1. **Chemistry of Cellular Components**
   Chapter 3
2. **3.1 Strong and Weak Chemical Bonds**
   - *elements in organisms*:
     - hydrogen, oxygen, carbon, nitrogen, phosphorus, and sulfur
   - *Molecule*
   - *Covalent bond*
   - *Monomers*
   - *Polymers*
   - *Macromolecules*
3. **3.1 Strong and Weak Chemical Bonds**
   - *Hydrogen bond*:
   - *Electronegative*
   - Polarity
     - *Polar*
     - *Nonpolar*
   - *Van der Waals forces*
   - *Ionic bonds*
   - *Hydrophobic interactions*
4. **Some Functional Groups of Biochemical Importance**
5. **Some Functional Groups of Biochemical Importance**
6. **3.2 Overview of Macromolecules and Water**
   - Water is the major constituent of cells
   - ~95% of the dry weight of a cell consists of macromolecules
7. **3.2 Overview of Macromolecules and Water**
   - *Proteins*:
     - polymers of amino acids
     - structural and enzymatic roles
   - *Nucleic acids*:
     - polymers of nucleotides
     - RNA & DNA
   - *Lipids*
     - Polar compounds
     - both hydrophobic and hydrophilic properties
   - *Polysaccharides*
     - Polymers of sugar units
8. **3.2 Overview of Macromolecules and Water**
   - Water as a Biological Solvent
     - Cellular molecules bathed in water
     - *polarity*
       - Dissolve, stability of large molecules, nonpolar aggregate, cohesive
     - *Cohesiveness*
       - ordered arrangements, surface tension & specific heat
9. **3.3 Polysaccharides**
   - *Carbohydrates (sugars)*
     - carbon, hydrogen, & oxygen (1:2:1ratio)
     - *Pentoses (C_5 sugars)*:
       - nucleic acids
     - *Hexoses (C_6 sugars)*:
       - cell wall &energy reserves

10 **3.3 Polysaccharides**
- *Monosaccharides*
  - connected by glycosidic bonds
    - *Disaccharides*
    - *Trisaccharides*
    - *Oligosaccharides*
    - *Polysaccharides*
    - *Glycoproteins*:
      - polysaccharides + proteins
    - *Glycolipids:*
      - polysaccharides + lipids

11 **3.3 Polysaccharides**
- *Glycosidic bonds*:
  - Two geometric orientations:
    - alpha (α) & beta (β)

12 **3.4 Lipids**
- *Lipids*
  - Amphipathic
    - hydrophilic & hydrophobic
  - *Simple lipids (fats, triglycerides)*:
    - three fatty acids & C_3 alcohol glycerol
  - *Complex lipids:*
    - simple lipids & additional elements
      - phosphorus, nitrogen, sulfur, or small hydrophilic organic compounds (sugars)
  - *Phospholipids:*
    - Contain phosphate groups

13 **3.5 Nucleic Acids**
- *Polynucleotides:*
  - DNA and RNA
- Nucleotides composed of
  - C_5 sugar
    - ribose (RNA) or deoxyribose (DNA)
  - Nitrogen base
    - *Purine bases*
      - two rings
    - *Pyrimidine bases*
      - single ring
  - Phosphate

14 **3.6 Amino Acids and the Peptide Bond**
- Amino Acids
  - carbon, hydrogen, oxygen, and nitrogen
    - 2 of 22 contain sulfur, 1 contains selenium
  - All contain two important functional groups
    - Carboxylic acid group (-COOH)
    - Amino group ($-NH_2$)
  - *peptide bonds*

15 **Structure of the 22 Genetically Encoded Amino Acids**

16 **3.7 Proteins: Primary and Secondary Structure**
- *Enzymes*

- Catalytic proteins; catalysts for chemical reactions
- *Structural Proteins*
  - Integral parts of cellular structures

17 **3.7 Proteins: Primary and Secondary Structure**

- *Primary structure:*
  - linear polypeptide
- *Secondary structure:*
  - α-heix & β-sheet
- *Tertiary structure*:
  - three-dimensional shape
  - *Disulfide bonds*
- *Quaternary structure*:
  - two or more polypeptides

18 **3.8 Proteins: Higher-Order Structure and Denaturation**

- *Denaturation:*
  - *Unfolding of Polypeptide Chains*
    - Loss of biological function
    - Reversible or irreversible
    - Result of pH, temperature, chemicals