Likewise, flip-flop (transverse diffusion) of lipid molecules across the bilayer is very slow as represented in Fig. 11-31.

Lateral asymmetry of lipid and proteins in each layer of the bilayer is also observed as shown in Figs. 9.8 and 9.9.

Another important characteristic of membranes is that they are impermeable to ions and most polar molecules in the absence of specific membrane proteins that can facilitate diffusion across the nonpolar lipid bilayer.

Membranes are permeable to water molecules due to trans membrane proteins called aquaporins that have channels for the movement of H_2O through the lipid bilayer of the membrane.

The slow rate of diffusion of ions, including H^+, across membranes enables the formation of concentration gradients across membranes from the active transport by proteins.

Begin our discussion of enzymes.

Enzymes are proteins that catalyze biochemical reactions.

Enzymes are classified according to the kind of reaction catalyzed.

The classifications are indicated in Table 10.1

One of the most characteristic properties of enzyme catalyzed reactions is their kinetics, i.e., the rates of reactions under different sets of conditions.

Compare the kinetics of sucrose hydrolysis in the absence and presence of an enzyme to illustrate these properties.

In the absence of an enzyme sucrose is slowly hydrolyzed to glucose plus fructose with a linear dependence of the velocity (rate) on sucrose concentration as follows

$$\text{Sucrose} + H_2O \rightarrow \text{Glucose} + \text{Fructose}$$

The reaction corresponds to the following kinetic scheme

The velocity is given by

In the presence of the enzyme sucrase, sucrose is rapidly hydroyzed to glucose plus fructose with a hyperbolic dependence of the rate on sucrose concentration as follows

$$\text{Sucrose} + H_2O \xrightarrow{E} \text{Glucose} + \text{Fructose}$$

The curve is consistent with the following kinetic scheme

The kinetic scheme indicates that the substrate forms a reversible complex with the enzyme prior to its conversion to products.

We can also derive a rate equation for this kinetic scheme.

First observe that the rate of product formation should be proportional to the ES concentration

To determine what the ES conc. is we must consider the following equation that describes the conc. dependence of ES with time