

Part two of the lecture : Kinetics

What is the definition of *Kinetics* ? studying the *rate* of chemical reactions and what control that reactions . so , this differs from the definition of ΔG and there is no relationship between them . for example , ΔG for a reaction may be -10 and the reaction is very fast and it may be -1000 and the reaction is very slow .

In general, velocity describe <u>changing</u> in something per <u>time unit</u>. so we can define rate of chemical reaction : changing in the concentration of reactants or products per time unit . (from this definition you know that you can calculate the rate from reactants or products and this what doctor focused on) so, if you calculate the rate of reaction from reactants , the same result will be when you use products to calculate the rate and this follow : <u>Mass Conservation Law</u>. But there is a difference in the sign because reactants consume in the reaction (take negative charge).

Order of the reaction : what is the order of the reaction ? It describe how much is the change of products compared with the change of reactants **Or** how much do we need from this reactant to make out that product .

We will talk only about two orders : zero order and first order

First order reaction : In this order , the formation of products is depending on one reactant and in the same amount (if we used 3 molecules of reactant , we will get 3 molecules of product and so on).

The rate of the reaction is directly proportional to the concentration of the reactant . Thus , as concentration of reactant reduced , the rate of the reaction slow down , and vice versa .

The plot of this order is **Linear** because the changing in concentration of reactant is <u>constant</u> so the rate law is : rate = K * C while C is the concentration of reactant . (if you rearrange this equation , you can calculate the unit of K which is 1/time) .



Zero order reaction : in this order , the product does not depend on any of the reactants . NOW the question is : does that make sense ? surely NO so when does this make sense ? when the concentration of substrate is very High . **explanation** : when the concentration of substrate is low , any increase in substrate will cause the rate to increase because of *increasing the probability of collision* . In high concentrations , most all active sites of enzyme become **saturated** so there is no increase in the probability of collision and the reaction rate will not be affected . (Example for understanding : you have 10 enzyme molecules and 2 substrate molecules . you increase substrate molecules to 4 , so probability of collision increases and the rate becomes higher . at very high number of molecules of substrate , 10 enzyme molecules will be saturated and the rate will not change)

In zero order , rate = K so unit of K is (concentration/time)



NOW let's talk about plots of enzymes :

We can draw plot to describe the behavior of an enzyme by two concepts : zero order and first order. We call this plot : **hyperbolic plot or saturation plot**

Properties of this plot :

First , when the concentration of substrate is **low** , it is **first order** and increasing concentration will increase the rate (plot is linear) .

Second , when the concentration become **very high** , increasing substrate will not affect the rate so it is **zero order** (platue) .

And these properties happens in *all* enzyme plots .



[S], concentration of substrate (mol L-1)

NOW we will discuss another concept : Vmax

What is Vmax? it is the highest velocity that the enzyme can reach. it is a property for the enzyme itself (important note).

Some students may make a mistake and think that Vmax affected by concentration

of substrate . thus , go with us in this example to understand this point .

We have a car with engine can run with maximum speed 200. person drives this car with 80 or 100 speed. some people say that the maximum speed is 100, Is this true? surely **NO**, because the maximum speed is a property for the engine not for the driver. this is the same for enzyme maximum velocity.

So , increasing substrate will not affect ${f V}$ max because it is a property for enzyme when it

is fully saturated (not for substrate) . Each enzyme has its ${f V}$ max which will be reached

at certain concentration .The only way to change the Vmax is changing the enzyme concentration itself . because this will increase the number of active sites and then increasing Vmax .



This is **THE END** and we will leave you with this question:

How we can know the V_{max} of an enzyme experimentally ?