Syntheses

The process of building larger molecules by combining smaller molecules.

While energy is released when larger molecules are broken down into smaller ones, energy is absorbed in making larger ones.
One form of Syntheses

Polymerization reactions – these reactions involve joining monomers in order to make polymers which may be long chains or network molecules

Biology involves “step-growth polymerization”
Example of Step Growth Polymerization

Hexamethylene diamine (Monomer A) + Adipic Acid (Monomer B) → Beginning polymer

Beginning Polymer + Monomer A → Longer Polymer

Longer Polymer + Monomer B → Extended Polymer + H₂O

Polymer (nylon 66)
What is a peptide bond?

A peptide bond is an amide bond that links two amino acids together.
Amino Acid

What is an amino acid?

Amino acids are the building units of proteins. The compounds contain four types of atoms: carbon, hydrogen, oxygen, and nitrogen.

A few amino acids contain sulfur

Amino acids contain an amino group (-NH$_2$) and a carboxylic acid functional group (-COOH)
Amino Acid Structure
### Examples of Amino Acids

<table>
<thead>
<tr>
<th>Alanine (Ala)</th>
<th>Arginine (Arg)</th>
<th>Asparagine (Asn)</th>
<th>Aspartic Acid (Asp)</th>
<th>Cysteine (Cys)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glutamic Acid (Glu)</td>
<td>Glutamine (Gln)</td>
<td>Glycine (Gly)</td>
<td>Histidine (His)</td>
<td>Isoleucine (Ile)</td>
</tr>
<tr>
<td>Leucine (Leu)</td>
<td>Lysine (Lys)</td>
<td>Methionine (Met)</td>
<td>Phenylalanine (Phe)</td>
<td>Proline (Pro)</td>
</tr>
<tr>
<td>Serine (Ser)</td>
<td>Threonine (Thr)</td>
<td>Tryptophan (Trp)</td>
<td>Tyrosine (Tyr)</td>
<td>Valine (Val)</td>
</tr>
</tbody>
</table>
Dehydration Synthesis

Is a process that creates bonds between amino acids in the formation of a peptide bond.
Proteins

- The joining of many amino acids together makes a protein.
- Leads to a primary structure that proceeds to a ternary and finally a quarternary structure.
- Alpha helix.
Levels of Protein Building

(a) Lys ± Ala ± His ± Gly ± Lys ± Val ± Leu ± Gly - Ala ± 
Primary structure (amino acid sequence in a polypeptide chain)

(b) Secondary structure (helix)

(c) Tertiary structure: one complete protein chain (β chain of hemoglobin)

(d) Quaternary structure: the four separate chains of hemoglobin assembled into an oligomeric protein

Figure 6-1. Levels of protein structure.
(a) Primary structure, (b) secondary structure, (c) tertiary structure, and (d) quaternary structure.
[Figure copyrighted © by Irving Geis.]
Dehydration

Involves the removal of a water molecule
Polymerization

Links the sugar of one nucleotide with the phosphate of the next nucleotide
Nucleotide

What is a nucleotide?

Nucleotides are composed of a phosphate group, a five carbon sugar, and a base. The base may be one of five different types containing a carbon and a nitrogen.

Nucleotides are the blocks upon which RNA (ribonucleic acid) and DNA (deoxyribonucleic acid) are built.
Nucleic Acids

- Many nucleotides added together create a nucleic acid - DNA and RNA most common nucleic acids.
- Hydrogen bonds hold the base pairs from two opposing strands together.
Polymerization

Requires a condensation or dehydration reaction.
Lipids

• What defines a lipid?
  – Polar in nonpolar solvents- insoluble in water (hydrophobic)
  – Large hydrocarbon portion- few polar groups NH$_2$ and COOH
  – Fats, and oils

• Some common examples of lipids
  – Cholesterol, steroids, triglycerides
Lipids

- Structure

linolenic acid, an omega-3 fatty acid
(the omega carbon atom is shown in blue)
Triglycerides

• Structure