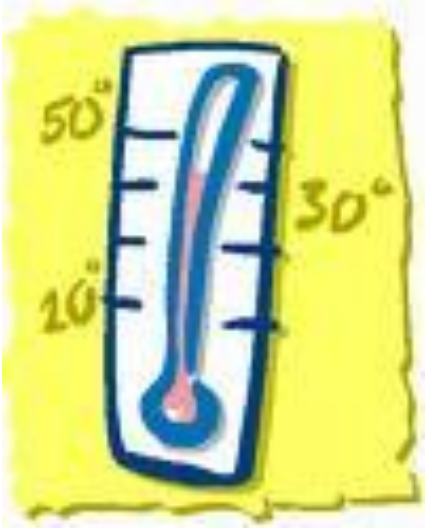
The effects of temperature on the rate of an enzyme catalyzed reaction.



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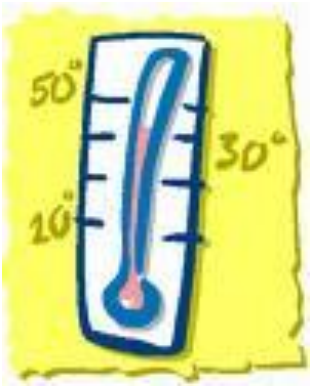
LAB 9

Objectives:

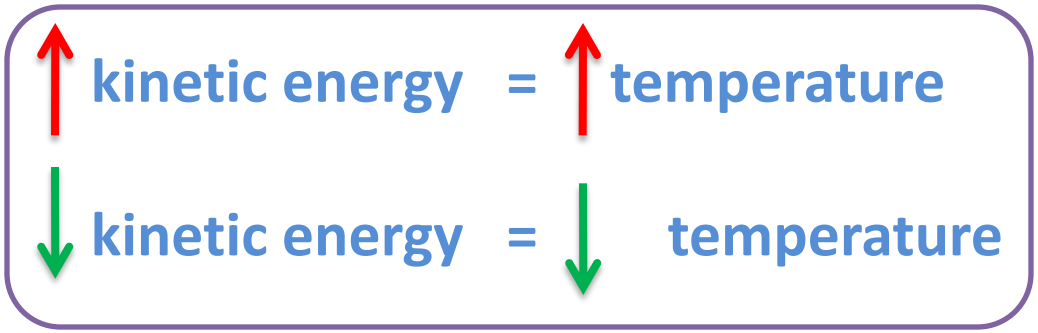
1- To establish the relationship between temperature and the rate of an enzyme catalyzed reaction.

2- To determine the optimum temperature for such a reaction.



What Is The Effect Of Temperature On Enzyme Activity?

- The temperature of a system is to some extent a measure of the kinetic energy of the molecules in the system.
- Thus the lower the kinetic energy, the lower the temperature of the system and , likewise, the higher the kinetic energy, the greater the temperature of the system.



Increases in the temperature of a system results from increases in the kinetic energy of the system. This has several effects on the rates of reactions.

1) More energetic collisions

2) The number of collisions per unit time will increase.

3) The heat of the molecules in the system will increase.

1) More energetic collisions

When molecules collide, the kinetic energy of the molecules can be converted into chemical potential energy of the molecules.

If the chemical potential energy of the molecules become great enough, the activation energy of a reaction can be achieved and a change in chemical state will result.

Thus the greater the kinetic energy of the molecules in a system, the greater is the resulting chemical potential energy when two molecules collide.

As the temperature of a system is increased it is possible that more molecules per unit time will reach the activation energy. Thus the rate of the reaction may increase.

2) The number of collisions per unit time will increase.

In order to convert substrate into product, **enzymes must collide with and bind to the substrate at the active site.**

Increasing the temperature of a system will increase the number of collisions of enzyme and substrate per unit time.

Thus, within limits, the rate of the reaction will increase.

3) The heat of the molecules in the system will increase.

As the temperature of the system is increased, the internal energy of the molecules in the system will increase.

The internal energy of the molecules may include the translational energy, vibrational energy and rotational energy of the molecules, the energy involved in chemical bonding of the molecules as well as the energy involved in nonbonding interactions.

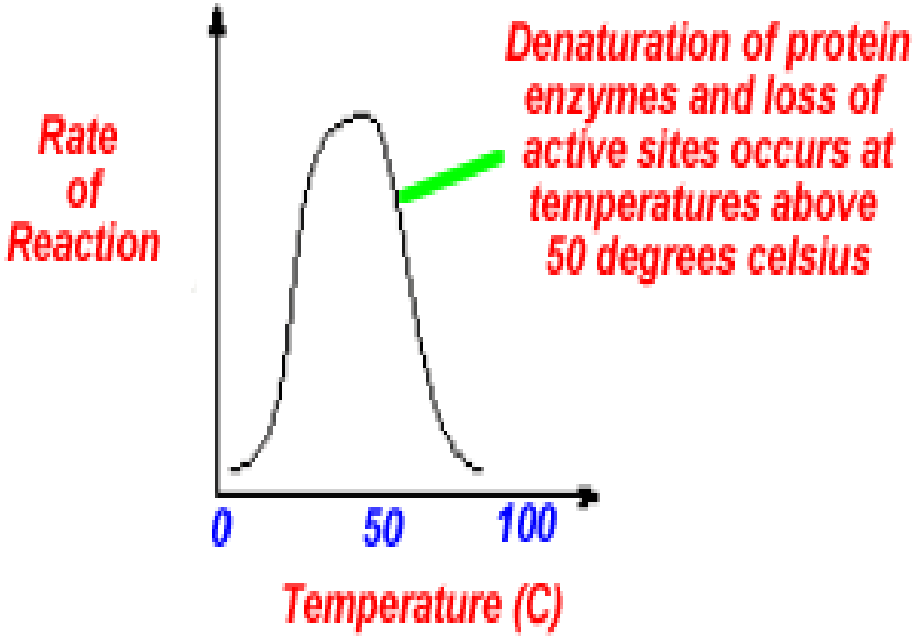
Some of this heat may be converted into chemical potential energy.

If this chemical potential energy increase is great enough some of the **weak bonds** that determine the **three dimensional shape of the active proteins** many be broken.

This could lead to a **thermal denaturation** of the protein and thus inactivate the protein.

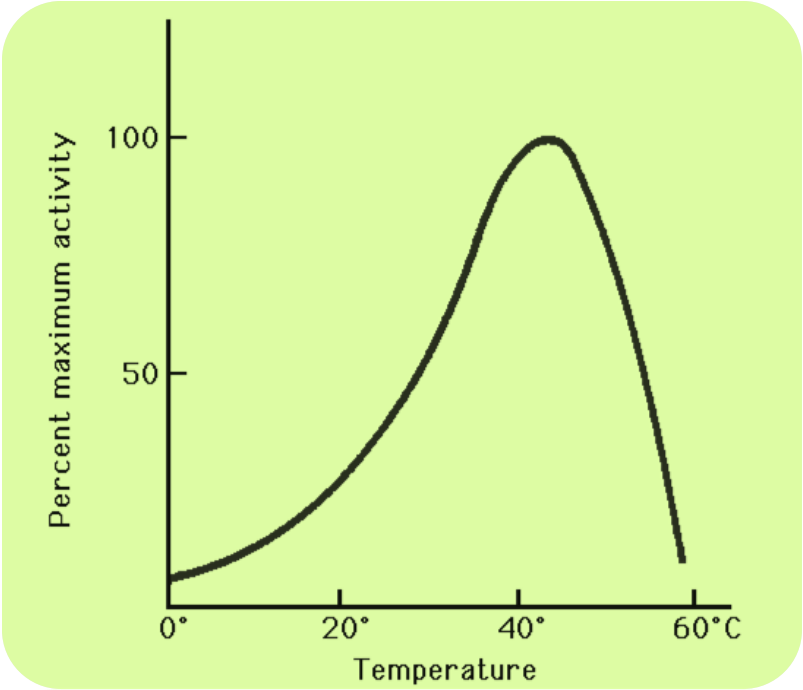
Thus too much heat can cause the rate of an enzyme catalyzed reaction to decrease because the enzyme or substrate becomes denatured and inactive.

Enzyme Activity and Temperature



Conclusion :

The rate of an enzyme catalyzed reaction is affected by changes in temperature. At a low temperature (e.g. 0 ºC) the rate of reaction is low. As the temperature is increased, the rate of reaction increase until an optimum temperature is reached.



Within optimum temperature range, the rate of reaction is approximately doubled for every 10 ºC rise in temperature.

With further rise in temperature, above the optimum temperature the rate of reaction decrease, due to denaturation of the enzyme protein and hence loss of activity.

The optimum temperature is the result of the balance between the rate of increase in the enzyme activity on the one hand and the rate of decrease due to denaturation on the other.

The optimum temperature may be determined by measuring the amount of substrate transformed to product by an enzyme in a given time at different temperatures.

Most enzymes are completely inactivated above 70 ºC.

For most enzymes, the optimum temperature is at or above the temperature of the cells in which the enzyme is found in vivo.

Method

Desired temperature (°C)	Method of preparation
0-4	Ice plus tap water in an ice bucket
10	Tap water and ice
20	Tap water at room temperature
30	Thermostatted water bath
37	Thermostatted water bath
50	Thermostatted water bath
80	Hot tap water
100	Boiling water bath

Result

Tm	Absorbance at405nm	velocity
0-4		
10		
20		
30		
37		
50		
80		
100		