Workshop Exercise on Life & Its Chemistry – Part 2

NOTE to STUDENTS and FACILITATORS: One of the main purposes of the Workshops is to allow free exchange of information by **having each member of a Learning Community in turn answer one part** of a discussion question. As each student explains a term or gives a definition in their own words, it should allow for free verbal EXCHANGE and promote learning by interaction. **Try to insure that everyone in your Learning Community does a question or two and the purpose of the exercise is that they must EXPLAIN THEIR ANSWERS to the rest of the community.**

PART 2. THE CHEMICAL BUILDING BLOCKS OF LIFE…

Exercise 8. Biological Building Blocks.

The Building Blocks of Chemical Biology. The great diversity of molecules and molecular structure found in all living cells is simplified when one realizes that most of the larger molecules found in cells are made from only 30 small precursor molecules. In the Table 3 below, one member of your community *fill in* the spaces with the names of these monomers; then review the answers among all the members of your community.

Table 3. The 30 Most Common Monomers in Cells

Kind of Molecule	Number known to be present in cell	Monomer Name	Role in Cell
?	**20**	?	?
?	**5**	?	?
?	**2**	?	?
?	**3**	?	?

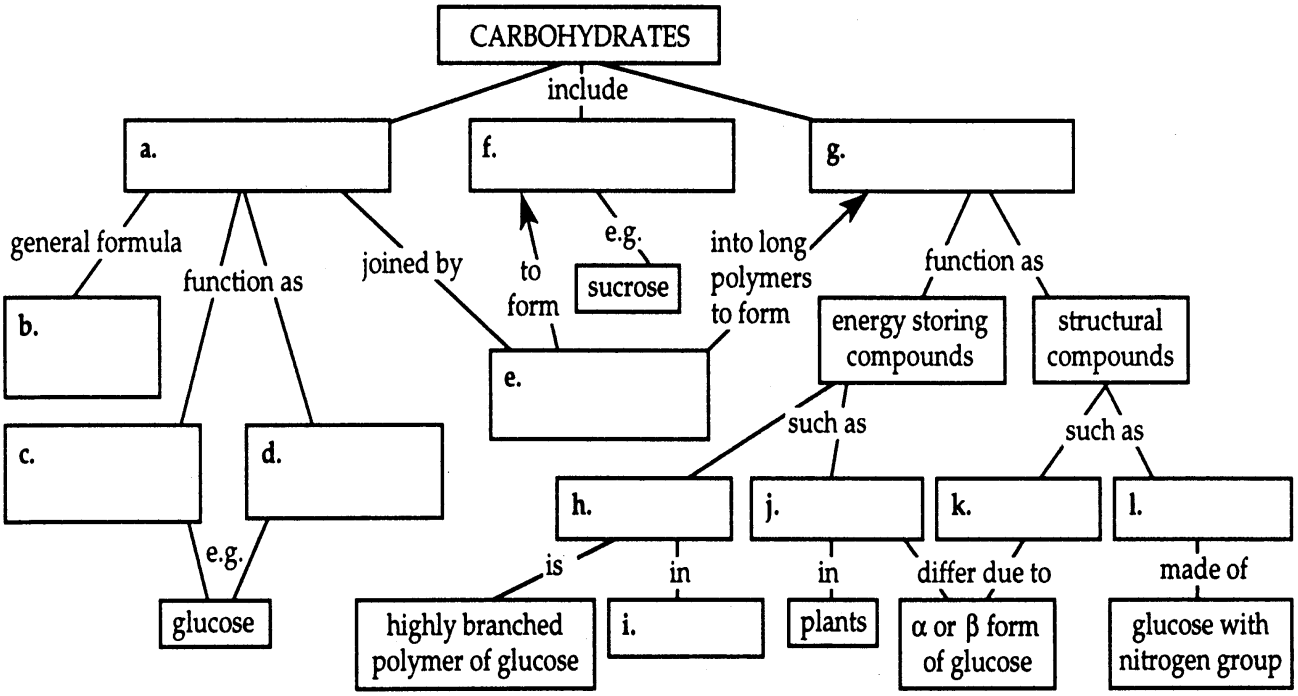
The individual monomeric precursor molecules above consist primarily of seven fundamental ***Functional Groups,*** which confer chemical reactivity on the molecules of which they are part. In Table 4 below members of the workshop in turn should *identify* these 7 functional groups, draw the structural formula of the functional groups, indicate for each functional group at least 1 cellular molecule in which that group is found, and place an N, P, or U to indicate whether the group is negatively charged, positively charged or uncharged near neutral pH of cells. Review these functional groups with the entire workshop.

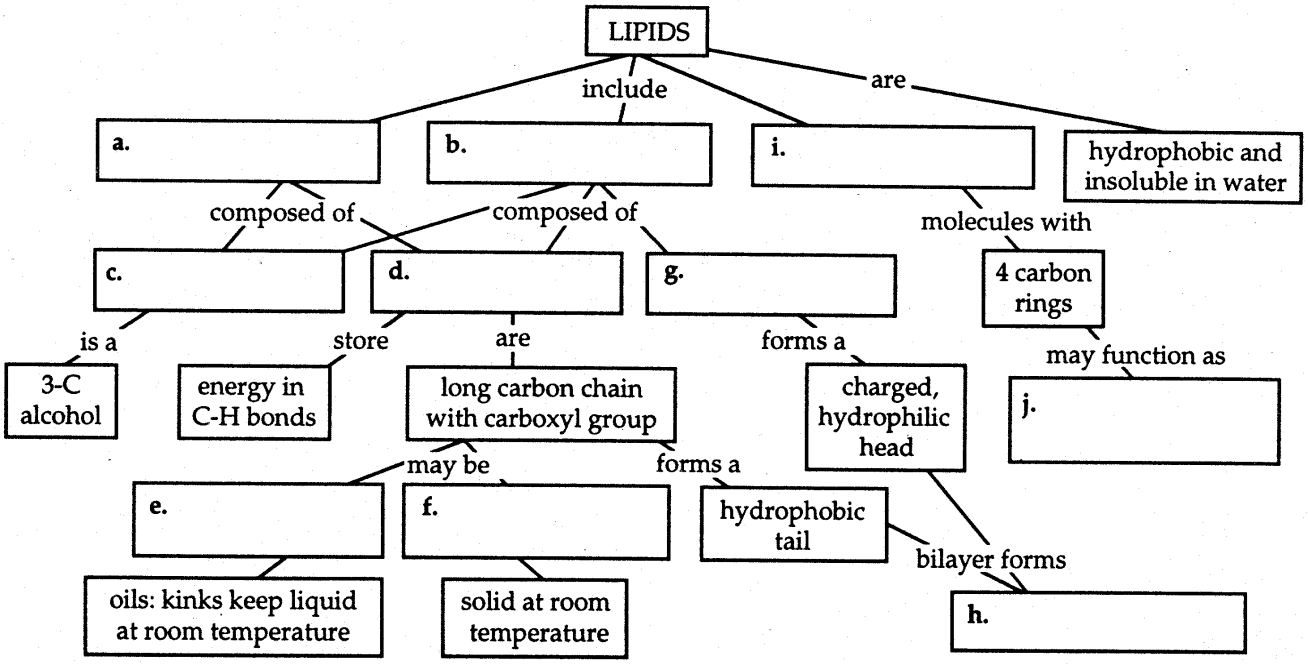
Table 4. Some Common Functional Groups Found in Biological Molecules

Functional Group --->							
Its Structure --->							
Typical Molecule Containing This Group							
Form that predominates at neutral pH							

N = Negatively Charged Groups @ Near Neutral pH of Cells
P = Positively Charged Groups @ Near Neutral pH of Cells
U = Uncharged Groups @ Near Neutral pH of Cells

Exercise 9. CONCEPT MAPS for the major macromolecules [carbohydrates & lipids].
Have members of your learning community in turn fill in one of the boxes in alphabetical order. If appropriate explain the concept at each lettered box.





In Chemistry Part 1 we learned that all matter is composed of atoms and the atoms of organisms are arranged into large, complex macromolecules. Life is built upon these macromolecules. They store energy for later use, form membranes, provide structural support, help control chemical reactions within the organism, and store the hereditary information that is used to direct every aspect of the organism's life and is passed on to the next generation. The four major categories of macromolecules are carbohydrates, lipids, proteins, and nucleic acids.

Exercise 10: Macromolecules [Select one member to answer part (a) below]:

a. PROTEINS (text pg. 75-84) and ENZYMES (text pg. 153-161)
Define what a **protein** is and/or of what it is made. *(Being in favor of young people is not an answer)*
Define all the different **functions** that a protein may have.

b. NUCLEIC ACIDS (pg. 85-88) [Select one member to answer part (b) below]:
Define what a **nucleic acid** is and/or of what it is made. How many different kinds of nucleic acids can you name? (Optional: Talk briefly about which you think came first, DNA or RNA & why?)

c. Some **KEY TERMS** in the Chemistry of Life. [Select one member each to answer part (c) below]:
Have one member, each, of your Learning Community, in turn, define one of these terms :

active site

cofactor

conformation

enzyme inhibitors

chaperone proteins (heat shock proteins)

globular proteins

allosteric regulation

fibrous proteins

purines & pyrimidines

double helix

d. Match the following numbers with the appropriate statement. A number may be used more than once.

Numbers: 0, 1, 2, 3, 4, 5, 6, 12, 20

Statements:

a. the number _____ of different nitrogenous bases in DNA

b. the number _____ of different chemical classes of amino acids

c. the number _____ of chains of nucleotides in a DNA molecule

d. the number _____ of different nitrogenous bases in RNA

e. the number _____ of different amino acids found in proteins

f. the number _____ of chains of nucleotides in most RNA molecules

Exercise 11. [Select one member in turn to answer part (a) below]:

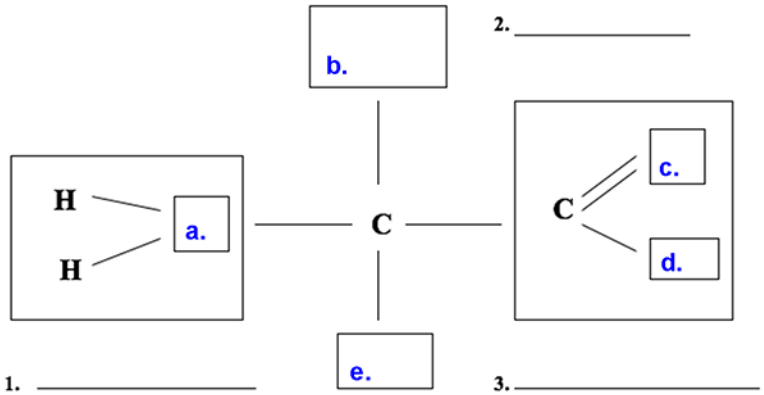
a. Provide the appropriate term to complete each statement.

1. The most abundant protein in your body is collagen which is a type of _____ protein.
2. _____ amino acids have side groups that contain an organic ring structure.
3. _____ refers to a protein losing its three dimensional structure.
4. Hereditary information is stored in macromolecules called _____?

b. Select one member each, in turn, to answer part (b) below:

1. What determines a protein's conformation?
2. Can we use DNA and Proteins to monitor the progress of evolution? If so, How?
3. How does a cell's chemical and physical environment affect enzyme activity?
4. Why would a change in pH cause a protein to denature?
5. A denatured protein may reform to its original functional shape, when returned to its normal environment. What does this indicate about a protein's conformation?
6. Why would transfer to an organic solvent (such as alcohol) cause denaturation of a protein?
7. The double helix structure of DNA has been compared to a spiral staircase. What makes up the sides of the staircase and what the steps? What holds these parts together?

c. Fill in the missing atoms in the structure of the amino acid below (a, b, c, b, & e); then identify the 3 functional groups (1 , 2, & 3) that make up the structure of each amino acid.



d. Matching: identify items 1 through 10 as either **P**rimary, **S**econdary, **T**ertiary, or **Q**uaternary levels of protein structure?

1. hydrogen bonding of peptide backbone ____
2. amino acid sequence _____
3. alpha helix _____
4. disulfide bridges _____
5. motifs as helix-turn-helix _____
6. Two or more polypeptide chains _____
7. Structure of hemoglobin _____
8. Ionic bonding _____
9. Hydrophobic interactions _____
10. Unstructured regions of a polypeptide ____