Endocrine System

Hormones

Regulation

- 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**

1. **Target cell**
2. **Steroid hormone**
3. **DNA**
4. **mRNA**
5. **Protein**
6. **Cytoplasm**
7. **Blood**

- Ex: Secreted protein = Growth factor (hair, bone, muscle, gametes)

**Action of protein hormones**

1. **Signal**
2. **Signal-transduction pathway**
3. **Protein hormone**
4. **Protein carrier**
5. **Receptor protein**
6. **GTP**
7. **ATP**
8. **G protein**
9. **Enzyme**

- Activates enzyme
- Produces an action

**Ex: Action of epinephrine (adrenaline)**

1. **Signal**
2. **Epinephrine**
3. **Receptor protein**
4. **Cytosol**
5. **GTP**
6. **ATP**
7. **G protein**
8. **Enzyme**

- Activates enzyme
- Produces a response

**Benefits of a 2° messenger system**

- **Amplification!**
- **Cascade multiplier!**
- **FAST response!**

**Maintaining homeostasis**

- **Hormone 1**: Raises body condition
- **Gland**: High
- **Body condition**: Low

**Nervous System Control**

- **Hypothalamus**: Nervous system control
- **Body temperature**: High
- **Feedback**: Sweat
- **Constricts surface blood vessels**: Low
- **Hypothalamus**: Nervous system control
- **Body temperature**: Low
- **Feedback**: Shiver
- **Constricts surface blood vessels**: High
Nervous & Endocrine systems linked

- **Hypothalamus** = “master nerve control center”
  - nervous system
  - receives information from nerves around body about internal conditions
  - **releasing hormones**: regulates 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 could 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

Female reproductive cycle

Feedback

Effects of stress on a body