrane-bounded organelles (including a nucleus)
4. **Organelle** – a specialized structure within a eukaryotic cell within which particular cell processes occur

B] CONCEPTS:

1. The Cell Theory (3 parts)
    a. All organisms are composed of one or more cells
    b. Cells are the smallest living things
    c. Cells arise only by division of a previously existing cell
2. Major kinds of cells: Prokaryotic & Eukaryotic
    a. Similarities – plasma membrane, cytoplasm, central genetic molecule (DNA), ribosomes
    b. Differences – eukaryotic cells have a nucleus and other membrane bound organelles (much more internal complexity and specialization)
    c. Unicellular organisms can be prokaryotic or eukaryotic
    d. Multicellular organisms are all made up of eukaryotic cells
3. Cell structures
    a. the plasma membrane –
        i. consist of two layers of lipids (mainly phospholipids) and diverse proteins
        ii. controls movement of molecules into and out of the cell
    b. ribosomes – sites where protein molecules are manufactured in a cell
    c. cell wall – protective or supportive structure composed of cellulose or chitin found outside of the plasma membrane (absent in animal cells)
4. Description and function of cellular organelles:
    a. Nucleus – control center of cell; directs protein synthesis and cell reproduction
    b. Mitochondria – major site of energy production in most eukaryotic cells
    c. Chloroplast – site where photosynthesis occurs in plant cells (absent in animal cells)
5. Similarities and differences between plant and animals cells

CHAPTER 5: ENERGY AND LIFE

A] TERMINOLOGY:

1. **Enzymes** – protein molecules that catalyze chemical reactions within cells
2. **Substrate** – the starting molecules of a particular enzyme based chemical reaction
3. **Active site** – location on an enzyme molecule where the chemical reactions actually occur (much like a lock that only a particular “key”, or substrate, will fit)

B] CONCEPTS:

1. First law of thermodynamics – energy can change from one state to another but it can never be destroyed, nor can new energy be made (the total amount of energy in the universe remains constant)

2. Second law of thermodynamics – disorder in a closed system is continuously increasing (entropy increases)
3. In chemical reactions, chemical bonds break and reform and atoms become rearranged into new molecules (same atoms that you begin with you end with, they are just rearranged)
4. All chemical reactions require an input of energy to start the reaction
5. How enzymes make substances react
    a. The enzyme's active site
    b. Lower energy required for reaction to occur
    c. The enzyme is not affected by the reaction and can be used over and over again
    d. Factors affecting enzyme activity (temperature & pH)
6. ATP/ADP cycle
7. In general, making chemical bonds stores energy and breaking chemical bonds releases energy

CHAPTER 6: PHOTOSYNTHESIS: ACQUIRING ENERGY FROM THE SUN

A] TERMINOLOGY:

1. **Photosynthesis** – sequence of chemical reactions that uses energy from sunlight to power the synthesis of organic molecules from carbon dioxide
2. **Chlorophyll** – the green pigment used by plants (and other photosynthetic organisms) to capture (absorb) the energy of light for use in photosynthesis
3. **Pigment** – molecules that absorb particular frequencies of light and reflect others

B] CONCEPTS:

1. The electromagnetic spectrum
    a. Shorter wavelength = higher energy
    b. From short wavelength to long: gamma rays, x-rays, UV light, visible light, infrared radiation, microwaves, radio waves
    c. Visible light spectrum: know in order (from shortest to longest wavelength) – purple, blue, green, yellow, orange, red
2. Why do things appear different colors? Light absorbed vs. reflected
3. General formula: $6\ CO_2 + 12\ H_2O$ + light energy ----→ $C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$
4. Photosynthesis is assisted by the pigment chlorophyll in the chloroplasts of green plant cells

CHAPTER 7: HOW CELLS HARVEST ENERGY FROM FOOD

A] TERMINOLOGY:

1. **Cellular respiration** – the dismantling of food molecules to obtain energy (or the series of chemical reactions that transfer the energy contained in food molecules into energy contained in ATP molecules)
2. **Anaerobic** – chemical reactions that do not require oxygen
3. **Aerobic** – chemical reactions that require oxygen
4. **Fermentation** – chemical reactions that produce ATP without the use of oxygen

B] CONCEPTS:

1. General formula: $C_6H_{12}O_6 + 6\ O_2$ --------→ $6\ CO_2 + 6\ H_2O$ + 36 ATP + heat
2. Aerobic respiration occurs in the cytoplasm and mitochondria, but most energy transferred to ATP in the mitochondria
3. Energy is released from glucose when it is broken apart and the energy is transferred to molecules of ATP
4. Connection between the general formula of aerobic cellular respiration and why humans need to eat and breath
5. All living things need to undergo respiration (animals and plants, etc.)
6. Alcoholic fermentation
    a. An anaerobic reaction
    b. Glucose converted to carbon dioxide and ethanol
    c. Only a net production of 2 ATP

CHAPTER 8: MITOSIS

A] TERMINOLOGY

1. **Mitosis** - a process of cell division that produces two identical cells from an original parent cell (exact and complete duplication of the genetic instructions)
2. **Chromosomes** - hereditary structure in the nucleus of eukaryotic cells which is composed of DNA and protein
3. **Homologous chromosomes** - pairs of chromosomes in normal cells that are usually the same size and shape and contain information about the same traits of an organism
4. **Karyotype** – picture or map of the chromosomes of a cell arranged into their homologous pairs
5. **Cancer** – unrestrained cell growth and division caused by damage to genes regulating the cell division cycle
6. **Metastasis** – the spread of cancer cells to other areas of the body

B] CONCEPTS

1. Mitosis – Generalized overview of how it is accomplished with emphasis on:
    a. Exact replication of the cell's chromosomes (genetic information)
    b. Daughter cells have the same genetic information as each other
    c. Daughter cells have the same genetic information as the parent cell
    d. Cytoplasmic division result in two cells from the original starting cell
    e. This process is the basis of body growth, cell replacements, tissue repair, and asexual reproduction in eukaryotes
2. Chromosomes
    a. Composed of DNA and protein molecules
    b. There is a constant chromosome number within an organism's body cells
    c. There is a constant chromosome number within a given species of organism

    d. Most eukaryotic multicellular organisms have their chromosomes occurring in pairs (homologous chromosomes) in their body cells
3. Cancer
    a. Results when cells lose control over their replication cycle, getting stuck in mitosis
    b. Causes of damage to the cell's DNA – chemicals, environmental factors, viruses

CHAPTER 9: MEIOSIS

A] TERMINOLOGY

1. **Meiosis** – process of cell division in which the number of chromosomes in certain cells is halved during gamete (sperm & egg) formation
2. **Zygote** – first cell of a new multicellular organism (a fertilized egg cell)
3. **Fertilization** – fusion of a sperm nucleus with an egg nucleus
4. **Sexual reproduction** – reproduction requiring meiosis and the fusion of egg and sperm cell
5. **Asexual reproduction** – reproduction by means of mitosis resulting in offspring that are genetically identical to the parent that produced them

B] CONCEPTS

1. Meiosis - Generalized overview of how it is accomplished with emphasis on:
    a. This process is the basis of gamete (sperm & egg) formation in sexual reproduction
    b. Daughter cells have half the normal number of chromosomes
    c. Daughter cells have one of each type of chromosome (no homologous pairs)
    d. Daughter cells can be different from each other (in terms of the genetic information they hold) and different from the parent cell
    e. Entails two division events and results in 4 cells from the original starting cell
2. Fertilization –
    a. Return to the normal number of chromosomes and homologous pairs of chromosomes (one set from each parent)
    b. Sexual reproduction leads to an increase in variation in offspring
3. Similarities and differences between meiosis and mitosis

CHAPTER 10: FOUNDATIONS OF GENETICS

A] TERMINOLOGY

1. **Genetics** – the branch of biology dealing with the principles of heredity and variation in organisms
2. **Gene** - refers to a specific genetic trait (e.g. flower color, seed shape, etc.)
3. **Allele** – a particular form of a gene
4. **Dominant allele** - allele which shows its effect when present in a heterozygous pair

5. **Recessive allele** - allele which does not show its effect when present in a heterozygous pair
6. **Homozygous alleles** - pair of alleles for a single gene which contain the same genetic information
7. **Heterozygous alleles** - pair of alleles for a single gene which contain different genetic information
8. **Genotype** - an organism's allelic makeup (paired information stored in the homologous chromosomes; e.g. AA)
9. **Phenotype** - the expressed traits of an organism (e.g. red roses)
10. **Polygenic inheritance** - pattern of inheritance where a single trait is controlled by more than one gene
11. **Pleitropy** - pattern of inheritance where one gene has an impact on more than one trait
12. **Incomplete dominance** - pattern of inheritance where heterozygous individuals exhibit a phenotype that is in between the phenotypes of the homozygous individuals (e.g. red + white = pink)
13. **Codominance** - pattern of inheritance where heterozygous individuals show full expression of both the phenotypes of the homozygous individuals (e.g. red + white = red & white striped)
14. **Autosomes** - all the pairs of chromosomes of the cell that are not involved in sex determination
15. **Sex Chromosomes** - pair of chromosomes involved in sex determination
16. **Sex linked trait** – a trait determined by a gene on a sex chromosome
17. **Nondisjunction** - a problem in meiosis where members of a chromosome pair fail to separate resulting in some daughter cells with one too many chromosomes and others with one too few chromosomes

B] CONCEPTS

1. Gregor Mendel's contribution to genetics
2. Monohybrid cross – using a Punnett square or probability to determine results of cross
3. Dihybrid cross and independent assortment of alleles
4. Other patterns of inheritance
    a. Several genes sometimes control a single phenotypic trait (e.g. height & eye color) (= polygenic inheritance)
    b. Continuous variation in traits of organisms usually shows a "bell curve" result
    c. Pleitropy (e.g. multiple effects caused by mutation in DNA causing sickle-cell anemia or cystic fibrosis)
    d. Incomplete dominance
    e. Codominance (e.g. AB blood type)
5. The environment can affect how genes are expressed – the phenotype is the result of both genetics and the environment
6. What a human karyotype looks like (46 total chromosomes; 22 homologous pairs of autosomes & 1 pair of sex chromosomes)
7. Sex chromosomes (XY = male in humans) (XX = female in humans)

8. X-linked recessive inheritance (e.g. color blindness & hemophilia)
9. Nondisjunction – examples of autosome nondisjunction (Down syndrome) & sex chromosome nondisjunction (Triple X, Turner syndrome, Kleinfelter syndrome)

CHAPTER 11: DNA: THE GENETIC MATERIAL

A] TERMINOLOGY

1. **DNA** – Deoxyribo-Nucleic Acid
2. **DNA replication** – the copying of DNA before cell division
3. **Mutation** – change in the nucleotide sequence of DNA

B] CONCEPTS

1. The discovery of DNA as the genetic molecule
    a. The experiment with mice performed by Frederick Griffith – bacterial transformation
    b. The proof of DNA as the molecule involved with transforming non-virulent bacteria (non-disease causing) to virulent form (disease causing) by Oswald Avery and coworkers
    c. James Watson and Francis Crick discover the double helix structure of DNA and provide the mechanism for DNA exact replication and an explanation of its role as the hereditary molecule
2. Structure of DNA
    a. Double helix
    b. Base pairing (A-T; C-G)
    c. The four nucleotides of DNA: adenine, thymine, guanine, cytosine
    d. Replication – DNA able to make an exact copy by having the two strands separate, each serving as the template for a new strand. Exact copying results due to the complimentary base pairing
3. Mutations
    a. Effect depends on the identity of the cell in which the mutation occurs
    b. Mutations of gametes (sperm or egg) affects all cells of new organism and can be passed to subsequent generations; raw material for evolutionary change
    c. Mutations of non-reproductive cells can lead to cell death or possibly cancer

CHAPTER 12: HOW GENES WORK

A] TERMINOLOGY

1. **Gene expression** – the use of information in DNA to direct the production of particular proteins
2. **Transcription** - the transfer of the genetic information from a DNA molecule to a RNA molecule
3. **Translation** - the transfer of genetic information from the nucleotide code of RNA to the amino acid sequence of a protein molecule
4. **RNA** – Ribo-Nucleic Acid

5. **Codon** - three nitrogenous bases that code for a particular amino acid
6. **Genetic code** - the amino acid translations of each of the codons
7. **Ribosome -** a cellular structure in all types of cells where translation of genetic information from mRNA to protein occurs

B] CONCEPTS

1. General process: DNA to RNA to protein
2. Structure of RNA
    a. single helix
    b. ACGU nucleotides
3. Similarities and differences of RNA vs DNA
4. Role of DNA: DNA provides instructions on how to make protein molecules (carbohydrates and lipids produced by an organism are indirectly produced as a result of the action of protein molecules)
5. Protein Synthesis –converting a gene into a protein
    a. Transcription – begins in nucleus when RNA strand copies the genetic information in the DNA molecule; the mRNA can move from the nucleus into the cytoplasm and to the ribosomes
    b. Translation – involves mRNA & tRNA at the ribosomes where the information is translated from the nucleic acid sequence (language) of RNA to the amino acid sequence (language) of protein
    c. Special sequences of nucleotides on the DNA provides signals for the "start" of a gene and the "stop" point for RNA copying
6. Translation is accomplished by translating a sequence of 3 nucleotide bases in mRNA (a codon) to a particular amino acid (the building blocks of proteins)
7. Same genetic code is employed by all living things
8. Cells in a multicellular organism are able to control their genes – each cell participates in regulating the body as a whole (also allows for cell differentiation)

CHAPTER 13: THE NEW BIOLOGY

A] TERMINOLOGY

1. **Genome** – the full complement of genetic information of an organism; including all of the genes and other DNA
2. **DNA Sequencing** – a process that allows each nucleotide of a DNA strand to be read in order (e.g. AACCGGATA…)
3. **Genetic engineering** – the ability to manipulate genes and move them from one organism to another
4. **Restriction enzyme** - enzyme that cuts DNA at specific points which have certain sequences of nucleotides
5. **DNA fingerprint** - a technology that answers identity questions concerning individual organisms by looking at DNA fragments that have been sorted by the size of the fragments
6. **Gene therapy** - transfer of normal or modified genes, often with the intent to correct a genetic defect
7. **Cloning** - the process of making an identical genetic copy of an organism

8. **Embryonic stem cells** – cells formed during early embryonic development of an organism that have the potential to become any type of cell found in the adult organism
9. **Adult stem cell** – partially undifferentiated cells maintained in adult organisms that have the potential to become a limited number of different kinds of adult cells of one tissue type
10. **Therapeutic cloning** – cloning process used to produce replacement cells, tissues or organs for replacement or repair of damaged cells, tissues or organs
11. **Reproductive cloning** – cloning process used to produce a genetically identical offspring
12. **Gene therapy** - transfer of normal or modified genes, often with the intent to correct a genetic defect

B] CONCEPTS

1. Human genome
    a. Sequencing (finding the exact order of CGAT nucleotides) of human DNA accomplished in 2000
    b. About 20-25,000 protein encoding genes have been identified for humans (although we are not sure what proteins all those genes code for)
    c. Some chromosomes have very few genes
    d. Most of the human genome is non-coding DNA
2. Restriction enzymes
    a. originally obtained from bacteria cells - evolved as a way for bacteria to destroy the DNA of invading viruses
    b. each particular type of enzyme cuts double stranded DNA at a particular nucleotide sequence (e.g. EcoRI cuts between the G and the A of the sequence GAATTC)
    c. Many of these enzymes leave single stranded tails or "sticky ends" on the cut fragments
3. DNA fingerprints – use in forensic science
    a. each person has their own unique DNA sequence
    b. restriction enzymes are used to cut this unique DNA into different sized fragments (fragment pattern is also unique)
    c. fragments are arranged in a pattern, from long to short size, by the use of gel electrophoresis
4. Genetic engineering
    a. Human proteins manufactured in bacteria cells for medical treatments
    b. Plants that produce their own insectides
    c. Plants that are resistant to specific herbicides
    d. Crops that are more nutritious
    e. Ethical considerations
        i. is eating genetically modified food dangerous?
        ii. are genetically modified crops harmful to the environment?
5. Cloning
    a. Dolly as the first cloned offspring from an adult cell (a sheep)
    b. Other organisms that have been successfully cloned

6. Human adult and embryonic stem cells offer the possibility of replacing damaged or lost human tissues
7. Therapeutic vs. reproductive cloning – what is the difference in the end products?
8. Gene transfer therapy – promise and problems

CHAPTER 14: EVOLUTION AND NATURAL SELECTION

A] TERMINOLOGY

1. **Evolution** – change over time
2. **Natural selection** - nature determines which organisms will survive and reproduce based on the unique inherited variations that the organism possesses; the major driving force of evolution
3. **Fossils** - traces or remains of living things from a previous geologic time
4. **Homologous structures** - structures that are of the same evolutionary origin, with the same basic anatomy, but which may or may not differ in function
5. **Analogous structures** - similar structures that evolve within organisms that have developed from different ancestors; they have a similar function but have different basic anatomies and evolutionary origins
6. **Gene pool** (allele frequencies) - all the genetic resources available within a population
7. **Migration** - evolution (or the lack of evolution) due to amounts of immigration and emigration between different populations
8. **Genetic drift** - evolution that is driven by chance events alone
9. **Sexual selection** - evolution due to preference of one sexual partner for certain attributes in the other sexual partner
10. **Artificial selection** - people determine which organisms will survive and reproduce based on desired variations that an organism possesses
11. **Stabilizing selection** - selection for an central (average) phenotype
12. **Disruptive selection** - selection for both extremes of phenotype and selection against the central average phenotype
13. **Directional selection** - selection for an extreme phenotype
14. **Speciation** - the process by which new species are formed during the process of evolution
15. **Biological species concept** - a population or group of populations that interbreed freely in the wild and do not interbreed with other populations and which can produce fertile offspring
16. **Reproductive isolating mechanisms** - mechanisms which prevent different species from mating and having fertile offspring with one another

B] CONCEPTS

1. Charles Darwin provides the idea of “descent with modification” and the mechanism that causes change over time – natural selection (he published his ideas in the book: On the Origin of Species)
2. Natural selection (based on 2 basic observations about living things)

    a. Observation – organisms produce many more offspring than can survive
    b. Observation – organisms show variation in their structures and behaviors that are inherited
    c. Conclusion – Nature decides which variations are the best for survival and reproduction. Those with the "best" variations will survive and reproduce while those with less desirable variations will die and their undesirable variations will not be passed on to the next generation
    d. Remember – passing variations (genes or alleles) forward in time (reproductive success) is the key for being evolutionarily successful!
3. Evidence of evolution
    a. Fossil record
    b. Anatomical record
    c. Molecular record
4. Agents of evolution
    a. Mutation (the ultimate source of genetic variation in a population)
    b. Migration (immigration and emigration)
    c. Genetic drift (effect often associated with size of the population)
    d. Nonrandom mating (sexual selection)
    e. Selection (compare and contrast artificial selection and natural selection)
5. Types of selection – stabilizing, disruptive & directional selection
6. How new species evolve – speciation and reproductive isolation
    a. Prezygotic isolation mechanisms
    b. Postzygotic isolation mechanisms

CHAPTER 16: EVOLUTION OF MICROBIAL LIFE

A] TERMINOLOGY

1. **Virus** – genetic material (DNA or RNA) encased in a protein shell that can infect cells and reproduce within them; not considered to fit the definitions of life
2. **AIDS** - Acquired Immune Deficiency Syndrome
3. **HIV** - Human Immunodeficiency Virus

B] CONCEPTS

1. Origin of life – experiments show that organic molecules that serve as the building blocks of life can form spontaneously, as can cell-like structures (first steps toward the origin of life)
    a. What the Earth was like when life first formed
    b. Miller & Urey's experiment – spontaneous formation of complex organic molecules from simple inorganic molecules
    c. Prokaryotic life was the first type of life on the planet
2. Viruses
    a. Do not fit the definition/description of life – considered to be non-living
    b. Basically a bit of genetic material (DNA or RNA) enclosed in a protein shell
    c. Able to duplicate themselves within living cells (cannot duplicate without living cells)

3. HIV and AIDS

CHAPTER 19: POPULATIONS AND COMMUNITIES

A] TERMINOLOGY

1. **Ecology** – the study of how organisms interact with each other and with their environment
2. **Population** – members of one species that inhabit a defined geographical area
3. **Community** – all living things that inhabit a defined geographical area
4. **Ecosystem** – a community and all the nonliving factors with which it interacts
5. **Biosphere** – the combination of all ecosystems of the planet (all life and the area where life is found)
6. **Exponential growth** - population growth model of the rate of expansion of a population under ideal conditions; the population multiplies by a constant factor during constant time intervals
7. **Carrying capacity** - the number of individuals in a population that the environment can just maintain with no net increase or decrease
8. **Logistic growth** - population growth model of an ideal population whose growth is slowed by limiting factors
9. **Niche** – the functional role of an organism with other organisms and their interactions with their physical environment
10. **Habitat** - the actual area or home where a living thing resides
11. **Coevolution** - process where two different species evolve in response to changes in the other
12. **Symbiosis** - a close relationship between two different species
13. **Mutualism** - a type of symbioses where two species live together in close association, both benefiting from the relationship
14. **Commensalism** – a type of sybiosis where two species live together in close association and one species benefits while the other is neither helped nor harmed
15. **Parasitism** - a type of symbioses where an organism of one species benefits from its interactions with another, whereas the other species is harmed
16. **Predation** - a relationship in which members of one species eats members of another species
17. **Aposematic coloration** – warning coloration
18. **Cryptic coloration** – coloration that blends an organism into its environment (camouflage)
19. **Mimicry** - evolutionary process which leads to similarity in body form and color in two or more species that are not closely related
20. **Ecological succession** - process of community change which occurs in an area after disturbance

B] CONCEPTS

1. A population's growth rate is an outcome of 4 events: births, deaths, immigration and emigration
2. With exponential growth, the larger a population is, the faster it grows
    a. A graph of population size against time produces a J-shaped growth curve

    b. This type of growth cannot continue indefinitely – sooner or later required resources for life are used up and the population will crash
3. Resources in short supply put limits on population growth
4. With logistic growth, the population stabilizes around its carrying capacity – a graph of population size against time produces an S-shaped growth curve
5. Processes such as competition for resources, emigration and the accumulation of toxic wastes all tend to increase as a population approaches its carrying capacity for a particular habitat
6. **The Principle of Competitive Exclusion** – if two species are competing for a limited resource, the species that uses the resource more efficiently will eventually eliminate the other
7. Close interactions between species can lead to coevolution
8. Predation reduces competition – can lead to increased biological diversity
9. Plant defenses – physical structures and defensive chemicals
10. Animal defenses - aposomatic and cryptic coloration
11. By the process of ecological succession, one array of species replaces another in a sequential fashion
    a. Primary succession occurs in habitats more or less devoid of life – involves the initial colonization of life in a particular area
    b. Secondary succession occurs in areas where an existing community has been severely disturbed

CHAPTER 20: ECOSYSTEMS

A] TERMINOLOGY

1. **Producers** – organisms capable of producing their own energy-storing molecules (food), usually by photosynthesis
2. **Consumers** – organisms that obtain their energy-storing molecules by eating other organisms or their waste products
3. **Trophic level** – organisms within an ecosystem whose source of energy is the same number of consumption "steps" away from the source (usually the sun)
4. **Food chain** – food energy passing through an ecosystem from one trophic level to another in a simple linear progression
5. **Food web** - the interconnected and interwoven feeding relationships between organisms in an ecosystem, with many organisms feeding at several trophic levels

B] CONCEPTS

1. In an ecosystem energy flows in one way through organisms while nutrients are cycled among organisms
2. An organism's trophic level describes how many steps it is from the ecosystem's energy source (usually the sun)
3. Ecologists measure the amount of energy and nutrients that enter an ecosystem, the amounts captured, and the proportions stored in each trophic level
4. Only 5% to 20% of the available energy passes from one trophic level to the next
5. Ecological pyramids – way of describing characteristics of trophic levels (e.g. numbers, biomass, energy)

CHAPTER 22: HOW HUMANS INFLUENCE THE LIVING WORLD

A] TERMINOLOGY

1. **Biological magnification** - the tendency for toxic substances to build up in progressively higher levels of a food chain
2. **Global warming** - a worldwide increase in temperature resulting from increased greenhouse gases in the atmosphere
3. **Greenhouse effect** - the blocking of outward heat radiation from the atmosphere by a group of chemicals known as greenhouse gases
4. **Biodiversity** - the number of different species and their relative abundance
5. **Ozone** - an unstable molecular form of oxygen where 3 oxygen atoms are bonded together instead of the normal 2.
6. **CFCs (chlorofluorocarbons)** - a group of man-made chemicals that release chlorine when they break down and have a great destructive effect on the Earth's stratospheric ozone layer

B] CONCEPTS

1. Link between agricultural chemicals, aquatic ecosystems, and biological magnification
2. Global warming
    a. Atmospheric concentrations of greenhouse gases trap heat and keep Earth warm enough for life
    b. Increase in world temperature correlates with increased presence of carbon dioxide in the atmosphere
    c. The overwhelming consensus among scientists is that greenhouse gases produced from humans is causing global warming (especially carbon dioxide produced by burning of fossil fuels & deforestation)
    d. Effects – global climate change; agricultural effects; rising sea levels
3. Human activities linked with extinction: habitat loss, species overexploitation, and species introductions
4. Ozone in the upper atmosphere has been declining, exposing Earth’s surface to higher levels of dangerous UV radiation
    a. A class of human made chemicals called chlorofluorocarbons (CFCs) are major destroyers of the ozone layer
    b. Ozone holes (zones of lower than normal ozone concentration) have formed over the Earth’s polar areas, especially the South Pole
    c. An international agreement has been signed by most countries of the world to phase out the manufacture and use of CFCs
    d. The ozone holes should recover slowly because of this and associated international agreements
5. The world’s human population has surpassed 6.7 billion
    a. Changes in technology have given humans more control over their food supply, led to the development of cures for many diseases & have

produced improvements in shelter and storage capabilities – changes that allowed humans to expand the carrying capacity of their habitats

b. Human growth curve (see Fig. 22.11)
c. Birth rates fall as nations become more industrialized, but their per capita consumption of resources increases