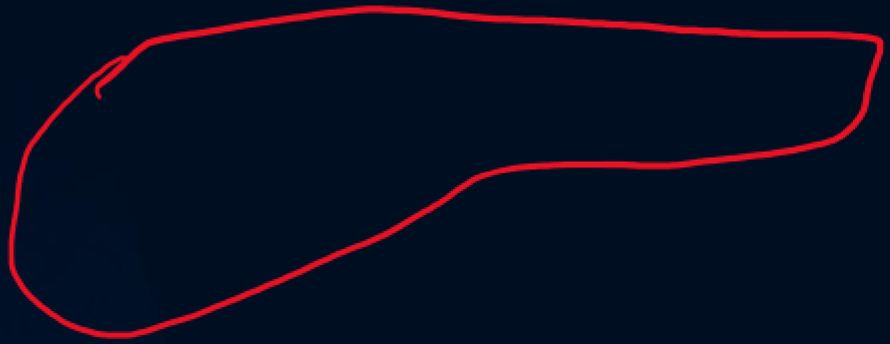
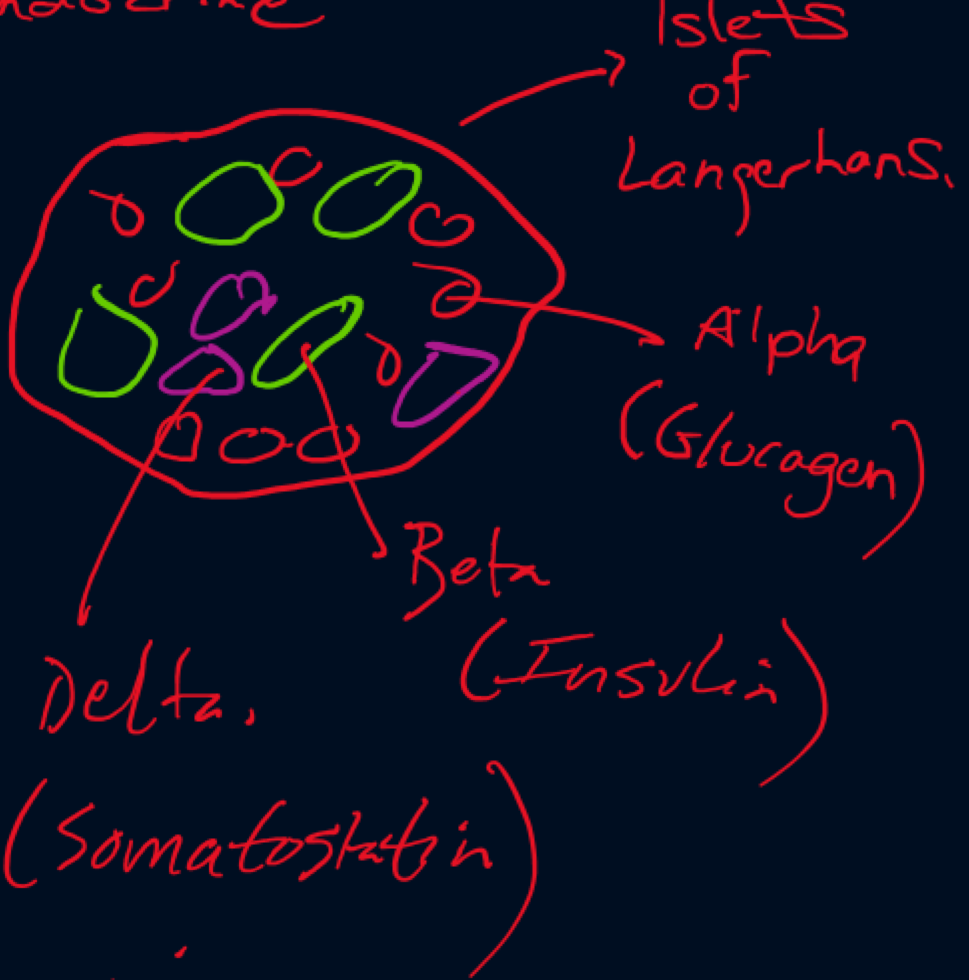
# Endocrine Part 3

DIABETES MELLITUS

Pancreas.



Endocrine




Homeostasis of blood sugar.

← 3.6 – 6.2 mmol/L →

(4 – 6)

Hypoglycemia

Hyperglycemia
(DKA; HHS)

# Glucose Metabolism.

Sandwhich

↓

Glucose. } 2 ATP

(no $O_2$)

($O_2$) Aerobic metabolism ← Pyruvate → Anaerobic metabolism

Lactic Acid

Tethanol

↓

Ketoacid metabolism ← Acetyl Coa → Fat metabolism

↳ glycogen.

↓

Creb Cycle.

electron transport chains

34 ATP

ATP. (Walk-Up Stairs)

# Glucose Metabolism and Regulation

→ Glucose Transporters.

GLUT. 1 – 15

2

3

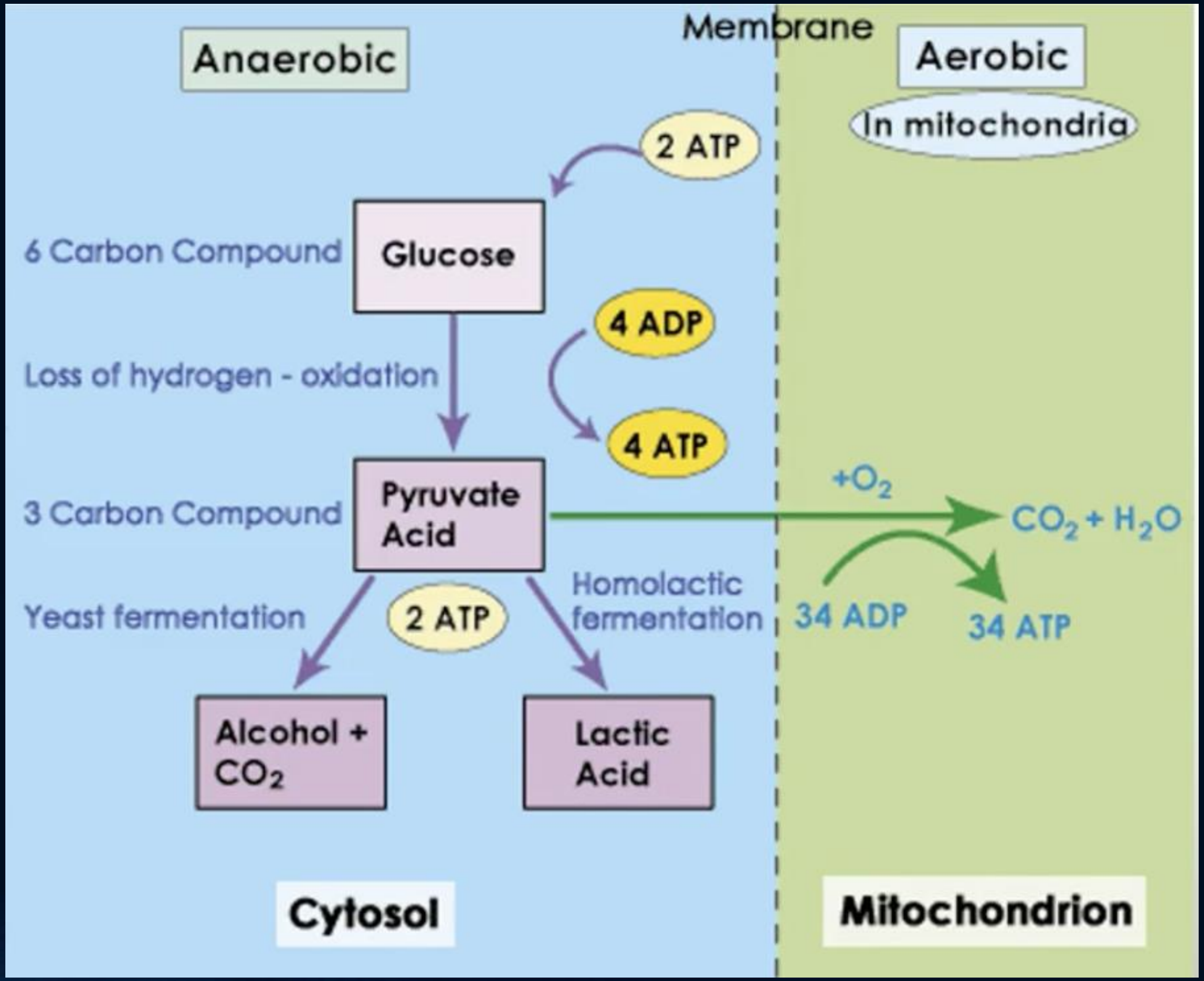
$\boxed{4}$

5

6

GLUT4 needs Insulin

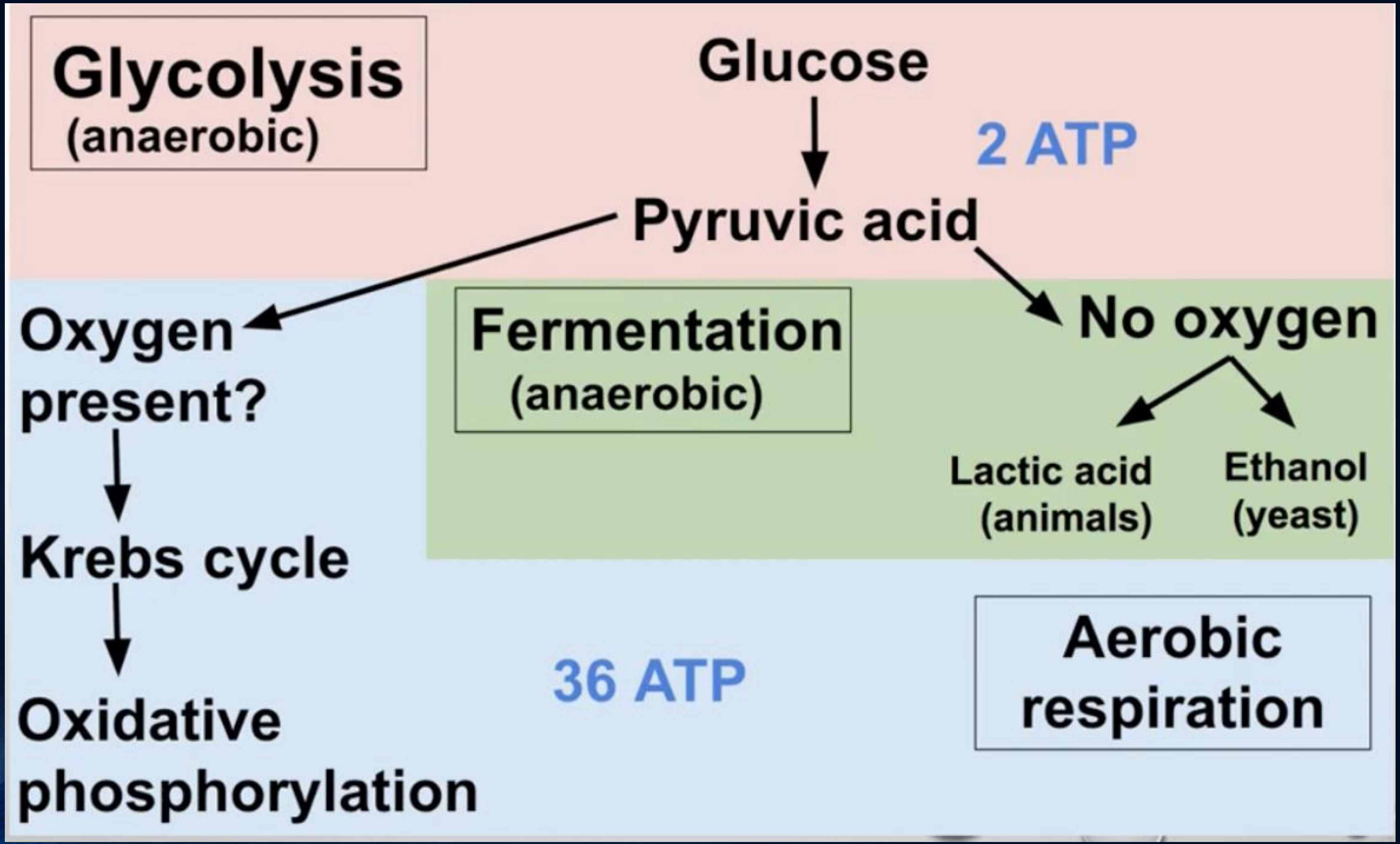
- Sk. muscle.
- Adipose tissue.


Membrane
Anaerobic
Aerobic
In mitochondria
2 ATP
6 Carbon Compound
Glucose
4 ADP
Loss of hydrogen - oxidation
4 ATP
3 Carbon Compound
Pyruvate Acid
+$O_2$
$CO_2 + H_2O$
Yeast fermentation
2 ATP
Homolactic fermentation
34 ADP
34 ATP
Alcohol + $CO_2$
Lactic Acid
Cytosol
Mitochondrion

# Glucose Metabolism

- In CHO metabolism, pyruvic acid (3C) is converted to Acetyl CoA (2C)
  - Acetyl CoA enters citric acid cycle in mitochondria to produce NADH and FADH2
  - NADH and FADh2 are used to make ATp during oxidative phosphorylation in the enzyme transport system
- In absence of glucose, cells will begin to metabolize lipids and then proteins
  - Lipids are chopped apart into 2C Acetyl CoA unites which can enter into citric acid cycle; Acetyl CoA units can also combine to form acetoacetic acid – ketone bodies

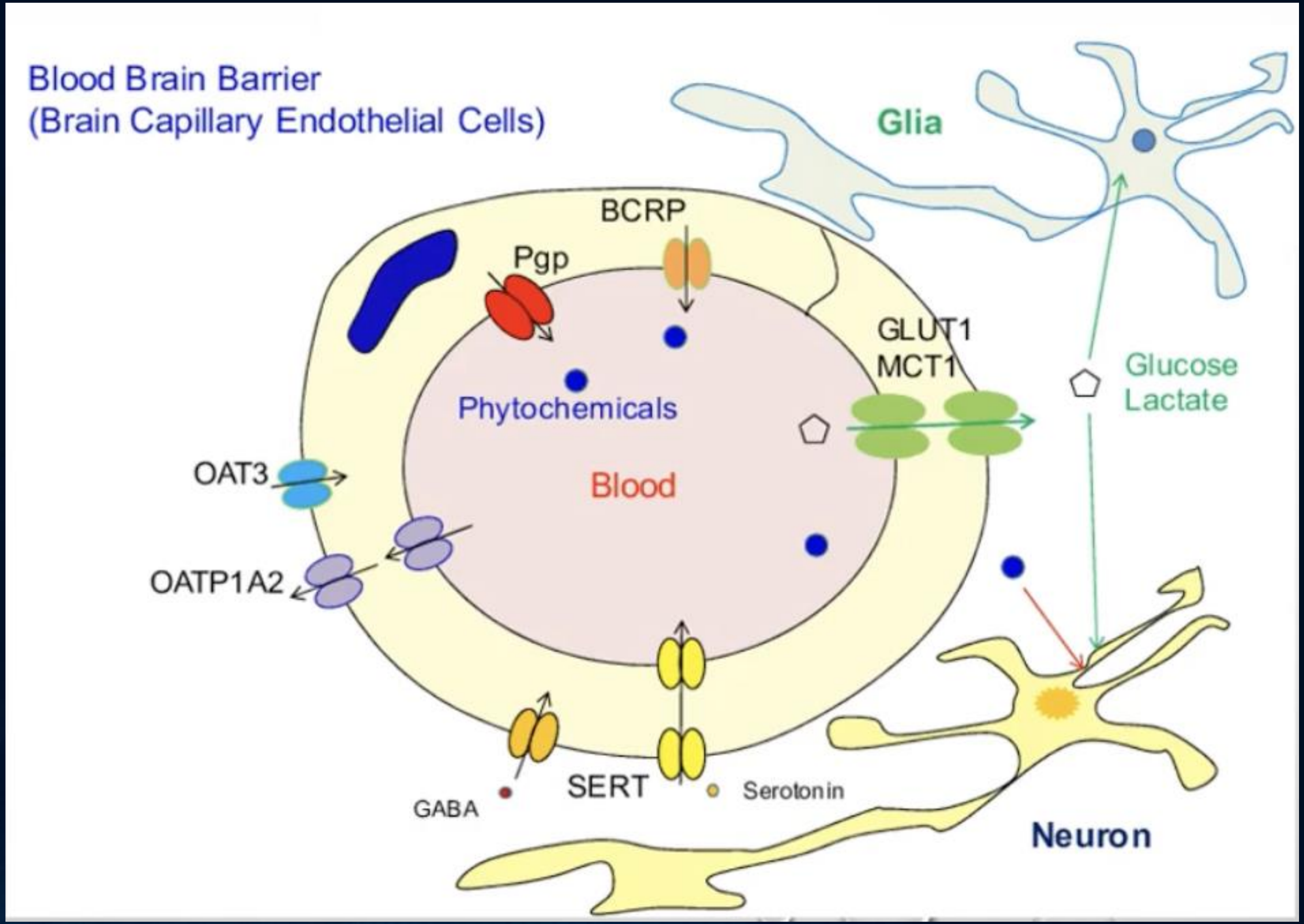
# Glucose Metabolism



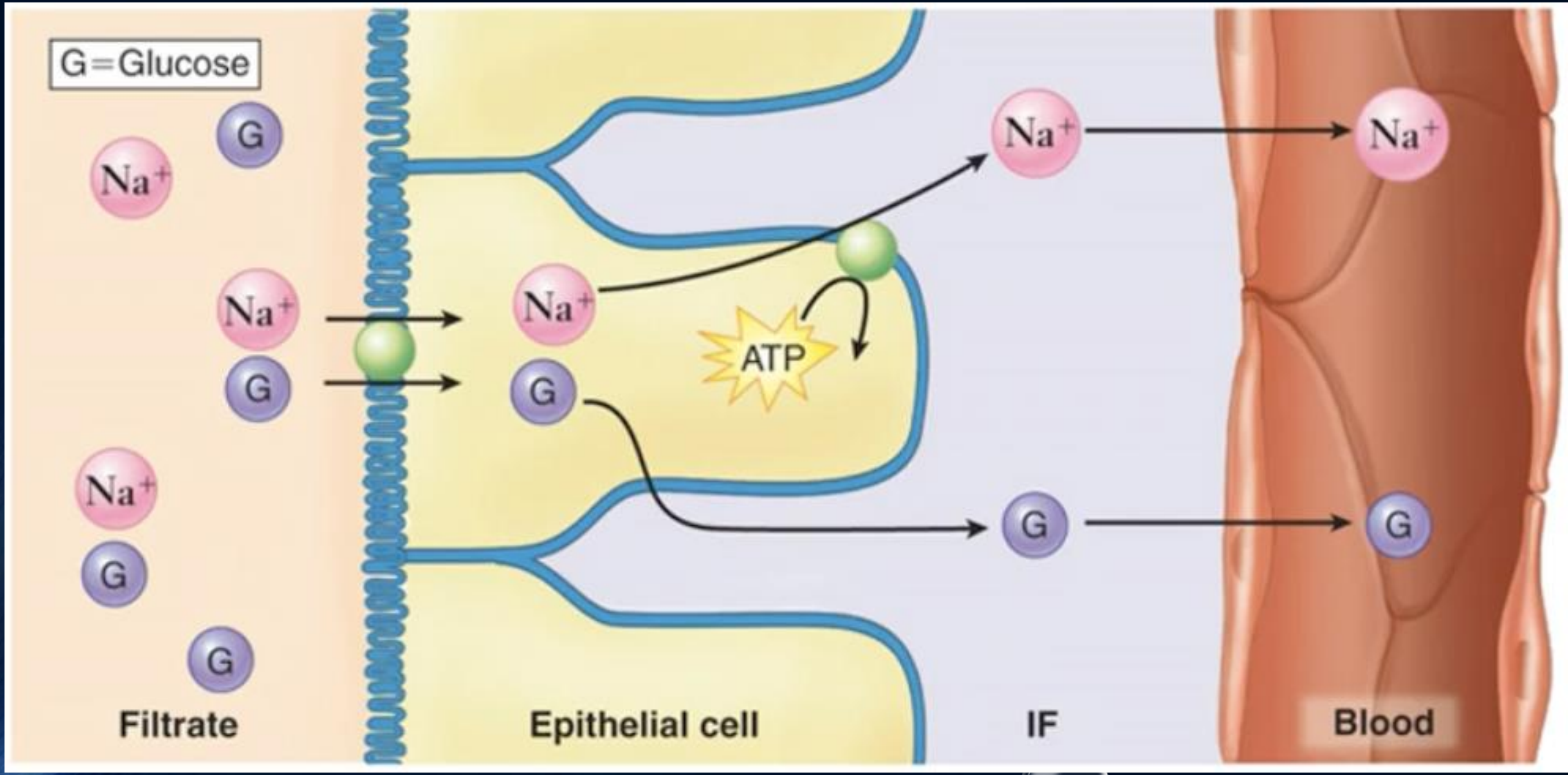
# Glucose Transporters

- GLUT 1 – expression does not depend on insulin
  - Found in blood brain barrier – necessary for transporting glucose from the blood into the brain
  - Heart tissue
- GLUT 2 – expression does not depend on insulin
  - Found on liver cells
  - Pancreatic islet beta cells
  - Basolateral surface of tubule cells in kidney, brush border of GI
- GLUT 3 – expression does not depend on insulin
  - Nervous tissue
- GLUT 4 – <u>expression depends on insulin</u>
  - Skeletal muscle tissue
  - Adipose tissue

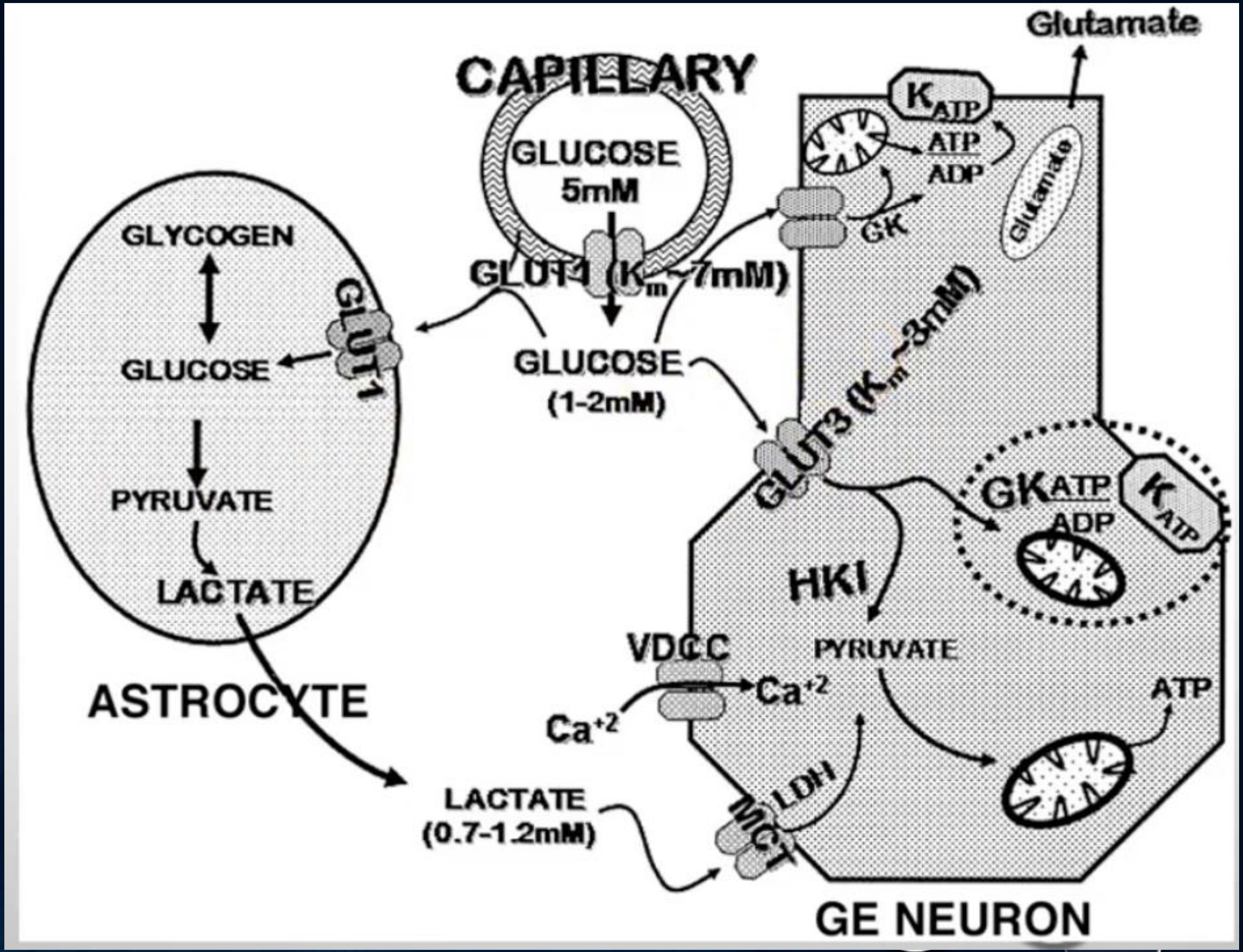
# GLUT 1 Transporters



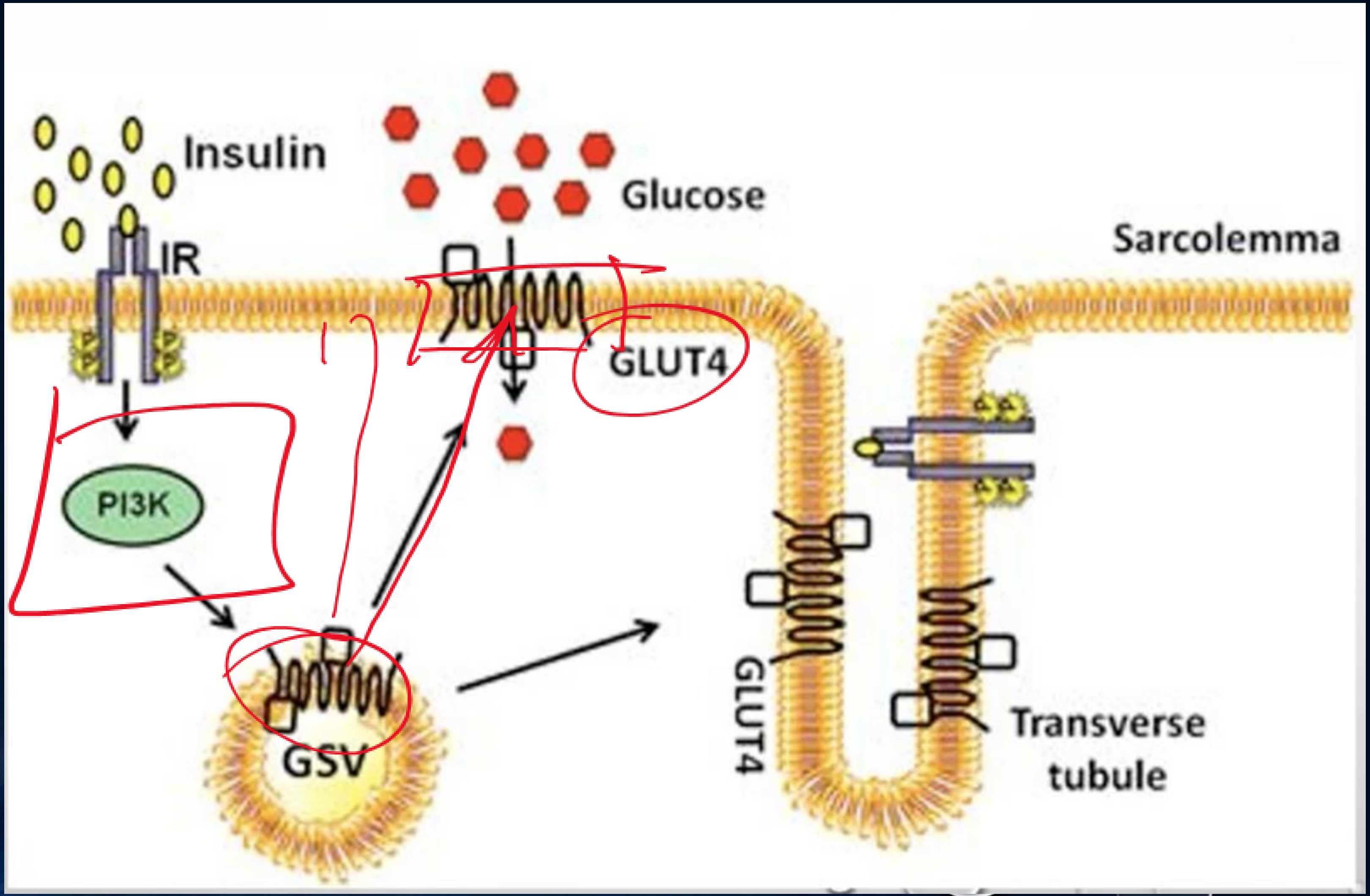
# GLUT 2 Transporters



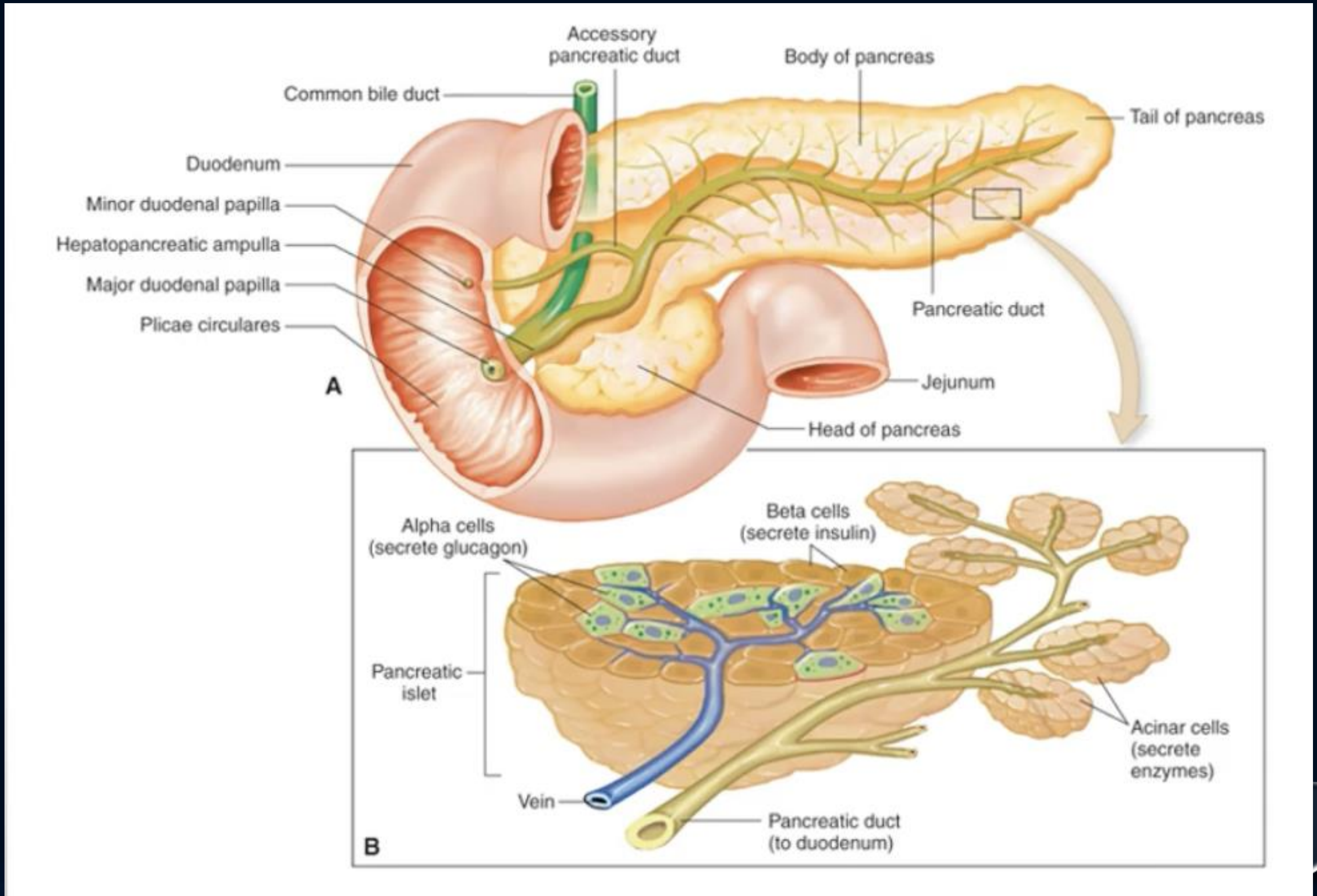
# GLUT 3 Transporter



# GLUT 4 Transporter



# Role of Pancreas



high blood sugar

Stimulate insulin ($\beta$ cells)

nervous system (PNS)

(block) SNS

$\alpha$ cells

Delta cells

# Regulation of Blood Glucose - Insulin

- Stimulus for secretion by pancreatic beta islet cells ("fed state")
  - Increased blood glucose – sensed by glucokinase (enzyme that converts glucose to glucose-6-P)
  - Inctivatio of PNS
- Secretion of incretins by small intestine
  - GIP, GLP-1
- Actions
  - Increases expression of GLUT4 transporters, especially on skeletal muscle cells, adipocytes
  - Promotes uptake of glucose into these cells types as well as liver cells
  - Promotes conversion of monomers – polymers (glycogen, TG, protein)
  - Net effect is to reduce blood glucose

Insulin (↓ blood Glucose)

→ bring glucose into cells.

glycolysis (ATP)

Fat production

glycogenesis ↑

- liver
- Sk muscle.

Pr
Fats

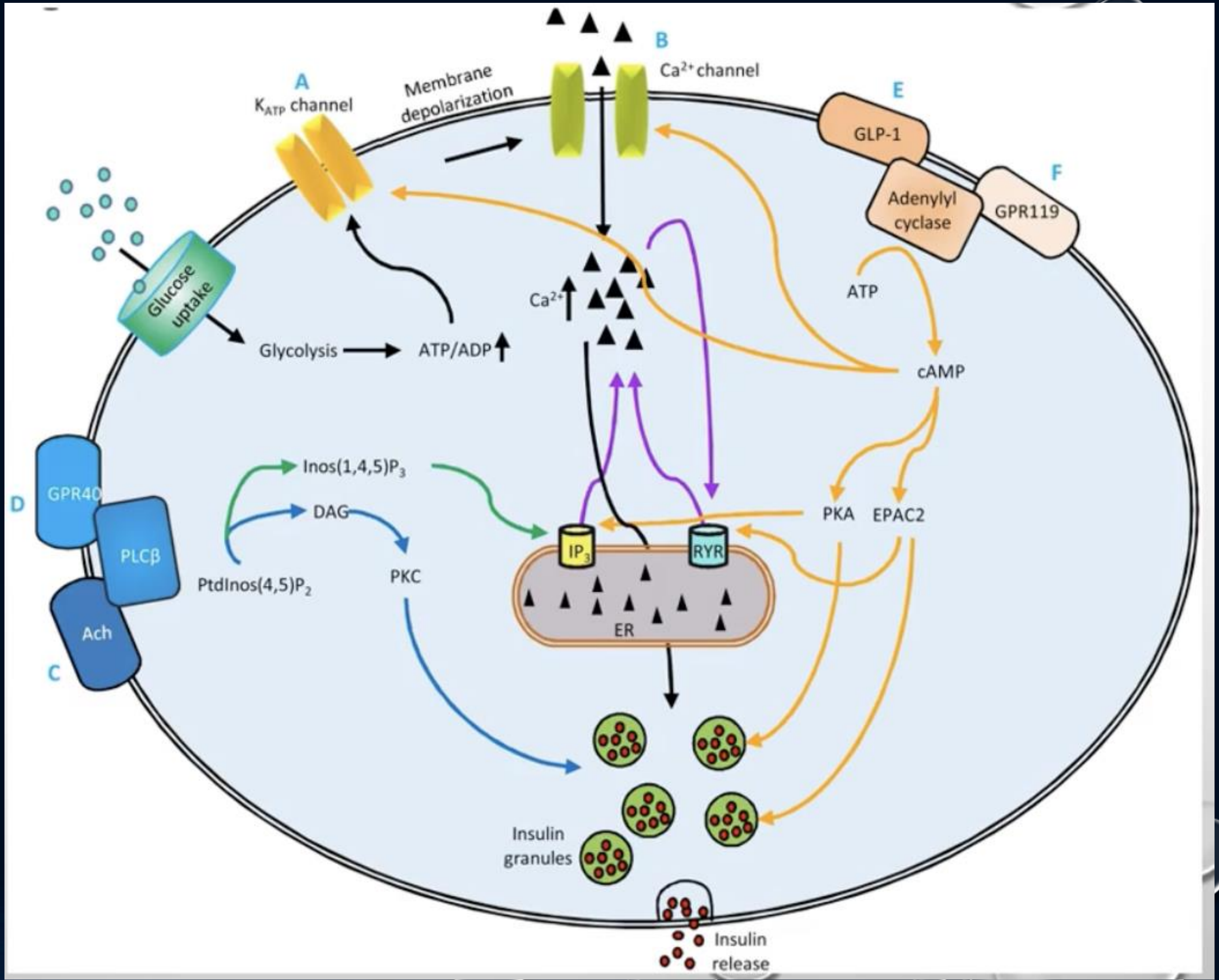
↑ gluconeogenesis

glycogenolysis ↑

Glucagon.
(↑ blood Sugar)
(mobilizes stores)

# Insulin Release

Structural classifications of hormones



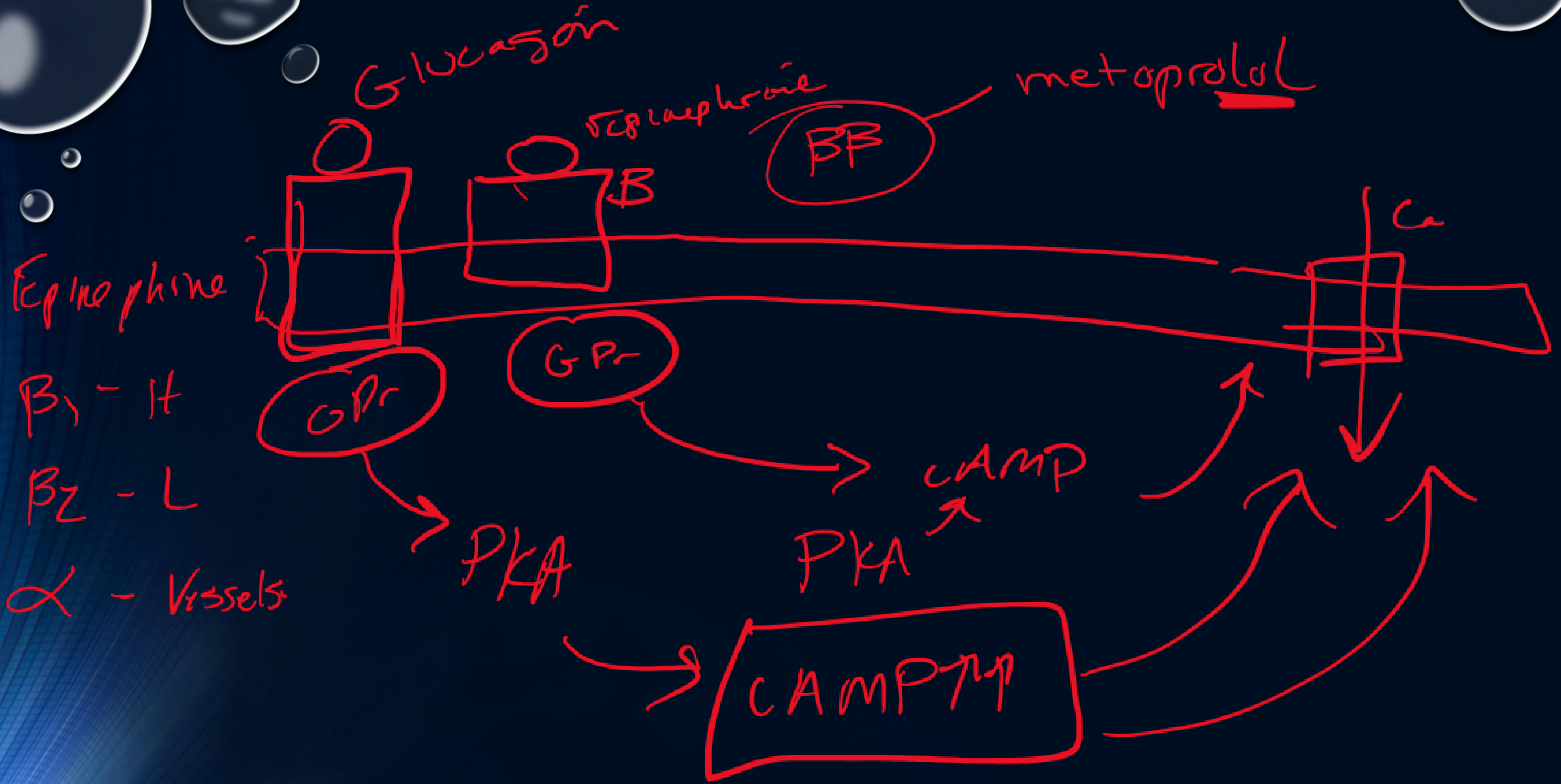
# Regulation of Blood Glucose - Glucagon

- Stimulus for secretion by pancreatic alpha islet cells ("fasted state")
  - Decreased blood glucose
  - Increased activity of SNS via alpha-1 receptors
  - Glucagon secretion inhibited by incretins
- Actions – at liver cells, adipocytes and skeletal muscle tissue
  - Glycogenolysis: glycogen – glucose
  - Gluconeogenesis: AA/TG/Glycerol - glucose

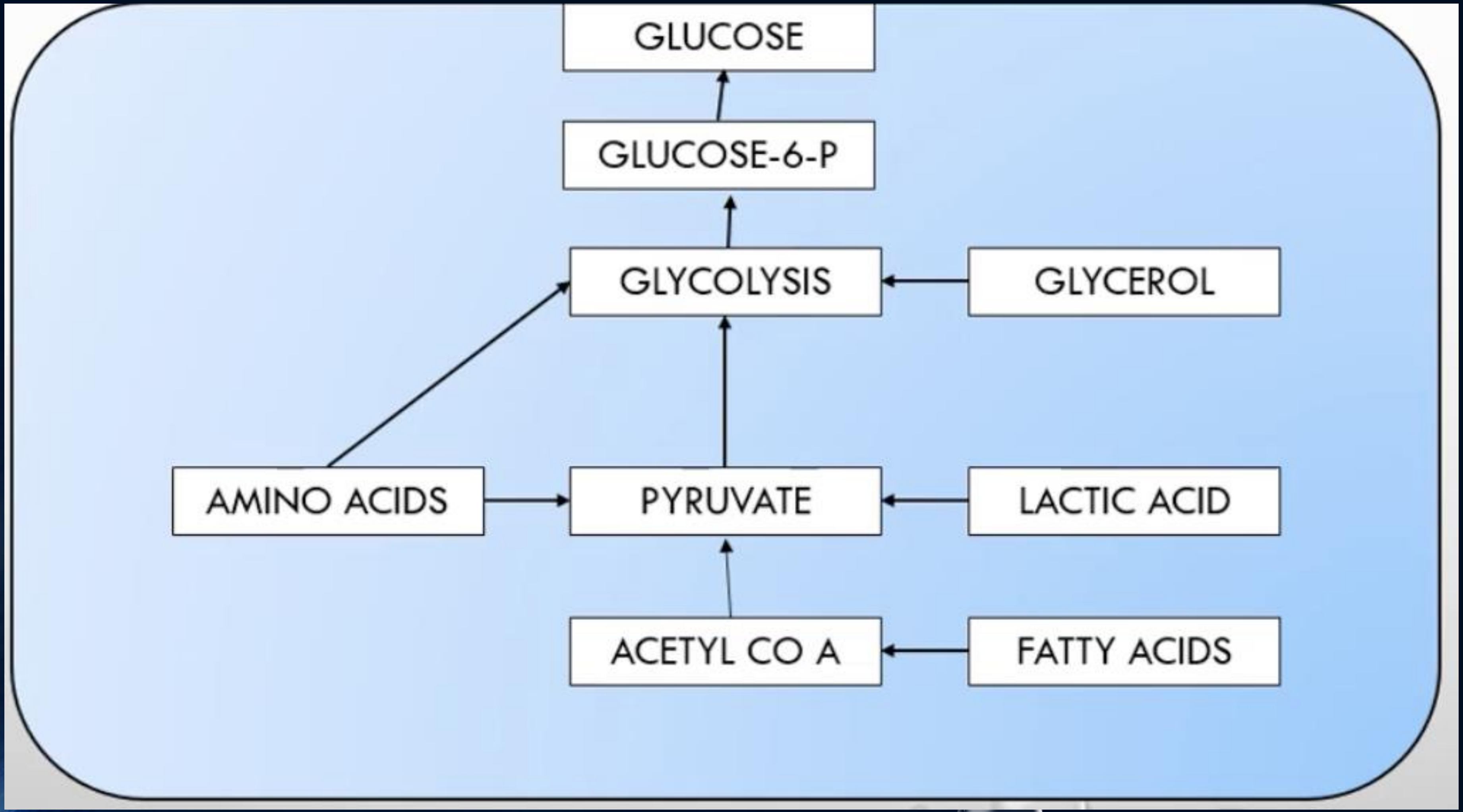
BP overdos

Relaxation
Smooth muscle.

Anaphylaxis


Glucagón
BB
metoprolol
B
Ca
Epinephrine
$B_1$ - H
$B_2$ - L
α - Vessels
GPr
GPr
cAMP
PKA
PKA

# Gluconeogenesis



# Regulation of Blood Glucose - Others

- Epinephrine
  - Secreted by adrenal medulla in response to SNS activity
  - Effects
    - Directly stimulates release of glucagon
    - Stimulates skeletal muscle cells and liver cells – glycogeneolysis / gluconeogenesis
- Glucocorticoids
  - Secreted by adrenal cortex following circadian rhythm, stress
  - Effects
    - Promotes gluconeogeneis by liver cells
- Growth Hormone
  - Secreted by anterior pituitary gland
  - Effects
    - Increased gluconeogeneiss by adipocytes