Unit IV – Problem 2 – Physiology: Endocrine Function of Pancreas & Glucose Homeostasis

Factors increasing blood glucose	Factors decreasing blood glucose
Glucose absorption from digestive tract (from diet)	Transport of glucose into cells for: energy production or storage (as glycogen or triglycerides)
Hepatic glucose production through: breaking down stored glycogen and gluconeogenesis	Urinary excretion of glucose (occurring only if blood glucose level is extremely high).

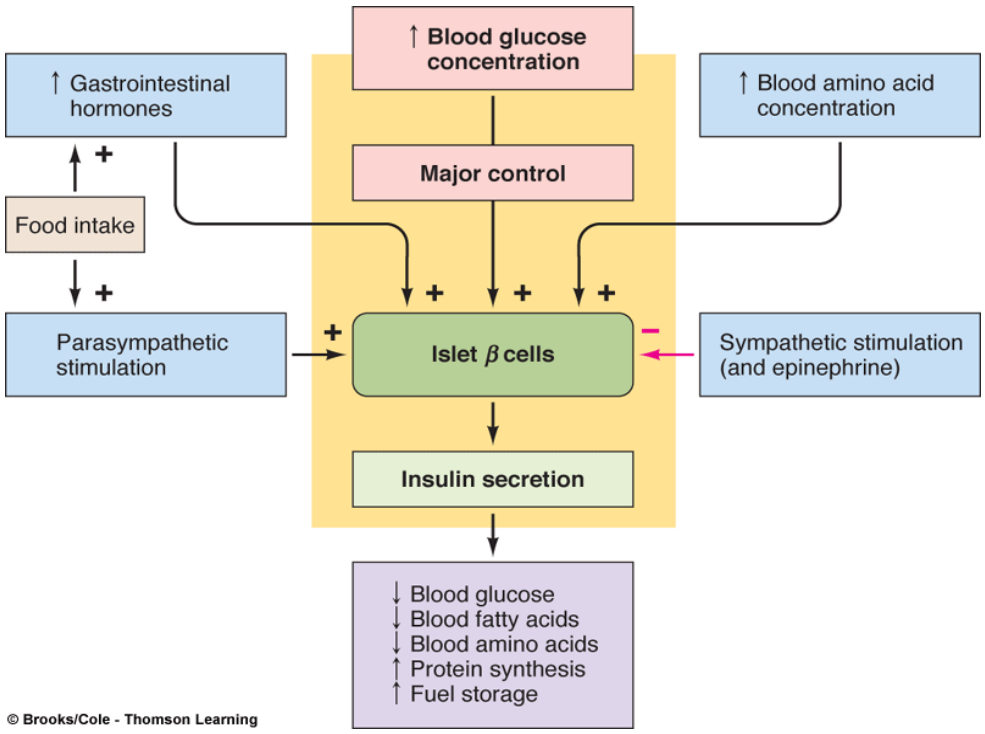
- **Glucose homeostasis:**

During a short fast	During a long fast
• Breakdown of liver glycogen to maintain blood glucose (notice that muscle glycogen is for local use only because it doesn't have the enzyme glcose-6-phosphatase).	• Lipolysis: breaking sown TAG stored in adipose tissues. • Glucneogenesis by using non-carbohydrate precursors such as: lactate, glycerol and amino acids.

- **In well-fed state, there is facilitation of cellular storage of nutrients:**
  - Glucose will be stored as glycogen in the liver.
  - Lipids will be stored as TAG in liver and adipose tissue.
  - Amino acids will be stored as proteins in muscles.

  Note: release of these metabolic substrates during fasting is mediated by the function of counter—regulatory hormones (glucagon, epinephrine, cortisol and growth hormone).
- **Principle actions of insulin:**
  - Controlling cellular uptake of glucose in muscles and adipose tissue through GLUT-4 receptor (insulin dependent). GLUT-2 receptor which is found in β-cells of islet of Langerhans and liver is insulin-independent.
  - Increasing DNA replication and protein synthesis via control of amino acid uptake.
  - **Insulin receptor**: tyrosine kinase activity.
- **Actions of insulin on:**
  - **Carbohydrate metabolism**: stimulating glycogenesis in liver and skeletal muscles. Inhibiting glycogenolysis and gluconeogenesis.
  - **Fat metabolism**: promoting TAG storage and inhibiting lipolysis (by blocking the action of the enzyme hormone-sensitive lipase).
  - **Protein metabolism**: protein anabolic effect (in muscles).
- **How is insulin secreted from β-cells of islet of Langerhans?**
  1. Glucose enters β-cells and causes activation of glucokinase.
  2. This will result in increased glucose-6-phosphate.
  3. Closure of potassium-channels.
  4. Depolarization of the cell.
  5. Opening of Ca^{++} channels.
  6. Exocytosis of secretory granules.

- **Factors controlling insulin secretion:**



- **Glucagon: increasing blood concentration of glucose through:**
  - Breakdown of glycogen stored in the liver.
  - Activation of hepatic gluconeogenesis.

  Note: glucagon is secreted in response to hypoglycemia.