Endocrine glands

• The principal endocrine glands in the human body are the hypothalamus, pituitary, thyroid, parathyroids, adrenals, pancreatic islets, gonads, and pineal.

• Some organs have an endocrine function in addition to their main function, e.g. the heart, lungs, kidneys, liver, gastrointestinal tract, and placenta.
1) **hormones** synthesized from cholesterol eg adrenal cortex hormones like aldosterone and cortisol

2) **Polypeptide / Protein hormones** eg anterior and posterior pituitary gland hormones, pancreas, parathyroid

3) **Derivatives of amino acid tyrosine** eg thyroid hormone (thyroxine and triiodothyroxine) and adrenal medullae (epinephrine and norepinephrine)
MECHANISM OF ACTION OF HORMONES

• Hormones of the same class have similar mechanism of actions. They can be divided into classes of hormones:
  
  – Lipid soluble hormones (Lipophilic)

  Steroid + thyroid hormones

  Hydrophobic
  Membrane permeable

  – Polar/ non lipid soluble Hormones

  All other hormones

  Hydrophilic
  Membrane-impermeable
Second messengers

• Some actions of hydrophilic hormones are carried out and completed on binding of the hormone to its receptor without the need to another chemical mediator, activation or inhibition of ion channels.

• Most of hydrophilic hormones, however, exert their actions on target cells by inducing the production of another, chemical mediator inside the cell.
### EFFECTS ON cAMP LEVELS

**ACTIVATION OF ADENYLATE CYCLASE**
- Hormone
- Protein receptor
- G protein (activated)
- Adenylyl cyclase
- cAMP
- Acts as second messenger
  - Activates enzymes
  - Open ion channels

**INHIBITION OF ADENYLATE CYCLASE; ACTIVATION OF PDE**
- Hormone
- Protein receptor
- G protein (activated)
- PDE
- cAMP
- Reduction in cAMP leads to enzyme inhibition

**Examples:**
- Epinephrine and norepinephrine (β receptors)
- Calcitonin
- Parathyroid hormone
- ADH, ACTH, FSH, LH, TSH
- Glucagon

### EFFECTS ON Ca²⁺ LEVELS

**EXTRACELLULAR FLUID**
- Hormone
- Protein receptor
- G protein (activated)
- PLC
- Opening of Ca²⁺ channels
- Entry of Ca²⁺
- Activates enzymes

**Cytoplasm**
- Calcium
- Acts as second messenger
- Calmodulin

**Activation of Phospholipase C**
- PLC
- via DAG
- via IP₃
- Release of stored Ca²⁺

**Examples:**
- Epinephrine and norepinephrine (α and β receptors)
- Oxytocin
- Regulatory hormones of hypothalamus
- Several eicosanoids

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