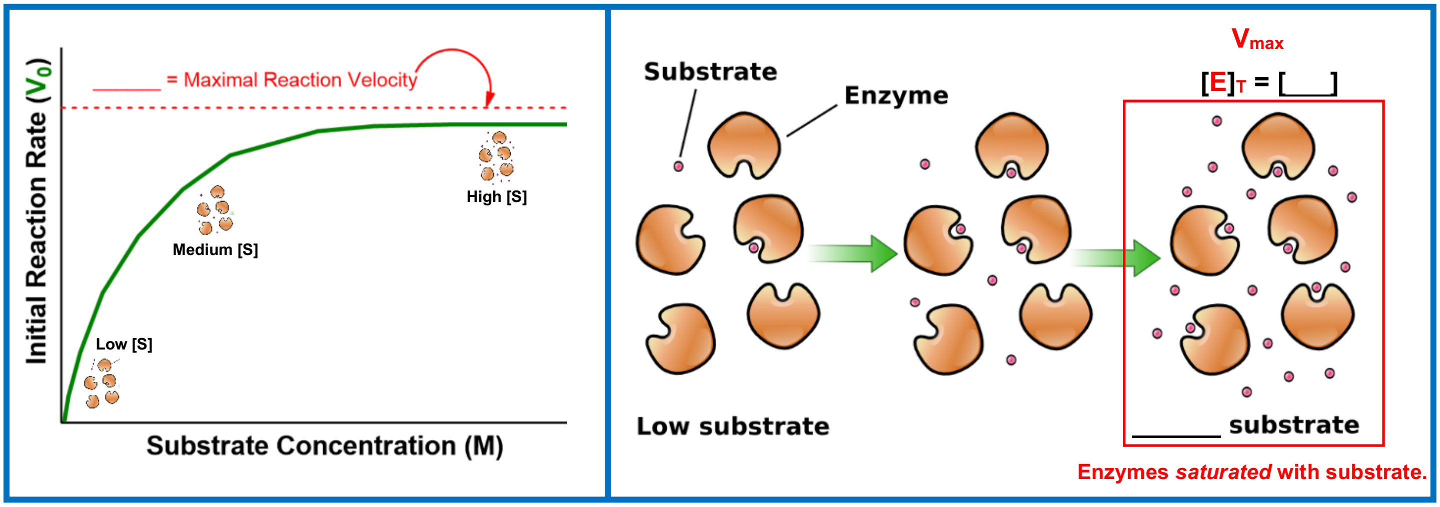
## CONCEPT: $V_{MAX}$ ENZYME

### Maximum Reaction Velocity ($V_{max}$)

- $V_{max}$: the _______________ *maximum* reaction velocity at ∞ large [S] resulting from ______________ active sites.
  - □ Reaction velocities can ____________ $V_{max}$ but it can _________ actually be attained by any enzyme.
  - □ Recall: ________ velocity ($V_0$) is the *best chance* a reaction has at *approaching* its maximum velocity ($V_{max}$).
- $V_{max}$ acts as a horizontal _____________ to limit reaction velocity.



**PRACTICE:** In a Michaelis-Menten kinetics plot ($V_0$ vs. [S]), what is the reason that the curve reaches a plateau and $V_0$ cannot increase any further upon adding more substrate?

a) The enzyme becomes locked in an inactive conformation.

b) Enzymes match rate of catalysis & rate of ES formation.

c) The active site of all the enzymes are saturated with substrate.

d) There is an inhibitor present.

e) $V_{max}$ can only be attained by some enzymes.

f) Enzyme is locked in an inactive conformation.

### $V_{max}$ can be Expressed with a Rate Law

- Recall: $V_{max}$ can only occur at *saturating* [___] where all available enzyme active sites are 100% full.
  - □ *Under saturating [S]*, all available enzymes ($E_T$) will be associated with substrate to form ES, so $[E]_T$ = [____].
- $V_{max}$ & $[E]_T$ relationship is expressed via substituting variables into the _______ _____ for the Product formation step.

**Review:**

$$V_0 = \frac{\Delta[\quad]}{\Delta t}$$

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} E + P$$

Rate Law for
P formation step

$$V_0 = \_\_\_[ES]$$

**New:** Variable substitution.

*Under saturating [S]

$$V_0 \approx V_{max} \qquad [ES] \approx [E]_T$$

$$V_{max} = \_\_\_[E]_T$$

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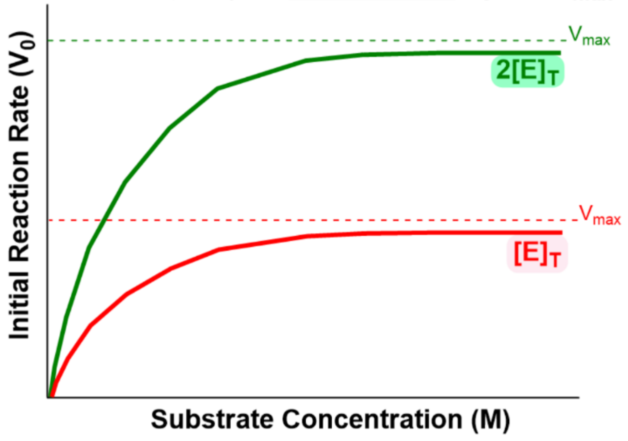
### $V_{max}$ is Affected by $[E]_T$

- The $[E]_T$ _____________ impacts the theoretical maximum reaction velocity (______).
    - □ The _____ the $[E]_T$, the _____ the **$V_{max}$**.

**EXAMPLE:** Analyze the graph and fill-in the blank below.

*Increasing **$[E]_T$** will ____________ **$V_0$ and $V_{max}$**.



**PRACTICE:** $V_0$ for an enzyme-catalyzed reaction:

a) Increase when pH increases.

b) Is limited by the [S].

c) Is limited by the [E].

d) Is limited by the reaction's slowest step.

e) b & c.

f) b, c & d.

**PRACTICE:** What kind of kinetics is observed initially in an enzymatic reaction under conditions where [S] is saturating?

a) Cooperative kinetics.

b) First order kinetics.

c) Zero order kinetics.

d) Second order kinetics.

e) The system is at equilibrium and reaction proceeds equally in both directions.