Endocrine: (p. 611-612) ductless glands, maintain homeostasis, secrete hormones, interconnected with the nervous system by hypothalamus (a neuroendocrine organ)

<table>
<thead>
<tr>
<th>hormone class</th>
<th>nature, example</th>
<th>site of action</th>
<th>administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>amino acid derivatives</td>
<td>catecholamines: epinephrine norepinephrine dopamine thyroxine melatonin</td>
<td>either membrane or nucleus</td>
<td>orally</td>
</tr>
<tr>
<td>peptides (stomach can digest)</td>
<td>chain of amino acids, insulin, etc</td>
<td>membrane receptors</td>
<td>parenterally</td>
</tr>
<tr>
<td>steroid, lipids</td>
<td>cholesterol backbone or prostaglandins, etc</td>
<td>penetrate to nucleus</td>
<td>orally</td>
</tr>
</tbody>
</table>

hormones (first messenger) acts on target cells’ specific surface receptors

Interaction affects cell activity by 5 mechanisms, 2nd internal messenger:
1. change membrane permeability
   - antidiuretic hormone
2. gene activation, trigger protein synthesis
   - growth hormone
3. regulate enzyme activity
   - thyroxine on mitochondria
4. induce secretion
   - gastrin
5. stimulate mitosis
   - thyroid stimulating horm.

Second messenger system (p. 610) binds to receptor, activates G protein

- adjusts cAMP conc, intracellular messenger:
  - increase: G protein activates adenylyl cyclase: ATP to cyclic AMP (ADH, FSH, LH, TSH)
  - decrease: G protein enhances breakdown of cAMP (α2 nor- and adrenaline receptors)
  - increase Ca++ levels, acts as second messenger (oxytocin, α1 nor- and adrenaline receptors)

80% prescription drugs target G protein-coupled receptors

Steroids & thyroxine bind to nuclear receptors, regulate gene activity (or mitochondrion) (p 612)

Homeostasis by negative feedback system
- positive stimulus may be hormonal (from anterior pituitary)
- humoral (from blood as in parathormone)
- neural (from CNS as in adrenal medulla)