



Endocrine & Cell Communication Part IV: Maintaining Balance (Homeostasis)




Simple Hormone Pathways

- For example, the release of acidic contents of the stomach into the duodenum stimulates endocrine cells there to secrete secretin.
- This causes target cells in the **pancreas**, a gland behind the stomach, to raise the pH in the duodenum.
- The increased pH results in a decrease of secretin secretion.



Feedback Regulation

- A **negative feedback** loop inhibits a response by reducing the initial stimulus, thus preventing excessive pathway activity.
- Positive feedback** reinforces a stimulus to produce an even greater response.
- For example, in mammals oxytocin causes the release of milk, causing greater suckling by offspring, which stimulates the release of more oxytocin.




AP Biology Curriculum Framework

EK 3.D.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.

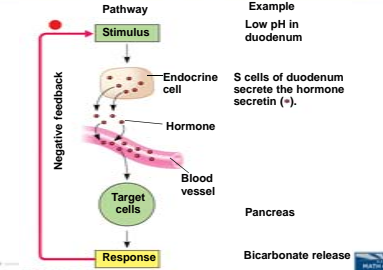
c. Signals released by one cell type can travel long distances to target cells of another cell type.

- Endocrine signals are produced by endocrine cells that release signaling molecules, which are specific and can travel long distances through the blood to reach all parts of the body.

illustrative example-insulin




Simple Hormone Pathways

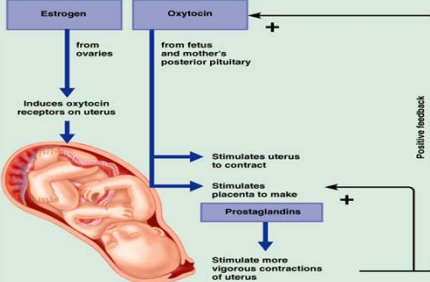


Pathway
Stimulus → Endocrine cell → Hormone → Blood vessel → Target cells → Response

Example
Low pH in duodenum
S cells of duodenum secrete the hormone secretin (+).
Pancreas
Bicarbonate release



An example of positive feedback




Estrogen (from ovaries) → induces oxytocin receptors on uterus

Oxytocin (from fetus and mother's posterior pituitary) → Stimulates uterus to contract

→ Stimulates placenta to make **Prostaglandins**

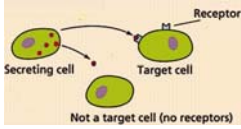

→ Stimulate more vigorous contractions of uterus

→ Positive feedback




Simple Hormone Pathways

- Hormones are released from an endocrine cell, travel through the bloodstream, and interact with specific receptors within a target cell to cause a physiological response


Negative Feedback

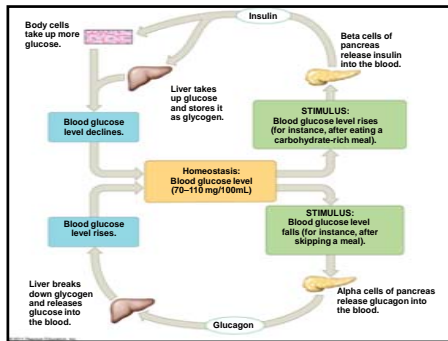
- Secretin secretion regulation is an example of negative feedback in action.



Insulin and Glucagon: Control of Blood Glucose

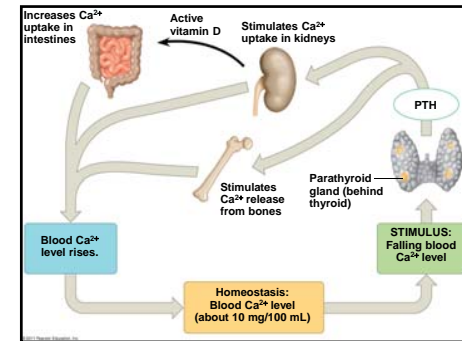
- Hormones work in pairs to maintain homeostasis.
- Insulin** (decreases blood glucose) and **glucagon** (increases blood glucose) are antagonistic hormones that help maintain glucose homeostasis.
- The pancreas has clusters of endocrine cells called pancreatic islets with alpha cells that produce glucagon and beta cells that produce insulin.





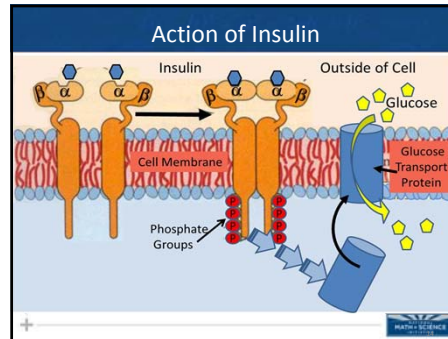
Out of Balance: Diabetes Mellitus

- *Type 1 diabetes mellitus* (insulin-dependent) is an autoimmune disorder in which the immune system destroys pancreatic beta cells.
- *Type 2 diabetes mellitus* (non-insulin-dependent) involves insulin deficiency or reduced response of target cells due to change in insulin receptors.



AP Curriculum Framework

- EK 3.D.4 Changes in signal transduction pathways can alter cellular response.
 - A. Conditions where signal transduction is blocked or defective can be deleterious, preventative or prophylactic.
 - Illustrative example - diabetes



Homeostasis in blood calcium levels

- PTH increases the level of blood Ca^{2+}
 - It releases Ca^{2+} from bone and stimulates reabsorption of Ca^{2+} in the kidneys.
 - It also has an indirect effect, stimulating the kidneys to activate vitamin D, which promotes intestinal uptake of Ca^{2+} from food.
- Calcitonin decreases the level of blood Ca^{2+}
 - It stimulates Ca^{2+} deposition in bones and secretion by kidneys.

Out of Balance: Diabetes Mellitus

- **Diabetes mellitus** is perhaps the best-known endocrine disorder.
- It is caused by a deficiency of insulin or a decreased response to insulin in target tissues.
- It is marked by elevated blood glucose levels.

Insulin & Glucose Regulation

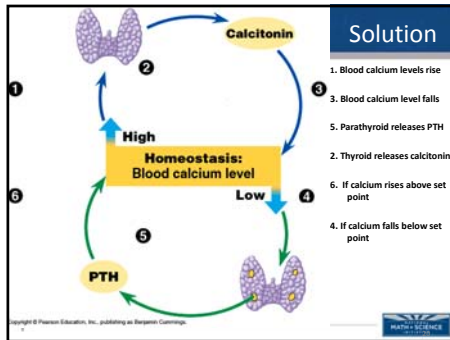
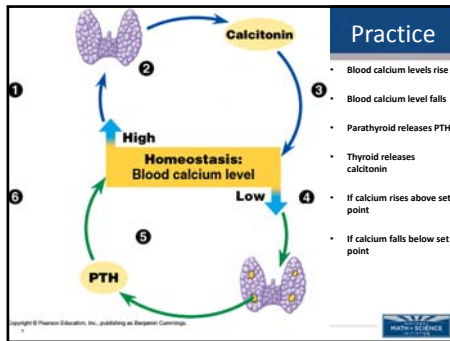
Insulin and Glucose Regulation

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Homeostasis In Blood Calcium Levels

Hormonal Regulation of Calcium

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$E = mc^2$