

# METABOLISM

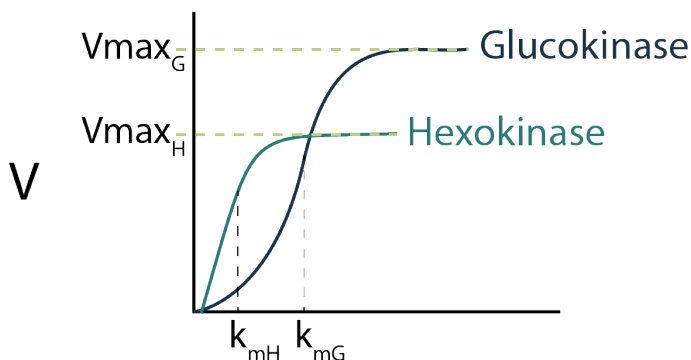
## Section I - Hexokinase & Glucokinase

### I. Enzyme terminology

- Kinases add phosphate groups (usually from ATP).
- Phosphatases remove phosphate groups.
- Phosphorylases add inorganic phosphate (usually without ATP).
- Dehydrogenases perform redox reactions.
- Mutase rearranges a functional group within the molecule.
- Hydroxylases add a hydroxyl group (-OH).
- Carboxylases transfer  $\text{CO}_2$  groups.

### II. Michaelis-Menten kinetics (Figure 2.5.2)

- $V_{\text{max}}$  = maximum speed of a reaction
- $K_m$  = the concentration of a substrate which permits the enzyme to achieve half of  $V_{\text{max}}$
- $\downarrow K_m = \uparrow$  affinity of the substrate for the enzyme (only low concentrations of the substrate are necessary for the enzyme to bind)
- $\uparrow K_m = \downarrow$  affinity of the substrate for the enzyme (high concentrations of the substrate are necessary for the enzyme to bind)



[S]

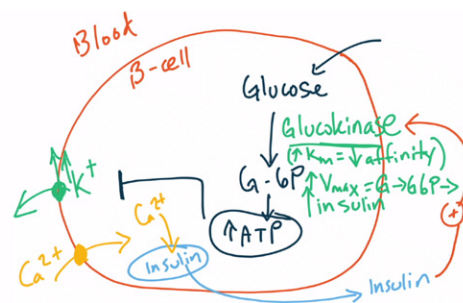
Figure 2.5.2 - Glucokinase and Hexokinase curves

### III. Hexokinase



- Present in most tissues (except pancreatic beta cells and liver)
- Inhibited by glucose-6-phosphate
- Not induced by insulin
- $\downarrow K_m \rightarrow$  When glucose is present, the cell rapidly converts it into glucose-6-P  $\rightarrow$  energy
- $\downarrow V_{\text{max}} \rightarrow$  Prevents the cell from hoarding too much glucose and thus only utilizes what is needed

### IV. Glucokinase



- Present in pancreatic beta cells and liver
- Not inhibited by glucose-6-phosphate
- Induced by insulin
- $\uparrow K_m \rightarrow \downarrow$  glucose utilization by the liver when blood glucose concentrations are low
- $\uparrow V_{\text{max}} \rightarrow \uparrow$  ability of the liver to convert glucose  $\rightarrow$  glycogen during well fed states

## REVIEW QUESTIONS



1. An experiment is conducted to determine the maximum velocity of two enzymes. The results of the experiment are shown below.

Glucose concentration (mM)	Rate with enzyme X ( $\mu\text{mol/L/sec}$ )	Rate with enzyme Y ( $\mu\text{mol/L/sec}$ )
10	120	50
20	330	250
30	400	500
40	400	600
50	400	600

What enzyme from the experiment most closely resembles an enzyme in the glycolytic pathway that is regulated by concentrations of glucose-6-phosphate?

- $V_{\text{max}}$  of enzyme X =  $400 \mu\text{mol/L/sec}$  (substrate concentration of 30 mM)
- $V_{\text{max}}$  of enzyme Y =  $600 \mu\text{mol/L/sec}$  (substrate concentration of 40 mM)
- The  $V_{\text{max}}$  of enzyme X is reached at a lower substrate concentration than enzyme Y  $\rightarrow$  has a lower  $K_m$  than enzyme Y
- Enzyme X has a lower  $K_m$  and  $V_{\text{max}}$  than enzyme Y  $\rightarrow$  it more closely resembles hexokinase (this is regulated by glucose-6-phosphate and glucokinase is not)

