Hormones are one form of communication in our body

Together, the endocrine and nervous systems are responsible for most of the communication in our bodies.

Our endocrine organs secrete hormones into our bloodstream. These hormones travel in our bloodstream and bind to receptors on specific target tissues.

Because hormones only bind receptors on target tissues:

- Their effect is not felt immediately (usually minutes to hours).
- They have LARGE effects on the body at small concentrations (usually in the nM range!).
- Their effects can be long lasting (months in the case of pregnancy).
Hormones are one form of communication in our body

Because there are so many types of hormones, they play a wide range of roles:

Changes in **plasma membrane permeability** (electrical state)  
**Synthesis of proteins** within the cell  
**Activation** of enzymes  
**Stimulation of mitosis**  
**Promotion of secretory activity** by the cell (sometimes stimulates secretion of more hormones)
Hormones are one form of communication in our body

Remember that hormones work to regulate function within our body

**Pheromones** are a special category of chemical messengers that mediate interactions *between* individuals

Pheromones are common in many groups of animals:
- species recognition
- territory marking
- navigation
- parent-offspring interactions
- reproduction (gender recognition, sex attractants, receptivity indication, etc.)

**Human pheromones** are probably unimportant: only one or two conclusively demonstrated (control timing of female reproductive cycles). **NO** proven sex attractants, social indicators, etc.
Hormones are chemical substances

There are 100s of hormones produced by our bodies. All can be classified chemically as:

- amino acid based molecules
- steroids (derived from cholesterol)
- prostaglandins (another lipid-derived messenger molecule)

As we’ll see in a minute, a hormone’s composition greatly affects its mechanism of action.
The mechanism depends on the composition

**Steroid hormones** can freely pass through the cell membrane, so they have a different mechanism of action than **amino acid-based hormones**
The mechanism depends on the composition of the hormones. Steroid hormones can freely pass through the cell membrane, so they have a different mechanism of action than amino acid-based hormones.
Negative feedback example: home heating system

Thermometer (sensor)

Furnace (effector)

Thermostat (comparator)

Thermometer (the sensor) measures *actual* temperature and sends signal to thermostat (the comparator)
Negative feedback example: home heating system
Negative feedback example: home heating system

Thermometer (sensor)

Furnace (effector)

Thermostat (comparator)

Thermostat compares *actual* temperature to *setpoint* (the *desired* temperature): *too cold*!
Negative feedback example: home heating system

Thermometer (sensor)

Furnace (effector)

Thermostat (comparator)

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Thermostat sends a signal to furnace (the effector)
Negative feedback example: home heating system

Heat from furnace raises temperature; when setpoint temperature is reached, furnace is shut off.
Negative feedback example: home heating system

- Thermometer (sensor)
- Furnace (effector)
- Thermostat (comparator)

Thermostat sends a signal to furnace (the effector)
Negative feedback example: home heating system

Heat from furnace raises temperature; when setpoint temperature is reached, furnace is shut off.
1. The hypothalamus secretes hormones that...

- stimulate the anterior pituitary gland to secrete hormones that...
- stimulate other endocrine glands to secrete hormones

(a) Hormonal

1. Capillary blood contains low concentration of Ca²⁺, which stimulates...

- capillary (low Ca²⁺ in blood)
- thyroid gland (posterior view)
- parathyroid glands

(b) Humoral

1. Preganglionic SNS fiber stimulates adrenal medulla cells...

- preganglionic SNS fiber
- CNS (spinal cord)
- medulla of adrenal gland

(c) Neural

2. To secrete catecholamines
The thyroid gland regulates our metabolism

**Thyroid hormone** consists of two hormones, $T_3$ and $T_4$
Controls the rate at which glucose is burned or oxidized

**Iodine** is essential for the formation of these hormones

**Calcitonin** lowers blood calcium levels
Parathyroid hormone counteracts calcitonin

The parathyroid glands are located on the posterior surface of the thyroid gland.

They secrete parathyroid hormone, which causes an increase in blood calcium levels.

Where does the calcium come from?

What type of cell “releases” it?

Because PTH and Calcitonin counteract each other, we call them antagonists; lots of hormones act antagonistically.
Glucocorticoids (e.g., cortisol)
Mineralocorticoids (e.g., aldosterone)
Sex steroids (e.g., testosterone)
Epinephrine
Norepinephrine

Cortex
Medulla
Adrenal gland
Kidney
Adrenal cortex hormones

Mineralcorticoids (mainly aldosterone)
Regulate water and electrolyte balance of the body by targeting kidney tubules for selective reabsorption of ions
Aldosterone regulates blood sodium levels (and thus blood pressure)

Cortisone and cortisol
Work in the management of long-term stress by promoting glucose metabolism, release of prostaglandins, reducing swelling

Sex hormones
Made in low amounts throughout life
Mainly androgens are made
Some estrogens are also made here
Adrenal medulla hormones

Stimulated by the sympathetic nervous system to secrete its hormones

*Catecholamines* (adrenaline or epinephrine) are released
**Short-term stress response**

1. Increased heart rate
2. Increased blood pressure
3. Liver converts glycogen to glucose and releases glucose to blood
4. Dilation of bronchioles
5. Changes in blood flow patterns leading to increased alertness and decreased digestive and kidney activity
6. Increased metabolic rate

**Long-term stress response**

1. Retention of sodium and water by kidneys
2. Increased blood volume and blood pressure

**More prolonged**

1. Proteins and fats converted to glucose or broken down for energy
2. Increased blood sugar
3. Suppression of immune system
**Pancreatic Islets**

*Beta cells* secrete the hormone *insulin*, which signals cells to “take up” more circulatory glucose, reducing blood glucose levels.

The hormone *glucagon* acts as an antagonist to insulin, causing glucose release from the liver during times of low blood sugar; it is secreted by *alpha cells*.
Pineal gland

Pinecone shaped gland located in the brain’s third ventricle

Melatonin is secreted

Melatonin levels are highest at night, and are lowest around noon

Believed to regulate the sleep cycle as well as regulate the timing of sexual maturity
Thymus gland

Located in the upper thorax, posterior to the sternum

Secretes *thymosin* which helps the thymus act as an incubator for *T cells*, which help boost your immune response
Ovarian hormones

Product estrogens and progesterone

Estrogens are produced by *Graafian follicles* and promote the development of secondary sexual characteristics in females.

Estrogens also play a large role in the *menstrual cycle* and help the breasts to produce milk.

Progesterone quiets the muscles of the uterus during pregnancy to discourage abortion.

Progesterone is secreted by the *corpus luteum*.
Testicular hormones

Testosterone is the most important of the androgens secreted by the testes

Causes development of male sex characteristics

Necessary for continued production of sperm
The placenta

Has many sustaining qualities for growing babies

Human chorionic gonadotropin (hCG) is produced early in pregnancy to signal the ovaries to continue producing estrogen and progesterone so the uterine lining is not sloughed off

Later, the placenta produces its own estrogen/progesterone

Human placental lactogen also functions to prepare the breasts for lactation