**Endocrine System**

**Hormones**

- Why are hormones needed?
  - chemical messages from one body part to another
  - communication needed to coordinate whole body
  - daily homeostasis & regulation of large scale changes
    - solute levels in blood
      - glucose, Ca++, salts, etc.
    - metabolism
    - growth
    - development
    - maturation
    - reproduction

**Regulation & Communication**

- Animals rely on 2 systems for regulation
  - **endocrine system**
    - system of ductless glands
    - secrete chemical signals directly into blood
    - chemical travels to target tissue
    - target cells have receptor proteins
    - slow, long-lasting response
  - **nervous system**
    - system of neurons
    - transmits “electrical” signal & release neurotransmitters to target tissue
    - fast, short-lasting response

**Regulation by chemical messengers**

- **Neurotransmitters** released by neurons
- **Hormones** release by endocrine glands

**Classes of Hormones**

- **Protein-based hormones**
  - polypeptides
    - small proteins: insulin, ADH
  - glycoproteins
    - large proteins + carbohydrate: FSH, LH
  - amines
  - modified amino acids: epinephrine, melatonin
- **Lipid-based hormones**
  - steroids
  - modified cholesterol: sex hormones, aldosterone

**How do hormones act on target cells**

- **Lipid-based hormones**
  - hydrophobic & lipid-soluble
    - diffuse across cell membrane & enter cells
    - bind to receptor proteins in cytoplasm & nucleus
    - bind to DNA as transcription factors
    - turn on genes
- **Protein-based hormones**
  - hydrophilic & not lipid soluble
    - can’t diffuse across cell membrane
    - bind to receptor proteins in cell membrane
    - trigger secondary messenger pathway
    - activate internal cellular response
    - enzyme action, uptake or secretion of molecules...
Action of lipid (steroid) hormones

- Steroid hormone binds to receptor protein in cytoplasm.
- Becomes transcription factor.
- mRNA is read by ribosome.
- Protein secreted.
- Ex: secreted protein = growth factor (hair, bone, muscle, gametes).

Action of protein hormones

- Protein hormone binds to receptor protein.
- Activates enzyme.
- Acts as 2° messenger.
- Transcription factor produces an action.
- Response.

Ex: Action of epinephrine (adrenaline)

- Receptor protein binds to hormone.
- Activates adenyl cyclase.
- Activates cAMP.
- Activates phosphorlase kinase.
- Glycogen released to blood.
- FAST response!

Benefits of a 2° messenger system

- Amplification!
- Cascade multiplier!
- Released to blood.

Maintaining homeostasis

- Negative Feedback Model.

Nervous System Control

- Controlling Body Temperature

- Hypothalamus responds to body temperature (37°C).
- Nerve signals to shiver or dilate vessels.
- Sweat.
- Negative Feedback.
Regulation of Blood Sugar

**Insulin**
- Body cells take up sugar from blood
- Liver stores glycogen
- Reduces appetite

**Glucagon**
- Liver releases glucose
- Triggers hunger

**Blood Sugar Level** (90mg/100ml)

Feedback

Endocrine System Control

Blood Osmolarity

**ADH (Antidiuretic Hormone)**
- Increased water reabsorption
- Increased thirst

**Osmoreceptors in Hypothalamus**
- Reduced blood osmolarity

**Increased Water & Salt Reabsorption**
- Increased blood pressure

Feedback

Nervous & Endocrine systems linked

**Hypothalamus** = “master nerve control center”
- Nervous system
  - Receives information from nerves around body about internal conditions
- **Releasing hormones** regulate release of hormones from pituitary

**Pituitary gland** = “master gland”
- Endocrine system
  - Secretes broad range of “tropic” hormones regulating other glands in body

Homology in hormones

What does this tell you about these hormones?

How could these hormones have different effects?

Regulating metabolism

**Hypothalamus**
- **TRH** = TSH-releasing hormone

**Anterior Pituitary**
- **TSH** = thyroid stimulating hormone

**Thyroid**
- Produces thyroxine hormones
- Metabolism & development
  - Bone growth
  - Mental development
  - Metabolic use of energy
  - Blood pressure & heart rate
  - Muscle tone
  - Digestion
  - Reproduction
Goiter
Iodine deficiency causes thyroid to enlarge as it tries to produce thyroxine

Endocrine System Control
Regulation of Blood Calcium

Feedback

Female reproductive cycle

Feedback

Any Questions??

Effects of stress on a body