Chapter 6

1. Explain the difference between "essential nutrients" and "growth factors".
   Essential nutrients → all nutrients that an organism must have
   Growth factors → organic nutrients that cannot be synthesized by the microbe

2. List the chemical contents of the cell (hint: two compounds, six elements).
   - Water
   - Proteins
   - Carbon
   - Hydrogen
   - Oxygen
   - Phosphorus
   - Sulfur
   - nitrogen

3. List the sources and roles of each of the following elements:
   a. Nitrogen → Found in nitrogen gas from the atmosphere. Part of proteins, DNA, RNA, and ATP (the primary source of N for heterotrophs). Used to synthesize amino acids & other compounds

   b. Oxygen → major component of carbohydrates, lipids, nucleic acids, proteins, salts, & water. Important for structural and enzymatic functions (metabolism)

   c. Hydrogen → major in all organic compounds & several inorganic ones (water, salts, gases). Used to maintain pH & as acceptor of oxygen during aerobic cellular respiration

   d. Phosphorus → sourced from phosphate, derived from phosphoric acid. Found in rocks & oceanic mineral deposits. Key components of nucleic acids & is essential to genetics

   e. Sulfur → widely distributed in the environment (rocks, sediments w/ compounds like gases). Essential component of some vitamins and amino acids

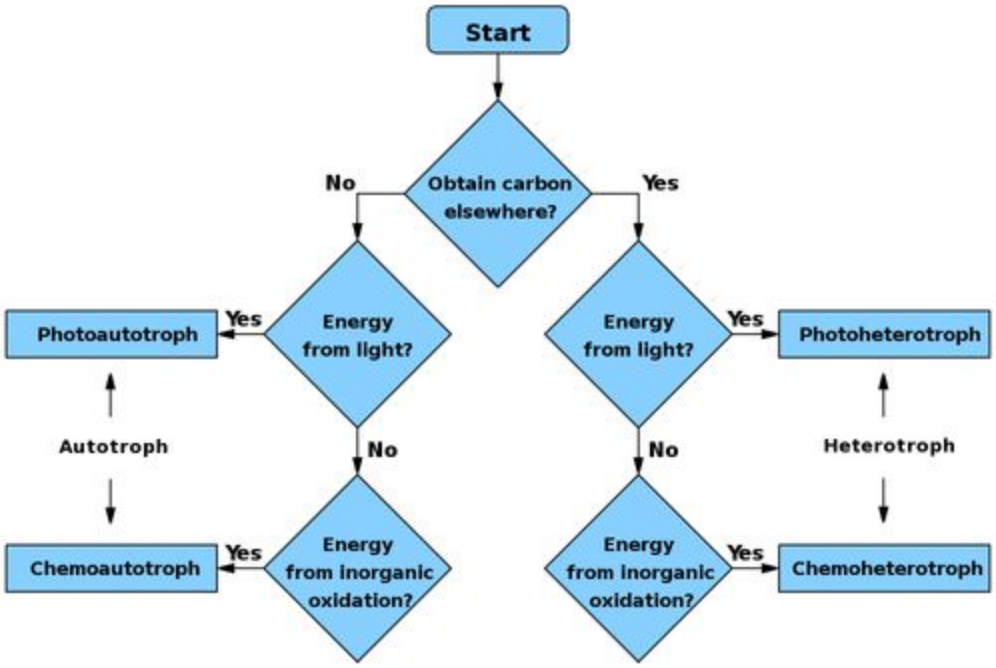
4. What are the main purposes of the following nutrients?
   a. Potassium → essential to protein synthesis and membrane function

   b. Sodium → important to some types of cell transport

   c. Calcium → cell wall and endospore stabilizer

   d. Magnesium → component of chlorophyll. Membrane & ribosome stabilizer

   e. Iron → component of proteins of cell respiration



5. Define and list the types of saprobes.
   Saprobes are chemoheterotrophs
   - Some are free-living microbes that feed on organic debris from dead organisms
   - Opportunistic pathogens → normally nonpathogenic, but can cause disease in an immunologically compromised host
   - Facultative parasite → not restricted to a host

6. What are parasites?
   Organisms that benefit by deriving nutrients at the expense of the host.

7. Explain extracellular digestion (as seen in a saprobe).
   Enzymes are secreted outside the cell, they break down the nutrients (by hydrolyzing bonds), and then the smaller molecules are absorbed into the cell

8. Niche is the totality of adaptations organisms make to their habitat (how they deal with environmental conditions).

9. What are some examples of toxic forms of oxygen?
   Singlet oxygen (O_2), superoxide ion (O_2^-), peroxide (H_2O_2), and hydroxyl radicals (OH^-)

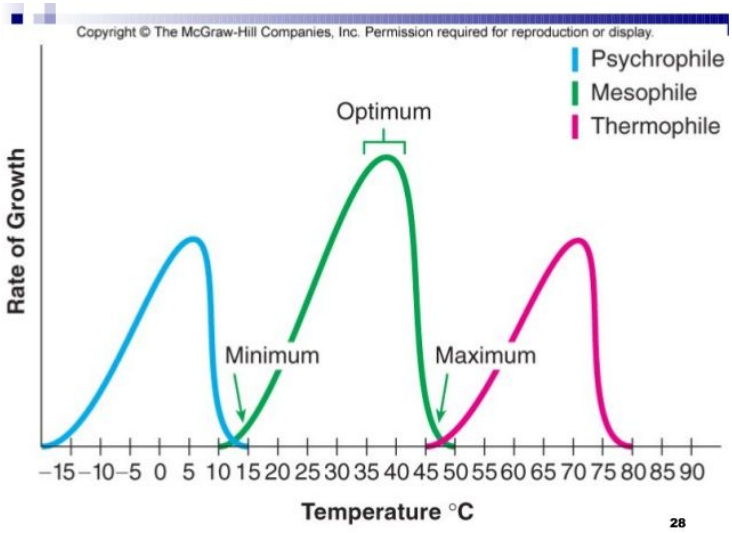
10. Give an example of enzymes used to neutralize toxic oxygen molecules.
    Superoxide dismutase and catalase convert superoxide ions to a nontoxic chemical form

Microbe	Uses Oxygen	Doesn't use oxygen	Trait
Aerobe	X		Utilizes oxygen & can detoxify it
Obligate aerobe	X		Cannot grow without oxygen
Facultative anaerobe	X		Utilizes oxygen when present
Microaerophilic	X		Needs only a small amount of oxygen
anaerobe		X	Does not utilize oxygen
Obligate anaerobe		X	Cannot survive in oxygen environment
Aerotolerant anaerobe		X	Doesn't use oxygen but can live with it

11. Halophiles require a high concentration of salt.

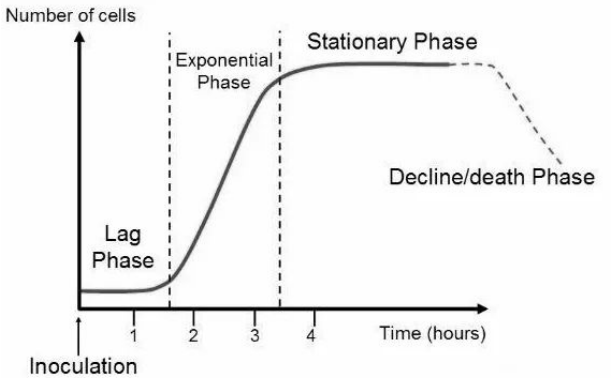
12. What is the main process of bacterial cell division?
    binary fission (or transverse fission)

13. Write out the rate of population growth equation.
    (*starting #*) × 2^n = *total #*



14. A scientist starts with 5 bacterial cells (generation 1) and promotes 6 more generations of growth. How many bacterial cells does he finish with?
    320 cells

15. Draw and explain the population growth curve.



16. What are the 5 I's of culturing microbes?
    1. Inoculation
    2. Incubation
    3. Isolation
    4. Inspection
    5. Identification

17. fastidious microbes require growth factors and complex nutrients

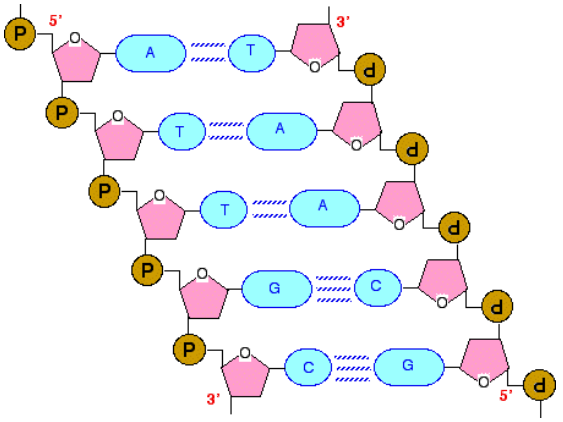
18. A mound of cells is called a colony.

19. What technique uses an inoculating loop to spread a sample onto an agar plate?
    Streak plate technique

20. Pour plate technique uses diluted samples in a series of liquid medium tubes

Chapter 8

1. What are the three basic categories of genes?
    - Genes that code for proteins
    - Genes that code for RNA
    - Genes that control gene expression



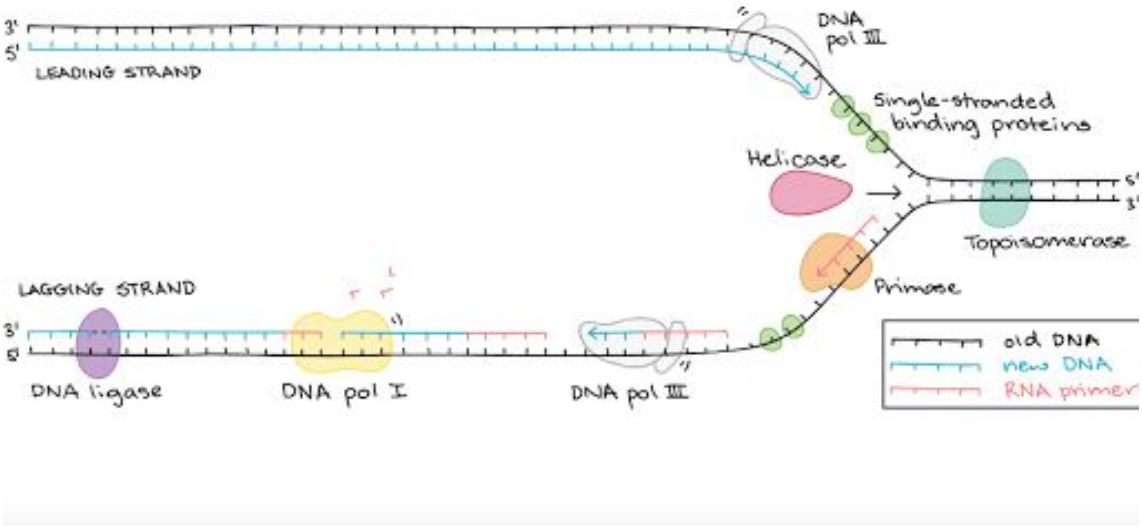
2. What is a phenotype?
    The observable expression of a genotype

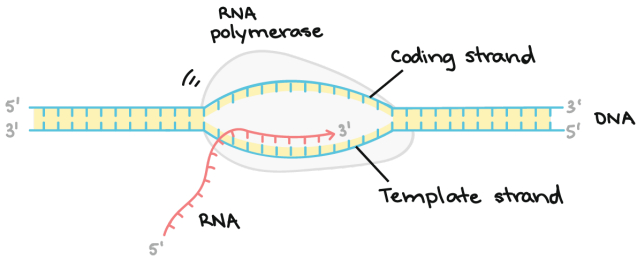
3. Explain the structure of DNA
    - Two strands twisted into a double helix
    - Nucleotides (each one consists of a 5 carbon sugar [deoxyribose], a phosphate group, & a nitrogenous base [adenine, thymine, guanine, or cytosine])

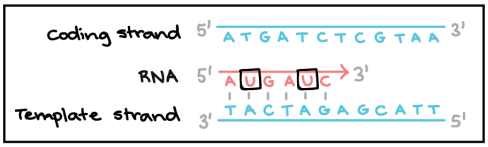
4. How is RNA different from DNA?
    RNA is single-stranded, contains a ribose sugar, and has uracil instead of thymine

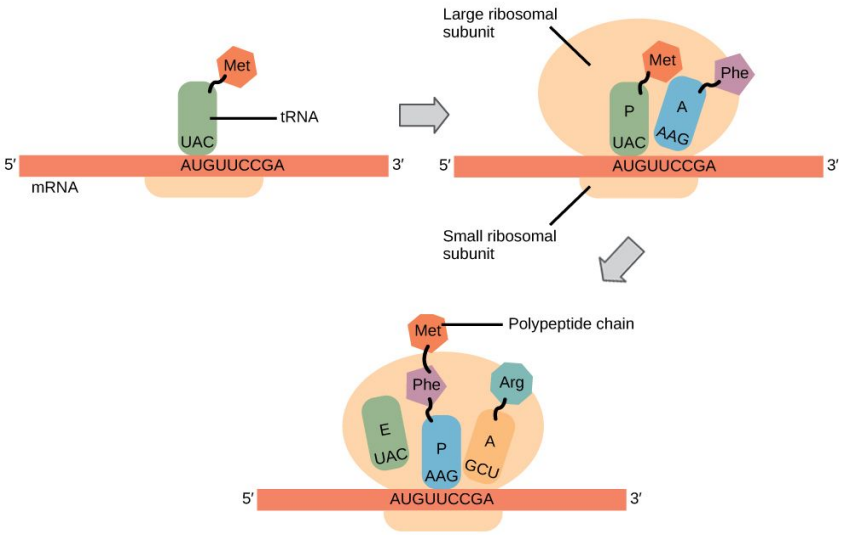
5. What is the purpose of DNA replication?
    To make a copy of the DNA molecule, so it can be passed onto the offspring.

6. What is a codon?
    A triplet of nucleotides on the mRNA, which specifies for a specific amino acid









7. How does transcription & translation differ between prokaryotes and eukaryotes?
   In prokaryotes, the process can occur at the same time. In eukaryotes, transcription must finish the the mRNA must be transported out of the nucleus.

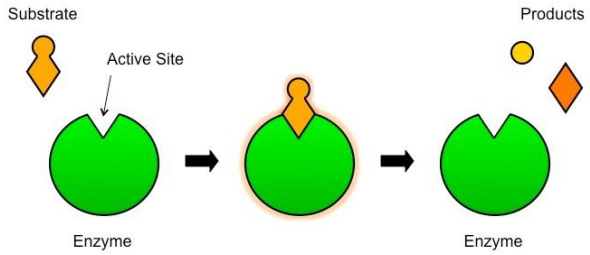
8. Describe the viral genome.
   One or more pieces of DNA or RNA, usually containing only the genes needed to produce new viruses

9. What is an operon?
   An operon is a set of genes that are all regulated by one thing (as a single unit. Operons consist of a promoter region, an operator, and a set of genes

10. An inducible operon is normally (on / off), and is turned (on / off) by the presence of a substrate.

11. A repressible operon is normally (on / off), and is turned (on / off) by the presence of the product synthesized.

12. What is a substrate?
    The reactant molecule that an enzyme binds to, causing a reaction and forming products



13. What are the two types of repressors?
    - Those that are active when alone & inactive when bound to a regulatory molecule
    - Those that are inactive when alone & active when bound to a regulatory molecule

14. Define the following terms:
    a. Wildtype → the natural, non-mutated characteristic

    b. Mutant strain → the characteristic with a mutation

    c. Spontaneous mutation → random change in the DNA due to errors

    d. Induced mutation → results from exposure to known mutagens

    e. Genetic recombination → when an organism acquires and expresses genes that originated in another organism

15. What are the three means of genetic recombination?
    - Conjugation
    - Transformation
    - Transduction

Chapter 13

1. What are the components of a virus?
   Capsid, nucleic acid, and envelope (in majority of viruses)

2. Define the following terms:
   a. Virulent → able to infect

   b. Virion → an extracellular, virulent virus particle

   c. Nucleocapsid → the capsid and nucleic acid together

   d. Capsomers → subunits that make up the capsid

3. What are spikes?
   Exposed proteins used for attachment of the virus to the host cell

4. What are the purposes of a capsid / envelope?
   Protects the nucleic acid when the virus is not in a host cell, and helps the virus bind to a cell surface

5. What are the functions of the following enzymes?
   a. Polymerases → catalyze the bonding together of nucleotides

   b. Replicase → catalyzes the self-replication of a single-stranded RNA

   c. Reverse transcriptase → synthesis of DNA from RNA

1. D Adsorption 2. E Penetration 3. F Uncoating 4. A Synthesis 5. C Assembly 6. B Release	A. Viral components are produced B. Assembled viruses are released by building (exocytosis) or host cell lysis C. The new viral particles are put together D. Binding of virus to specific molecule on host cell E. Genome enters host cell by endocytosis or fusion F. The viral nucleic acid is released from the capsid/envelope

6. endocytosis is when the entire virus is engulfed and enclosed in a vacuole or vesicle.

7. fusion is when the envelope merges directly with the host cell membrane resulting in nucleocapsid's entry into the cytoplasm.

8. Define oncogenic.
   Enter the host & permanently alter genetic material, resulting in cancer

9. What are persistent infections?
   When the cell harbors the virus and is not immediately lysed

10. What are temperate phages?
    DNA phages that undergo adsorption and penetration but don't replicate immediately

11. lysogeny is the potential ability of bacteria to produce phage (allows spread of the virus without killing the host initially)

Chapter 9

1. Define the following terms:
   a. Microbial genetics → the study of how microbes inherit traits

   b. Molecular biology → the study of how DNA directs protein synthesis

   c. Genomics → the study of an organism's genes

   d. Biotechnology → the use of microorganisms, cells, or cell components to make a product

   e. Recombinant DNA → DNA made from two different sources

2. How is cDNA made?
   Made from eukaryotic mRNA using the enzyme reverse transcriptase, which makes DNA out of RNA

3. Vectors are self-replicating DNA used to carry the desired gene to a new cell.

4. How do biologists use mutations?
   Induce mutations to try create a more desirable trait

5. Explain blue-white screening.
   - A plasmid (containing LacZ gene and ampicillin resistance gene) is cut with a restriction enzyme
   - A foreign DNA (containing a desired gene that interferes with the LacZ gene) is cut with the same enzyme and inserted into the middle of the LacZ gene
   - The plasmid is introduced to bacteria
   - Only some plasmids took in the foreign DNA
   - Only some bacteria took in the plasmids
   - The bacteria that took the plasmids will grow in the presence of ampicillin
   - The bacteria that took the plasmids and the foreign DNA (within the plasmids) cannot hydrolyze x-gal (found in the medium) because the foreign DNA is blocking the LacZ gene. The LacZ gene can metabolize x-gal (bacteria is a white color)
   - The bacteria that took in the plasmids, without the foreign DNA, can hydrolyze x-gal, and will produce galactose & an indigo color (turns bacteria blue)

6. What type of medium is used in blue-white screening?
   Differential & selective

7. What is PCR?
   Polymerase chain reaction → a technique to make multiple copies of a piece of DNA

8. Explain gel electrophoresis.
   Restricted DNA is placed at one end of a layer of agarose gel and electrical current passes through the gel, causing the DNA to move

9. What did Edward Jenner do?
   Demonstrated that inoculation with cowpox material provides humans with immunity to smallpox

10. What type of vaccine consists of only a portion of a pathogen's antigen?
    Subunit vaccines

11. What is gene therapy used for?
    To replace defective or missing genes

12. What happens in gene silencing?
    Harmful mRNA transcripts are destroyed. siRNAs bind to the mRNA and mark it for enzymatic destruction, which silences the gene

13. Reverse genetics is a way of determining the function of a gene by blocking the gene and correlating it to the characteristic that is lost.

Chapter 7

1. Define the following terms:
   a. Decontamination → using physical, chemical, and mechanical methods to destroy/reduce undesirable microbes in a given area

   b. Prions → a proteinaceous infectious agent that causes pathologies

2. What are the primary targets capable of causing infection or spoilage?
   - Vegatative bacterial cells & endospores
   - Fungal hyphae & spores
   - Protozoan trophozoites & cysts
   - Parasitic worms
   - Viruses
   - Prions

3. Categorize microbe targets according to resistance strength (highest, moderate, least).
    - Highest resistance → prions & bacterial endospores
    - Moderate resistance → species with unique cell walls, protozoan cysts, & naked viruses
    - Least resistance → most bacterial vegetative cells, fungal spores and hyphae, yeast, enveloped viruses, & protozoan trophozoites

4. disinfectant - physical or chemical agents used on inanimate objects to destroy vegetative pathogens.

5. antiseptic - chemical agents applied directly to exposed body surfaces to destroy/inhibit vegetative cells

6. What is "sanitization technique"?
   Any cleansing technique that mechanically removes microbes from inanimate surfaces

7. What factors affect death rate?
    - Number of microbes
    - Nature of microbes in the population
    - Temperature & pH of environment
    - Concentration or dosage of agent
    - Mode of action of the agent
    - Presence of solvents, organic matter, or inhibitors

8. List the factors that influence the rate at which microbes are killed.
    - Microbial loads
    - Level of resistance
    - Length of exposure
    - Type of control agent selected / mode of action

9. What are cellular targets?
    - Cell wall
    - Cell membrane
    - Protein & nucleic acid synthesis
    - Proteins

10. List the methods of physical control.
    - Heat → moist or dry
    - Cold temperatures
    - Desiccation
    - Radiation
    - Filtration

11. What are the levels of chemical decontaminants/germicides?
    - High level → kills endospores; may be sterilants
    - Intermediate level → kill fungal spores, resistant pathogens, and viruses
    - Low level → eliminate only vegetative bacteria, fungal cells, & some viruses

12. List the germicidal categories.
    - Phenols, phenolics, bisphenol
    - Biguanides
    - Halogens
    - Alcohols
    - Heavy metals
    - Soaps & detergents
    - Chemical food preservatives
    - Antibiotics
    - Aldehydes
    - Gases and aerosols
    - Peroxygens & other forms of oxygen