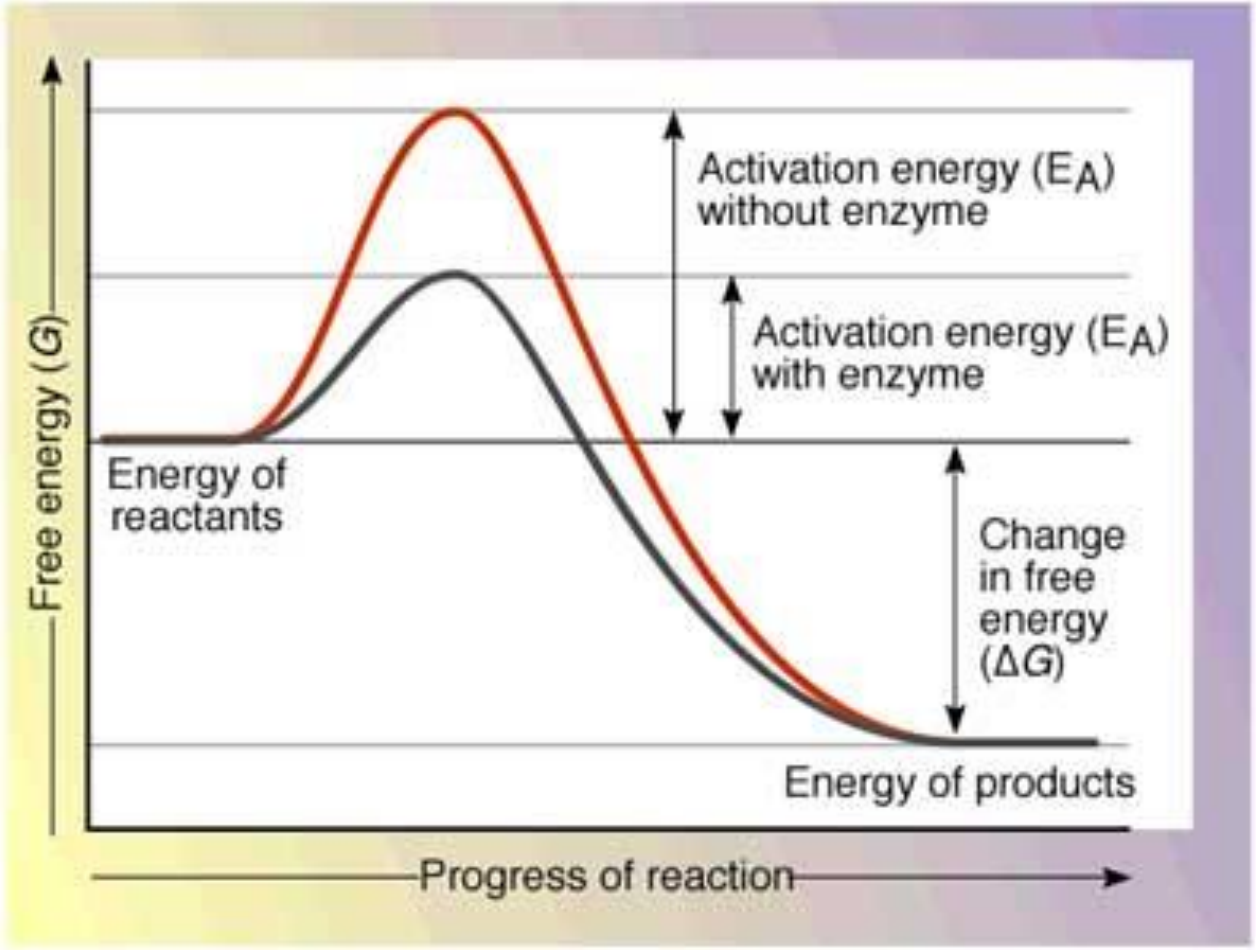
Enzyme Kinetics – AP

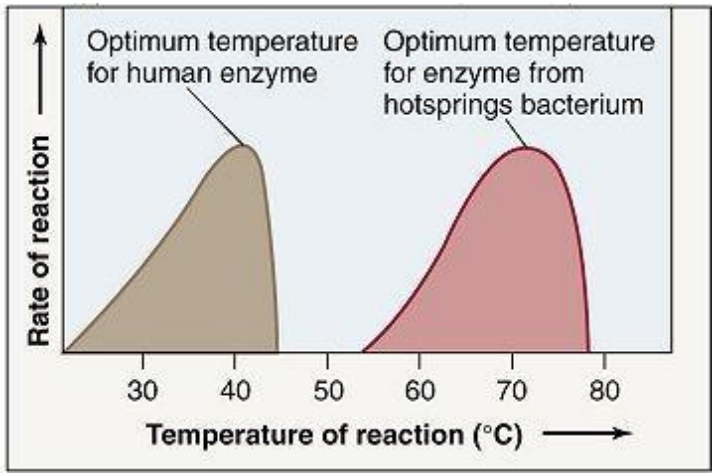
SBI4UP

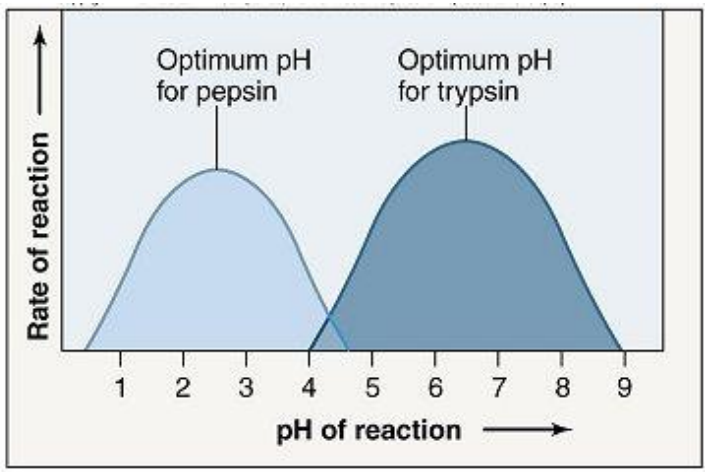
MS. FRANKLIN

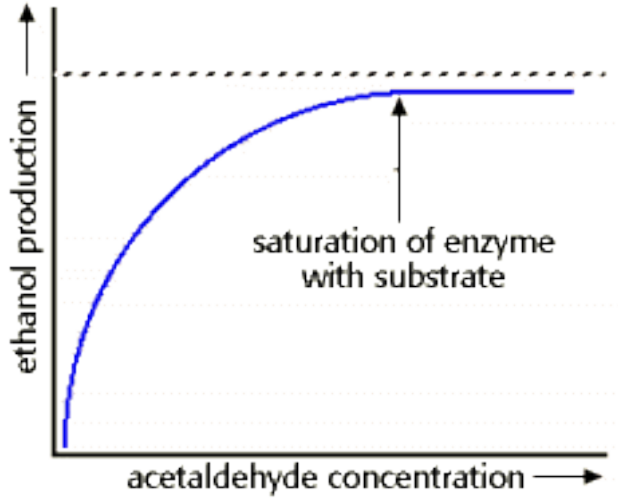
Remember . . . Enzymes

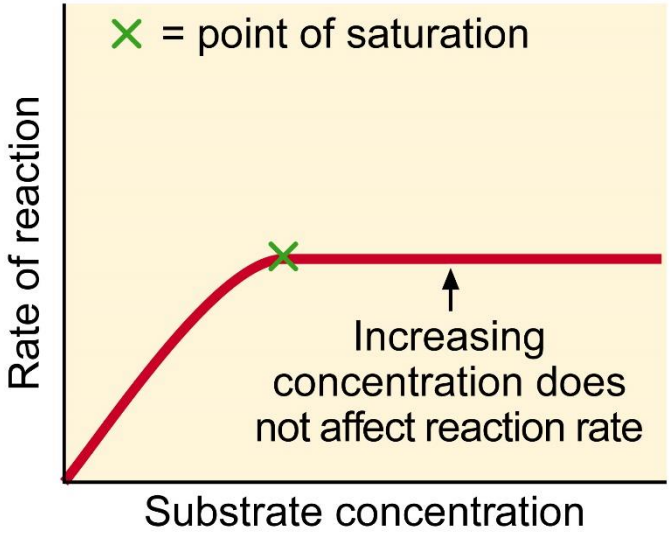


Remember . . . Factors Affecting Enzyme Activity









Enzyme Kinetics

- Enzyme kinetics are a measurement of velocity or reaction rates
- Used to compare enzymes under different conditions, tissues or organisms
- Used to compare the activity of the same enzyme in the presence of different substrates (helps scientists understand enzyme specificity)
- Used to measure enzyme purity (each enzyme will have a specific activity level in the presence of specific substrate)
- To study different types of inhibitors and their effects on enzyme activity
- For the development of specific drugs that will behave like enzyme inhibitors

Enzyme Kinetics

The mechanics of enzymes are studied by looking at kinetic measurements on enzyme-substrate reaction systems.

The studies measure the ***rates of enzyme-catalyzed reactions*** at different substrate and enzyme concentrations.

Key Terms:

V_{max}:

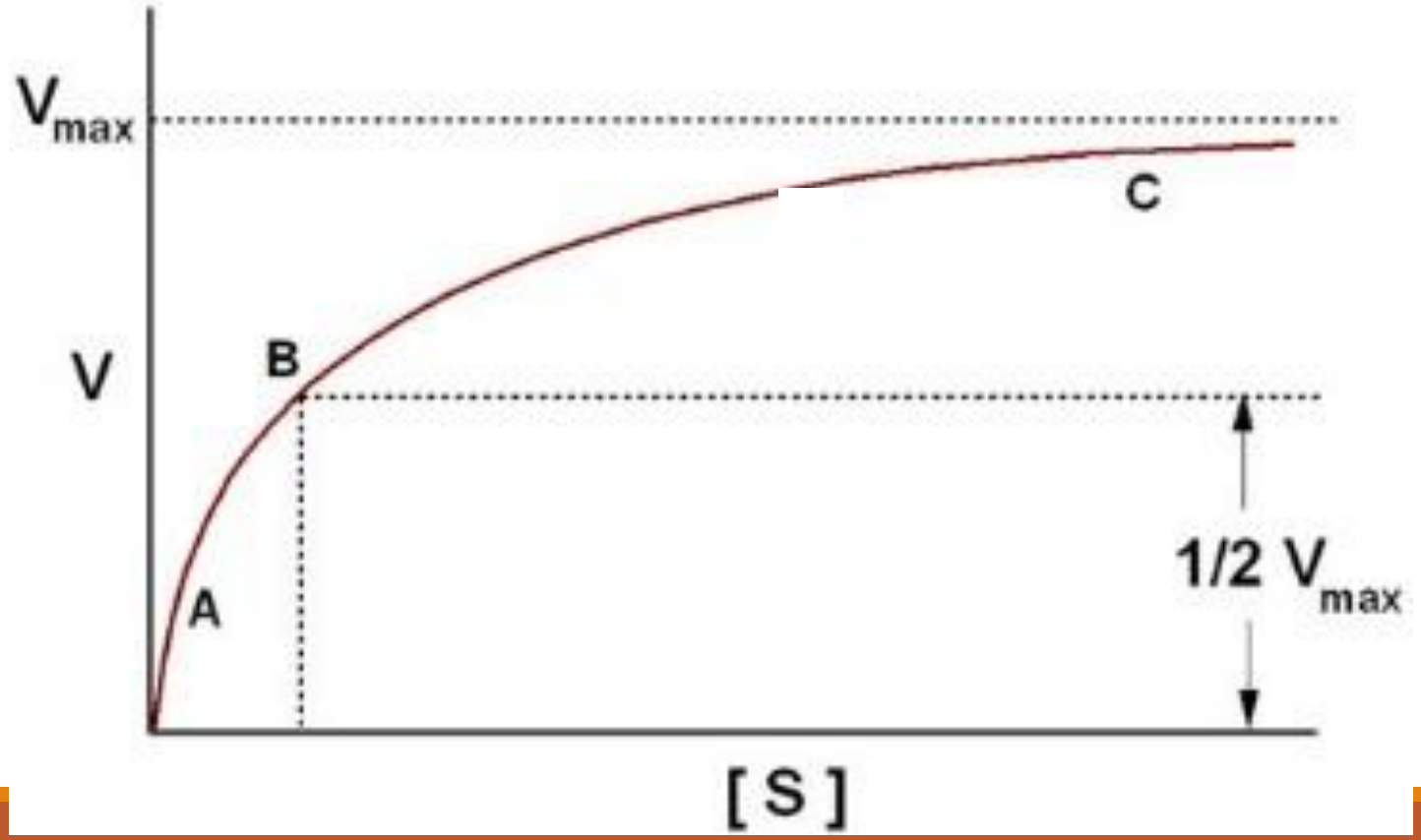
K_M:

Enzyme Kinetics

When studying the kinetics of enzyme activity, one must consider 2 variables: Velocity (V) *and* Substrate Concentration ([S])

½ V_{max} = K_M

K_M *depends on Temperature, pH and substrate*

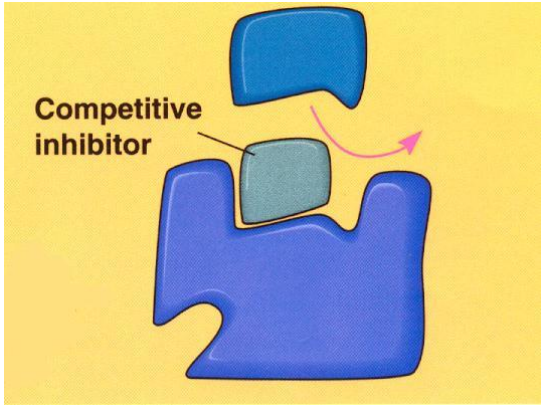


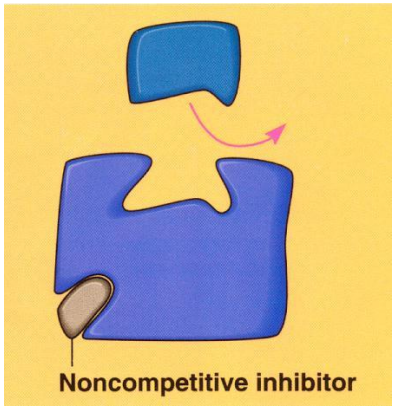
Enzyme Kinetics

As previously seen, inhibitors can affect the overall activity of an enzyme. Depending on the type of inhibitor (competitive vs. non competitive), the K_M and V_{max} will be affected differently.

Remember . . .

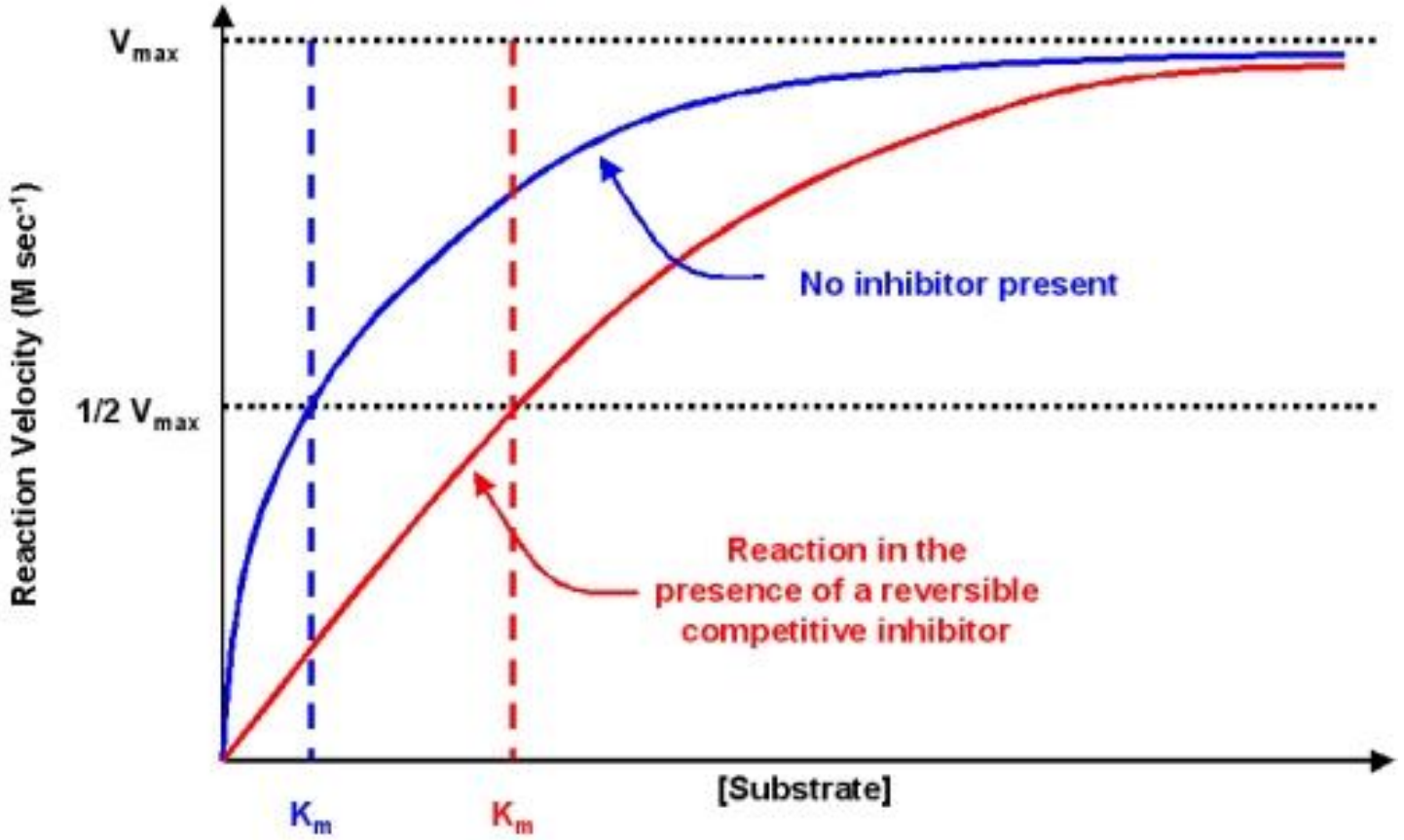
Competitive inhibitors will bind to the active site of the enzyme and prevent the substrate from binding.





Noncompetitive inhibitors will bind to an allosteric site on the enzyme and change the shape of the active site. This also prevents a substrate from binding.

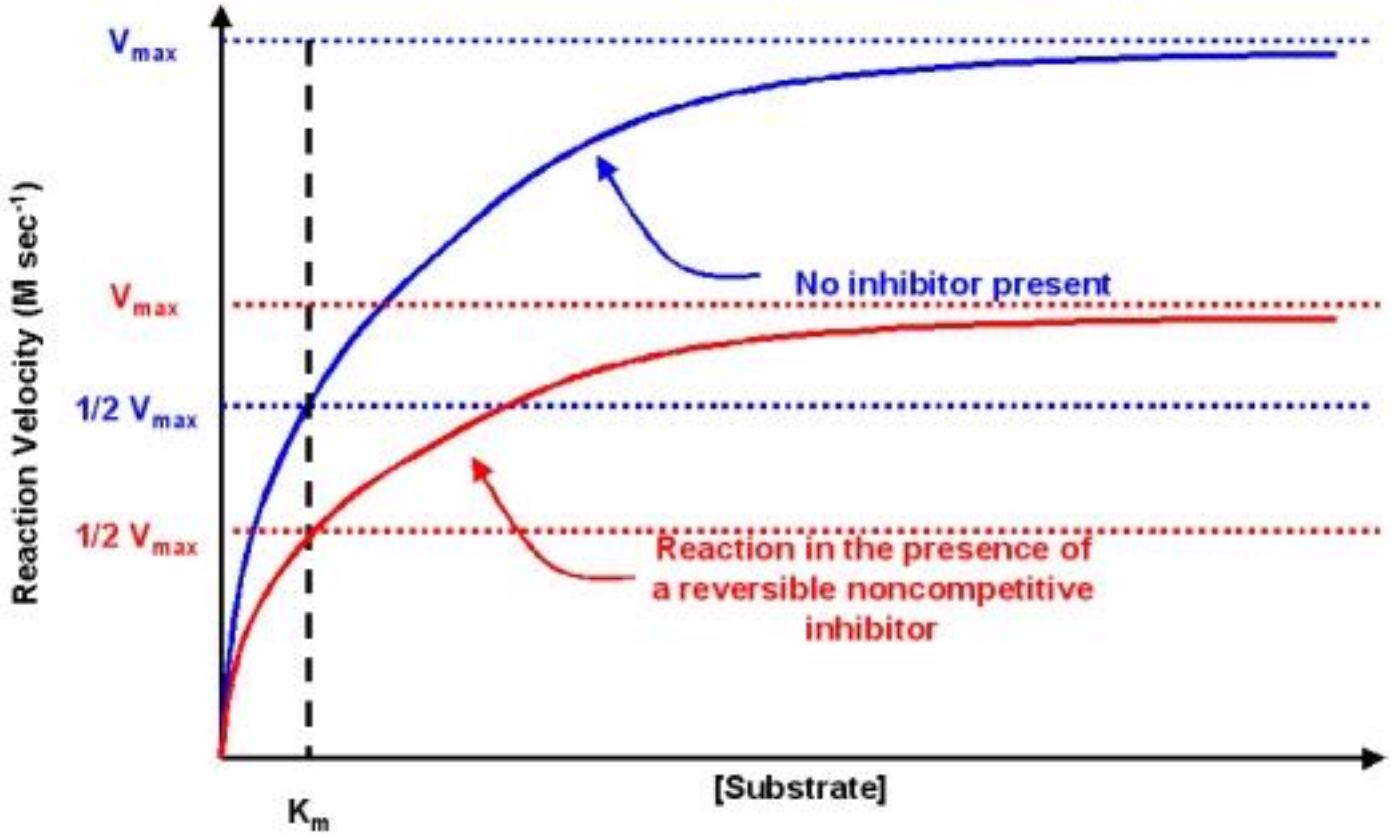
1. Competitive Inhibitor and Enzyme Kinetics



The greater the substrate concentration the less likely the inhibitor will bind to the active site of the enzyme.

Thus, if a competitive inhibitor is present a greater amount of substrate will be required to reach the same V_{max}.

2. Noncompetitive Inhibitor and Enzyme Kinetics



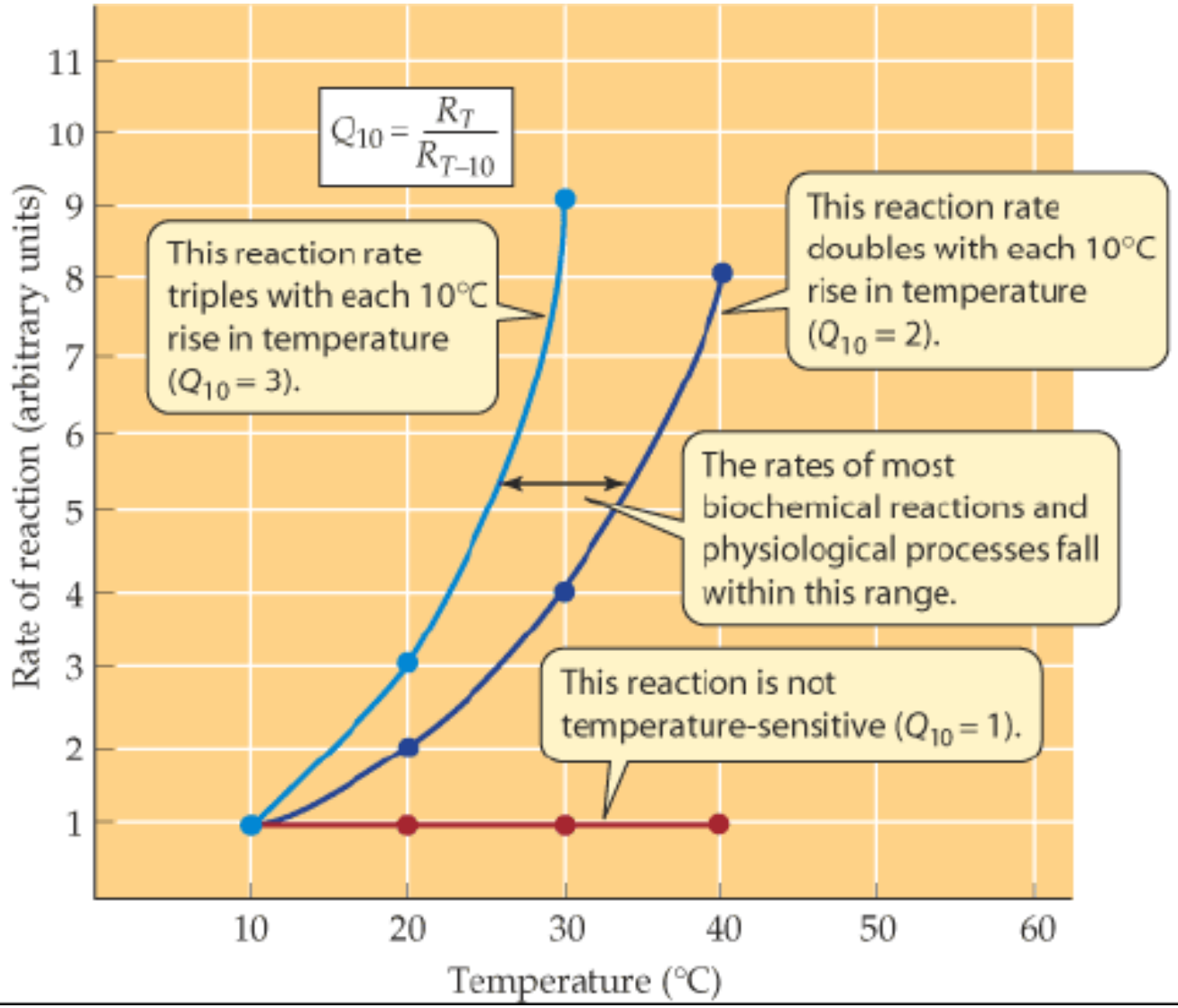
Changing the substrate concentration will not effect the K_M.

The amount of enzymes with an available active site decreases in the presence of a noncompetitive inhibitor, decreasing V_{max}.

Q_{10} and Enzyme Kinetics

Q_{10} is a measure of the *temperature sensitivity* of an enzymatic reaction rate or a physiological process due to an increase by 10°C

It is useful in studying cold blooded organisms because it expresses the temperature dependence of a biological process.



Q_{10} and Enzyme Kinetics

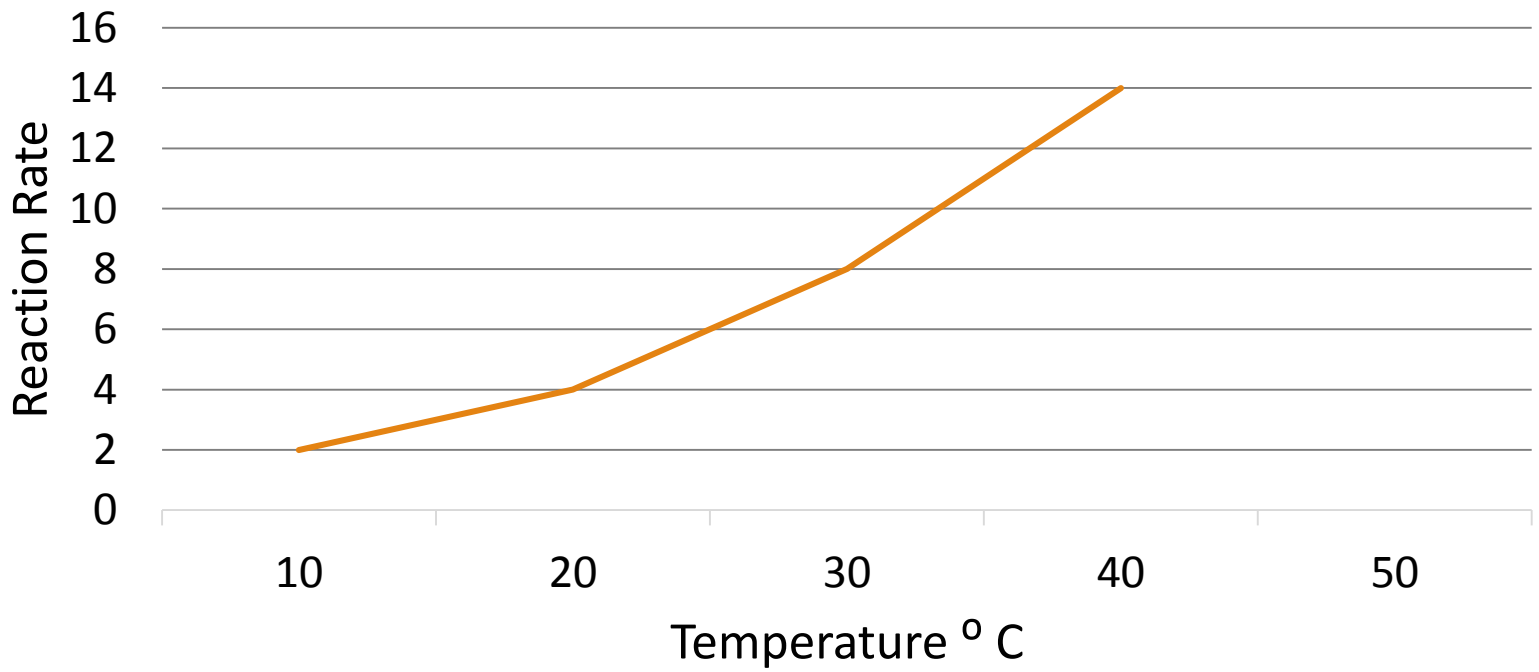
- Q_{10} is a unitless quantity, as it is simply the factor by which a rate changes for every 10°C increase in body temperature.
- The greater the value of Q_{10}, the greater the effect of temperature on the rate of reaction.
- Enzymes typically have a Q_{10}= 2 – 4
- When Q_{10} = 1, temperature has no effect on the rate of reaction

FORMULA USED TO CALCULATE Q_{10}:

$$Q_{10} = \left(\frac{K_2}{K_1}\right)^{\left(\frac{10}{T_2 - T_1}\right)}$$

Practice Problem 1

Calculate the Q_{10} for the following enzymatic reaction rate.

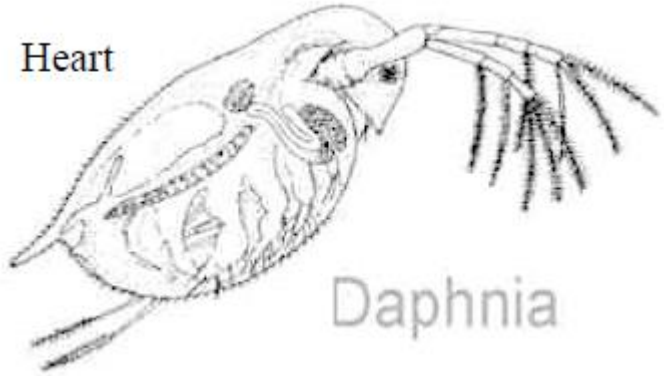


CALCULATIONS:

Practice Problem 2

Determine the Q_{10} value for the heart rate in Daphnia, the water flea.

Temperature (C°)	Average Heart Rate (beats per minute)
14	127
20	162
26	197



CALCULATIONS:

Practice Problem 3

If $Q_{10} = 2$, then an enzymatic reaction that takes place at a given rate at 5°C would take place approximately how many times faster at 25°C?

CALCULATIONS:

Homework

Complete the worksheets given in class