



# Endocrine

434 Physiology team  
presents to you:

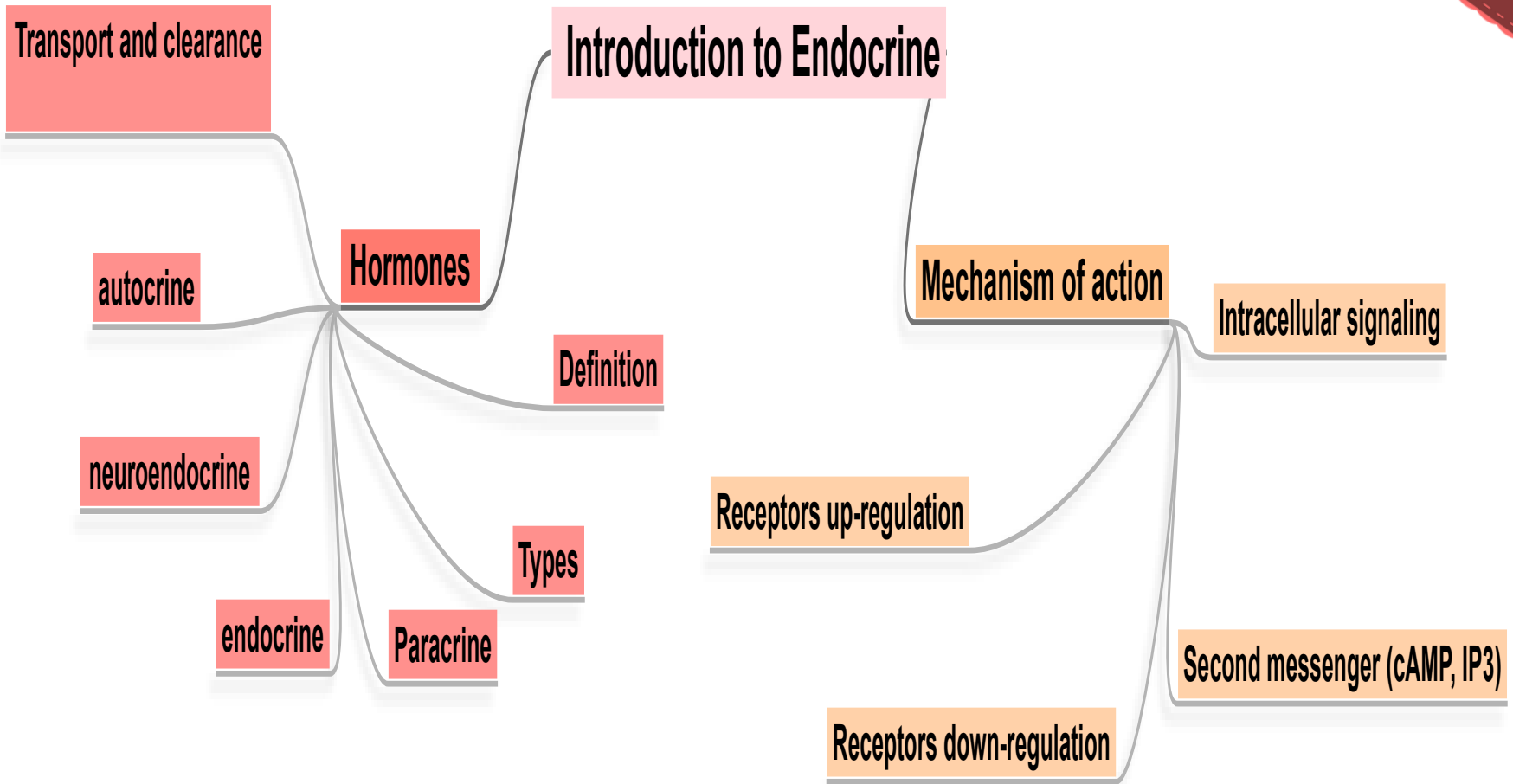
## Introduction to Endocrine

- Important
- Further explanation

- Mind map.....3
- Endocrine System Overview.....4
  
- Transport of hormones.....6
- Types of hormones.....6
- Hormone Action.....7
- (cAMP) Second Messenger Mechanism.....8
- Calcium-calmodulin complex.....9
- Tyrosine kinase receptors.....10
- Steroid & Thyroid hormone.....11
- Target Cell Activation.....12
- Hormone Concentration in Blood.....13
- Control of Hormone Release.....14
- MCQs.....17
- SAQS.....18

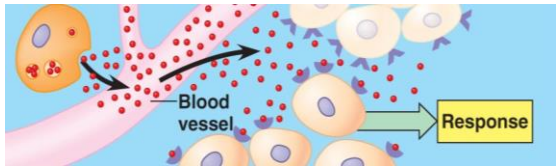
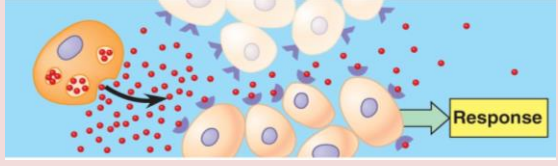
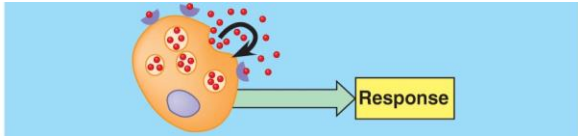
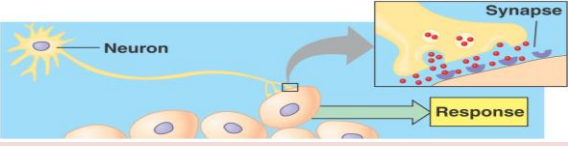
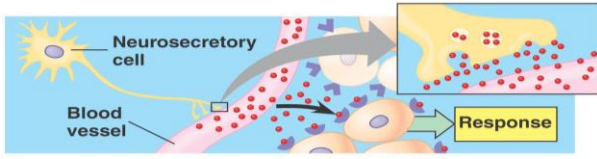


**Please check out this link before viewing the file to know if there are any additions/changes or corrections. The same link will be used for all of our work [Physiology Edit](#)**



# Endocrine System: Overview

- **Endocrinology:** It is study of homeostatic functions of substances called HORMONES, that are released from glands called endocrine glands distributed throughout the body.
- **Endocrine system :** the body's second great controlling system which influences metabolic activities of cells by means of hormones
- **Hormones:** Are secretions of ductless glands that are directly released into the blood stream. They can act on cells in the vicinity or on distant target cells.
- Endocrine glands : pituitary, thyroid, parathyroid, adrenal, pineal, and thymus .
- The pancreas and gonads produce both hormones and exocrine products also Liver .
- The hypothalamus has both neural functions and releases hormones
- Other tissues and organs that produce hormones : adipose cells, pockets of cells in the walls of the small intestine, stomach, kidneys, and heart.

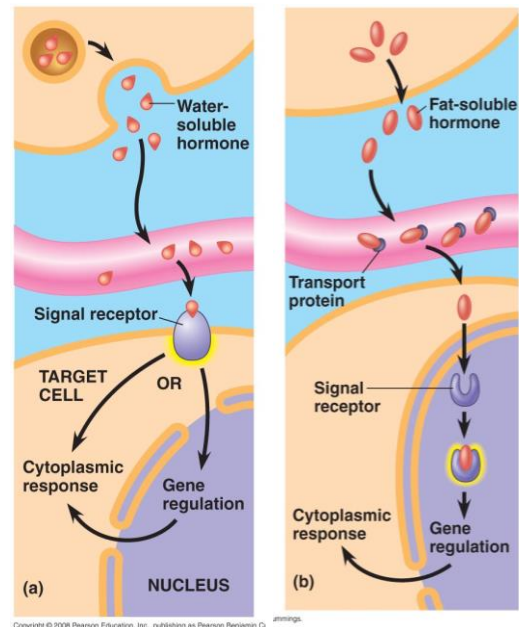
<ul style="list-style-type: none"> <li>• <b>Endocrine hormones</b></li> </ul>	<p>Released by glands or specialized cells into circulating blood and influence the target cells.</p>	
<ul style="list-style-type: none"> <li>• <b>Paracrine</b></li> </ul>	<p>Secreted by cells into extracellular fluid and affect neighboring target cells of a different type.</p>	
<ul style="list-style-type: none"> <li>• <b>Autocrine</b></li> </ul>	<p>chemicals that exert their effects on the same cells that secrete them.</p>	
<ul style="list-style-type: none"> <li>• <b>Neurotransmitters</b></li> </ul>	<p>Released by axon terminals into the synaptic junction and act locally.</p>	
<ul style="list-style-type: none"> <li>• <b>Neuroendocrine hormones</b></li> </ul>	<p>Secreted by neurons into circulating blood and influence the target cells.</p>	
<ul style="list-style-type: none"> <li>• <b>Cytokines</b></li> </ul>	<p>Peptides secreted by cells into the extracellular fluid and can function as autocrine, paracrine or endocrine hormones.</p>	<p>Examples :</p> <ul style="list-style-type: none"> <li>• Interleukins</li> <li>• Lymphokines</li> <li>• Adipokines “ from adipocytes”</li> </ul>

\*Autocrines and paracrines are not considered hormones since hormones are long-distance chemical signals

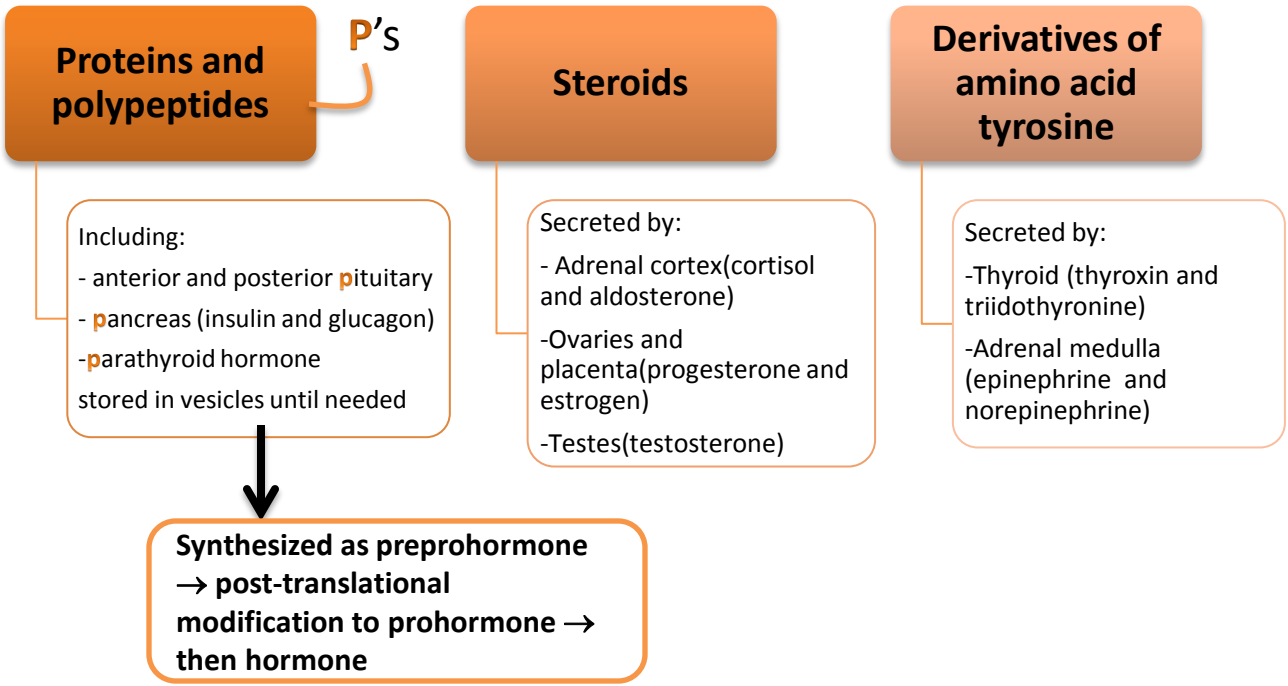
# Transport of hormones:

Water soluble hormones- hydrophilic (peptides & catecholamine) dissolved in plasma

Fat soluble hormones – hydrophobic Steroids and thyroid hormones transported bound to plasma proteins (90%).  
binding to proteins helps to :  
-provide reservoirs  
-Slow hormones clearance



# Types of hormones:



# Hormone Action:



## Hormones alter target cell activity by one of the following mechanisms:

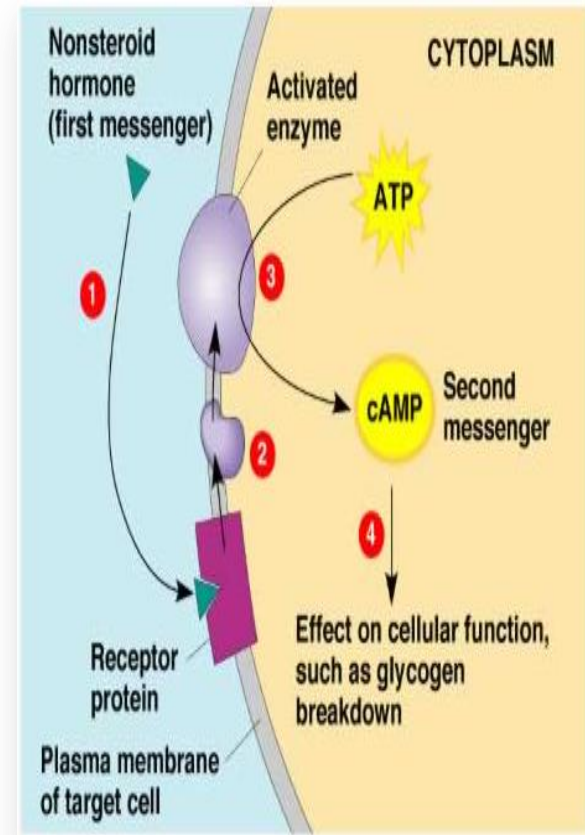
- ❖ Ion Channel–Linked Receptors.
- ❖ G Protein–Linked Hormone Receptors.
- ❖ Enzyme-Linked Hormone Receptors.
- ❖ Intracellular Hormone Receptors and Activation of Genes (steroid and thyroid hormones)

### • Receptor's Locations :

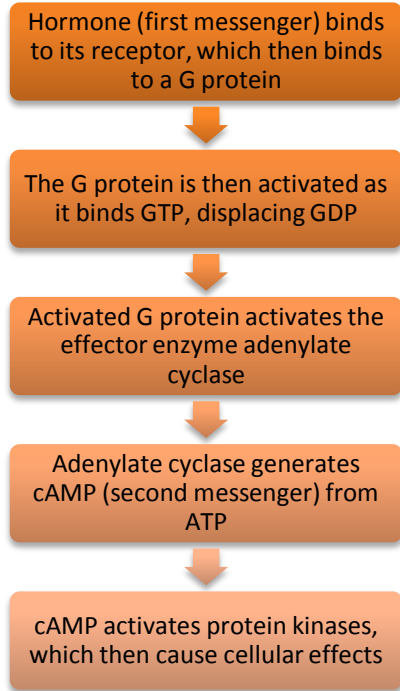
1. On the surface of cell membrane (proteins, peptides and catecholamines).
2. In the cell cytoplasm (Steroids).
3. In the cell nucleus (thyroid hormones).

### • Receptors:

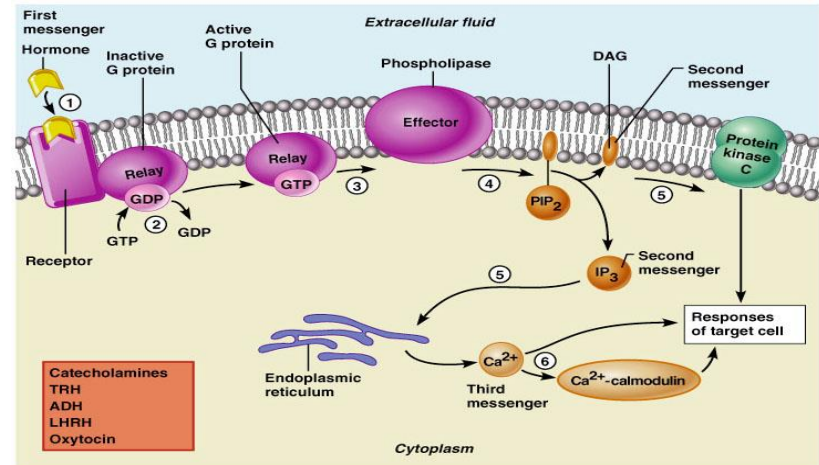
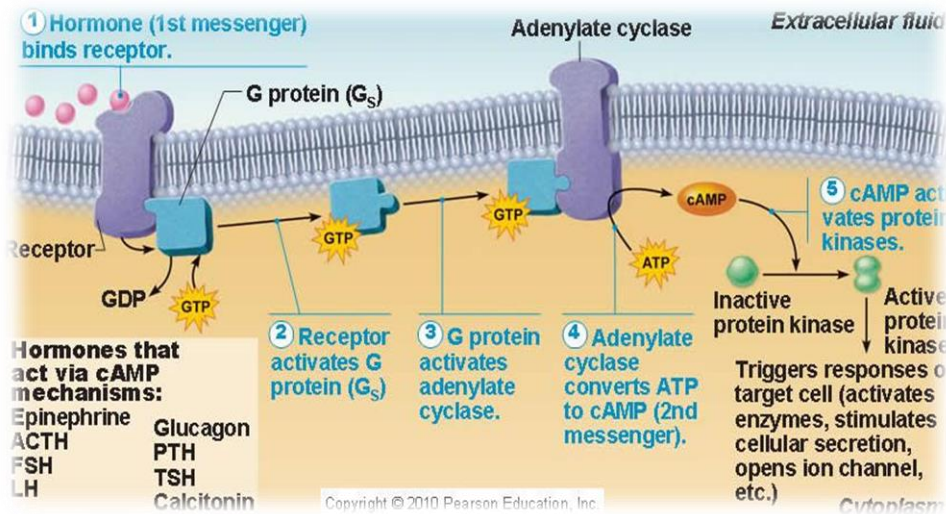
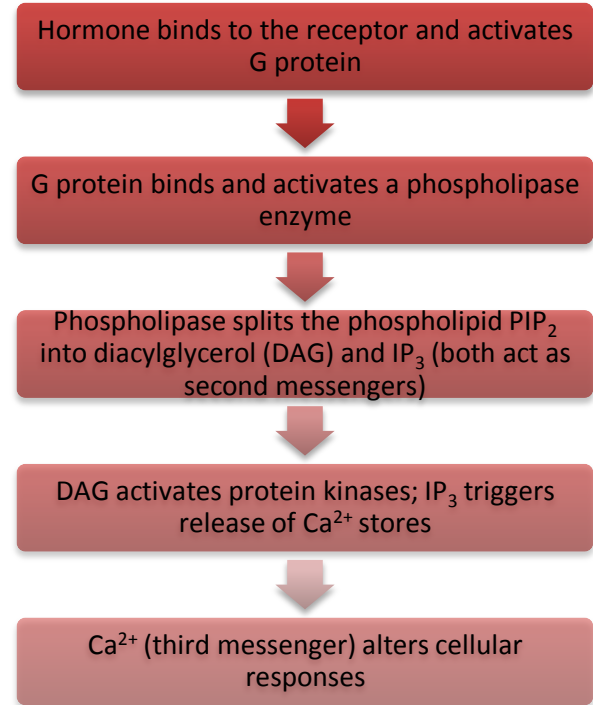
- Hormonal receptors are large proteins
- 2000-100,000 receptors/cell
- Receptors are highly specific for a single hormone



## ❖ Cyclic Adenosine Monophosphate (cAMP) Second Messenger Mechanism :

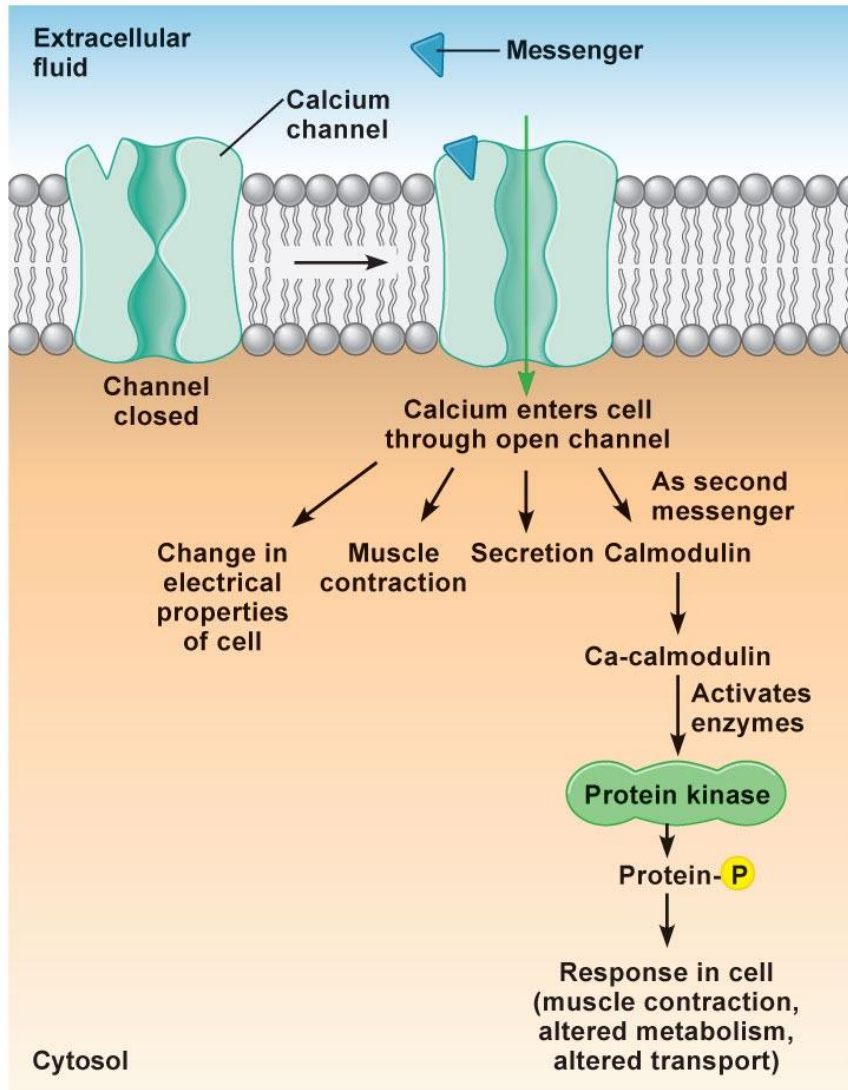


## ❖ Cell Membrane Phospholipid Second Messenger System:





## ❖ Calcium-calmodulin complex Second Messenger Mechanism :



### Calcium entry may be initiated by:

1. Changes in membrane potential that open calcium channels
2. A hormone interacting with membrane receptors that open calcium channels

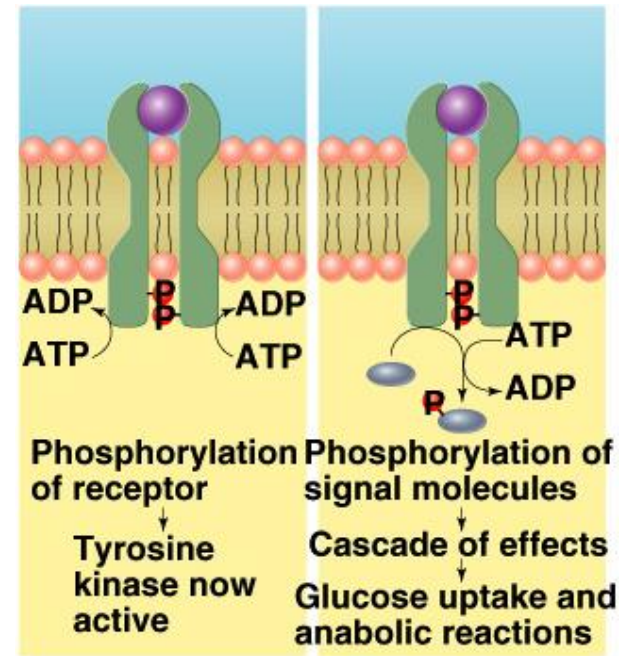
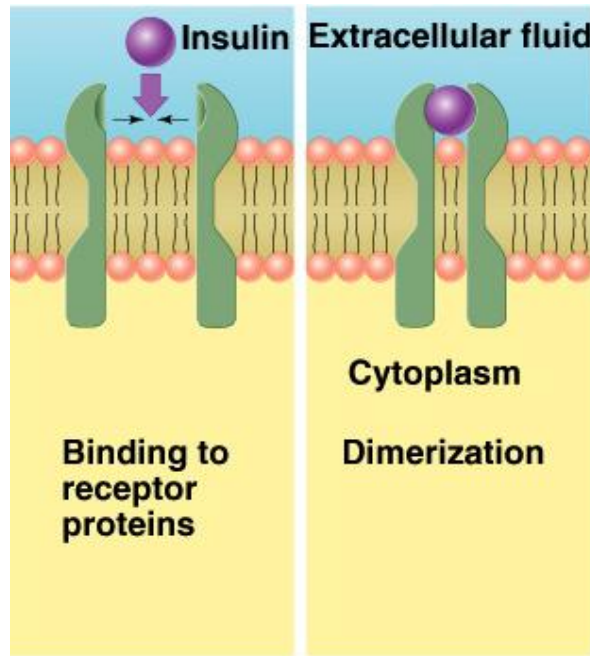
Calcium ions bind with the protein **calmodulin**

Calmodulin changes its shape and initiates multiple effects in the cell including activation or inhibition of protein kinases

Activation of calmodulin-dependent protein kinases by **phosphorylation** causes activation or inhibition of proteins involved in the cell's response to the hormone

Example: calmodulin activates **myosin light chain kinase**, which acts directly on the myosin of smooth muscle to cause smooth muscle contraction

## ❖ Second Messenger: Tyrosine Kinase Receptors



- Is used by insulin & many growth factors to cause cellular effects
- Surface receptor is tyrosine kinase
- Consists of 2 units that form active dimer when insulin binds

- Activated tyrosine kinase phosphorylates signaling molecules
- Induction of hormone/growth factor effects

# Protein Hormones Mechanism of Action

Adenylyl Cyclase Mechanism		Phospholipid Mechanism	Guanyl Cyclase	Tyrosine Kinase/Cytokine Receptor Mechanism
ACTH	HCG	GnRH	ANP	Insulin
LH FSH	MSH	TRH		IGF-1
TSH	CRH	PTH		GH
GHRH	Calcitonin	Angiotensin II		Prolactin
Somatostatin	PTH	ADH (V1)		
ADH (V2)	Glucagon	Oxytocin		

Note: The doctor said he's not going to ask about it

# Steroid & Thyroid Hormones

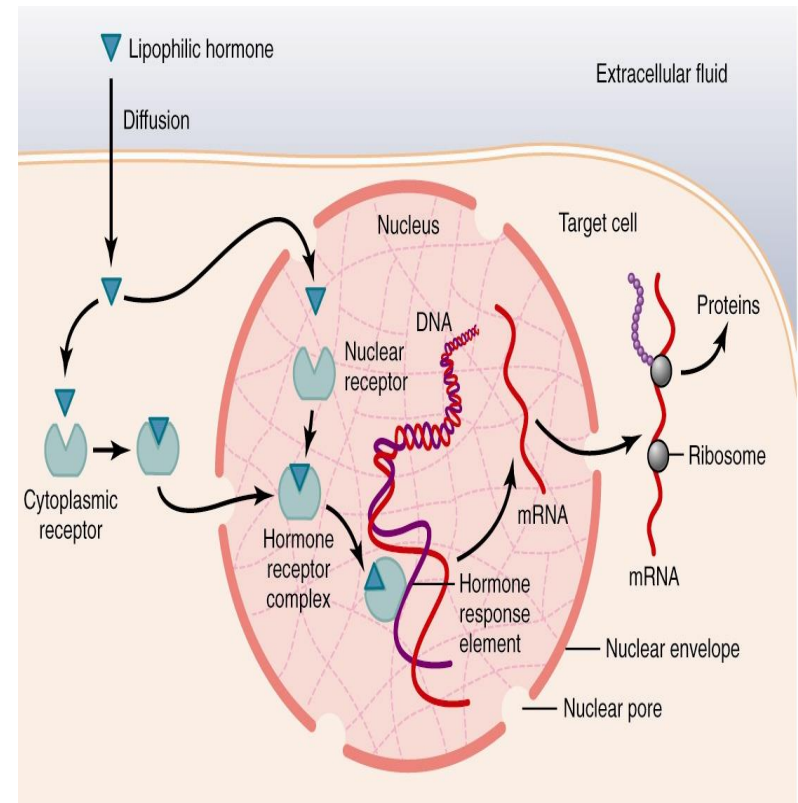
Steroid hormones and thyroid hormone **diffuse** easily into their target cells

Once inside, they bind and activate a specific intracellular receptor

The hormone-receptor complex travels to the nucleus and binds a DNA-associated receptor protein

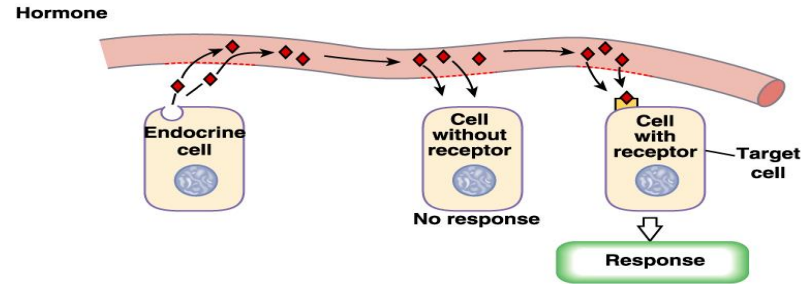
This interaction prompts DNA transcription to produce mRNA

The mRNA is translated into proteins, which bring about a cellular effect



# Target Cell Activation

**Target cells** refer to cells that contain specific receptors (binding sites) for a particular hormone.



Target cell activation depends on

1- Blood levels of the hormone

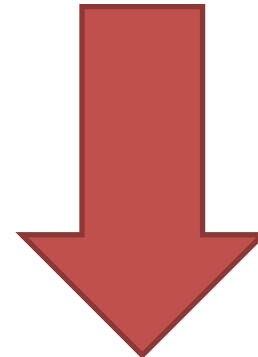
2- Relative number of receptors on the target cell

3- The affinity of those receptors for the hormone



## Up-regulation

Target cells form more receptors in response to the hormone



## Down-regulation

Target cells lose receptors in response to the hormone

# Hormone Concentrations in the Blood

- ✓ Hormones circulate in the blood in two forms **Free** or **Bound**  
e.g. Steroids and thyroid hormone are attached to plasma proteins
- ✓ **Concentrations of circulating hormone reflect:**
  1. Rate of release
  2. Speed of inactivation and removal from the body (degradation)
- ✓ **Measurement of Hormone Concentration**
  1. Radioimmunoassay (RIA)
  2. Enzyme-Linked Immunosorbentm Assay (ELISA)

- ✓ **Hormones are removed from the blood by:**
  - Degrading enzymes
  - The kidneys
  - Liver enzyme systems
- ✓ Clearance of protein bound hormones is **slower** than clearance of peptide hormones

## Types of Hormone Interaction

### Permissiveness

- one hormone cannot exert its effects without another hormone being present

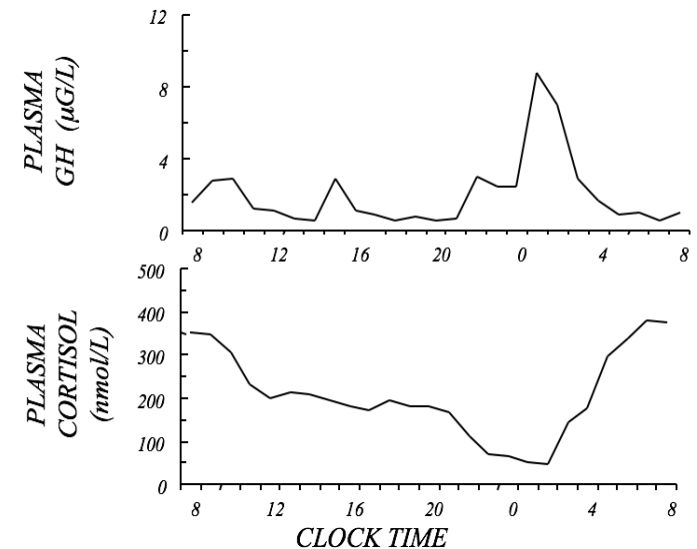
### Synergism

- the total effect of two hormones together is greater than the sum of their individual effects

### Antagonism

- one or more hormones opposes the action of another hormone

## Hormonal Rhythms



# Hormone Interactions Examples

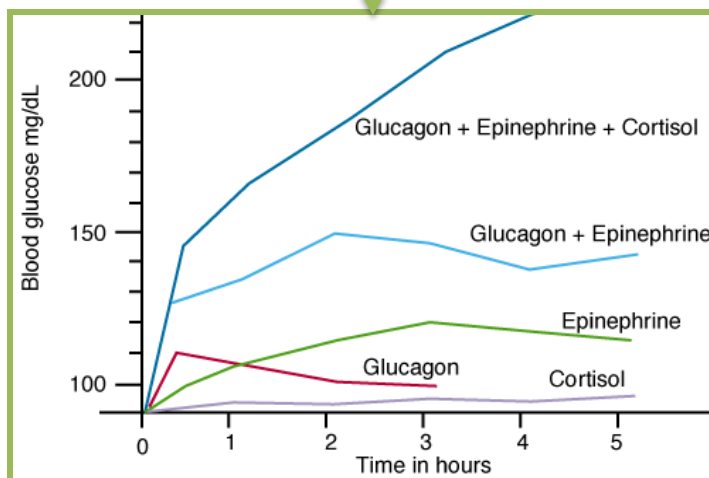
## Permissiveness

- Thyroid hormone have permissive effect on growth hormone action
- Deficiency of thyroid hormone in infants leads to dwarfism.

## Synergism

- Glucagon antagonizes the action of insulin
- Calcitonin and parathyroid hormone have antagonistic actions

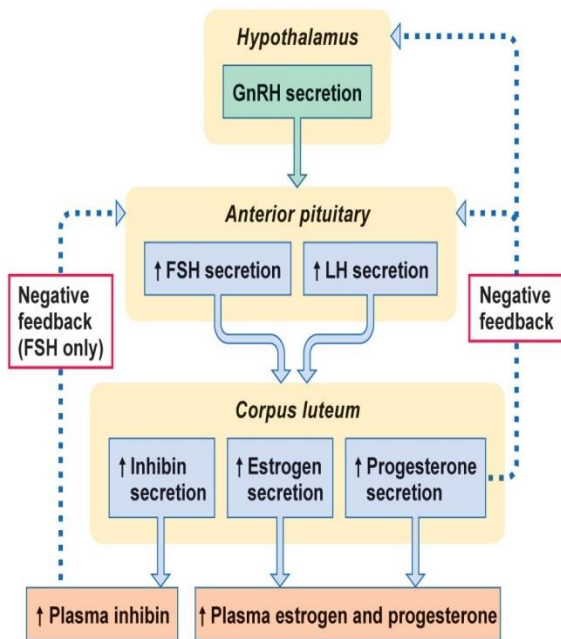
## Antagonism



Blood glucose levels & synergistic effects of glucagon, cortisol and epinephrine

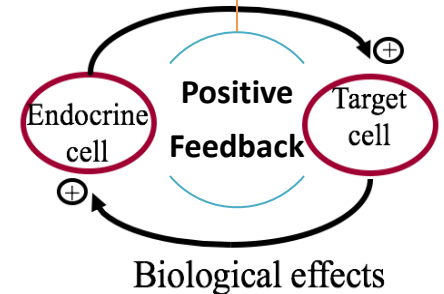
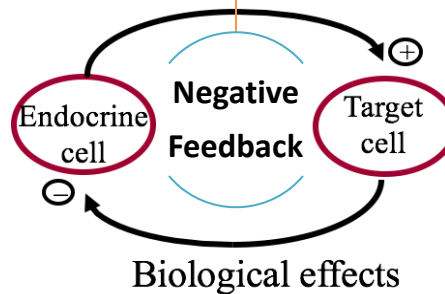
# Control of Hormone Release

- ✓ Blood levels of hormones are controlled by **Negative** & **Positive** feedback systems, vary only within desirable range
- ✓ Hormones are synthesized and released in response to **humoral**, **neural**, and **hormonal** stimuli



- Initial stimulus
- Physiological response
- Result

## Feedback Control



**Most Common**  
**Example:** LH from pituitary stimulates the testis to produce testosterone which in turn feeds back and inhibits LH secretion

**less common**  
**Example:** include LH stimulation of estrogen which stimulates LH surge at ovulation



Answer key: 1- C, 2-D, 3- D, 4-A , 5- B, 6- B

1- They are chemicals that exert their effects on the same cells that secrete them.

- A. Neurotransmitters
- B. Paracrine
- C. Autocrine
- D. Endocrin

2- They are water soluble hormones

- A. Catecholamines
- B. Steroid & Thyroid
- C. Peptides
- D. A & C

3- Hormonal Receptors are

- A. Highly specific for a single hormone
- B. Large proteins
- C. 2000-100,000 receptors/cell
- D. All above

4- Steroid & Thyroid hormones diffuse easily into their target cells?

- A. True
- B. False

5- It happens when one or more hormones opposes the action of another hormone

- A. Synergism
- B. Antagonism
- C. Permissiveness

6- Estrogen stimulation by LH is an example of

- A. Negative feedback mechanism
- B. Positive feedback mechanism

**Q1: Mention the types of hormones:**

Proteins and polypeptides

Steroids

Derivatives of amino acid tyrosine

**Q2: What is the receptor location of each type?**

Proteins, peptides and catecholamines → On the surface of cell membrane

Steroids → In the cell cytoplasm

Thyroid hormones → In the cell nucleus

**Q3: What do concentrations of circulating hormones reflect?**

Rate of release

Speed of inactivation and removal from the body (degradation)

**Q4: Define permissiveness and give an example for it:**

one hormone cannot exert its effects without another hormone being present

Example: Thyroid hormone have permissive effect on growth hormone action

Thanks for checking our work

*Good Luck*

**Done by:**

Nouf Al Harbi

Amal Afrah

Lina Al Jurf

