Hormones and the Endocrine System

Chapter 40
Chemical Signals

- Pheromones are any chemical signal that act **between** organisms.
- Hormones are chemical signals that regulate metabolic functions **within** organisms.
- The endocrine system contains the organs, glands, and tissues that secrete and regulate hormones.
Types of Hormones

- **Peptide Hormones (ADH, Calcitonin, Insulin, Epinephrine)**
  - Peptides (made of amino acids) typically never enter the cell
  - They initiate a cascade of enzymes within the cell by triggering proteins in the plasma membrane
  - Peptides typically act quickly, but the effect is short-lived

- **Steroid Hormones (Testosterone, Estrogen, Vitamin D)**
  - Steroids are only produced in the adrenals, ovaries and testes
  - Because they are made of 4-ringed lipids, they are able to pass through the plasma membrane
  - Inside the cell they bind to a protein (typically in the nucleus) and trigger transcription of specific, desired mRNA strands
  - Steroids typically act slowly, but the effect is long lasting.
Hypothalamus & Pituitary

- The hypothalamus regulates internal temperature, heartbeat, body temperature, and water balance
  - Notice how these four things are connected anyway, so they might as well all be controlled by the same structure, right?
- The pituitary is a tiny gland connected to the hypothalamus
- The pituitary stimulates:
  - The kidneys to increase or decrease water absorption
  - The uterus to contract during childbirth
  - The mammary glands to release milk
- Pituitary also controls growth hormones
The reason you need iodine is for the hormones produced by your thyroid.

The thyroid gland universally increases the metabolic rates of the organism in all cells.

The parathyroid glands stimulate and control the release of calcium in the bones, muscles, and bloodstream. As we learned earlier, calcium is essential in controlling nerve impulses at the synapse.

The parathyroid helps to regulate control of nerves and muscles and prevents tremors or shakes.
Adrenal glands sit on top of the kidneys and produce epinephrine (adrenaline), and norpinephrine, which control your “flight or fight” responses.

These glands also produce aldosterone, which regulates salt levels in your bloodstream and can produce sex hormones for each gender.

- Even if you are a male these will produce estrogen, and even if you are a female these will produce testosterone.

Cortisol is produced in extreme fight or flight scenarios by creating large amounts of glucose for energy while suppressing pain and immunity.

- You can run from the tiger without realizing how tired you are.
- You may be bleeding to death and in pain, but you won’t notice.
The pancreas lies between the kidneys and the duodenum.

The pancreas secretes insulin when there is a high blood glucose level (such as after eating).

Insulin triggers the liver to uptake the glucose
- The glucose is stored as fat reserves or as glycogen.

When blood sugar is low, the pancreas releases glucagon instead of insulin.

Glucagon stimulates the liver to breakdown glycogen and fat reserves into glucose.
Diabetes is when the liver and other body cells do not take up and/or metabolize glucose.

Any excess glucose from your food that your cells do not absorb gets released in the urine instead of stored as glycogen in the liver.

Since humans don’t constantly eat, we rely on our liver to break glycogen and return glucose slowly into our blood the rest of the time.

- But what if the liver never stores the excess glucose...?

Diabetes actually is harming you when you eat, but you won’t experience the effects until a few hours later.

As a life-saving backup system, cells rapidly breakdown fats for energy in a toxic process called keto-acidosis.

Keto-acidosis can cause hallucinations, extreme mood swings, comatosis, and death within minutes to hours.
Type 1: insulin-dependent
- In type 1 diabetes, the pancreas does not produce insulin
- Usually the result of genetic or viral disease to the pancreas
- The treatment includes daily monitoring of glucose levels and injections of insulin, sometimes directly into the pancreas through a tube called a “local.”

Type 2: noninsulin-dependent
- Most people with diabetes have type 2. Why...?
- Usually the result of obesity and inactivity.
  - Type 2 can become type 1 if not treated.
- The liver and muscles do not respond to the insulin the pancreas produces
- Best treatment of this is monitoring diet and exercise and taking medicines to stimulate increased pancreas activity.
Type 1 Diabetes
Type 2 Diabetes
The testes and ovaries produce high levels of one of the two sex hormones, androgens and progesterones.

One androgen, testosterone, brings about the secondary male sex characteristics (body hair, enlarged larynx, muscle growth).

One progesterone, estrogen, likewise stimulates pelvic widening (for childbirth), fat, muscle and gland distribution to breasts, and initiation of menstruation.

The pineal gland produces melatonin, which controls circadian rhythms and the body clock (such as when puberty occurs).
Because androgens promote muscle growth, many athletes take supplemental anabolic steroids such as testosterone precursors.

The steroids do an effective job of increasing muscle mass, but they also do an effective job of increasing the other effects of androgens:

- Severe acne
- High cholesterol
- Liver dysfunction
- Overactive and, thus, reduced genitals
- Breast encouragement in men, reduction in women
- Mania (‘roid rage).
This question is worth an extra 5% on your essay exam
You may check your answers with me ahead of time for a yes or no response as many times as you like.

Explain how Diabetes affects the electron transport chain