MICHAELIS CONSTANT : K_M

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_{cat}} E + P$$

$$k_1 * [E] * [S] = (\ k_{-1} * [ES]\ ) + (\ k_{cat} * [ES]\ )$$

Formation of ES Complex = Dissociation of ES Complex + Breakdown to E+P

- This ratio of rate constants is known as the Michaelis Constant (K_M) ;

$$K_M = \frac{k_{-1} + k_{cat}}{k_1}$$

- k_{cat} is another name for k_2
- When k_{cat} is small:
  - We essentially remove it from the equation. $K_M = \frac{k_{-1}}{k_1}$
  - @ maximum turnover
    - [ES] is high as it as it "builds up"
- Comparing k_1 and k_{-1} = likelihood substrate is bound to the enzyme , aka affinity
  - IF ($k_1 > k_{-1}$) { K_M == Small ; Reaction Prefers to be in Eyzme-Substrate Complex –> Then Eventual Formation of Product }
  - IF ($k_1 < k_{-1}$) { K_M == Large ; Reaction Prefers to be Separated into Enzyme + Substrate }

RATE LIMITING

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} \boxed{ES \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} EP} \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} E + P$$

- One of the steps will be rate limiting
  - Takes the longest amount of time to complete
- Typically in an enzyme catalyzed reaction, it is the conversion of the substrate to the product.
- Equilibrium must also be considered in these reactions
  - As first, a lot of enzyme will bind to the substrate
  - As the concentration of ES builds up (due to the rate limiting step) some of the ES will convert back to E+S
  - While this must also be considered for the presence of EP and E+P , the conversion of product back to the EP is minimal due to the low activation energy for its dissociation and because the product is often used immediately in another reaction in a cell.
  - The substrates high affinity for the enzyme also plays a role