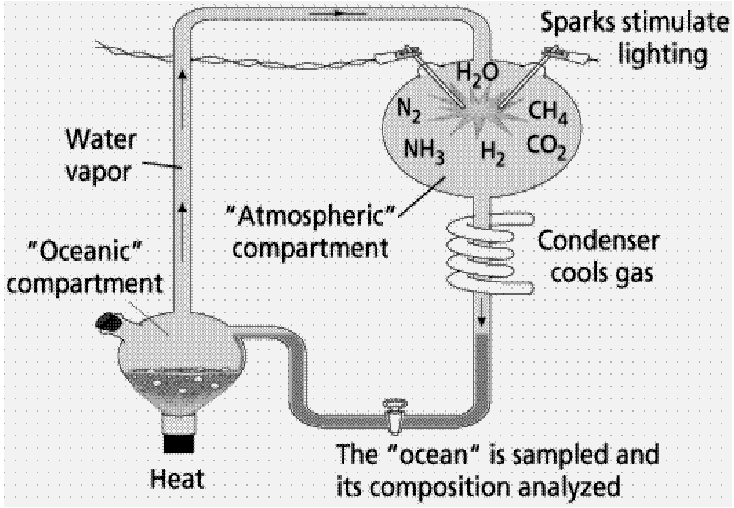
Guided Reading: Chapter 4

(p.52) **1.** Why is organic chemistry so important in the study of biology?

Organic chemistry so important in the study of biology because although a cell is composed of 70-95% water, the rest is composed of carbon-based (organic) compounds such as proteins, DNA, carbohydrates and lipid (fats).

(p.53 **2.** Use the figure of Stanley Miller's experiment below to help explain the keys elements of his experiment.

Stanley Miller's 1953 simulation demonstrated the environmental conditions of the lifeless, primordial Earth resulting in the spontaneous synthesis of some organic molecules. The key elements of this experiment include:
(1) Energy source in the form of sparks representing lightning.
(2) An Atmospheric Compartment containing H_2O, H_2, NH_3, CH_4, and CO_2.
(3) An Oceanic Compartment where organic molecules can be collected.



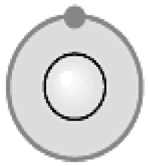
(p.53) **3.** What was collected in the sample for chemical analysis?

The "ocean" was collected for chemical analysis.

(p.52) **4.** What was concluded from the results of this experiment?

The presence of a variety of organic compounds (amino acids) that play key roles in living cells lead to the conclusion that the conditions of primitive Earth were conducive to the spontaneous synthesis of organic compounds.

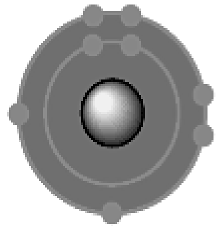
(p.54) **5.** Identify the atoms below, list their valence numbers and identify how many different atoms each can covalently bond with.



Hydrogen

(Valence = 1)

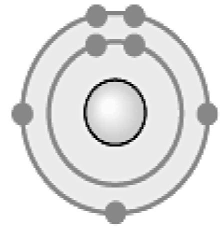
Can covalently bond with 1 other atom.



Oxygen

(Valence = 2)

Can covalently bond with 2 other atoms.



Nitrogen

(Valence = 3)

Can covalently bond with 3 other atoms.

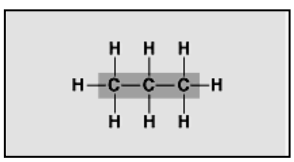
(p.54) **6.** In the space to the right, draw an electron distribution diagram of carbon. It is essential that you know the answers to these questions:

a. How many valence electrons does carbon have? 4

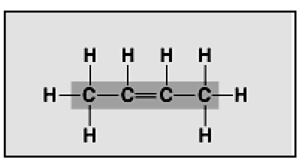
b. How many bonds can carbon form? 4

c. What type of bonds does it form with other elements? covalent

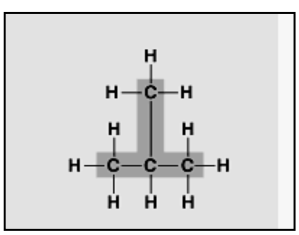
(p.55) **7.** Carbon chains form skeletons. Label the diagrams below and use them to describe the types of carbon skeletons that can be formed.



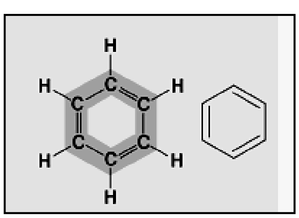
LINEAR: Carbon skeletons can be linear of varying lengths.



DOUBLE BONDS: Carbon skeletons can have double bonds at various locations.



BRANCHING: Carbon skeletons can be branched at various locations.



RINGS: Carbon skeletons can arranged in rings.

(All of these molecules are HYDROCARBONS)

(p.54) **8.** What is special about carbon that makes it the central atom in the chemistry of life?

The electron configuration of carbon gives it covalent capability with many different elements which makes it the central atom in the chemistry of life.

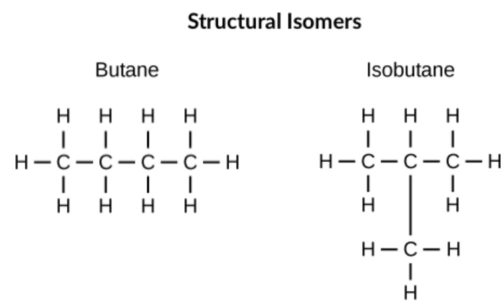
(p.55) **9.** What is a *hydrocarbon*? Name two. Are hydrocarbons hydrophobic or hydrophilic?

Hydrocarbons are organic molecules consisting only of carbon and hydrogen.
Four hydrocarbons include methane, ethane, propane and butane.
Most hydrocarbons are nonpolar and therefore hydrophobic.

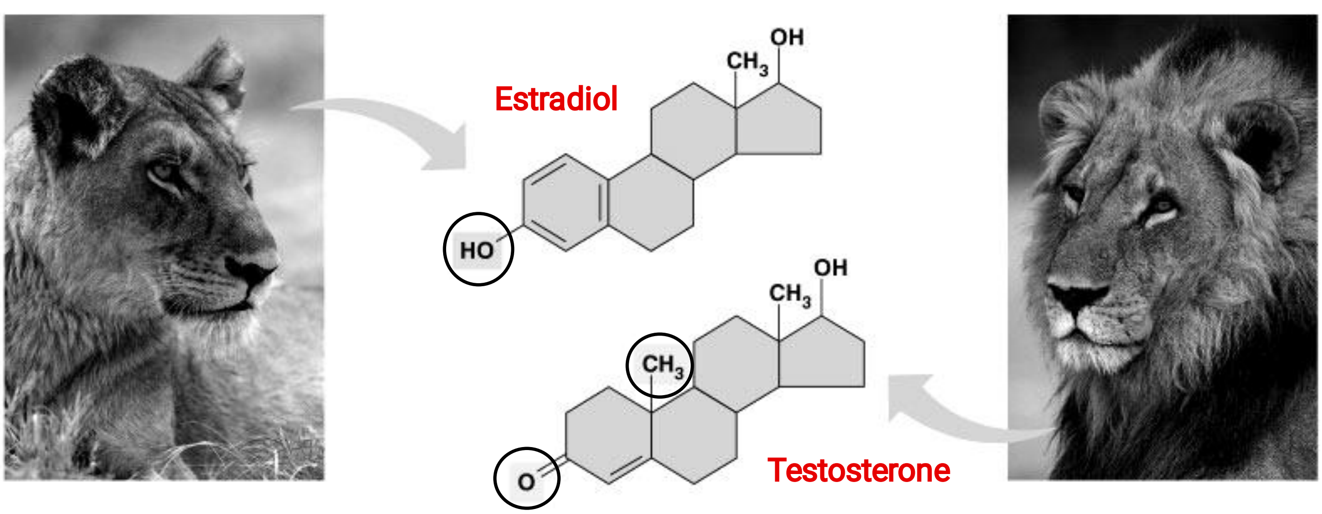
10. In Chapter 2 you learned what an *isotope* is. Since students often confuse this word with *isomer*, please define each term here and give an example.

(p.29) **a. Isotope** - Isotopes are atoms with the same atomic number (# of protons) but different atomic mass (more neutrons).

(p.56) **b. Isomer** - Isomers are compounds with same molecular formula but different structure.



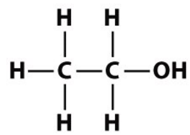
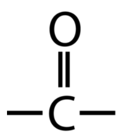
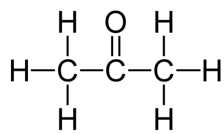
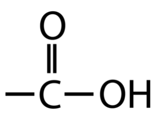
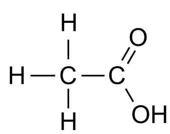
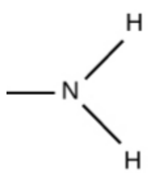
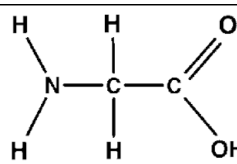
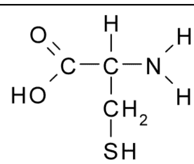
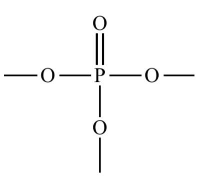
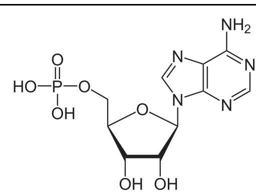
(p.57) **11.** Here is an idea that will recur throughout your study of the function of molecules: Change the structure, change the function (***Structure dictates Function***). You see this in the study of proteins and enzymes, and now we are going to look at testosterone and estradiol (*estrogen*). Notice how similar these two molecules are, and yet you know what a vastly different effect each has. Label each molecule in the sketch below, and circle the differences.



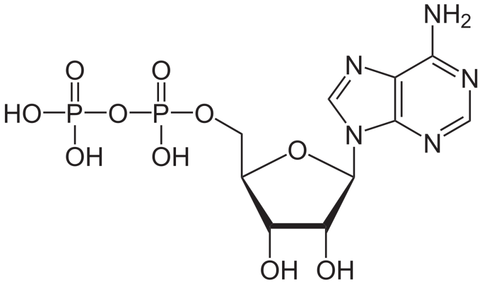
(p.57)**12.** Define functional group.

A functional group is a component of an organic molecule most commonly involved in chemical reactions.

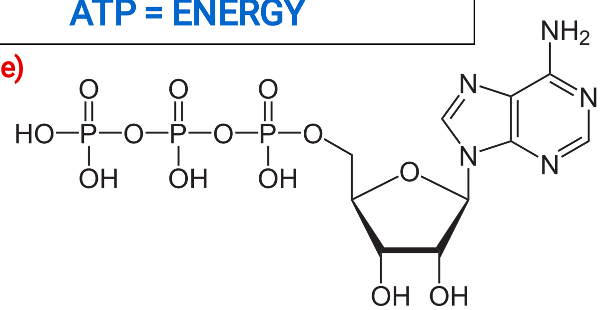
(p.58) **13.** Fill in the table below: after each functional group – draw the structure, write and example and Note the functional properties.

Group	Structure	Example	Functional Properties
Hydroxyl	-OH	 (Ethanol)	Has a polar covalent bond, which helps alcohols dissolve in water.
Carbonyl		 (Acetone)	
Carboxyl		 (Acetic Acid)	The -OH is a source of hydrogen ions (protons) giving it acidic properties.
Amino		 (Glycine)	The -NH2 is a hydrogen ion (proton) acceptor giving it basic/alkaline properties.
Sulfhydryl	-SH	 (Cysteine)	The sulfhydryl group is found in the amino acid cysteine and forms disulfide bridges that stabilize proteins.
Phosphate			Cells harness the transfer of phosphate groups to perform work. ATP = ENERGY

((adenosinemonophosphate)



((adenosinediphosphate)



((adenosinetriphosphate)