Topic 17: Endocrine Integration

- What is endocrine integration?
- What glands are included?
- What is the hypothalamo-hypophyseal axis?
  - Development, Morphology & Function
  - How does the hypothalamo-hypophyseal axis regulate other endocrine organs?
- What is the pineal gland and what does it do?
- What are the adrenal glands and what do they do?
- How is metabolism regulated?
  - Thyroid glands
  - Pancreatic islets, insulin and diabetes

What is Endocrine Integration?

- Endocrine glands secrete hormones
- Hormones signal cells all over the body
- Allows longer term response to stimuli
- Multiple targets respond to same signal

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What is Endocrine Integration?

<table>
<thead>
<tr>
<th>Nervous</th>
<th>Endocrine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect</td>
<td>Time</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect</td>
<td>Area</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Activation</td>
<td></td>
</tr>
<tr>
<td>Signal</td>
<td></td>
</tr>
<tr>
<td>Signal Conduit</td>
<td></td>
</tr>
<tr>
<td>Target</td>
<td></td>
</tr>
</tbody>
</table>

What glands are included?

- Endocrine glands are distributed throughout the body
- Many developmental origins
- All secrete __________

![Diagram of endocrine glands and nervous system](Liem et al. Fig. 15-2)
How do hormones work?

- How hormones work
  - Lock & key mechanism
  - Bind to receptor
  - Signalling cascade -
    - Gene transcription

1. Water soluble, can't cross plasma membrane
2. Bind membrane receptor
3. Initiate signaling cascade
4. Activate enzymes

Liem et al. Fig. 15-3

Glands & Hormones

1. Lipid soluble hormones (steroids)
2. Need carrier in blood
3. Enter cell
4. Bind to receptor
5. Hormone-receptor complex enters nucleus
6. H-r binds to acceptor on chromosome
7. Initiates gene transcription
8. Protein synthesis

Liem et al. Fig. 15-3
What is the Hypothalamo-Hypophyseal Axis?

- **Endocrine system**
- **Neural ectoderm**
- **Neurohypophysis**
- **Adenohypophysis**

What does the Hypothalamo-Hypophyseal Axis do?

<table>
<thead>
<tr>
<th>Hypothalamus</th>
<th>Hypophysis</th>
<th>Target Tissue</th>
<th>Target Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyrotropin RH</td>
<td>Thyrotropin</td>
<td>Thyroid</td>
<td>Thyroid H Secretion</td>
</tr>
<tr>
<td>Melanotropin</td>
<td>Melanotropin</td>
<td>Skin</td>
<td>Melanin synthesis &amp; Dispersal</td>
</tr>
<tr>
<td>Growth Hormone</td>
<td>Growth Hormone</td>
<td>Body</td>
<td>Protein Synthesis, Growth</td>
</tr>
<tr>
<td>Prolactin</td>
<td>Prolactin</td>
<td>Reproductive Tissues</td>
<td>Milk Synthesis, Growth, Reprod, Water Balance</td>
</tr>
<tr>
<td>ACTH</td>
<td>Corticotropin</td>
<td>Adrenal Glands</td>
<td>Adrenal H Release</td>
</tr>
<tr>
<td>Vasopressin</td>
<td>Vasopressin</td>
<td>Kidney</td>
<td>Urine Production</td>
</tr>
<tr>
<td>Oxytocin</td>
<td>Oxytocin</td>
<td>Reprod. Tissues</td>
<td>Uterine Muscle Contraction</td>
</tr>
</tbody>
</table>
**What is the Pineal Gland and what does it do?**
- What has this gland evolved from?
- Circadian rhythms, regulation of sleep
- Secretion of ____________ from pinealocytes
  - Response to photocyte
  - Inhibition by light, sensed by eyes
  - From eye
  - Suprachiasmatic nucleus of hypothalamus acts as biological clock
  - Neurons to pineal gland

**How have Adrenal Glands evolved?**
- Associated with kidneys
- Evolution:
  1. __________ tissue
  2. __________ tissue
  3. Cortical tissue islets
  4. __________ glands
  5. Multiple adrenal glands
  6. One pair of adrenal glands
  7. Distinct medulla & cortex

**What are the Adrenal Glands?**
- Chromaffin cells
- Neural stimulation to release norepinephrine & epinephrine
- Act on Sympathetic NS
- Released during times of stress
  - Periferal
  - Corticotropin stimulates release of glucocorticoids
    - Cortisol
    - Corticosterone
  - Inhibit blood glucose use diverting glucose to CNS

**How is Metabolism regulated?**
- Highly vascularized
- Follicles secrete colloid
- Exocrine (digestion)
- Endocrine – Islets of Langerhans
- Thyroid (T4)
- Production of
  - Insulin
  - Glucagon
  - T3 & T4 increase metabolic rate in:
    - Heart
    - Liver
    - Muscle
    - Kidney

**How does the thyroid regulate metabolism?**
- Stimulation of Thyrotropin RH:
  - __________
- T3 & T4 increase metabolic rate in:
  - Heart
  - Liver
  - Muscle
  - Kidney
**Thyroid Disorders**
- Iodine deficiency
- Thyroid hypothyroidism
- More rare
- Mental retardation
- Weight gain or difficult to lose weight
- Weight loss
- Restlessness
- Difficulty concentrating

**Developmental hypothyroidism**

**Weight gain or difficult to lose weight**

**More rare**

**Mental retardation**

**Weight loss**

**Restlessness**

**Difficulty concentrating**

**Pancreas**
- Secrete hormones of opposing effects
  - Decreases blood glucose
  - Increases blood glucose

**Insulin**
- Decreases blood glucose
- Increased glycogen synthesis
- Glucose absorption by kidneys
- Suppression of glycogen breakdown

**Glucagon**
- Increases blood glucose
- Breakdown of glycogen in liver

**Diabetes**
- High blood glucose
  - Glucose not being used by tissues
  - Excreted in urine instead
  - Protein & fat used for energy
- Diabetes
  - Failure to produce insulin
  - Insulin injections to control blood glucose
- Insulin receptors are insulin-resistant
- Includes adult onset diabetes
- Diabetes
  - Mother diabetic during pregnancy
  - Can develop into Type II later in life
  - Must control diet during pregnancy

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