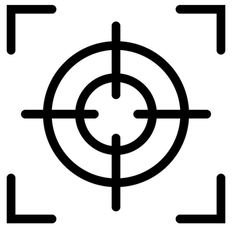
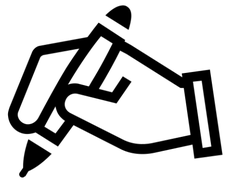
Topic 13: Hormone

Chapter Analysis



FOCUS

- one of the three chapters under umbrella topic of Co-ordination and Response in Humans
- linked to nervous system and homeostasis



EXAM

- commonly tested in MCQ and structured questions
- tested twice in section B in the past 5 years

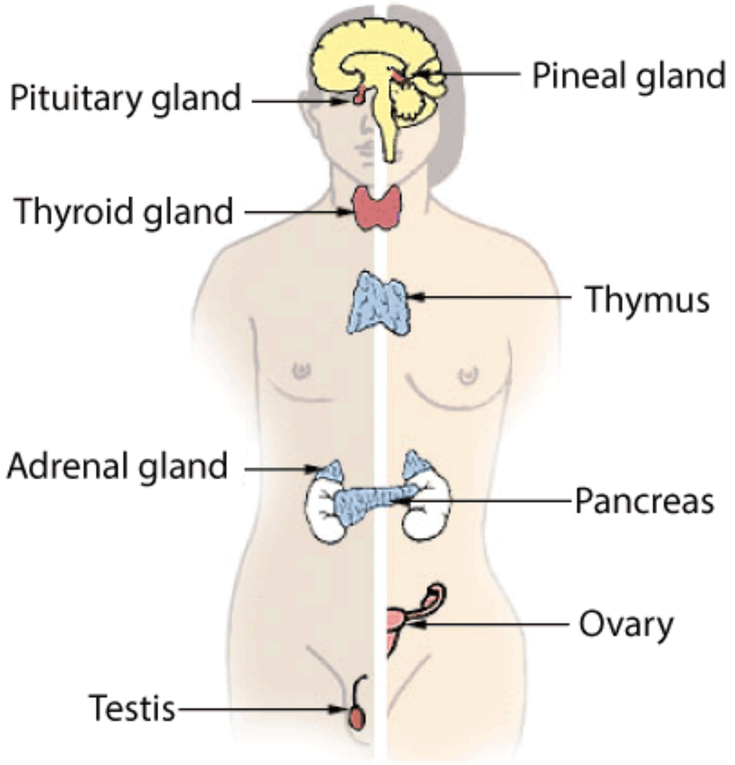
WEIGHTAGE

- Constitute to around 5% in Paper 2 in the past 5 years

Key Concept

hormone
insulin and glucagon
diabetes

hormone



- Hormone is a chemical substance, **produced by endocrine gland** and **secreted directly to blood**
- It is **transported by blood** to target organ to exert its effect
- After they have performed their functions, they are **destroyed by the liver**.

There are 2 types of glands

1. **Exocrine glands** are glands that **secrete their products via ducts** eg sweat glands and salivary glands
2. **Endocrine glands** are glands that **secrete their products directly into the bloodstream** (our focus)

- Some glands are both exocrine and endocrine, eg pancreas, which secretes pancreatic juice via the pancreatic duct, and also secretes the hormone insulin and glucagon from the islets of Langerhans directly into the bloodstream.
- Other examples of endocrine glands that secrete hormone is as below:
  - Pituitary gland secretes antidiuretic hormone (ADH)
  - Hypothalamus regulates the secretion of some pituitary hormones.
  - Adrenal gland secretes adrenaline.
  - Pancreas islets of Langerhans secrete insulin and glucagon.
  - Testis (in males) secretes testosterone.
  - Ovary (in females) secretes oestrogen and progesterone.

blood glucose regulation

insulin and glucagon

1. When blood glucose level increases beyond the norm, more **insulin** is released by islets of Langerhans in pancreas to the bloodstream

2. **Blood transport insulin** to the effector cells which are muscles cells and liver cells

3. Insulin **decreases blood glucose concentration** by:
   - Stimulating body cells to **increase glucose uptake** by increasing **permeability** of plasma membranes to glucose
   - Stimulating the liver and muscle cells to store glucose in the form of **glycogen**
   - **Decreasing glycogen breakdown** in the liver
   - **Decreasing the conversion of fatty acids and amino acids to glucose** in the liver

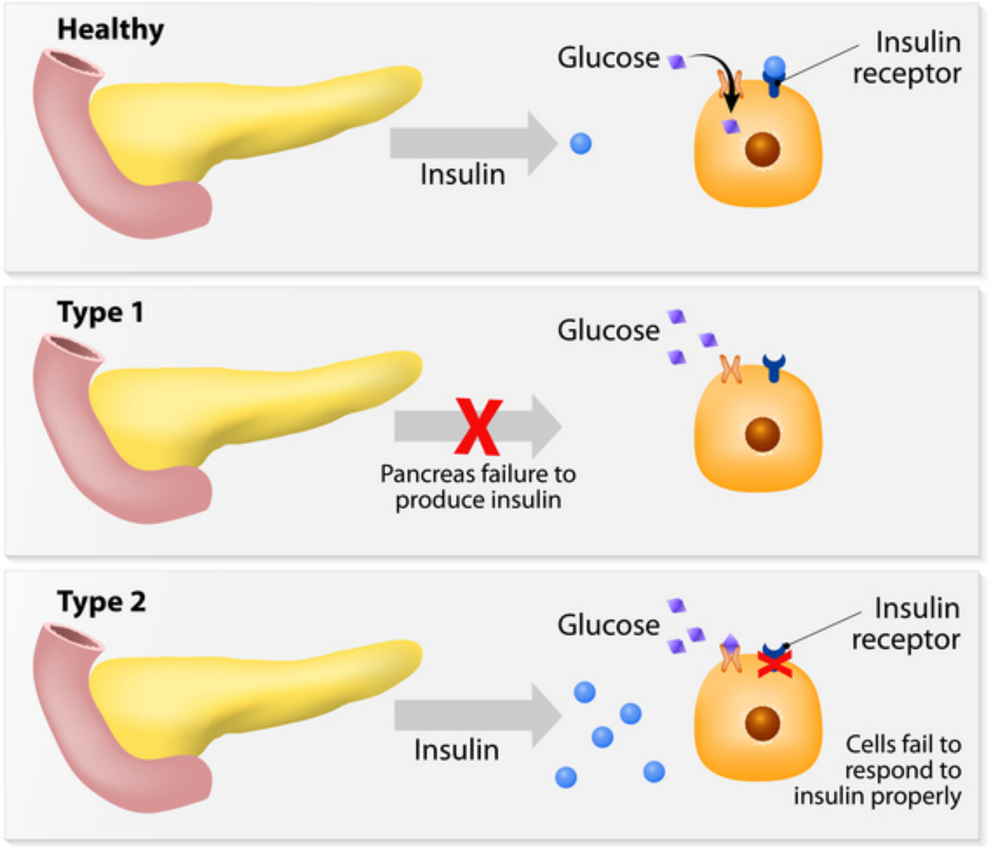
1. When blood glucose level falls below the norm, more **glucagon** is released by islets of Langerhans in pancreas to the bloodstream

2. **Blood transports glucagon** to the effector cells which are liver cells

3. Glucagon **increases blood glucose concentration** by stimulating liver cells to:
   - **Convert stored glycogen** in liver to glucose
   - **Convert amino acids and fatty acids** to glucose
   - **Convert lactic acid** into glucose

normal blood glucose level

diabetes mellitus

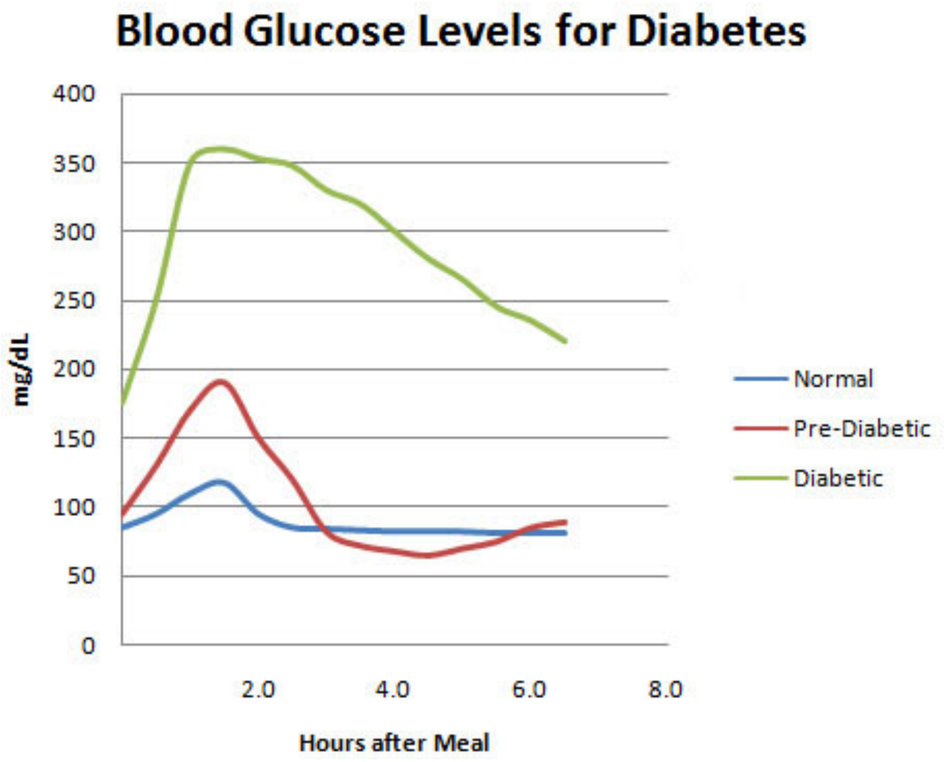


- Diabetes mellitus is a condition in which the **body does not produce sufficient insulin** or **does not respond** to insulin.
- The **excess glucose cannot be converted to glycogen** and cannot be completely reabsorbed in the kidneys and are excreted in the urine.

There are 2 types of diabetes

1. **Type 1 diabetes** or early onset diabetes develops early in a person's life.
   - It is usually genetic.
   - The islets of Langerhans are **unable to produce or secrete sufficient insulin**
2. **Type 2 diabetes** or late onset diabetes develops later in a person's life.
   - It is usually due to **lifestyle factors** such as overweight people are more likely to develop type 2 diabetes.
   - The target cells, such as the muscle and liver cells, **do not respond well to insulin.**

diabetes mellitus



Symptoms

1. A **persistent high blood glucose** concentration even a few hours after meal
2. Presence of glucose in the urine as **selective reabsorption could not fully absorb all glucose** presence in the blood
3. Difficulty of **wound healing**
4. Excessive urination, excessive thirst and weight loss

Treatment

- For type 1 diabetes, islets of Langerhans are unable to produce or secrete sufficient insulin, thus the patients have to **inject insulin directly into their bloodstream**. They also have to ensure that they have a **supply of sugary food** such a glucose sweets, as their blood glucose can drop too low if they use too much insulin, exercise too much or eat too little.
- For Type 2 diabetes, their target cells do not respond to insulin. The patients can control their blood sugar level through **diet and lifestyle changes**. For example, regulate the carbohydrate content in their diet, regular exercises

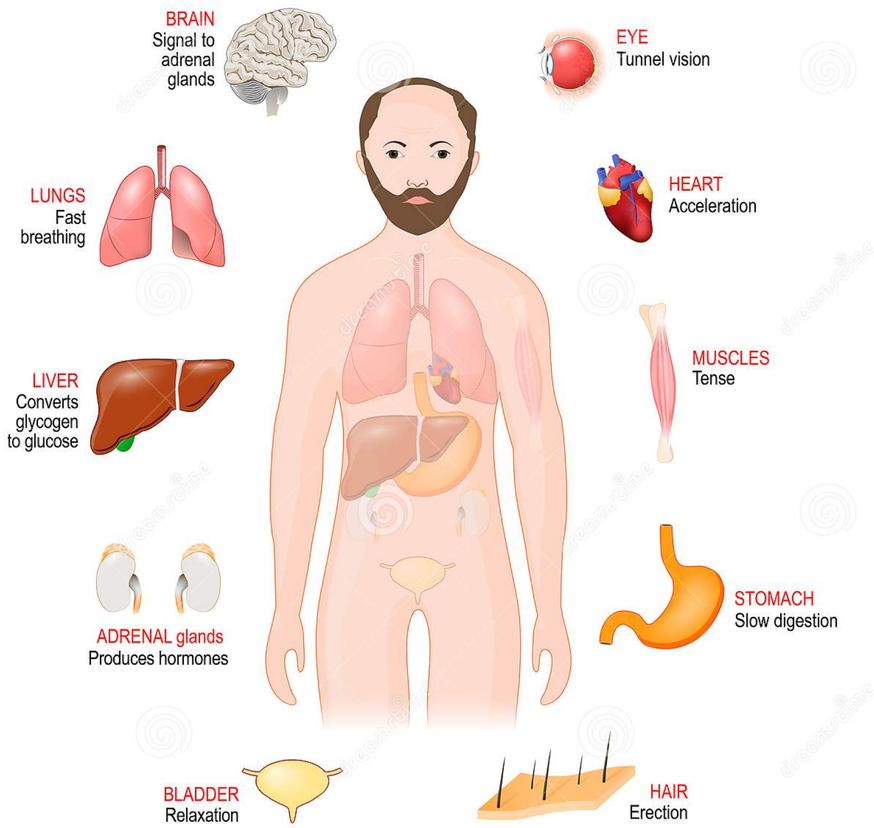
Key Concept

Adrenaline

nervous control vs endocrine control

Adrenaline

When faced with danger or stress, we have a **fight-or-flight response.**
no matter which we choose, **adrenaline** will be secreted by **adrenal gland** located above the kidney



EFFECTS OF ADRENALINE

1. Stimulate liver to **increase conversion of glycogen to glucose** so more glucose are available for **muscle contraction**
2. **Increased glucose release into blood** by liver cells
3. **Increased metabolic rate**, causing **more energy** to be released in cellular respiration
4. **Increased heart rate** and blood pressure to **increase oxygen and glucose supply** to muscle cells
5. **Dilated bronchioles** to **increase breathing rate and depth**, allowing **more oxygen** to be taken in for cellular respiration
6. Increase the rate of **blood clotting**
7. **Constrict arterioles to the digestive system**, so to channel blood supply to important organs such as heart, brain and skeletal muscles
8. **Constricts arterioles in skin**, causing paleness, so to channel blood supply to important organs such as heart, brain and skeletal muscles.
9. **Pupils dilate** to enhance vision
10. **Contracted hair erector muscles,** causing hair to stand and produce ‘goose bumps’

nervous control vs endocrine control

Nervous Control	Endocrine Control
means of coordination within our bodies.	
a stimulus causes the transmission of a message to effector which carries out the response.	
Involve **nerve impulses** which are **electrical signals**	Involve **hormones** which are **chemical substances**
Impulses are **transmitted by neurons**	Hormones are **carried by blood**
Usually **fast** responses	Usually **slow** responses
Responses are **short** lived	Responses can be **both short** lived or **long lasting**
Maybe **voluntary or involuntary**	Always **involuntary**
Effect is usually localised	Can affect more than one organ

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