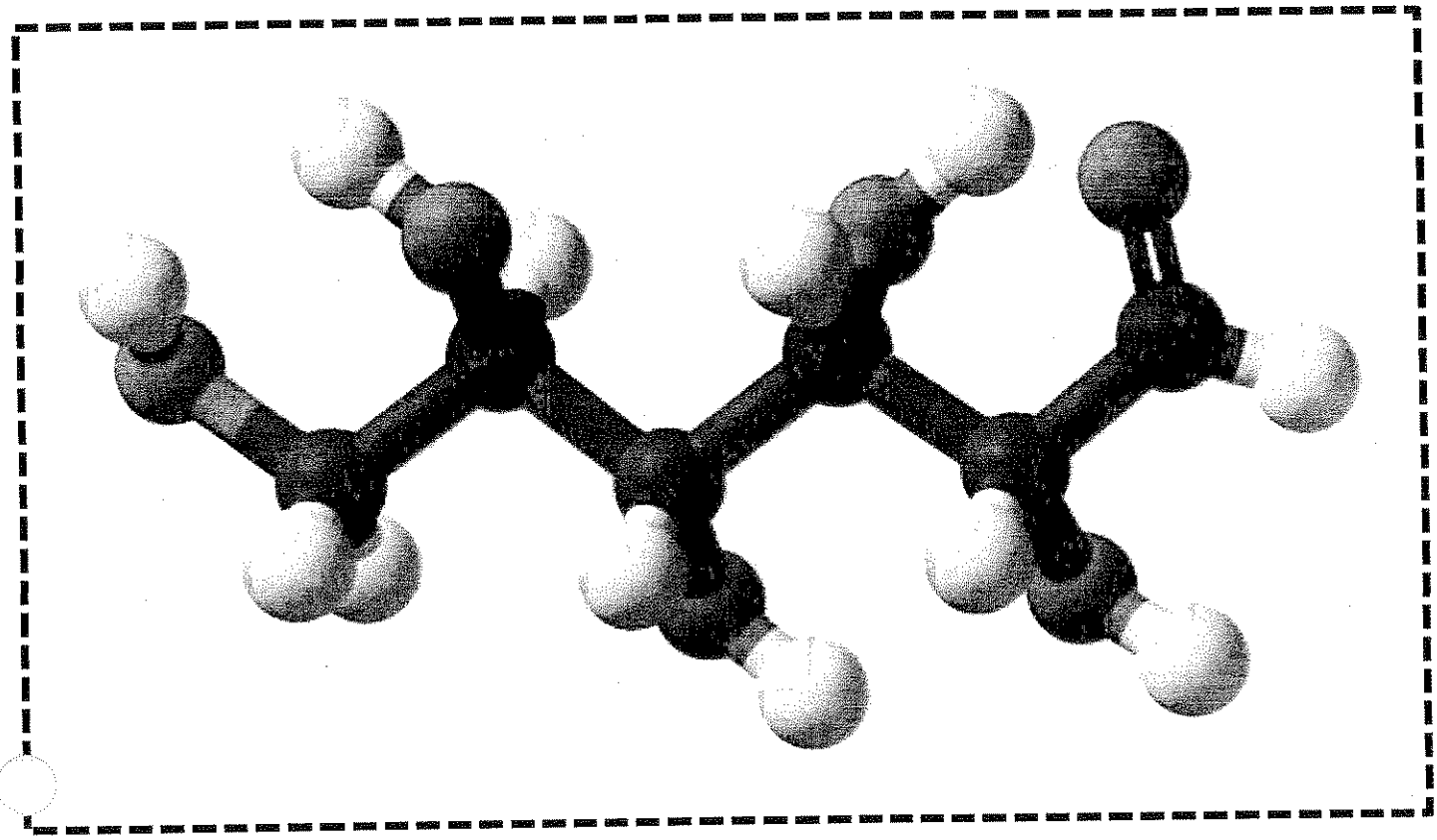


BIOCHEMISTRY

Notes and Observations

Name: _____Hour_____

IMPORTANT VOCABULARY:

Ionic	Covalent	Polar	Nonpolar
Hydrophobic	Hydrophillic	Hydrogen bond	Organic
Inorganic	Hydrocarbon	Isomer	Alkane
Functional group	Macromolecule	Monomer	Polymer
Hydrolysis	Dehydration synthesis	Carbohydrate	
Monosaccharide	Polysaccharide	Lipid	Fatty acid
Glycerol	Protein	Amino Acid	
Peptide bond	Enzyme	Nucleic Acid	DNA
RNA	Nucleotide		

LEARNING GOALS:

After this unit you should be able to...

- Draw structure of water
- Describe and demonstrate the polar properties of water
- Describe the difference between polar and nonpolar covalent bonds
- Show how water attracts itself and other polar molecules
- Describe the formation of hydrogen bonding
- Identify the valence e- of carbon
- Draw a single, double and triple bond
- Draw a straight and branched chain and a ring structure
- Understand the three major properties of carbon
- List the characteristics of all organic molecules
- Demonstrate and write the molecular, structural, formula of alkanes
- Identify isomers
- Understand the difference between dehydration synthesis and hydrolysis
- Identify the 4 major macromolecules by element, picture and monomer unit
- Describe the function of each macromolecule
- Build each type of macromolecule and demonstrate dehydration synthesis

Nature of Molecules: Properties of Water

Ideas:

1. Living systems are made up of 5 major types of molecules
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____
2. Organisms are made up of different arrangements of these molecules, giving all life a biochemical framework

II. Inorganic vs. Organic

A. Living systems can be categorized into inorganic and organic molecules.

1. _____: molecules containing 1 or no carbon atoms

2. _____: molecules containing 2 or more carbon atoms

III. Chemistry Of Water:

A. Essentials:

- Most _____ are surrounded by water and cell themselves are about _____ water.
- The abundance of water is the major reason Earth is habitable and is essential for all living things.

B. 6 Characteristics of WATER:

1. Structure:
   - Water contains 2 _____ atoms and 1 _____ atom.

2. POLARITY:

What demo/activity does this fit with? _____

- Water has slightly _____ and _____ ends
  - Ex: ELECTRONS in water molecule spend more time *near the oxygen* side than the hydrogen side creating a partially charged ends

3. Bond Type:
What demo/activity does this fit with? _____

- Water is bonded together by COVALENT BONDS: _____

  _____

  - Two types:

  a. Nonpolar covalent: _____

  b. Polar covalent: _____

4. Creates Hydrogen Bonds:
What demo/activity does this fit with? _____

- **Water** can bond with **other** _____ molecules or **other** _____**molecules**
  - Form Hydrogen Bonds or: _____ _____ between molecules.
- **Rule**: Usually form between _____

**This property is what orders other molecules into a higher level of structural organization. Ex. Cell Membrane, DNA, Proteins

Look at the water molecule and how it forms hydrogen bonds

5. Relationship to other molecules

What demo/activity does this fit with? _____

- _____: *"water loving"*

  Ex. water molecules attract other polar molecules

What demo/activity does this fit with? _____

- _____: *"water fearing"*

  Ex. water molecules repel nonpolar molecules - do not form hydrogen bonds

KEEP IN MIND! There will be large molecules that may have both hydrophilic and hydrophobic properties – ends of the molecules differ

6. Make Chemical Reactions Happen:

- Water is _____ for chemical reactions within the body.
- Most reactions take place in _____ **solutions: "in water"**
  - WATER is a _____ and due to its polar properties it has the ability to **break apart or combine** molecules.

a. **Dehydration synthesis**: loss of a water molecule results in a combination of molecules

b. **Hydrolysis**: addition of a water molecules results in the breaking apart of molecules

Bio Notes
Biochemistry: Understanding the Carbon atom and Organic Compounds

Background:
As we learned previously, compounds containing the element of carbon are considered organic, that is if they contain 2 or more carbon atoms. Of course there are exceptions to the rule. Methane gas (CH_4) only contains 1 carbon but is considered a hydrocarbon but carbon dioxide (CO_2) is not. There are **4 essential macromolecules** that contain carbon; **carbohydrates, lipids, proteins and nucleic acids**. Each one of these molecules is needed for the composition of living organisms

What make these macromolecules so versatile is the atom that composes these organic structures. **Carbon** is the **backbone** that builds each of these macromolecules and has the ability to bond to itself and other atoms common to organic structures.

Directions:
Below you will complete three activities to show the properties of carbon. Read the left side of the data table which will explain the property of Carbon and complete the action by drawing on the right side of the data table.

Properties of Carbon	Action
PROPERTY #1 **Tetravalent: 4 valence shell electrons** ▪ **Carbon can bond to itself or other atoms by sharing electrons**	Draw the Lewis dot structure of Carbon – showing the 4 valence shell electrons

PROPERTY #2 **Ability to form strong covalent bonds** ▪ **When carbon shares electrons with itself or other atoms it can form three types of bonds** ▪ **Single – 2 shared electrons**	In the box to the right draw two carbon atoms next to each other and draw a pair of dots between them to represent a single bond. Below drawing, replace the dots with 1 straight horizontal lines and drawing 2 carbon atoms on either side. You created a single bond	**Single Bond**

#2 ▪ **Double – 4 shared electrons**	In the box to the right draw two carbon atoms next to each other and draw 2 pairs of dots between them to represent a double bond. Below drawing, replace the dots with 2 straight horizontal lines and drawing 2 carbon atoms on either side. You created a double bond	**Double Bond**

#2 ▪ **Triple – 6 shared electrons**	In the box to the right draw two carbon atoms next to each other and draw 3 pairs of dots between them to represent a triple bond. Below drawing, replace the dots with three straight horizontal lines and drawing 2 carbon atoms on either side. You created a triple bond	**Triple Bond**
PROPERTY #3 **Ability to join to other carbon atoms in the form of <u>chains and rings</u> to from large, complex macromolecules**	**Straight chain:** Draw a chain of 6 carbons bonded together **Branched chain:** Draw a branched chain of 6 carbons. 4 in a straight chain with 2 branching. **Ring Structure:** Draw a hexagon (***hex* – 6**)	

Carbon/Organic Compound Notes

I. What is an Organic Compound?

1. Composed of _____ or more _____ atoms.
2. Common elements that form organic molecules: _____(C), _____ (H), _____ (O), _____ (N), _____ (P) and _____ (S)
3. May be _____(nonpolar) or _____(polar) or both
4. May contain **Functional Groups:** _____

   _____

   Ex. –OH hydroxyl group (alcohol) – ethane to ethanol

5. Ex. macromolecules, antifreeze, acetone (nail polish), diamonds
6. Ex. Fossil Fuels: coal, oil, gas
   - Energy rich hydrocarbons are used as primary source of energy on Earth

Organic Macromolecules

Structure of Macromolecules in living things

1. **Monomer Units**: _____

2. **Polymers**: _____
   - Can be formed by identical or similar monomer units

3. **MACROMOLECULES**: very large carbon structures made up of _____ polymers

III. The Building and Breaking Apart of Macromolecules:

- Organic macromolecules may differ but, they are **ALL** assembled and disassembled in the same way.

1. Dehydration reactions:
   - _____ monomer units _____ to make larger molecules
   - _____ or _____ of a _____ molecule

2. Hydrolysis reaction: *"to break"*
   - **Reverse of dehydration**
   - _____ **of** _____ to _____ a larger molecule apart into smaller monomer units.

HYDROCARBON HANDOUT

Below you will find several examples of hydrocarbons. Note their prefixes that will correlate with naming, use during the formation of molecular and structural formulas.

Common Organic Prefixes: Need to know!

Meth-	Hex-
Eth-	Hept-
Prop-	Oct-
But-	Non-
Pent-	Dec-

Organic Alkanes: straight chain hydrocarbons that contain 1 or more Carbon atoms that are singly bonded to the maximum number of hydrogens.

Naming using the molecular formula: Prefix + ane

CH_4 – Methane

C_2H_6 – Ethane

C_4H_{10} –

C_5H_{12} –

H_8 –

Writing Molecular Formula using name:

Molecular Formula: Formula that gives the exact number of different atoms of an element in a molecule

Methane: CH_4

Hexane:

Octane:

How to draw a structural formula: Carbon is the backbone!

Structural Formula: chemical formula that show how the atoms are bonded to one another in a molecule

Methane:

Ethane:

Organic compounds form many ISOMERS

ISOMER: Same molecular formula but different molecular arrangement

Practice:

Name the organic prefix:

1. 1C _____
2. 2C _____
3. 3C _____
4. 4C _____
5. 7C _____
6. 9C _____

Predict the number of hydrogens for each alkane:

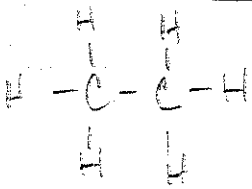
7. 3C structure would contain _____hydrogen
8. 6C structure would contain _____hydrogen
9. 10C structure would contain_____hydrogen

Write the name of the alkane by looking at the formula:

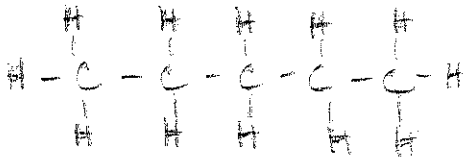
10. CH_4 _____
11. C_3H_8_____
12. C_7H_{16}_____
13. C_8H_{18}_____

Name the organic structure that is represented below: and write formula

14._____



15._____



16._____

4 Types of Macromolecules

Name:

From: www.sci.uidaho.edu

Macromolecules are typically BIG molecules, and they truly are the building blocks of cells. Macromolecules are generally built by combining many single units, or monomers, into larger units, called polymers. All cells are composed of the four general types of macromolecules, although each type can serve a cell in different ways. In this assignment, you will learn the four different types of macromolecules, how macromolecules are formed and broken down and how they are used in cells.

CARBOHYDRATES:

Carbohydrates are biological molecules that are always composed of carbon, hydrogen and oxygen. Like other macromolecules, carbohydrates play a number of roles for organisms. They are involved in energy storage and production, structure and signaling. The fundamental monomer of carbohydrates is called a monosaccharide. Monosaccharides can be linked together by glycosidic linkages, which are covalent bonds formed through dehydration reactions. Monosaccharides are linked together to form disaccharides, slightly larger oligosaccharides, or the largest class of carbohydrates, the polysaccharides.

LIPIDS:

Lipids are a diverse group of molecules that play diverse roles for cells and organisms. Some lipid types, such as phospholipids, are essential components of membranes. Other types of lipids serve as energy storage molecules, signaling molecules, or even pigments. One characteristic that all lipids share, however, is that they are all hydrophobic. This means that lipids are not soluble in water. The hydrophobic nature of lipids has important consequences for how lipids are used, transported, and metabolized in organisms.

PROTEINS:

Proteins are found everywhere – inside of cells, in membranes, and outside of cells – and play many roles for organisms. Many proteins act as enzymes, and catalyze very specific chemical reactions. Other proteins have roles in the transport of substances, self-defense and structure. Of the literally millions of different types of proteins used by living organisms, all proteins are made from the same 20 amino acids, and all are made in the same way.

NUCLEIC ACIDS:

The nucleic acids DNA and RNA are responsible for storing and transmitting the genetic code of all organisms. DNA is a huge polymer that stores information in the sequence of its monomers, called nucleotides. The information in DNA is used to produce proteins. RNA is used to transfer the information of DNA to sites of protein synthesis and to translate the information into the amino acid sequences of proteins.

DNA also serves as a partial record of the history of life, and allows us to peer into the past to discern evolutionary trends and relationships.

Together, these macromolecules are responsible for all of life's many processes

Macromolecule Tree Map Assignment

Name:

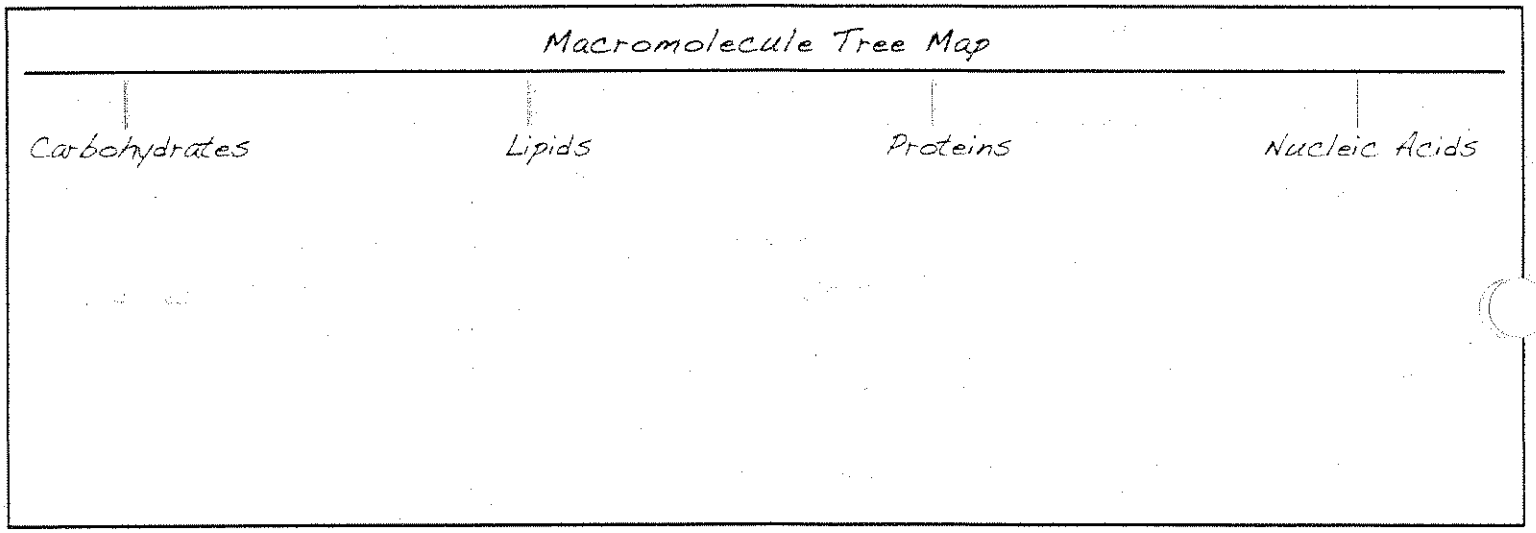
Use this handout along with your notes and your textbook (Owl) pages 55-59 to research the 4 major types of macromolecules.

Create a tree map with the four macromolecules making sure to include the following for each molecule:

-Which elements it is made of
-Monomer/subunit that the molecule is made of
-Picture of the molecule/molecular structure (correctly labeled)
-Different types of the molecule w/ description of each
-Function of the molecule (what is it used for?)
-Examples of the molecule
-Illustration that will help you remember as much as possible about the molecule

Get your information checked over by me before you begin your final tree map!

Tree Map Set Up:



Tips:
Use 11x17-sized paper
Collect required info first, and then plan how you will organize it on the paper
Make sure you have required details...but don't rewrite the whole book
Stick to short statements, no sentences!

Rubric (Hand in with tree map)

	Carbs	Lipids	Proteins	Nucleic Acids
Elements & Monomer Unit				
Molecule picture + Illustration				
Types & Examples				
Functions				
Totals	/8pts	/8pts	/8pts	/8pts
Neat/Shows Effort	/6pts			

FINAL GRADE= /36 Points

Protein

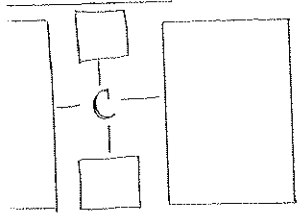
Common Names: _____

Key:

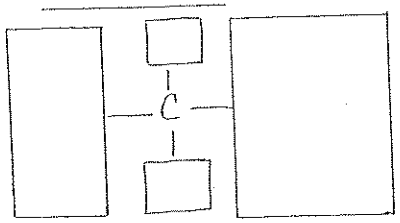
- H group
- R group
- Amino group
- Carboxyl Group

→ Monomer unit: Amino Acid - AA

1 AA



1 AA



Protein

Dipeptide AA-AA

Nucleic Acids

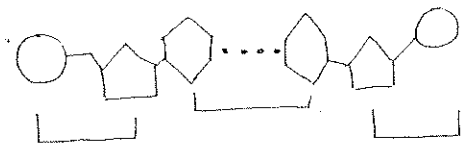
Common Name: _____ and _____

Key: Monomer Unit: Nucleotide

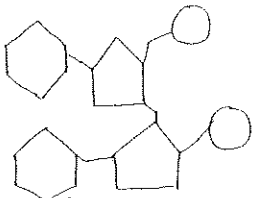
1 Nucleotide

- Phosphate group
- Pentose sugar (5c)
- Nitrogen Base

Ex: DNA



Ex: RNA



DNA

Name:

Shape:

Sugar:

Nitrogen Base:

RNA

Carbohydrates

mon Names: _____ and _____

mples:

1. _____ : _____

Ex: Fructose and Glucose

2. _____ : _____

Ex: Lactose and Sucrose

3. _____ : _____

a. _____ :

b. _____ :

c. _____ :

Lipids

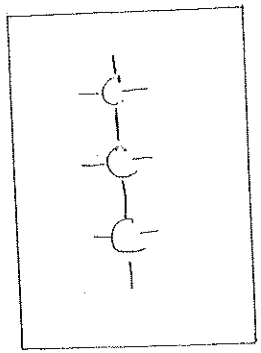
Common Names: _____

Key:

Glycerol

Fatty Acid

Monomer Unit

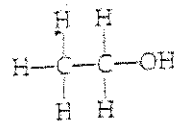
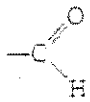
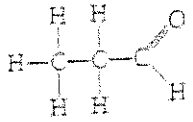
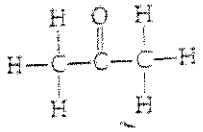
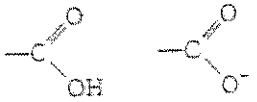
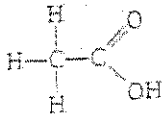
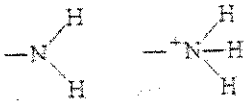
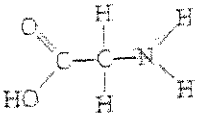
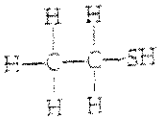
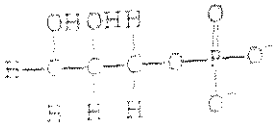


Typical Fat : Triglyceride

Common Functional Groups of Organic Compounds

* Be able to recognize and name
* There may be more than 1 functional group per molecule

Table 4.1 Functional Groups of Organic Compounds

Functional Group	Formula	Name of Compounds	Example
* Hydroxyl	—OH	Alcohols	 Ethanol (the drug of alcoholic beverages)
See various -OH groups with carbohydrates			
Carbonyl		Aldehydes	 Propanal
		Ketones	 Acetone
* Carboxyl	 (non-ionized) (ionized)	Carboxylic acids	 Acetic acid* (the acid of vinegar)
F. A. Chains			
* Amino	 (non-ionized) (ionized)	Amines	 Glycine* (an amino acid)
Proteins			
Sulfhydryl	—SH	Thiols	 Ethanethiol
* Phosphate		Organic phosphates	 Glycerol phosphate
Nucleic acids			

*The ionized forms of the carboxyl and amino groups prevail in cells. However, acetic acid and glycine are represented here in their non-ionized forms.

* Functional group are polar and hydrophilic

AMINO ACIDS – the building blocks of PROTEINS!

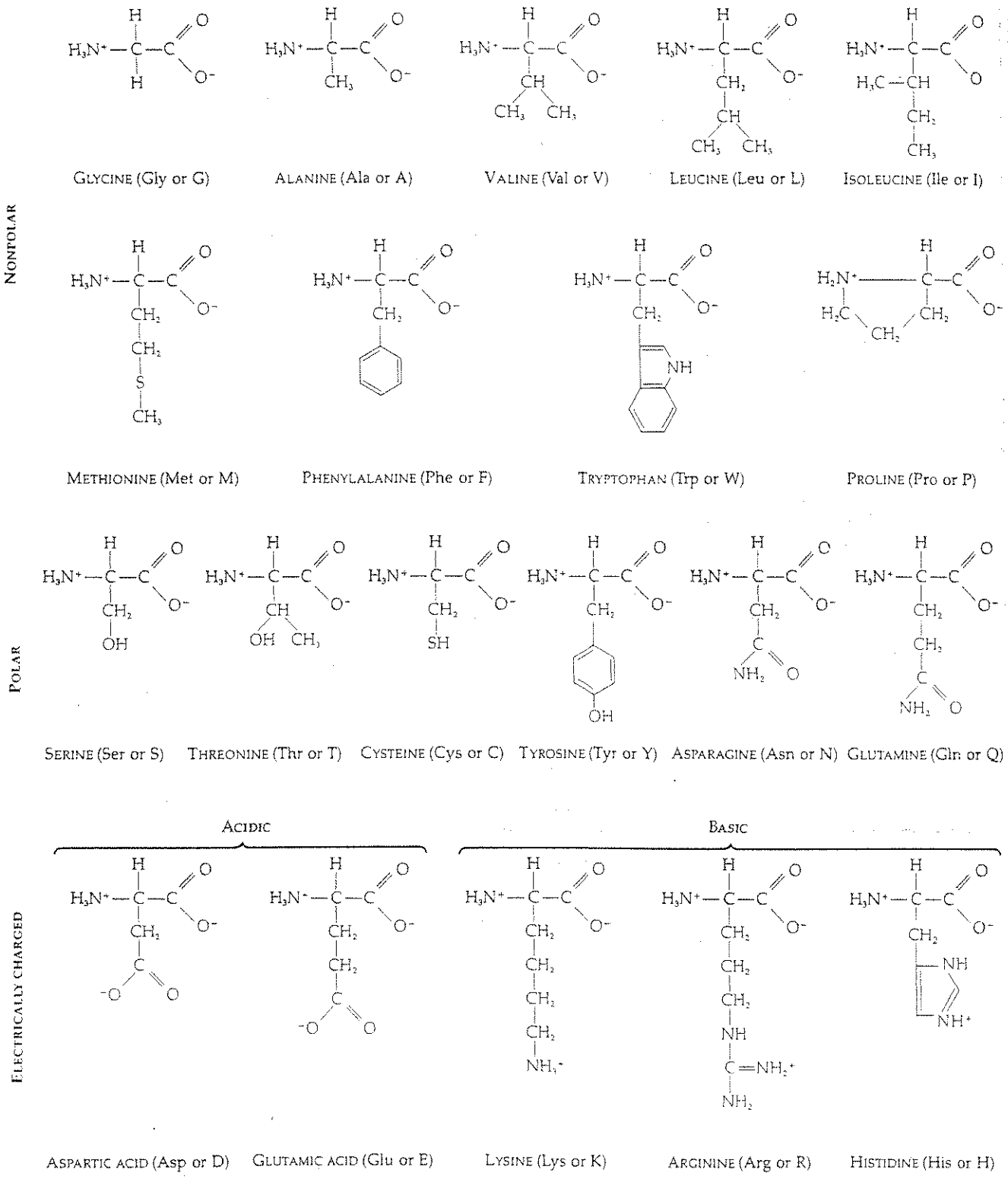


Figure 5.17
The 20 amino acids. The amino acids are grouped here according to the properties of their side chains (R groups). The amino acids are shown in their prevailing ionic forms at pH 7. The pH of the cell is in parentheses are the three-letter abbreviations and the one-