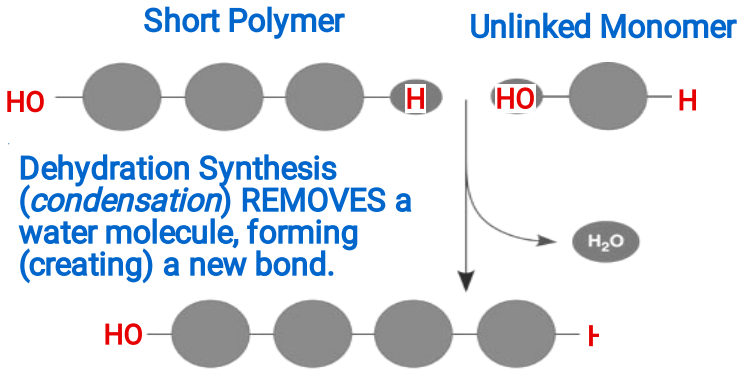
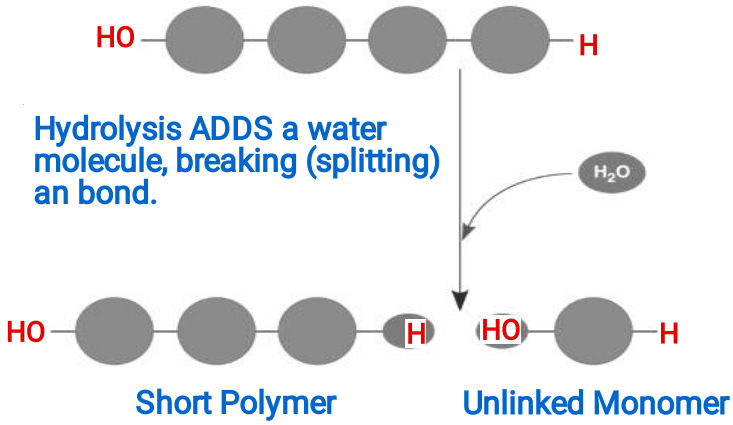
Chapter 5 - Guided Reading

(p.63) **1.** Label the diagram below – identify the type of reaction, the monomer and polymer along with a brief description of the reaction.



(p.63) **2.** Label the diagram below – identify the type of reaction, the monomer and polymer along with a brief description of the reaction.



(p.63) **3.** The root words of dehydration synthesis (condensation) and hydrolysis will be used many times to form other words you will learn this year. What does each root word mean?

dehydrate - remove water

synthesis - to make, create

hydro - water

lysis - split / break

(p.66) **4.** What are **polysaccharides**?

Polysaccharides are the polymers of sugars.

(p.66) **5.** List 3 functions of **polysaccharides**.

a) storage form of sugar (starch in plants / glycogen in animals)

b) building material for structures that protect the cell or whole organism. *(chitin in the exoskeleton of arthropods)* *(cellulose in plant cell walls)*

c) Sources of energy.

(p.67) **6.** Consider the following reaction: $C_6H_{12}O_6 + C_6H_{12}O_6 \longrightarrow C_{12}H_{22}O_{11} + H_2O$

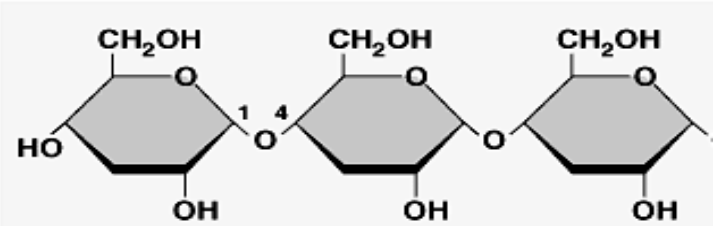
a. The equation is not balanced; it is missing a molecule of water. Write it in on the correct side of the equation.

b. So, what kind of reaction is this? dehydration synthesis / condensation

c. Is $C_6H_{12}O_6$ (*glucose*) a monomer, or a polymer? monomer

d. To summarize, when two monomers are joined, a molecule of water is removed. *(dehydration)*

(p.65) **7.** To the right is a molecule of starch, which shows 1 - 4 glycosidic linkages. What are **glycosidic linkages** and define this terminology in terms of carbon numbering.



Glycosidic linkages are covalent bonds formed between two monosaccharides by a dehydration reaction. These covalent bonds (sharing of electrons) between the #1 carbon of monosaccharide and the #4 carbon on the other monosaccharide.

(p.66-67) **8.** Compare and contrast **starch** and **glycogen**.

Both are storage polysaccharides but starch is found in plants and glycogen is found in animals (liver and muscle cells).

(p.68) **9.** What is **chitin**?

Chitin is an important structural polysaccharide used by arthropods such as insects and crustaceans to create their tough exoskeletons.

(p.68) **10.** Why are lipids grouped together?

(hydrophobic)

Lipids are grouped together because they all have little or no affinity for water.

(nonpolar)

(p.69) **11.** What are the building blocks of fats and lipids?

The building blocks of fats and lipids are glycerol and fatty acid molecules.

(p.69) **12.** If a fat is composed of **3 fatty acids** and **1 glycerol molecule**, how many water molecules will be removed to form it? Again, what is this process called?

Three molecules of water will be removed by the process of dehydration synthesis.

(p.70) **13.** List four important functions of fats.

a) Energy storage.

b) Cushions vital organs.

c) Insulates the body.

d)

(p.70) **14.** Contrast **saturated** and **unsaturated** fats – how does this relate to the concept that structure and function are linked?

Saturated fats contain no double bonds between the carbon atoms composing the chain and is completely "saturated" with hydrogen atoms. Unsaturated fats contain one or more double bonds formed by the removal of hydrogen atoms resulting in a kink in the carbon chain.

(animal fat)

(p.70) **15.** Name two saturated fats.

Lard and Butter

(plant and fish fat)

(p.70) **16.** Name two unsaturated fats.

Corn Oil and Olive Oil

(p.70) **17.** Why are many unsaturated fats liquid at room temperature?

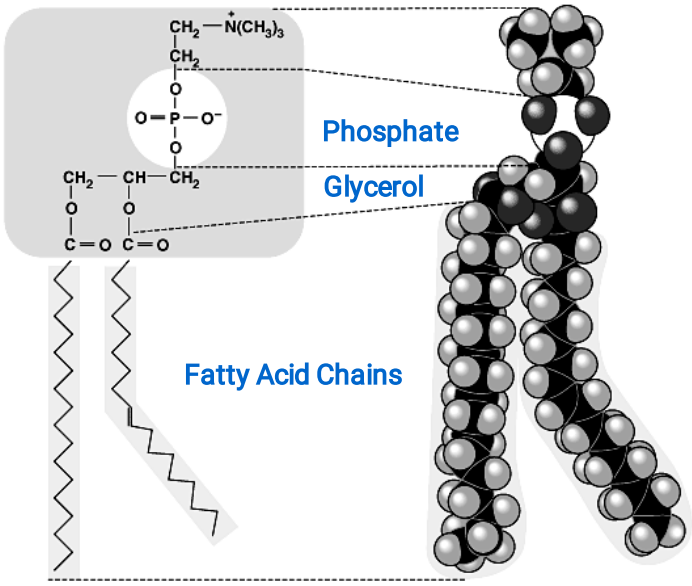
Many unsaturated fats are liquid at room temperature because the kinks where the double bonds are located prevent the molecules from packing together closely enough to solidify at room temperature.

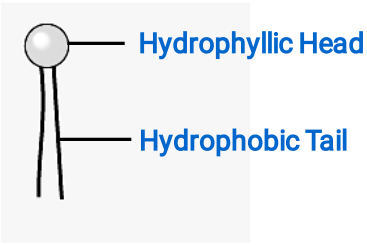
Duck Duck Go **18.** What is a **trans fat**? Why should you limit them in your diet?

Trans fats are produced from the industrial process of hydrogenation, in which molecular hydrogen (H_2) is added to vegetable oil, thereby converting liquid fat to semisolid fat.

Trans fats should be limited in your diet because they increase your risk for heart disease and other health problems.

(p.70)**19.** Below is a figure that shows the structure of a ***phospholipid***. Label it to show the ***phosphate group***, the ***glycerol***, and the ***fatty acid chains***. Also indicate the region that is ***hydrophobic*** and the region that is ***hydrophilic***.



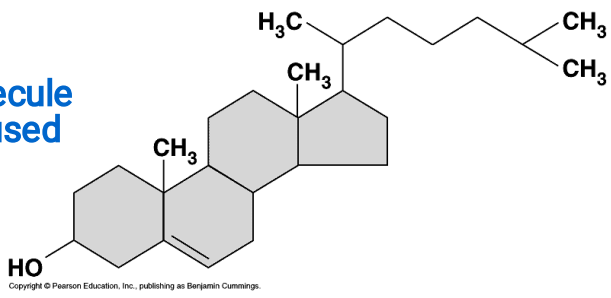


(p.70) **20.** Why is the tail ***hydrophobic***?

The tail is hydrophobic because it is a lipid and nonpolar.

(p.71) **21.** Use the diagram to the right to explain how you would you recognize a basic steroid molecule?

You would recognize a basic steroid molecule by it carbon skeleton consisting of four fused rings.



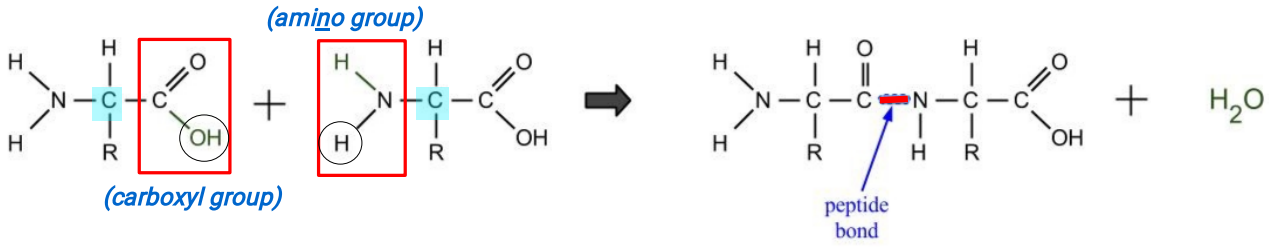
(p.72) **22.** List the eight types of proteins along with their basic function and a specific example of each.

Type of Protein	Function	Examples
Structural	Support and Shape	(1) Spider Silk (2) Collagen (3) Keratin
Storage	Storage of amino acids.	(1) Albumin (2) Casein
Transport	Transport of other substances	(1) Hemoglobin
Hormonal	Coordination of an organism's activities.	(1) Insulin
Receptor	Detection of a chemical stimulus.	(1) Nerve Cell Receptors (2) Glucose Receptors
Contractile	Movement	(1) Actin (2) Myosin *(muscle fibers)*
Defensive	Protection against disease.	(1) Antibodies (2) Cytokines
Enzymatic	Regulation of chemical reactions.	(1) Salivary Amylase *(digestive enzyme)* (2) ATP Synthase

(pp.73-74) **23.** What are the names for the monomers and polymers of proteins?

The monomers of proteins are amino acids and the polymers of proteins are polypeptides.

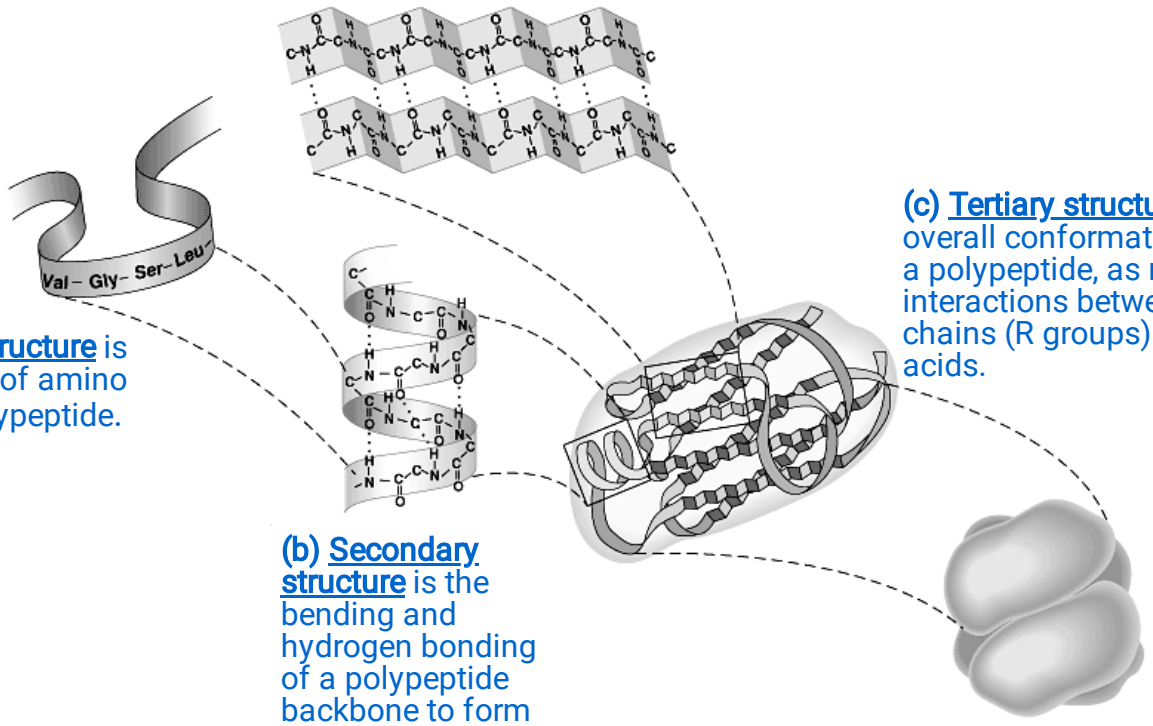
(p.73) **24.** Draw the dehydration synthesis of amino acids – note the **amino group**, the **carboxyl group** and the **alpha carbon**, circle the **water** molecule to be removed and then note the **peptide bond** formed when the two are joined.



(pp.74-77) **25.** Describe the four levels of protein structure along with a specific example of each.

Protein Structure	Examples
Primary - the unique (linear) sequence of amino acids	(1) Lysozyme *(antibacterial enzyme)*
Secondary - *(alpha helix)* *(beta pleated sheet)* repeated coiled or folded patterns that contribute to the proteins overall conformation	(1) Spider silk (2) Collagen
Tertiary - consists of irregular contortions resulting from the interactions between the side chains (R groups) of the various amino acids	(1) Salivary Amylase *(most enzymes)*
Quaternary - the overall protein structure that results from the aggregation of various protein subunits	(1) Hemoglobin

(p.79)**26.** Label each of the levels of protein structure on the figure below.



(a) Primary structure is the sequence of amino acids in a polypeptide.

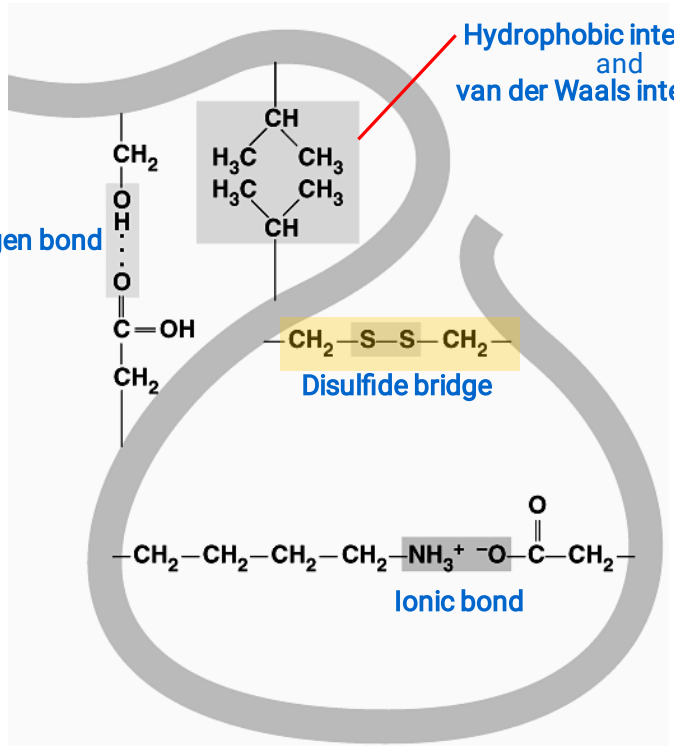
(b) Secondary structure is the bending and hydrogen bonding of a polypeptide backbone to form repeating patterns

(c) Tertiary structure in the overall conformation (shape) of a polypeptide, as reinforced by interactions between the side chains (R groups) of amino acids.

(d) Quaternary structure is the association between two or more polypeptides that make up a protein.

(p.77)**27.** Label the diagram below and use it to describe some of the molecular interactions responsible for the tertiary structure of a protein.

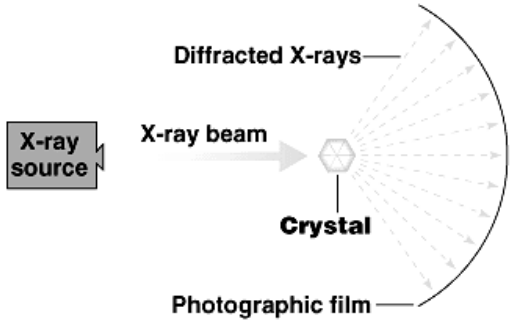
Hydrophobic side chains usually end up in the interior of the protein AWAY from water. Along with the clustering of hydrophobic groups, hydrogen bonds, ionic bonds and van der Waals interactions are all weak interactions (weak bonds) between side chains that collectively hold the protein in a specific conformation (shape). Much stronger are the disulfide bridges, covalent bonds between the side chains of two cysteine amino acids.



(p.73) **28.** How does the characteristics of an amino acid – *nonpolar*, *polar*, *acidic* or *basic* relate to the issue of tertiary and quaternary structure?

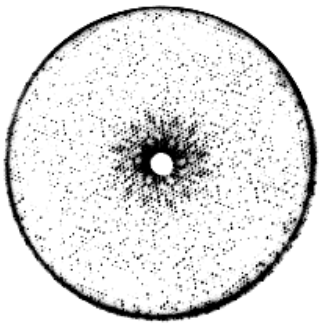
Nonpolar (*hydrophobic*) side chains usually end up in the interior of the protein AWAY from water. Polar (*hydrophilic*) side chains usually end up on the exterior of the protein towards from water. This includes acidic and basic side chains that are electrically charged and help to stabilize the entire tertiary and quaternary structure by forming ionic bonds

(p.81) **29.** Use the diagram below to help you describe the technique of x-ray crystallography.



❶ X-ray crystallography

An instrument aims an X-Ray beam through the protein crystal. The regularly spaced atoms of the crystal diffract (deflect) the X-rays into an orderly array.



❷ X-ray diffraction pattern from the crystal of a protein

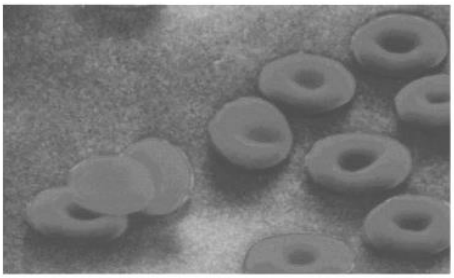
The diffracted X-rays expose photographic film, producing a pattern of spots

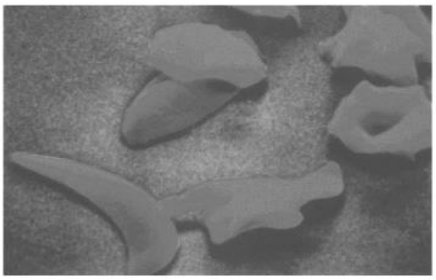
X-Ray crystallography involves crystalizing a molecule (protein/DNA) and then X-Raying it. Computer analysis of the results in a map of all the atoms of the molecules in three-dimensional space. Finally, scientists use other computer software to generate a three-dimensional model of the molecule.

(p.63) **30.** Do you remember when, in previous chapters, we said,

"Change the structure, change the function"?

Use the diagram below to help you explain how that principle applies to sickle-cell disease. Why is the structure changed?

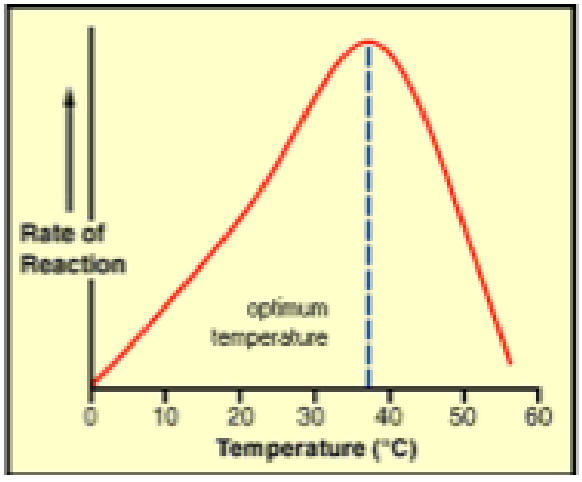


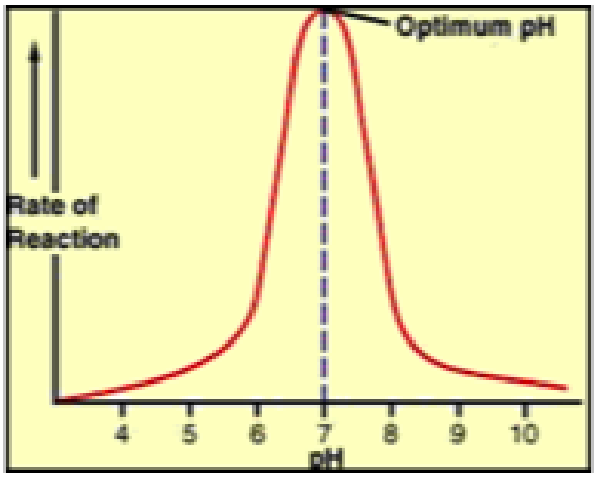


Sickle-cell disease is caused by a genetic mutation. Genes make proteins and proteins make you. Change the gene and you change the protein that gene makes, in this case, the protein in question is hemoglobin found in red blood cells which changes shape when the pH of the blood drops or becomes acidic during exercise.

(p.78) **31.** Besides mutation, which changes the primary structure of a protein, protein structure can be also be changed by **denaturation**. Define *denaturation*, and give at least two ways a protein may become denatured.

Denaturation is the unraveling and loss of a proteins native conformation (shape) caused by changes in temperature and pH,

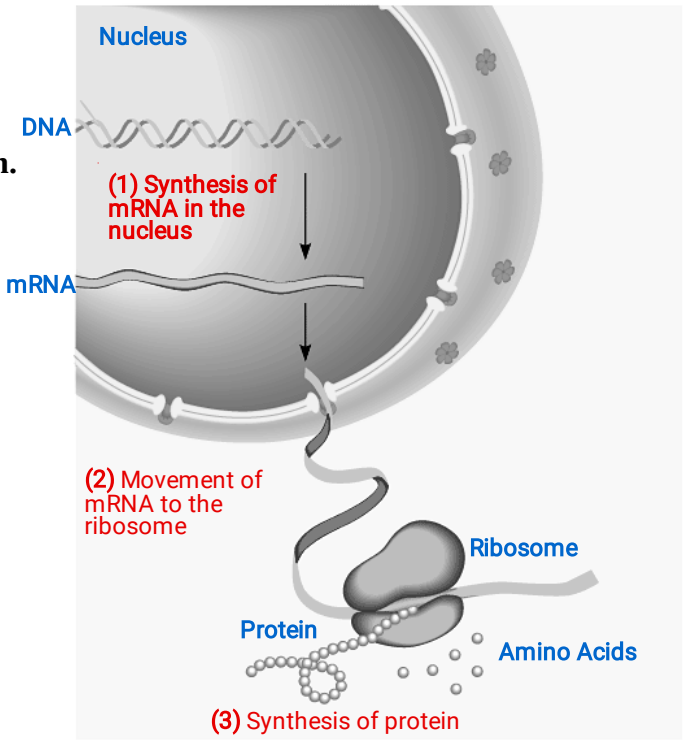




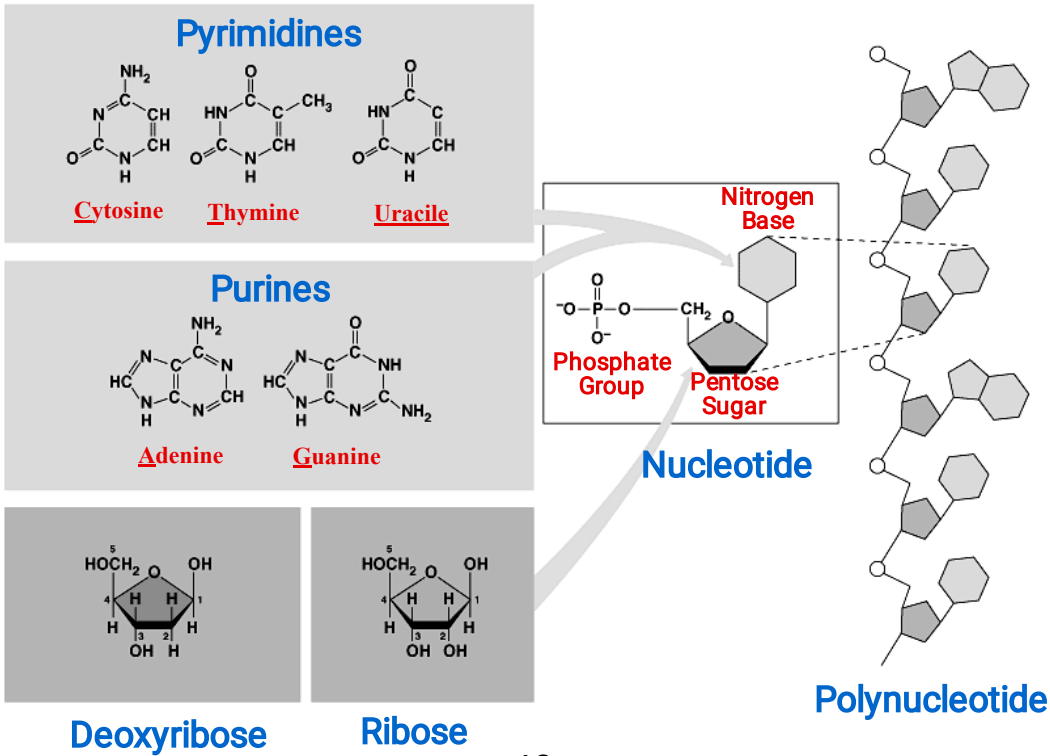
DNA and RNA will be the core topics of future chapters.
For now, you should just review the general functions and know the components.

(p.82) **32.** The flow of genetic information is from DNA ----> RNA ----> protein.
Use this figure below to briefly explain the process. Be sure label the **nucleus**, **DNA**, **mRNA**, **ribosome**, **amino acids** and **protein.**

In a eukaryotic cell, DNA in the nucleus programs protein production in the cytoplasm by dictating the production of mRNA which travels to cytoplasm and binds to ribosome. As a ribosome moves along the mRNA, the genetic message is translated into a polypeptide of specific amino acid sequence.



(p.83) **33.** The components of a **nucleic acid** are a **sugar**, a **nitrogenous base** and a **phosphate group**. Label each on the figure below along with the **purines** and **pyrimidines**.



(p.83) **34.** Notice that there are five nitrogen bases. Which four are found in DNA?

(1) Adenine **(2)** Thymine **(3)** Cytosine **(4)** Guanine

(p.63)**35.** Which four are found in RNA?

(1) Adenine **(2)** **Uracil** **(3)** Cytosine **(4)** Guanine

(p.63)**36.** How do ribose and **deoxy**ribose sugars differ chemically?

Deoxyribose has one less oxygen atom.

(p.83) **37.** To summarize, what are the three components of a nucleotide?

Phosphate Group | Pentose (5C) Sugar | Nitrogen Base

(p.82) **38.** To the right is a model of DNA, which was proposed by James Watson and Francis Crick. What is this shape called?

The shape is called a DOUBLE HELIX.

(p.63) **39.** What two molecules make up the "uprights" or side of the ladder?

The pentose sugar and phosphate groups make up the "uprights" or sides of the ladder.

(p.63)**40.** What molecules make up the rungs of the ladder?

The nitrogen bases make up the rungs of the ladder.

___13) An oil may be converted into a substance that is solid at room temperature by -
A) adding hydrogens, decreasing the number of double bonds in the molecules.
B) removing water, causing a dehydration synthesis reaction to occur.
C) removing hydrogens, increasing the number of double bonds.
D) cooling it, so that double bonds form and the fats solidify.

___14) What feature of fats makes them hydrophobic?
A) Fats have carboxyl groups.
B) Fats include one glycerol molecule.
C) Fats have polar fatty acids.
D) Fats have nonpolar hydrocarbon chains.

___15) Fatty acids are -
A) composed of carbon, hydrogen, and oxygen in a 1:2:1 ratio.
B) composed of carbon, hydrogen, glycerol, and a phosphate group.
C) hydrophobic.
D) composed of four linked rings.

___16) Fatty acids with double bonds between some of their carbons are said to be -
A) unsaturated.
B) saturated.
C) completely hydrogenated.
D) monoglycerides.

___17) The development of atherosclerotic disease can result from a diet high in -
A) fiber.
B) protein.
C) saturated fats.
D) sugars.

___18) If you were to add olive oil to your food as part of a diet to lower your risk of atherosclerotic disease, you would use olive oil that -
A) is liquid at room temperature.
B) is hydrogenated.
C) is modified to be solid at room temperature.
D) has lard added to it.

___19) Which of the following statements about animal cell lipids is *false*?
A) Fats are a form of lipid that function to store energy.
B) Phospholipids are important components of cell membranes.
C) Many lipids function as enzymes.
D) Cholesterol is a type of lipid that is a component of cell membranes and steroid hormones.

___20) A phospholipid is composed of -
A) one fatty acid molecule linked to three glycerol molecules.
B) one glycerol molecule linked to three phosphate groups.
C) one fatty acid molecule linked to one glycerol molecule and two phosphate groups.
D) one glycerol molecule linked to one phosphate group and two fatty acids.

___21) Which of the following substances is a lipid?
A) DNA B) cellulose C) steroids D) enzymes

___22) A major type of lipid found in cell membranes is -
A) triglycerides. B) phospholipids. C) glycerol. D) waxes.

___23) Amino acids can be distinguished from one another by -
A) the number of R groups found on the amino acid molecules.
B) the chemical properties of their R groups.
C) the type of bond between the R group and the rest of the amino acid molecule.
D) the chemical properties of their amino and carboxyl groups.