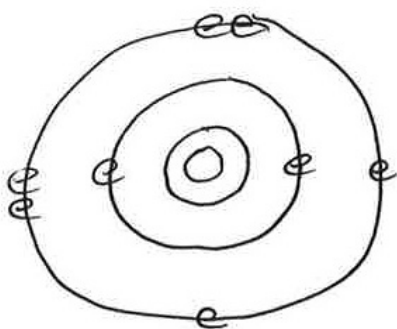


REVIEW QUESTIONS

# **ANSWER KEY**

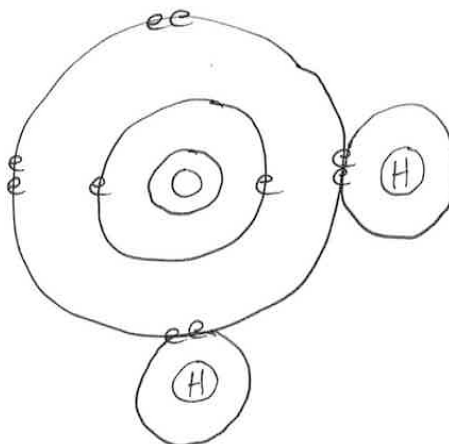
## CHAPTER 1

1. A substance that has distinct chemical properties and cannot be broken down into simpler substances by normal chemical means is a(n) **element**.
2. The smallest unit of an element is a(n) **atom**.
3. Two or more atoms bonded together is a(n) **molecule**.
4. A molecule containing two or more elements is a(n) **compound**.
5. The two subatomic particles contained in the nucleus of an atom are neutrons and protons. What are their charges? **Neutral and positive**.
6. The subatomic particles contained in the shells orbiting the nucleus are the **electrons**. Charge? **Negative**.
7. Atomic number is the number of **protons in an atom**.
8. Atomic weight or mass number is the sum of **protons and neutrons**.
9. Draw an oxygen atom (atomic number: 8).



Oxygen

10. Draw a water molecule ( $H_2O$ ) showing orbitals and shared electrons (atomic number of hydrogen: 1).



Water

11. A complete transfer of electrons from one atom to another resulting in oppositely charged atoms sticking together is called a(n) **ionic bond**.
12. When atoms are joined together because they are sharing electrons it is called a(n) **covalent bond**.
13. In a polar covalent bond how are the electrons being distributed in the molecule? **The atoms with the greatest pull on the shared electrons will cause the electrons to swarm around them more than the weaker atoms**.
14. In a non-polar covalent bond how are the electrons being distributed in the molecule? **The atoms involved have an equal pull on the shared electrons and consequently the electrons are equally distributed between the two or more atoms**.
15. Weak attractions between partially positive charged atoms and partially negative charged atoms within the same

molecule or between different molecules are called **hydrogen bonds**.

16. Water's cohesive property is due to its ability to **hydrogen-bond** with itself.
17. The pH scale is a measure of a substance's **H<sup>+</sup>** ion concentration.
18. A pH of 7 is termed **neutral**. Below pH 7 is considered **acidic** and above 7 is considered **basic**.
19. A move from pH 6 to pH 5 has made the solution **ten** times more acidic.
20. Substances that resist changes in pH are called **buffers**.

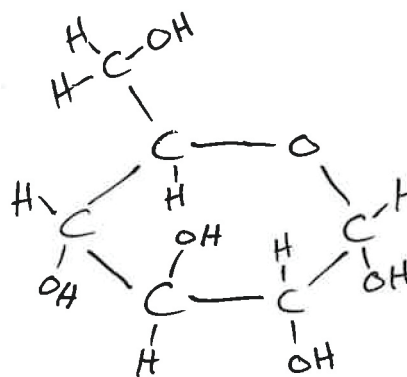
## CHAPTER 2

1. What are the 'TinkerToy rules' for carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur? **Carbon: 4 bonds, oxygen: 2 bonds, hydrogen: 1 bond, nitrogen: 3 bonds, phosphorus: 5 bonds, and sulfur: 2 bonds.**
2. Name the four main biomolecule categories. **Carbohydrates, lipids, proteins, and nucleic acids.**
3. Name the building blocks of each of the above groups. **All carbohydrates are made up of one or more monosaccharides (simple sugars). Those that are made up of multiple monosaccharides are disaccharides (two), oligosaccharides (few to under 100), and polysaccharides (100 or more). Lipids, particularly tri, di, or monoglycerides, are made of glycerol and fatty acids. Proteins are made up of amino acids. All nucleic acids (DNA and RNA) are made up of nucleotides, which in turn are made up of ribose or deoxyribose (a monosaccharide), a phosphate (PO<sub>4</sub><sup>3-</sup>), and a nitrogenous base [adenine, thymine (uracil instead of thymine in RNA), guanine, and cytosine].**
4. Name one example of a disaccharide. **Sucrose (table sugar)**
5. Two examples of polysaccharides. **Starch,**

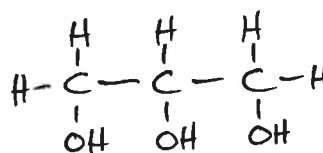
**glycogen, and cellulose.**

6. Draw glucose, glycerol, a fatty acid, an amino acid, and a stick figure of a nucleotide (using a circle for the phosphate, a pentagon for the sugar, and a rectangle for the nitrogenous base).

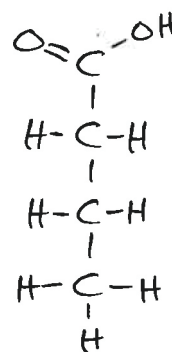
Glucose



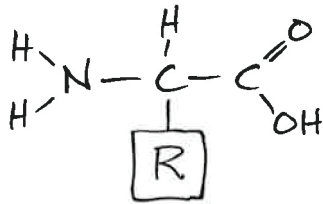
Glycerol



Fatty Acid



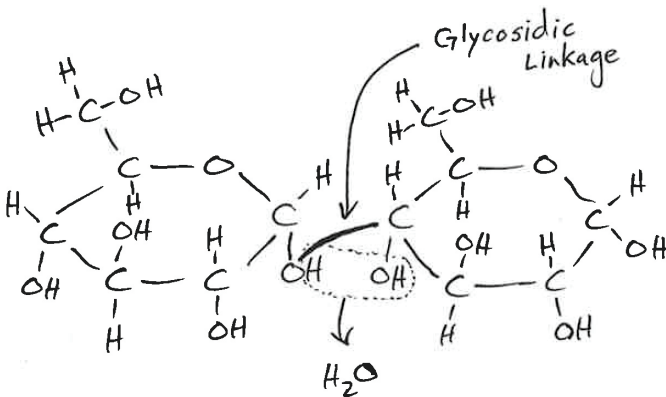
## Amino Acid



## Nucleotide

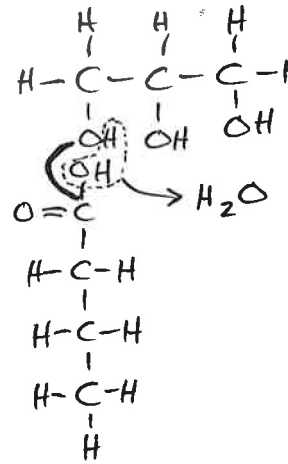


7. Draw glucose doing a dehydration synthesis reaction with another glucose forming a disaccharide. Label the glycosidic linkage.



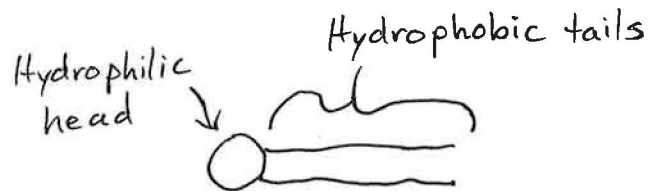
## Disaccharide

8. Draw a glycerol doing a dehydration synthesis reaction with a fatty acid to form a monoglyceride.

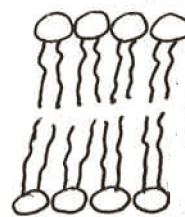


## Monoglyceride

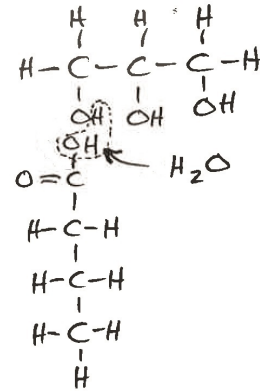
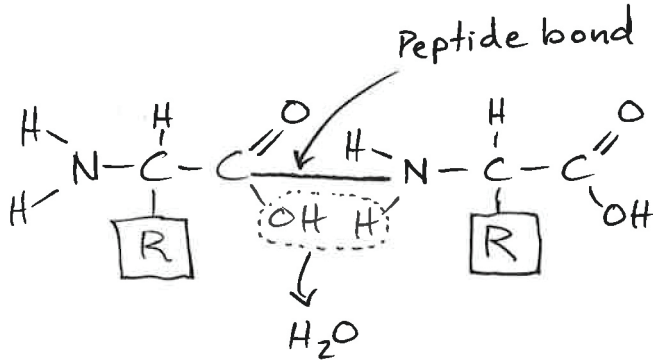
9. Draw a stick figure of a phospholipid and label the hydrophobic tails and the hydrophilic head. Why is the head hydrophilic? **The hydrophilic head has positive and negative charges which are attractive to water molecules.**



10. Draw a short section of a phospholipid bilayer.

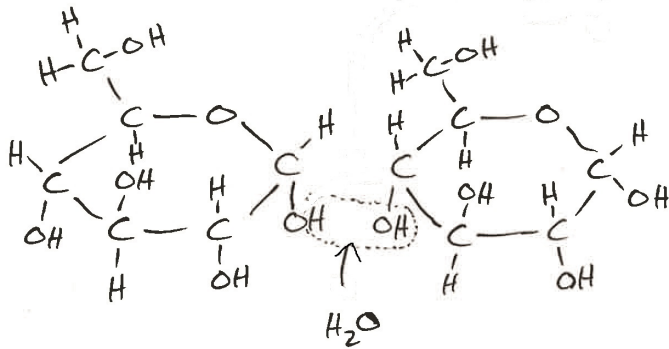
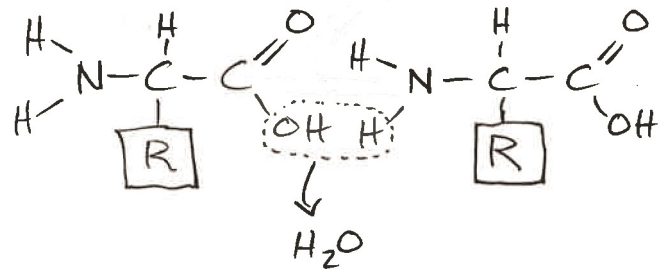


11. Draw an amino acid doing a dehydration synthesis reaction with another amino acid to form a dipeptide. Label the peptide bond.



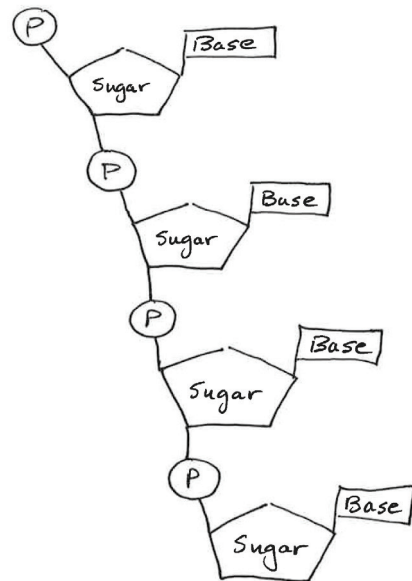
Monoglyceride

12. A chain of 60 amino acids is called a polypeptide.  
 13. Draw hydrolysis reactions separating the disaccharide, the monoglyceride, and the dipeptide.



Disaccharide

14. Using the stick figure form of a nucleotide, draw four nucleotides hooked together.

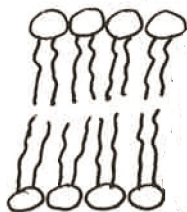


15. Describe how the sequence of amino acids relates to the function of the protein. **The sequence of amino acids constrains the protein to fold in certain ways, including loops, hairpins, alpha helix, or a beta plaited sheet. Shape determines function.**
16. Name five different types of jobs done by proteins. **Structural components (keratin, collagen, etc.); oxygen and CO<sub>2</sub> transport (hemoglobin); long-distance chemical messengers (protein hormones); short-distance chemical messengers (protein neurotransmitters); immunity (antibodies); membrane transport (membrane proteins); metabolic (synthetic and digestive) reactions (enzymes); locomotion (flagellar proteins); and muscle contraction (contractile proteins).**
17. Name two functions of nucleotides other than storing genetic information. **Nucleotides are also used to make Adenosine Triphosphate (ATP), which functions as cellular 'rechargeable batteries.' We also use them to make molecules called NADH, NADPH, and FADH<sub>2</sub>; these molecules are used to shuttle electrons around in important metabolic processes like cellular respiration and photosynthesis.**
3. Who was the Dutchman who viewed microscopic life with a microscope of his own making? **Antony van Leeuwenhoek.** In what century did he make these observations? **The 1600s (17th century).** What did he call these life forms? **Animalcules.**
4. What are the three tenets of the Cell Theory? **(1) All living things are composed of cells, (2) cells are the fundamental structural and functional unit of all living things, and (3) all cells arise from pre-existing cells.**
5. Who were the three men who composed this theory? **Theodor Schwann, Matthias Schleiden, and Rudolf Virchow.**

#### CHAPTER 4

#### CHAPTER 3

1. What other invention was closely associated with the microscope? **The telescope.**
2. Who was the English scientist who coined the term "cell"? **Robert Hooke.** What Latin word is cell derived from? **Cellulae.** Why did he pick that term? **The cork tissue he looked at looked like it was made up of many square or rectangular chambers which reminded him of the little rooms in a monastery.**
1. How do prokaryotic cells differ from eukaryotic cells regarding: A nucleus? **Organelles? Size? A prokaryotic cell does not have a membrane-bound nucleus or membrane-bound organelles and it is usually smaller than 10µm. A eukaryotic cell has a membrane-bound nucleus and organelles, and is usually much bigger than 10µm.**
2. What life forms have prokaryotic cells? **Bacteria and blue-green algae.** What life forms have eukaryotic cells? **All other life forms such as single-celled protozoa, algae, fungi, plants, and animals.**
3. Why can't cells be big? **As a living entity, cells have a large number of metabolic demands (they need to get a lot of stuff in and out of the cell. A cell's volume always increases disproportionately compared to its surface area. What thing becomes too small relative to the increased mass? The cell membrane.**
4. Using stick figures for phospholipids and blob-like shapes for proteins; draw a small section of a biological membrane.



5. Define diffusion. **Diffusion is the movement of a substance from an area of high concentration to an area of low concentration.**
6. What fundamental property of matter causes diffusion? **Brownian motion, the innate ability of molecules to randomly move about in three dimensions.**
7. How does concentration, temperature, and molecular size affect diffusion rate? **Increased concentration and temperature increases diffusion rate, and vice versa. On the other hand, the larger the molecule, the slower the diffusion rate.**
8. Define osmosis. **The diffusion of water across a semi-permeable membrane.**
9. A substance that is dissolved in a solvent is a **solute**.
10. If a plant cell is placed in a hypertonic solution, it will lose /gain water. This condition is called **plasmolysis**. When this occurs what happens to the turgor pressure? **It will go down, making the plant cell lose its turgidity.**
11. Movement of a substance across a membrane, through a protein gate but against a concentration gradient is called **active transport**.
12. The engulfing of a food particle by a cell so that a food vacuole is formed within the cell containing the food is **endocytosis**.

## CHAPTER 5

1. The **nucleus** contains the vast majority of DNA and is covered in a two-layered

envelope containing pores.

2. **Ribosomes** are tiny organelles used in the construction of proteins.
3. The **Endoplasmic Reticulum (ER)** is involved in the modification of newly made proteins.
4. The fluid of the cell is called the **cytoplasm**.
5. The organelle that 'burns' food to make ATP for the cells' energy needs is the **mitochondria**.
6. The organelle that captures sunlight energy to make glucose out of carbon dioxide and water is the **chloroplast**.
7. The organelle involved in modifying, packaging, and shipping various biomolecules to other organelles or the cell membrane is the **Golgi Body**.
8. An organelle that contains digestive enzymes for the demolition of various biomolecules is the **lysosome**.
9. Various proteins that form internal 'tent poles' or form internal transport rails throughout the cell are called the **cytoskeleton**.
10. The semi-rigid supporting framework outside the cell membrane is called the **cell wall**.

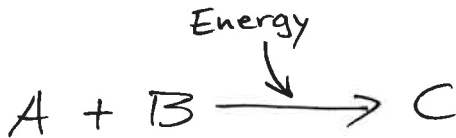
## CHAPTER 6

1. The law that states that matter cannot be created or destroyed but can be converted from one form to another is the **First Law of Thermodynamics**.
2. Contrast biosynthetic or anabolic with degradative or catabolic reactions. Which ones are endergonic and which ones are exergonic? **An endergonic reaction requires an input of energy and puts together molecules to build bigger molecules (biosynthetic/anabolic reaction). An exergonic reaction releases energy and breaks down larger molecules into smaller**

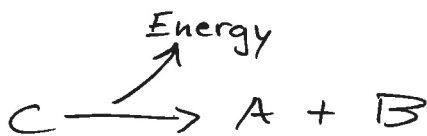


ones (degradative/catabolic). Using A, B, and C show both reactions in a simplified form.

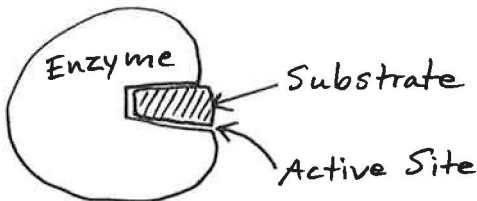
### Endergonic Reaction



### Exergonic Reaction



3. Proteins that speed up chemical reactions millions of times faster are called **enzymes**.
4. Name three things that affect enzyme activity. **Temperature, pH, and concentration.**
5. Using simple shapes draw an enzyme with its active site bound to a substrate. Label the enzyme, active site, and substrate.



6. Enzymes convert substrates into **products** using their active sites.
7. The sum total of all the chemical reactions in cells, tissues, or the entire body is called **metabolism**.
8. Heavy metals can act as poisons by binding to the enzyme's **allosteric site**. This deforms the active site which destroys enzyme function.

## CHAPTER 7

1. What is the general equation of photosynthesis?  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
2. The photosynthetic pigments are in clusters called **photosystem I** and **photosystem II**. These, along with the electron transport chain, move electrons from **water** (the ultimate electron source) to **NADP+**.
3. What accumulates inside the thylakoid discs when they are receiving light? **H+ ions**.
4. Phosphorylation of ADP occurs when H+ ions flow through a channel protein/enzyme called **ATP synthase**.
5. What are the two important products of the Light Dependent Reactions? **ATP and NADPH**
6. The cycle that produces glucose from  $\text{CO}_2$  is called the **Calvin-Benson cycle**.
7. The Light Dependent Reactions occur in the **thylakoid** membrane but the Light Independent Reactions (Calvin-Benson cycle) occurs in the **stroma**.
8. The major pigment that captures light energy and drives the electron transport system in the chloroplasts is **chlorophyll**.
9. Other pigments that capture a wider range of wavelengths of light and transfer that energy to chlorophyll are the **antenna pigments**.

## CHAPTER 8

1. The net production of ATP in glycolysis only is **two**.
2. The **Krebs** cycle generates the most NADH.
3. In glycolysis, glucose is ultimately split (by oxidation) into two **pyruvates**.
4. In cellular respiration the electron transport chain occurs in the **inner**



- membrane of the **mitochondrion** (organelle).
- In the mitochondria what two molecules release (“dump”) their electrons onto the electron transport system? **NADH and FADH<sub>2</sub>**.
  - What is pumped out into the intermembrane space of the mitochondrion as electrons zip through the electron transport system? **H<sup>+</sup> ions**
  - Phosphorylation of ADP occurs when **H<sup>+</sup> ions** flow through a channel protein/enzyme called **ATP synthase**.
  - How many NADHs are produced (total) when burning one molecule of glucose? **Ten**
  - In cellular respiration what important molecule from the air does all aerobic life need, that accepts electrons (and hydrogen) at the end of the electron transport system? **Oxygen**.
  - What happens to ATP production if ‘the answer to number 9’ is withheld? **ATP production grinds to a halt, and all life processes cease**.
  - What is the grand total ATP yield from burning one molecule of glucose into 6CO<sub>2</sub> and 6H<sub>2</sub>O? **Thirty-eight**.

## CHAPTER 9

- Who were the two main discoverers of the structure of DNA? **James Watson and Francis Crick**.
- Who also won the Nobel Prize with them? **Maurice Wilkins**.
- The data most valuable to this discovery was generated by two scientists named **Rosalind Franklin and Maurice Wilkins**.
- What are the three parts to a nucleotide? **A sugar (deoxyribose or ribose), a phosphate, and a nitrogenous base**.
- What are the four different nitrogenous bases? **Adenine, guanine, thymine, and cytosine**.
- The double helix can be likened to a twisted ladder. The “ladder sides” are called the **sugar-phosphate** backbones and the “rungs” are the base-pairs.
- In a chromosome, DNA is neatly wrapped around proteins called histones forming little repeating spools called **nucleosomes**.
- The enzyme that unzips the two parental strands of DNA apart and constructs a complementary strand of RNA is called **RNA polymerase**.
- Name three structural differences between RNA and DNA nucleotides. **RNA exists as a single-stranded molecule instead of DNA’s double-stranded molecule; RNA nucleotides have the sugar ribose instead of deoxyribose; and RNA has the same bases but substitutes uracil for thymine**.
- If a DNA strand is T-A-C-G-C-G-C-T-T-G-A-T-T-T-A, what is the mRNA sequence? (Put a slash between codons.) **A-U-G/C-G-C/G-A-A/C-U-A/A-A-U**.
- What is the amino acid sequence? (Use the three letter abbreviations for the amino acids; refer to the genetic code below.) First divide the RNA into threes: **AUG/CGC/GAA/CUA/AAU**. This will result in **Methionine (Met), Arginine (Arg), Glutamic acid (Glu), Leucine (Leu), and Asparagine (Asn)**.
- When protein is made from an mRNA transcript, the process is called **Protein Translation**.
- What molecule contains the anticodon and retrieves the appropriate amino acid? **tRNA**.
- True or False. Portions of RNA are snipped out (i.e., edited out) and the remaining pieces are spliced together before translation occurs. **True**.

## CHAPTER 10

1. What protein attaches to the operator to prevent certain genes from being transcribed in the lac operon? **Repressor protein or lac repressor.**
2. What is the place on DNA to which RNA polymerase attaches at the beginning of transcription? **The promoter.**
3. A gene or a set of genes that are turned on or off by a single switch is called a(n) **operon.**
4. In the lac operon, lactose binds to the **repressor** which causes it to fall off the operator.
5. If this binding occurs, name the first enzyme that is made (translated)? **Lactase ( $\beta$ -galactosidase).**
6. What does this enzyme do? **It chops lactose in two so the two resulting monosaccharides can be 'burned' in cellular respiration.**
8. List the seven basic steps in recombinant DNA technology. **Purify DNA containing gene of interest; Cut out gene of interest with appropriate restriction enzyme(s); Separate gene of interest from DNA it was cut from; Open up purified plasmid with the same restriction enzyme; Add gene of interest to the opened up plasmid; Splice gene of interest into plasmid using DNA ligase thus creating recombinant DNA; and Transformation of recipient cell with recombinant DNA (plasmid).**

## CHAPTER 11

1. Enzymes used to cut DNA at specific sequences are called **restriction** enzymes.
  2. The enzyme used to splice DNA fragments together is called **DNA ligase.**
  3. Overhanging ends of single-stranded DNA which facilitate the splicing process are called **'sticky ends'**.
  4. After a gene of interest is spliced into a plasmid, what must be done next in order to put the gene to work? **It must be successfully inserted into a recipient cell.**
  5. What mode of DNA acquisition involves the uptake of 'foreign DNA'? **Transformation.**
  6. What mode of DNA acquisition involves a virus as a vehicle to inject DNA into the cell? **Transduction.**
  7. What mode of DNA acquisition is from a bacterium to another bacterium through pilus? **Conjugation.**
- ## CHAPTER 12
1. Before mitosis, what process in the central dogma needs to occur for this process to occur? **DNA Replication.**
  2. This above process occurs during S (synthesis) phase of interphase.
  3. The enzyme that produces daughter strands of DNA by placing complementary nucleotides along each parental strand is called **DNA polymerase.**
  4. Why does this need to occur before mitosis? **All the genetic information in a cell needs to be duplicated so that when the nucleus divides, each new daughter cell receives a complete set of genetic information.**
  5. A skein of DNA and proteins is called a **chromosome.**
  6. Chromosomes are lined up at the spindle equator during **Metaphase.**
  7. DNA coils up into chromosomes, the spindle forms, and the nuclear envelope breaks up during **prophase.**
  8. Plant cytokinesis is accomplished through the formation of a **cell plate** at the spindle equator.
  9. Sister chromatids (one-copy chromosomes) migrate to opposite poles of the cell during **Anaphase of mitosis.**
  10. When the spindle disappears, the

chromosomes unravel, and the nuclear envelope reforms around each nucleus, the cell is in what phase of mitosis? **Telophase.**

### CHAPTER 13

- Homologous chromosomes separate during (b) **Anaphase I.**
- The reduction division occurs during (b) **Meiosis I.**
- Sister chromatids separate during (b) **Anaphase II.**
- Pairs of chromosomes that resemble each other in size, shape, and the genes they carry are called **homologous chromosomes.**
- Crossing over occurs during **Prophase I.**
- What does crossing over accomplish in terms of offspring? **It increases the possible number of genetic combinations.**
- What is the big difference between metaphase of mitosis and metaphase I of meiosis? **In mitosis, (six) two-copy chromosomes are neatly aligned along the spindle with identical copies facing opposite sides of the cell, whereas the chromosomes instead of lining up so that the sister chromatids separate, they align up as homologous pairs.**
- Reduction division is when the cell changes in ploidy from **2N to 1N.**
- Where does meiosis occur in animals and humans? In males? In females? **It happens to special cells in the gonads (for men, the testes and for women, the ovaries).**
- What does meiosis produce in animals and humans? **Gametes (sperm and eggs).**
- What does meiosis produce in plants? **It produces spores rather than gametes.**
- When a cell has two complete sets of genetic information it is said to be **diploid or 2N.**
- When a cell has one complete set of genetic information it is said to be **haploid or 1N.**

### CHAPTER 14

- Different versions of the same gene are called **alleles.**
- When two separate chromosomes match each other in size, shape, and the genes they carry, they are called **homologous chromosomes.**
- The combination of alleles for a given gene is the organism's **genotype.**
- The actual physical appearance of the organism is its **phenotype.**
- Do the following monohybrid cross: F1: Yy x Yy  
Pea Traits  
Y = yellow seeds (dominant)  
y = green seeds (recessive)  
R = round seeds (dominant)  
r = wrinkled seeds (recessive)

	Y	y
Y	YY	Yy
y	Yy	yy

- What is the proportion of yellow-seeded offspring in the F2 generation? **3/4**
- How do you determine whether yellow-seeded offspring is YY or Yy? **Cross it with a homozygous recessive green seed plant.**
- Do the following dihybrid cross: F1: YyRr x YyRr  
First determine the possible gametes and place them in the first column and row; then fill in the Punnett square.

	YR	Y <sub>r</sub>	yR	y <sub>r</sub>
YR	YYRR	YYR <sub>r</sub>	Y <sub>y</sub> RR	Y <sub>y</sub> R <sub>r</sub>
Y <sub>r</sub>	YYR <sub>r</sub>	YYrr	Y <sub>y</sub> R <sub>r</sub>	Y <sub>y</sub> rr
yR	Y <sub>y</sub> RR	Y <sub>y</sub> R <sub>r</sub>	yyRR	yyR <sub>r</sub>
y <sub>r</sub>	Y <sub>y</sub> R <sub>r</sub>	Y <sub>y</sub> rr	yyR <sub>r</sub>	yyrr

9. What proportion of offspring is green-round seeded?  $3/16$
10. What proportion of offspring is yellow-wrinkle seeded?  $3/16$
11. What proportion of offspring is green-wrinkle seeded?  $1/16$
12. Do the following dihybrid cross: F1: FfCc x FfCc  
Hydra Traits (\*Heterozygotes have six heads)  
F = Fire-breather (dominant)  
f = non-fire breather (recessive)  
\*C = ten headed (incompletely dominant)  
c = two headed

	FC	F <sub>c</sub>	fC	f <sub>c</sub>
FC	FFCC	FFC <sub>c</sub>	FfCC	FfC <sub>c</sub>
F <sub>c</sub>	FFC <sub>c</sub>	FFcc	FfC <sub>c</sub>	Ffcc
fC	FfCC	FfC <sub>c</sub>	ffCC	ffC <sub>c</sub>
f <sub>c</sub>	FfC <sub>c</sub>	Ffcc	ffC <sub>c</sub>	ffcc

13. What is the phenotype of these F1 parents?  
**Both breathe fire and have six heads.**
14. What proportion of F2 offspring can't breathe fire and has six heads?  $2/16$
15. What proportion of F2 offspring can't breathe fire and has ten heads?  $1/16$
16. What proportion of F2 offspring can

breathe fire and has two heads?  $3/16$

## CHAPTER 15

1. One of the first taxonomists of the fourth century B.C. was **Aristotle**.
2. Different classification schemes result from differences of opinion on what **characteristics** are the most important to compare or contrast.
3. A Swedish naturalist named **Carolus Linnaeus** was the father of modern taxonomy. He proposed the **binomial** system of naming that is still used today.
4. What are the seven ranks (taxa) in the classification hierarchy that Linnaeus developed (although it has been added to)? Go from general to specific. **Kingdom, phylum, class, order, family, genus, and species.**
5. Similar families are grouped into a single **order**.
6. A class is split into several **orders**.
7. What are three synonyms for the binomial? **Scientific name, Latin name, and species name.**
8. The binomial of the American toad is BUFO AMERICANUS. Rewrite it correctly. **Bufo americanus or Bufo americanus.**
9. What is its genus name? **Bufo**. Species name? **Bufo americanus**. Specific epithet? **americanus.**
10. Name three ways to visually represent biological diversity according to worldview? **The Linnaean Lawn, the Evolutionary Tree, and the Creationist Orchard.**
11. Which one above represents fixity of species? **The Linnaean Lawn.**
12. From an evolutionary perspective, butterfly wings and bat wings would be considered **analogous** structures because they didn't evolve from the same feature in

- their common ancestor.
13. From an evolutionary perspective, front flippers in dolphins and human arms would be considered **homologous** structures because they did evolve from the same feature in their common ancestor.
  14. From an evolutionary perspective, the evolution of a totally new anatomical feature (a derived character) is considered a(n) **apomorphy**.
  15. From an evolutionary perspective, a feature that both ancestor and descendants possess is called a **plesiomorphy**.
  16. A group of organisms which includes the ancestor and all of its descendants (monophyletic) is called a **clade**.
  17. From an evolutionary perspective, birds are a part of the **reptile** clade.
  18. If birds are excluded from the reptile clade for practical reasons, the remaining reptile group is termed **paraphyletic group**.
  19. If two or more clades are lumped into one group because they share a common feature but the grouping excludes the common ancestor and other members that would unite them into a single clade, it is termed **polyphyletic group**.
  20. Creationists object to evolution when it involves the **Addition of an apomorphy and its genetic program**.
- polysaccharide called **peptidoglycan**.
6. Cytoplasmic tunnels that temporarily connect bacterial cells and allow for the transfer of genetic information are called **conjugation pili**.
  7. A chain of rod-shaped bacteria hooked end to end is termed **streptobacillus**.
  8. Besides the circular chromosome, bacteria often contain smaller hoops of DNA called **plasmids**.
  9. Most species of bacteria:
    - c. **Perform many beneficial ecological functions**.
  10. Which one of the following Archaean groups is not an extremophile?
    - b. **Methanogens**

## CHAPTER 17

1. A complex arrangement of contractile proteins beneath the cell membrane of euglenoids that enable them to change shape is called a **pellicle**.
2. Some photosynthetic euglenoids have a **stigma or eyespot** that is light sensitive and enables them to determine the direction of the light and swim towards it.
3. Free-living dinoflagellates have two flagella. One is situated in a **longitudinal** groove. The other is in a **transverse** groove.
4. Red tide is caused by a population explosion of certain species of **dinoflagellates**.
5. The toxic chemicals that make red tide dangerous to certain sea life are **neurotoxins**.
6. What lives in the tissues of corals that enables them to live in such nutrient poor water? **zooxanthellae**. What do these microscopic tenants produce and how do they produce it? **Sugars produced through photosynthesis**.
7. Certain **dinoflagellates** are able to undergo

## CHAPTER 16

1. The viral capsid is a protein container for **DNA or RNA**.
2. True or False. Viruses have their own metabolism apart from the host cells they infect. **False**.
3. True or False. Viruses only infect animals and humans. **False**.
4. The two major groups of prokaryotes are the **Archaea and the Bacteria**.
5. Bacterial cell walls are made of a

- bioluminescence.
8. The beautiful cell walls of diatoms are composed of **silica-containing** compounds.
  9. Which marine protist is the most important photosynthesizer of the oceans? **Diatoms.**
  10. All photosynthetic (autotrophic) protists are termed **algae**.
  11. Large, marine autotrophic protists are colloquially called **seaweeds**.
  12. What are the technical names of the three algae groups that are largely multicellular? **Rhodophyta, Chlorophyta, and Phaeophyta.** What are the common names for each? **Red Algae, Green Algae, and Brown Algae.**
  13. The types of their **pigments** serve as the basis of their classification.
  14. The brown algae often have four major organs that compose their body. They are:
    - a. The **holdfast** which is used for anchoring the algae to the sea floor.
    - b. The **stipe** which acts a flexible stem or stalk.
    - c. The **blade** which is analogous to a leaf and serves as the primary site of photosynthesis.
    - d. The **pneumatocyst** is gas filled and grants buoyancy to some underwater seaweeds.
  15. Two important commercial polysaccharide products of seaweeds are **agar**, which is extracted from certain types of red algae and **alginate**, which is extracted from certain types of brown algae.
- Trypanosoma* are all examples of a disease-causing **flagellates**.
4. Shelled amebas that produce a test composed of glass compounds are called **radiolarians**.
  5. White Cliffs of Dover are partly composed of the shells of which protozoan group? **Foraminiferans.**
  6. Protozoans that get around with and obtain food with cilia are classified in the group called **Ciliophora or ciliates**.
  7. The common feature of all amebas is the **pseudopod** which is an extension of the cell used for locomotion and feeding.
  8. Single-celled, non-photosynthetic (heterotrophic) protists are colloquially called **protozoans**.
  9. Many freshwater protozoa have an osmotic problem because they live in a hypotonic environment. What organelle do they possess that helps them cope with the constant influx of water? **Contractile vacuoles.**
  10. Many ciliates have a depression on their cell surface where they channel food to be phagocytosed. This is called the **oral groove**.
  11. A plasmodial slime mold is a gigantic multinucleate cell. They resemble fungi in that they produce **sporangia** which produce spores.
  12. The 'slug' in cellular slime molds differs with the plasmodium in that it is composed of many **cells** moving together.
  13. Water molds differ from Fungi in two significant ways.
    - a. They have a cell wall made of **cellulose** rather than chitin.
    - b. They are **diploid** (ploidy) for most of their life cycle.
  14. Name one water mold that had a great historical impact. **Late blight of potatoes (*Phytophthora infestans*).**

## CHAPTER 18

1. The flagellates share a locomotion device called a **flagella**.
2. Shelled amebas that produce a calcium carbonate test (shell) are called **foraminiferans**.
3. *Giardia*, *Trichonympha*, and



15. What was the historical impact? **The Great Famine of 1845-1852 in Ireland.** In other words, what did the water mold do? **It destroyed the majority of Ireland's potato crop.**

## CHAPTER 19

- List six characteristics of Fungi other than eukaryotic, heterotrophic, and multicellular. **They are filamentous, i.e. they grow in long branching filaments called hyphae; their cell walls are made of chitin; they have no cilia or flagella; they are haploid for most of their life cycle; they have a unique mitosis and meiosis; and they reproduce by spores.**
- Fungi obtain nutrients through a process called extracellular digestion. This occurs when the hyphae exocytose lysosomes releasing digestive enzymes onto the surrounding organic material.
- Name three destructive activities of fungi. **They consume stored food and other useful products, cause various animal and human diseases (e.g. athlete's foot and ringworm), and cause various plant diseases.**
- Name three benefits of fungi. **Yeasts are used to make bread dough rise; certain cheeses get their flavors from molds growing on them; penicillin and cyclosporine are produced by fungus; mushrooms and morels are delicious; and fungi growth in compost releases nutrients that help plants.**
- The zygomycete fungi reproduce asexually from spores that have been released from knoblike spore containers called **sporangia**.
- In the black bread mold, tough spore containers called **zygosporangia** are formed from the sexual union of two different mating strains.
- Zygomycete hyphae with different job-descriptions have different names. The **sporangiophore** supports the sporangium and the root-like **rhizoids** penetrate the substrate and absorb nutrients.
- Ascomycete fungi reproduce asexually by spores called **conidia** which form pop-it bead-like chains.
- Ascomycete fungi, during the sexual phase form fruiting bodies called **ascomas**. The concave (usually) spore-producing surface called the hymenium is formed by one layer of densely packed parallel **asci** (**singular: ascus**) each containing eight **ascospores**.
- Name two examples of ascomycete fungi. **Correct answers include cup fungi, morels, truffles, yeasts, lots of colorful food-spoiling molds, Penicillium, and some pathogens (Dutch Elm disease and Chestnut blight).**
- An atypical ascomycete is yeast and is essential in the brewing and baking industry.
- The shelf fungi, mushrooms, puffballs, earthstars, and coral fungi are all examples of **basidiomycetes**.
- In mushrooms, the hymenium is found on the surface of the **gills**. The hymenium is composed of parallel-arranged **basidia** instead of asci. Each one forms four **basidiospores** which eventually get placed on the outside surface until they drop off.
- Septate hyphae is found in:
  - Zygomycetes
  - Ascomycetes
  - Basidiomycetes
  - Both a and b
  - Both b and c**
- Dikaryotic hyphae induces the formation of the fruiting body in:
  - Zygomycetes
  - Ascomycetes



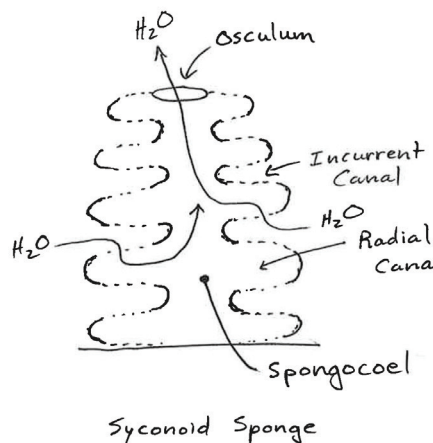
- c. Basidiomycetes
  - d. Both a and b
  - e. **Both b and c**
16. Two infamous plant pathogens of basidiomycetes are **corn smut and wheat rust**.
  17. Lichens are formed by a mutualistic relationship between **fungus and algae**.
  18. The growth form of lichen that is bushy and branching is called:
    - a. **Fruticose**
  19. The growth form of lichen that looks like it was spray-painted on a rock or bark is:
    - c. **Crustose**
  20. The mutualistic relationship between vascular plant roots and fungi is called a symbiotic mutualistic relationship. The fungi benefits from the **photosynthesis** of the plant and the plant benefits because the fungi enhances **water and mineral** absorption for the plant.

## CHAPTER 20

1. List five general characteristics of all animals. **They have eukaryotic cell structure; their cells lack walls; their cells manifest division of labor (multicellular); they eat (heterotrophic); and they can move using muscles or muscle-like tissue (motile).**
  2. What is the most common symmetry of animals? **Bilateral symmetry.**
  3. If an animal can be divided into similar halves by two or more planes running through the central axis of an animal it has **radial** symmetry.
  4. Name one animal that is asymmetrical. **The bath sponge.**
  5. Name one animal that is radially symmetrical. **Starfish or sea anemones.**
  6. Between invertebrates and vertebrates, which has the most diversity? **Invertebrates.**
7. Phylum **Chordata** is almost entirely composed of vertebrates.

## CHAPTER 21

1. Sponges are **filter**-feeders because they strain out microscopic plankton from the water that circulates through them.
2. Sponge skeletons are composed of beautiful siliceous or calcareous **spicules** that provide rigidity.
3. The specialized cells in a sponge that generate the water current, capture, and phagocytose the microscopic plankton are called **collar** cells.
4. What is the protein that serves as a flexible skeleton for sponges? **Spongin.**
5. What canals are lined with collar cells? **Radial canals.**
6. Asexual reproduction in sponges occurs through budding and by the production of tiny tough capsules containing sponge cells called **gemmules** that can survive adverse environmental conditions.
7. Be able to draw a simple body outline of a syconoid sponge (using dashes to show the pores (prosopyles). Label the incurrent canal, radial canal, spongocoel, and osculum. Use an arrow to show the pattern of water flow through the sponge.



8. In the more complicated leuconoid sponge, what is lined with collar cells? **Flagellated chambers.**
9. What important ecological service do sponges perform as they filter feed? **They are water filters, keeping plankton levels in check and providing microhabitats for many tiny creatures.**
10. What types of cells do they contract to change the size of their openings? **Skin-like cells that have contractile proteins.**
11. In sexual reproduction of most sponges, the sperm and egg cells are produced in:
  - a. **the same sponge.**

## CHAPTER 22

1. The hallmark characteristic of phylum Cnidaria are the possession of cells called cnidocytes which contain stinging organelles called **nematocysts.**
2. Cnidocytes are mostly concentrated in bands in the epidermis on which body part?
  - c. **Tentacles**
3. Are all nematocyst designed to sting? **No.**
4. Finger-like projections of the body wall surround the mouth and are called **tentacles.**
5. Describe the structure of a nematocyst and how it discharges. **If something touches the tentacle, the cnidocyte causes H<sub>2</sub>O gates in the nematocyst capsule membrane to open. Water rushes by osmosis and increases the capsule's pressure. Inside the capsule is an inverted, hollow, thread-like tube, all coiled up. The sudden pressure turns it inside out. Near the base of the tube are spines and stylets that snap out like blades on a pocketknife. These cut a tiny hole in the prey and a thread goes in. The pressure expels the capsule's venom through the thread into the prey.**
6. There are two general body forms of Cnidaria: the **polyp** and the **medusa.**
7. Hydra, coral, hydroid colonies, and sea anemones exhibit the **polyp** form while jellyfish exhibit the **medusa** form.
8. The digestive system of Cnidarians is composed mostly of the mouth and the gastrovascular cavity. Solid waste must be excreted out of the **mouth.**
9. Nutrients are absorbed by which cell layer? **Gastrodermis.**
10. Generally there are two cell layers that comprise the body wall: the **epidermis** and the **gastrodermis.**
11. Name two or three prey items of larger sea anemones. **Fish, sea stars, shrimp, or crabs.**
12. Name two very different ways coral polyps can feed themselves. **They can use their tentacles to catch food, or they have unicellular algae called zooxanthellae performing photosynthesis in their tissues.**
13. The Portuguese Man-of-war is a:
  - a. **colony of polyps.**
14. Sperm and eggs from the gonads are released out of the **mouth** of separate male and female jellyfish. Fertilization happens in the open sea water and the zygote grows into a small ciliated larva called a **planula.**
15. A thin to thick non-cellular layer is sandwiched between the epidermis and gastrodermis and is called the **mesoglea.**

## CHAPTER 23

1. Phylum **Platyhelminthes** are the flatworms because they are all dorsoventrally flattened.
2. List the three classes of flatworms (common name of the class is fine). **Flukes (Class Trematoda), tapeworms (Class Cestoda), and planaria (Class Turbellaria).**
3. The tapeworms don't need a digestive tract because **the gut of their host has digested the food already.**

4. Which two classes of flatworms have an incomplete digestive tract? **Class Trematoda and Class Turbellaria.**
5. Which class of flatworm is parasitic and has a mollusk for a primary host and a vertebrate for a final host? **Class Trematoda**
6. The tapeworms have segments called **proglottids** that detach and leave the host with the feces when they mature and are loaded with eggs.
7. Can these segments crawl on their own? **Yes.**
8. Tapeworms anchor themselves to the gut lining using hooks and or suckers mounted on the head-like **scolex**.
9. Planaria are known, after being cut in pieces, for each piece to **regenerate** the missing parts.
10. The planaria's mouth is located on the end of a hose-like **pharynx** which is positioned in the middle of the underside. Incoming food is brought into its **gastrovascular** cavity.
11. Roundworms:
  - a. have tapered ends.
  - b. have a complete digestive system.
  - c. are round in cross section.
  - d. **all the above**
12. Roundworms belong to **Phylum Nematoda**.
13. How does their digestive tract differ from Phylum Platyhelminthes? **They have a complete system that goes from their mouth to their anus.**
14. Many filarial worms cause massive swelling due to the blockage of **lymph** coming back from the extremities. The swelling is also aggravated by the victim's immune response called **inflammation**. This disfiguring disease is called **elephantiasis**.
15. Filarial worm larvae are injected into human hosts by a **mosquito**, which is the intermediate host.
16. More than half of roundworm species are: **b. parasitic**
17. True or False. Both free-living and parasitic nematodes live only in the tropics. **False.**
18. The segmented worms belong to Phylum **Annelida**.
19. List three major classes of segmented worms. **Class Oligochaeta (earthworms), Class Hirudinea (leeches), and Class Polychaeta (polychaetes).**
20. True or False. Earthworms are the only kind of oligochaetes. **False.**
21. Name three ways earthworms benefit the soil. **They contribute to the nitrogen supply in it by excreting, they aerate and mix it by burrowing, and they pull decaying plant material into their burrows which enriches it with organic nutrients.**
22. True or False. All leeches suck blood or body fluids out of their prey. **False.**
23. What class of segmented worm is mostly found in marine (ocean water) environments? **Class Polychaeta.**

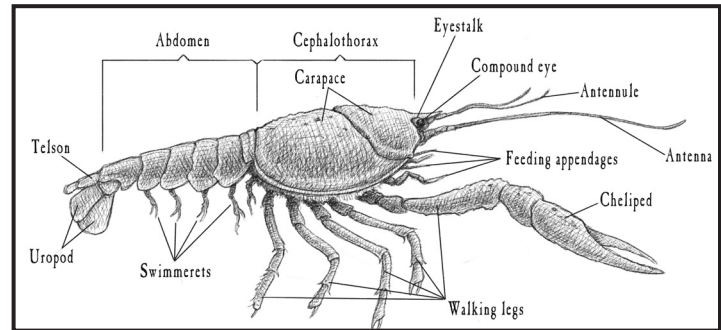
## CHAPTER 24

1. List six characteristics of mollusks (one is possessed by most but not all mollusks). **They have a mantle, a mantle cavity, gills or lungs in the cavity, a visceral mass, a head-foot, and a shell secreted by the mantle.**
2. Which class of mollusks are filter feeders? **Bivalves.**
3. The tongue-like rasping organ in many mollusks is the **radula**.
4. Name three mollusks that don't have a shell of any kind. **Octopus, slugs, and nudibranchs.**
5. In bivalves, what organ collects plankton on its surface and sweeps it toward the

- mouth with cilia? **Gills.**
- In bivalves, what organ is the gateway of water into the mantle cavity? **Incurrent siphon.**
  - What organ is the exit of water out of the bivalve? **Excurrent siphon.**
  - By expanding and contracting their mantle, cephalopods accomplish at least two important things. List them. **They bring seawater into their mantle cavity to allow gas exchange for the gills and they are able to use it to propel themselves.**
  - Name three types of cephalopods. **Chambered nautilus, squid, and octopus (alternative answer: cuttlefish).**
  - Name four types of bivalves. **Clams, oysters, scallops, and mussels.**
  - Name three types of gastropods. **Correct answers include snails, slugs, whelks, conchs, nudibranchs, and abalones.**
  - Slugs and land snails have two pair of tentacles. What do the upper ones have at their tips? **Eyes.**
  - centipedes and belong to Class **Chilopoda.**
  - The answers to both 5 and 6 have two major body regions; the head and the **trunk.**
  - List five general characteristics of a large group of arthropods called the crustaceans. **Two pairs of antennae, a pair of mandibles and two pairs of maxillae, biramous appendages, calcium salts within its cuticle, and some sort of gills for respiration.**
  - Sessile or stalked crustaceans called **barnacles** are covered in calcareous plates and use their wispy legs (cirri) to filter feed on plankton.
  - A group of crustaceans, many of which are popular among seafood lovers, that have ten walking legs, are the **decapods.**
  - Be able to label the crayfish with these body parts: carapace, cephalothorax, feeding appendages, walking legs (specify the chelipeds), abdomen, telson, uropods, swimmerets, antennules, antennae, and compound eyes.

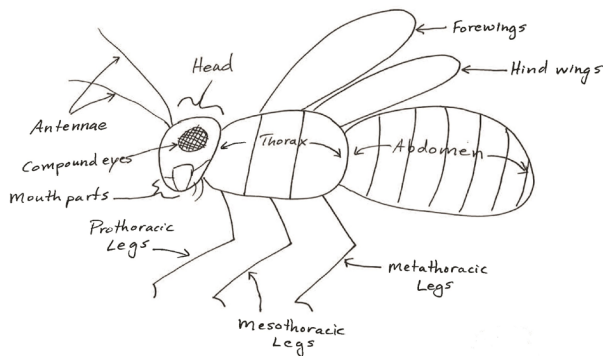
## CHAPTER 25

- List four major characteristics of the arthropods. **Exoskeleton, segmented body, jointed appendages, and a periodic need to molt.**
- Arthropod means **jointed foot.**
- In the molting process, the new cuticle is produced \_\_\_\_\_ the old cuticle.  
**a. underneath**
- An extinct group of arthropods having a head, thorax, and pygidium is the **Class Trilobita.**
- Slow, graceful arthropods that feed on lichens, detritus, and some plants and have two pairs of legs per segment (on most segments) are the **millipedes** and belong to **Class Diplopoda.**
- Fast, creepy predatory arthropods having one pair of legs per segment are the
- A group of crustaceans that is dorso-ventrally flattened and has seven pairs of legs is called the **isopods.** List two extremely different habitats in which these crustaceans can be found. **They can be found in deserts and on the ocean floor.**
- A group of crustaceans that is laterally



flattened and also has seven pairs of legs is called the **amphipods**.

14. The largest group of arthropods (by far) possessing head, thorax, abdomen, **six** legs, **four** wings (if present), and **one** pair of antennae is the insects.
15. Draw and label a generalized insect with these body parts: head, thorax, and abdomen; prothoracic, mesothoracic, and metathoracic legs; forewings and hind wings; antennae, compound eyes, and mouthparts.



16. The forewings of beetles, comprising the biggest order of insects (**Order Coleoptera**) are hardened wing covers called **elytra**.
17. Order **Diptera** are also known as the flies, only have **forewings**. In place of hind wings are gyroscopic organs called **halteres** needed for balance during flight.
18. Order Hemiptera are also known as the **true bugs**.
19. Butterflies and moths (Order **Lepidoptera**) have microscopic scales covering their **wings** and have siphoning mouthparts called a **proboscis**.
20. Beetles, flies, and butterflies, and wasps have **complete** metamorphosis because their larval body form is drastically different from their adult body form. The **pupa** stage is when most of the transformation occurs.
21. True or False. Horseshoe crabs are

crustaceans. **False**.

22. Arthropods called arachnids have two body regions: the cephalothorax and **abdomen**.
23. In arachnids, the cephalothorax has **chelicerae** (mouthparts), short sensory leg-like appendages called **pedipalps** and four pairs of **legs**.
24. Which of the following is not an arachnid?  
**b. Lice**
25. Order Araneae, the spiders, have **silk glands** which produce silk.
26. Spiders may use silk for:
  - a. Prey capture.
  - b. Prey wrapping.
  - c. Making egg sacs.
  - d. Lining their nests.
  - e. Containing sperm.
  - f. All the above.**
27. Which of the following are not arthropods?  
**d. Polychaetes**

## CHAPTER 26

1. Echinoderm means **spiny skin**.
2. Name the hydraulic system that all echinoderms share. **Water vascular system**.
3. Which is not part of this hydraulic system?  
**d. pedicellariae**
4. Echinoderm walking appendages are called **tube feet** and are extensions of the above system.
5. Give the common name(s) of these echinoderm classes.
  - a. Asterozoa: **Sea stars**
  - b. Echinozoa: **Sea urchins, sand dollars, and heart urchins**
  - c. Ophiurozoa: **Brittlestars**
  - d. Holothurozoa: **Sea cucumbers**
6. Which class of Echinoderms has members with relatively long spines? **Echinozoa**.
7. Which of the classes above (#5) have members that are mostly herbivorous on

- kelp and other seaweeds and uses a jaw-like apparatus called Aristotle's lantern to graze the bottom? **Class Echinoidea (specifically sea urchins).**
- Which of the above classes is usually lacking spines and can eviscerate when disturbed? **Class Holothuroidea.**
  - A predatory sea star can extrude its **stomach** outside its body and insert it into its bivalve prey.
  - Sea cucumbers collect food on their branching **tentacles**. Once enough is collected, it is inserted into its mouth and the food is swallowed.

## CHAPTER 27

- Sea squirts belong to:
  - Urochordata**
- Lancelets belong to:
  - Cephalochordata**
- What is unique about the mouth of lampreys and hagfish (the agnathans)? **They are jawless.**
- What is unique about the skeleton (except the jaw) of all sharks, skates, rays, chimaeras, and sawfish? **It is made out of cartilage.**
- Sharks, skates, rays, etc. belong to the Class **Chondrichthyes**.
- Class Osteichthyes are the bony fish. Give three examples that highlight some of the extreme variety in this group. **Sea horses, eels, and anglerfish.**
- The gill covering called the operculum is a feature of \_\_\_\_\_.
  - Bony fish**
- What type of fertilization do most frogs and toads (Order Anura) exhibit?
  - external**
- What is the order or common name of a legless group of tropical amphibians? **Order Gymnophiona (Caecilians).**
- Which amphibian order employs a spermatophore to inseminate the female resulting in internal fertilization? **Order Caudata.**
- What is the common name for order Testudines? **Turtles.**
- Most adult amphibians can breathe using both lungs and **skin**.
- True or False. All frogs are oviparous (lay eggs). **False.**
- List two main groups of order Squamata. **Snakes and Lizards.**
- Name one feature that is unique to order Squamata (other reptiles don't have it). **Hemipenes.**
- Name one feature that is unique to order Testudines (other reptiles don't have it). **The shell (upper carapace and lower plastron).**
- Name two general characteristics of all birds that would be considered novel traits or unique structures (apomorphies) by evolutionists, in that the presumed reptilian ancestor didn't have them? **Feathers and specialized lungs.**
- Match the following to the correct order.
  - Mallard duck **6. Order Anseriformes**
  - Sparrow **1. Order Passeriformes**
  - Penguin **4. Order Sphenisciformes**
  - Ostrich **5. Order Struthioniformes**
  - Turkey **3. Order Galliformes**
  - Hawk **2. Order Falconiformes**
- What two chordate (vertebrate) classes are endothermic? **Birds and mammals.**
- Name two general characteristics of all mammals that would be considered novel traits or unique structures (apomorphies) by evolutionists, in that the presumed reptilian ancestor didn't have them. **Hair or fur and mammary glands.**
- Name two general characteristics of all reptiles that would be considered novel traits or unique structures (apomorphies) by evolutionists, in that the presumed



amphibian ancestor didn't have them.

**Scales and claws.**

22. Match the following to the correct order.
- Fruit bat **3. Order Chiroptera**
  - Sperm whale **6. Order Cetacea**
  - Beaver **1. Order Rodentia**
  - Horse **5. Order Perissodactyla**
  - Cougar **7. Order Carnivora**
  - Deer **4. Order Artiodactyla**
  - Kangaroo **2. Order Marsupialia**
23. Which of the following are not vertebrates?
- Cuttlefish**

## CHAPTER 28

- Which of the following is not a characteristic of Plantae?
  - chitin cell walls**
- In the alternation of generations life cycle, sporophytes produce spores within a structure called a sporangium, through a cellular division called **meiosis**.
- What is the ploidy of the gametophyte generation?
  - Haploid**



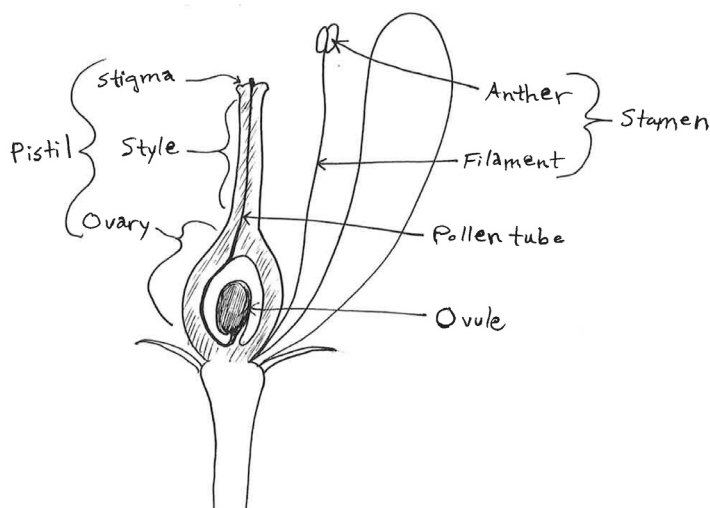
- What is the generation indicated by the upper bracket in the moss? **Sporophyte.**
- What are the visible spots on the undersides of fern pinnae called? **Sori.**
  - What is each spot composed of? **Sporangia with spores inside them.**
  - What structure in fern sporangia fling the spores abroad in a catapult fashion? **An annulus.**
- Which phylum of plants has a more conspicuous or dominant gametophyte generation?
  - Flowering plants
  - Conifers
  - Ferns
  - Mosses**
- Pine, spruce, fir, and cedar belong in the **Phylum Coniferophyta.**
- Male cones of conifers are made up of many tiny microsporangia which release microgametophytes which are also known as **pollen grains.**
- Female cones of conifers have many woody **ovuliferous** scales each of which bears two ovules on its upper surface.
- In conifers, successful pollination is achieved when pollen grain(s) of the correct species lands near the **micropyle** (opening in the integument) of the ovule.
- List four main differences between the two main classes of flowering plants, the eudicots and the monocots. **Eudicots have two cotyledons in each seed, while monocots have only one cotyledon. Eudicots have netted venation in their leaves, while monocots have parallel venation. Eudicots have a circular arrangement of vascular bundles in their herbaceous stems when viewed in cross section, while monocots have a scattered arrangement in their stems. Eudicots can produce wood (depending on the species), while monocots may produce strong**



fibrous stems, but never make wood.

Eudicots make floral parts in multiples of fours or fives, while monocot floral parts are in multiples of three.

12. Flowering plant pollination is simply the transfer of pollen to a receptive **stigma**. Name two very different creatures (from different phyla) that can serve as pollinators. **Insects (bees, wasps, flies, beetles, etc), birds, mice, bats, and even lizards can pollinate flowering plants.**
13. In flowering plants, sperm comes from within the **pollen grain**.
14. In flowering plants, the egg is within the ovule which is within the **ovary**.
15. Draw a simple longitudinal section of a complete flower. With a clear, neat line trace the growth of the pollen tube. Also label the pistil, composed of the stigma, style, ovary and ovule, and stamen, composed of filament and anther.



## CHAPTER 29

1. The study of the interactions between living creatures and their environment is called **ecology**.
2. A naturally functioning system comprised of a living (biotic) community and its

nonliving (abiotic) environment is a(n) **ecosystem**.

3. Name the three types of symbioses and their corresponding symbols. **Mutualism (+/+), commensalism (+/0), and parasitism (+/-).**
4. Give one example of a pair of creatures in a mutualistic relationship and state how both benefit each other. **Examples might be lichens, which are made up of algal and fungal symbionts; coral and zooxanthellae; clownfish and sea anemones; and bullhorn acacia and ants. Algae does photosynthesis and offers the fungus carbohydrates; fungi provides it with the microenvironment to give it minerals from rain and dust. Zooxanthellae does photosynthesis for corals, while coral polyps give zooxanthellae shelter. Clownfish help eat small pests, while sea anemones offer the clownfish shelter from predators. Bullhorn acacia provide shelter and valuable food for ants, while ants protect acacia from herbivores.**
5. Give one example of a pair of creatures in a parasitic relationship and state how one benefits and how the other is harmed. **Tape worms, liver flukes, and filarial worms feed on the insides of numerous creatures. Fleas, ticks, lice, and leeches all do the same on the outside.**
6. In logistic growth what prevents a population from continuing to grow exponentially? **Carrying Capacity – this limit is affected by abiotic factors (water, light, or minerals, etc.), and/or biotic factors (competition, parasites, predators).**
7. Which diagram more accurately represents the complex and variable energy flow in a community?
  - a. **Food web**
8. Which diagram shows the relative

abundance of producers, primary consumers, secondary consumers, etc.?

**c. Trophic pyramid**

9. What two major groups are decomposers?  
**Fungi and bacteria.**
10. Animals within the same population often compete for food, water, territory, sunlight, or mates. This is called **intraspecific** competition.
11. The total lifestyle of an organism including its habitat requirements (both biotic and abiotic) and how it uses these requirements to survive and reproduce are all part of its ecological **niche**.
12. When animals, plants, fungi, bacteria, and protists burn glucose during cellular respiration and release (or exhale)  $\text{CO}_2$ , it is a very important part of what biogeochemical cycle? **Carbon cycle.**
13. Name one other plant process that is also part of this cycle. **Photosynthesis.**
14. Ammonification, nitrogen fixation, nitrification, denitrification are all steps in the **nitrogen** cycle.
15. When atmospheric nitrogen is converted into ammonia by bacteria it is called **nitrogen fixation.**