MICHAELIS-MENTEN ENZYME KINETICS MODEL

Start with a mechanism:

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \underset{k_4}{\overset{k_3}{\rightleftharpoons}} EP \underset{k_6}{\overset{k_5}{\rightleftharpoons}} E + P$$

Make assumptions to simplify:

1. Assume the first step is fast and reactions are in equilibrium.
2. Assume the second step is irreversible and slow, therefore the rate determining step.
3. Assume the third step is fast.

$$E + S \underset{}{\overset{K_S}{\rightleftharpoons}} ES \xrightarrow{k_3} E + P$$

Experimental: Measure velocity of reaction at time = 0, v_O, when substrate concentration known $[S]_O$.

Now derive the Michaelis-Menten equation.
This relates experiment (v_0;$[S]_0$) to the mechanism (v_{max};K_m).

1. Initial velocity of the reaction. $v_o = k_3 [ES]$
2. Total concentration of enzyme. $[E]_{tot} = [E] + [ES]$

   (When [S]>>[E]) $[E]_{tot} = [ES]$ $v_o = v_{max}$ $v_{max} = k_3 [E]_{tot}$
3. ES complex dissociation equilibrium constant. $K_S = \dfrac{[E][S]_o}{[ES]}$

MICHAELIS-MENTEN EQUATION

$$\frac{v_o}{v_{max}} = \frac{[S]_o}{K_m + [S]_o}$$

$K_S \approx K_m$

when $v_o = {}^1/_2\, v_{max}$ $K_m = [S]_o$