Life’s molecular diversity is based on the properties of carbon

Characteristic chemical groups help determine the properties of organic compounds
Cells make a huge number of large molecules from a small set of small molecules.

Making polymers by a Dehydration reaction

Breaking polymers by a Hydrolysis reaction
Four major macromolecules

- Carbohydrates
- Lipids (Fats)
- Proteins
- Nucleic Acids

Monosaccharides are the simplest carbohydrates

- Glucose (an aldose)
- Fructose (a ketose)

Cells link two single sugars to form disaccharides
Polysaccharides are long chains of sugar units

Fats are lipids that are mostly energy-storage molecules

Phospholipids and steroids are important lipids with a variety of functions
Cholesterol, a steroid

Anabolic steroids pose health risks

Proteins are essential to the structures and functions of life

- **Structural proteins**: are found in hair and the fibers that make up connective tissues such as tendons and ligaments.
- **Contractile proteins**: Found in muscles
- **Defensive proteins**: The antibodies of the immune system
- **Signal proteins**: Such as hormones that coordinate body activity
More proteins

- **Receptor proteins**: may be built into cell membranes and transmit signals into cells.
- **Transport proteins**: like hemoglobin transport oxygen in the red blood cells.
- **Storage proteins**: such as ovalbumin, the protein of egg white, which serves as a source of amino acids for developing embryos.

General structure of an amino acid

```
H N H
\[ \text{Amino group} \]

H C O
\[ \text{Carboxyl group} \]
```

Peptide bond formation

```
H N H
Amino acid + Amino acid
Dehydration reaction
H N H

H C O
H C O

\[ \text{Peptide bond} \]

H C OH
Dipeptide
```
A protein’s specific shape determines its function

A protein’s shape depends on four levels of structure

Linus Pauling contributed to our understanding of the chemistry of life
Nucleic acids are information-rich polymers of nucleotides

Sugar-phosphate backbone

DNA double helix