ENDOCRINE GLANDS

SECRETION

AND

ACTION OF HORMONES
Classic Definition of a Hormone

- **Hormone** - Chemical messenger produced by a ductless gland or tissue and carried in the blood/lymph to a target organ where it effects a change in cellular activity.
(a) Exocrine glands

- Blood
- Vesicles
- Secretory tissue
- Primary fluid (ions + water)
- Exocytosis
- Ion transport
- Acinus
- Reabsorption of ions
- Duct
- Secretion

(b) Endocrine glands

- Blood
- Exocytosis
- Endocrine tissue
- Vesicles
Endocrine Glands

- Located at base of brain
- Testis in Male
- Adrenal Gland
- Ovary
- Kidney
- Pituitary
- Hypothalamus
- Thyroid
- Parathyroid
- Testis in Male
Higher Centers of Brain Control All Hormonal Functions

- Cerebrum
- Cerebellum
- Medulla Oblongata
- Pituitary Stalk
- Anterior & Posterior Pituitary
- Hypothalamus
- Third Ventricle
- Pineal Body
- Medulla Oblongata

Cerebellum
Anatomy of Cow Brain

Infundibular Stalk

Diaphragma sellae

Pituitary

Sphenoid Bone
Control of Endocrine Gland Function
Hypothalamic-Pituitary Interrelationships

Secreting neurons: GnRH, CRH, TRH, GHRH

Superior Hypophyseal Artery

Anterior Pituitary
Adenohypophysis non-neural tissue

Release of LH, FSH, ACTH, PRL, GH, TSH

Posterior Pituitary:
Neurohypophysis
Nerve endings come directly from hypothalamus

Release of Oxytocin or ADH into circulation

Hypophyseal Portal Vessels

Nerve cells which release peptide hormones: Oxytocin, ADH

Pituitary Stalk
Other forms of endocrine action

1) Paracrine - released from effector cell (E) interact with a different target cell (T1).
2) Autocrine - secreted by E interact with original E cell or similar cell types.
3) Juxtacrine - expressed on surface of E and interacts with target cell (T2) via direct cell-cell contact.
4) Intracrine - is not secreted by E and interacts with an intercellular receptor.
• Pheromones: A chemical substance that is liberated by one animal and causes a relatively specific behavior modification in a recipient animal following its chemoreception.
• Lee-Boot effect: Crowded female mice become anestrous when no males are present.
• Bruce effect: A newly mated female mouse will abort if placed with a strange male (not the previous mate).
• Dormitory effect: Menstrual synchrony in all-females living groups.
Structural Classes

• **Amines:**
  – Hormones derived from tyrosine and tryptophan.
    • NE, Epi, T₄.

• **Peptides, Polypeptides and Proteins**
  – **Polypeptides**
    • Chains of < 100 amino acids in length.
      – ADH.
    • Ex: Adrenalcorticotropic Hormone (ACTH) – 39 amino acids

  – **Peptide** - Few - Several amino acids
    • Ex: Gonadotropin Releasing Hormone (GnRH) - 10 amino acids
    • Oxytocin - 8 amino acids

  – **Protein hormones:**
    • Polypeptide chains with > 100 amino acids.
      – Growth hormone, Insulin, ACTH.
      – Prolactin - 198 amino acids
Structural Classes

- **Glycoprotein** - Protein hormone with carbohydrate molecules

- Steroids
  - Lipids derived from cholesterol
  - Are lipophilic (fat loving; can diffuse through plasma membrane) hormones.
    - Ex – testosterone, estradiol, progesteone, and cortisol
Mineralocorticoids, glucocorticoids and steroids are synthesized from cholesterol

- **Cholesterol** $C_{27}$
  - **Pregnenolone** $C_{21}$
    - **Glucocorticoids** $C_{21}$
    - **Mineralocorticoids** $C_{21}$
    - **Androgens** $C_{19}$
      - **Estrogens** $C_{18}$
<table>
<thead>
<tr>
<th>Gland</th>
<th>Hormone</th>
<th>Chemical class</th>
<th>Principal functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothalamus</td>
<td>Gonadotropin-releasing hormone (GnRH)</td>
<td>Peptide</td>
<td>(1) FSH and LH release</td>
</tr>
<tr>
<td></td>
<td>Prolactin-inhibiting factor (PIF)</td>
<td>Peptide</td>
<td>(1) Prolactin retention</td>
</tr>
<tr>
<td></td>
<td>Prolactin-releasing factor (PRF)</td>
<td>Peptide</td>
<td>(1) Prolactin release</td>
</tr>
<tr>
<td></td>
<td>Corticotropin-releasing hormone (CRH)</td>
<td>Peptide</td>
<td>(1) ACTH release</td>
</tr>
</tbody>
</table>
| Anterior pituitary | Follicle-stimulating hormone (FSH) | Protein | (1) Follicle growth  
(2) Estrogen release  
(3) Spermatogenesis |
|-------------------|-----------------------------------|---------|---------------------|
|                   | Luteinizing hormone (LH)          | Protein | (1) Ovulation  
(2) Corpus luteum formation and function  
(3) Testosterone release |
<p>|                   | Prolactin                         | Protein | (1) Milk synthesis |
|                   | Adrenocorticotropicin (ACTH)      | Polypeptide | (1) Release of glucocorticoid |
| Posterior pituitary | Oxytocin | Peptide | (1) Parturition (2) Milk ejection |</p>
<table>
<thead>
<tr>
<th>Ovary</th>
<th>Estrogens (estradiol)</th>
<th>Steroid</th>
<th>(1) Mating behavior (2) Secondary sex characteristics (3) Maintenance of female duct system (4) Mammary growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Progestins (&quot;progesterone&quot;)</td>
<td>Steroid</td>
<td>(1) Maintenance of pregnancy (2) Mammary growth</td>
</tr>
<tr>
<td></td>
<td>Relaxin</td>
<td>Polypeptide</td>
<td>(1) Expansion of pelvis (2) Dilation of cervix</td>
</tr>
<tr>
<td></td>
<td>Inhibin</td>
<td>Protein</td>
<td>(1) Prevention of release of FSH</td>
</tr>
<tr>
<td>Adrenal cortex</td>
<td>Glucocorticoids (Cortisol)</td>
<td>Steroid</td>
<td>(1) Parturition (2) Milk synthesis</td>
</tr>
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</tr>
<tr>
<td>Placenta</td>
<td>Human chorionic gonadotropin (hCG)</td>
<td>Protein</td>
<td>(1) LH-like</td>
</tr>
<tr>
<td></td>
<td>Pregnant mare serum gonadotropin (P.MSG)</td>
<td>Protein</td>
<td>(1) FSH-like (2) Supplementary corpora lutea in mare</td>
</tr>
<tr>
<td></td>
<td>Estrogens Progestins Relaxin</td>
<td>(See ovary)</td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td>Prostaglandin F$_2$ $\alpha$ (PGF$_2$ $\alpha$)</td>
<td>Lipid</td>
<td>(1) Regression of corpus luteum (2) Parturition</td>
</tr>
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