

Biology Lecture 5-6 (Part 4)

Hormones:

- There are two systems that control the body, the nervous system and the endocrine system
- Chemical signals secreted by the cells and distributed by the blood
- Cells that secrete hormones are called endocrine cells
- Target cells receive the hormones if they have the right receptor to bind the hormone
- This is a much slower method of transmission than the APs of the nervous system but it results in long term development
- Most hormones are peptides/proteins but some are also steroids and amines.
- The same hormone can cause different responses in different types of target cells
- Endocrine cells can exist by themselves or aggregate together in endocrine glands
- Temperature can play a role by triggering the release of certain hormones that can affect the development

Hormones in invertebrates (molting and metamorphosis)

- Two hormones work together to control molting
- Brain produces PTTH, which is stored in a pair of structures attached to the brain
- With appropriate stimulation, PTTH is released through the axon terminals to the prothoracic gland
- This in turn triggers the release of ecdysone, which will diffuse to target cells and stimulates molting
- PTTH is released periodically, which triggers regular molting
- Juvenile hormone plays a crucial role in metamorphosis
- It determines if the bug molts into another instar or adult
- When the production of Juvenile hormone ceases, the bug molts into adult
- In complete metamorphosis, declining juvenile hormone causes the larva to develop into the pupa. Pupa doesn't produce juvenile hormone so it molts into an adult

Vertebrate endocrine system:

- Pituitary gland plays central role in the endocrine system
- It plays a link between the nervous system and other endocrine glands
- It secretes hormones that are released by the brain (neurohormones) and also releases hormones of its own
- It is attached to the part of the brain called the hypothalamus
- Posterior pituitary gland releases two neurohormones called **antidiuretic hormone (ADH)** and **oxytocin**
- ADH increases the water absorption in the kidneys
- When the concentration of ADH is high, urine is very concentrated
- When the concentration of ADH is low, urine is diluted

- Release of ADH occurs whenever blood pressure falls or when blood becomes too salty
- Oxytocin serves two functions, it stimulates the contractions of the uterus that will deliver the baby and also stimulate the mammary glands to release milk from the breasts

How hormones work:

- A) effect the gene expression (modify the cell to produce certain things)
- B) affects the activity of existing enzyme
- C) Change the permeability of the cell membrane
- Insulin and Glucagon (produced by B and A cells in the pancreas)
- Diabetes I (Juvenile onset diabetes) is caused by the lack of insulin in the target tissues, can be cured by inject the patient with insulin
- Diabetes II (adult onset diabetes) is caused by the lack of insulin receptors/cells not responsive to insulin. Can be cured by having diets and exercises that decrease the concentration of glucose in the blood
- In the absence of insulin or insulin receptors, glucose fails to enter the cells and accumulates in the blood until it is excreted out by the blood
- This cause a shortage of glucose in the cells and they must use fat or glycogen to fuel their activities. This results in the body of the person wasting away as major organs are damaged
- Glucagon has the opposite effects to insulin. It stimulates the liver to convert glycogen back to glucose to resupply blood with glucose
- After a meal, insulin are released and cells consume glucose as their fuel and convert excess glucose to fat or glycogen.
- When the digestive tract is empty, insulin stops been released. When sugar level in blood falls below the normal, glucagon is released

Vitamin D and friends:

- Vitamin D is not a vitamin because can be synthesized by the body. (Vitamin is defined as the stuff that the body need but cannot synthesis, must be received from the diet)
- Vitamin D is produced by the cells on the skin when in contact with the UV rays from the sunlight
- Vitamin D is added to cow's milk and is not a natural component
- Vitamin D is a hormone
- Thyroid gland produces calcitonin, which regulates calcium levels in blood (99% calcium in bones, 0.1% in blood and calcium is crucial for the function of the nervous system)
- Calcium levels can be controlled by the a) absorption/deposition of bone b) excretion/absorption of calcium in the kidney and absorption of calcium in the digestive tract
- The hormones that controls the calcium levels are calcitonin, vitamin D, and PTH.
- Osteoblasts are the cells that deposit new bone
- Osteoclasts are the cells that break down new bone

- Calcitonin decrease the concentration of calcium in the blood by decrease the activities of the osteoclasts (and decrease the absorption of calcium in the kidney and digestive tracts)
- Parathyroid glands have receptors that are able to detect the concentration of calcium in the blood
- It produces PTH, which acts to raise the calcium level in the blood by activating the osteoclasts
- It also stimulates kidney to absorb calcium rather than excrete it
- It activates Vitamin D which in turns acts on the digestive tract to increase the absorption of calcium