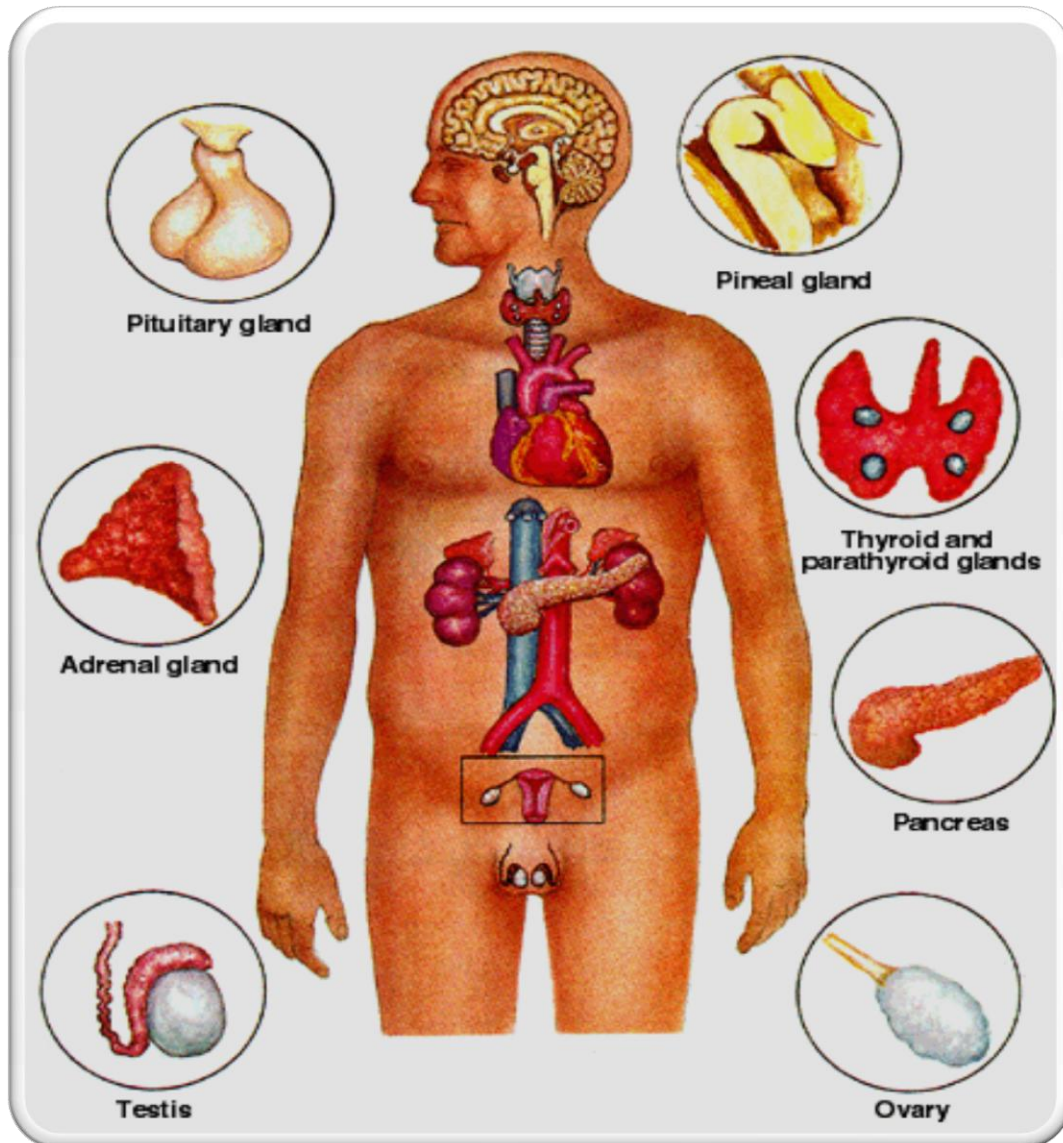


# *ENDOCRINE BLOCK*

## *PHYSIOLOGY TEAM 431*



**Done by : Manar Al-jebreen & Tariq Al-Otaibi**

**Revised by : Nour Al-Khawajah & Mohammed Asiri**

# Anterior pituitary gland

Red=important

□ Females' notes

□ males' notes

□ Clarification

## Anterior pituitary hormones:

### ✓ GH:

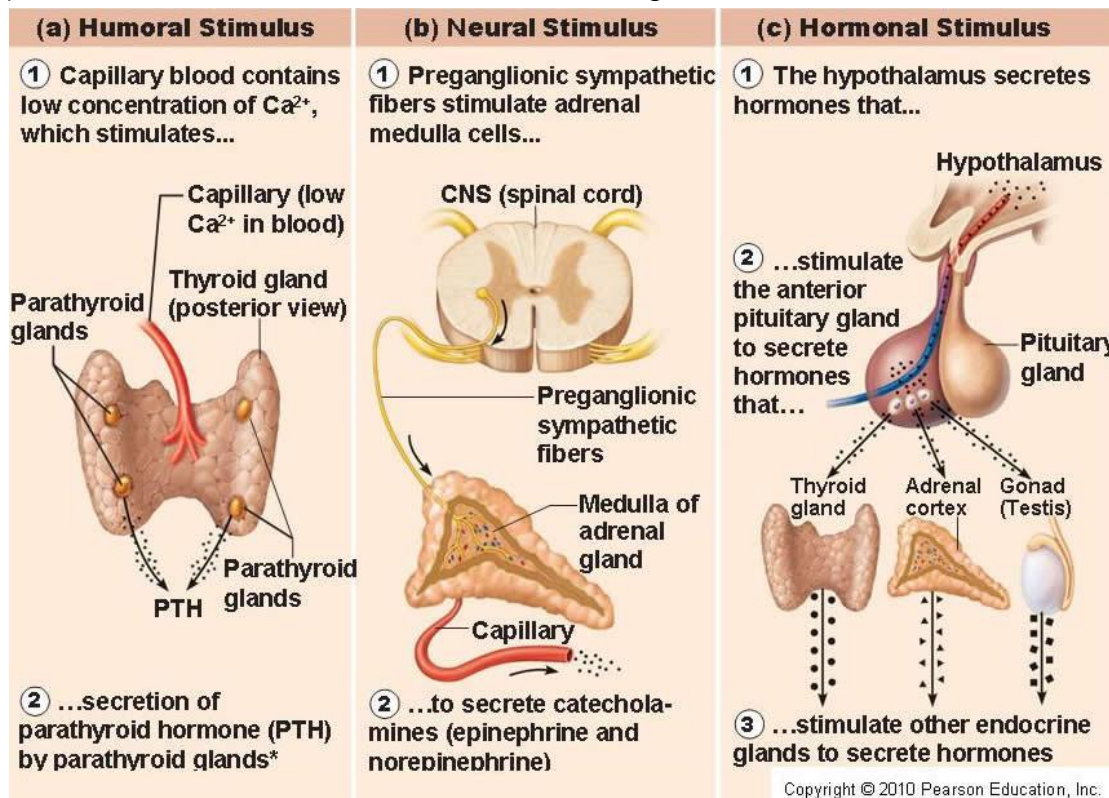
- Physiological functions
- Regulation of GH secretion
  - Feedback mechanism
  - Factors controlling secretion

### ✓ Prolactin:

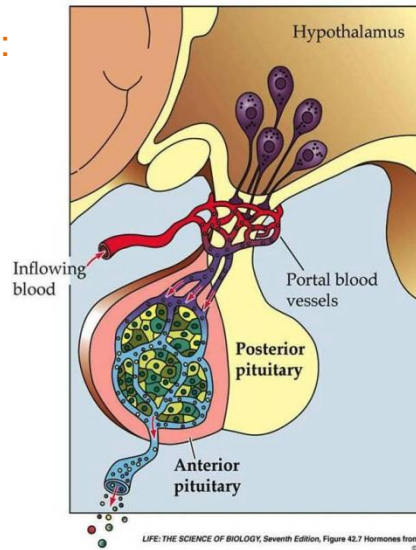
- Physiological functions
- Regulation of prolactin secretion

## Endocrine glands stimuli may be:

- Humoral stimulus: The level of some ions in the blood stimulates some glands.
- neural stimulus: nerve impulses stimulate the gland to secrete hormones.
- Hormonal stimulus: Hormones stimulate the gland to secrete other hormones.



- Anterior pituitary gland (adenohypophysis): is connected to hypothalamus by portal system: "hypothalamichypophysial portal vessels".



LIFE: THE SCIENCE OF BIOLOGY, Seventh Edition, Figure 42.7 Hormones from the Hypothalamus Control the Anterior Pituitary © 2004 Sinauer Associates, Inc. and W. H. Freeman & Co.

**Anterior pituitary hormones**

6 Hormones are secreted by the pituitary gland:

**FSH**

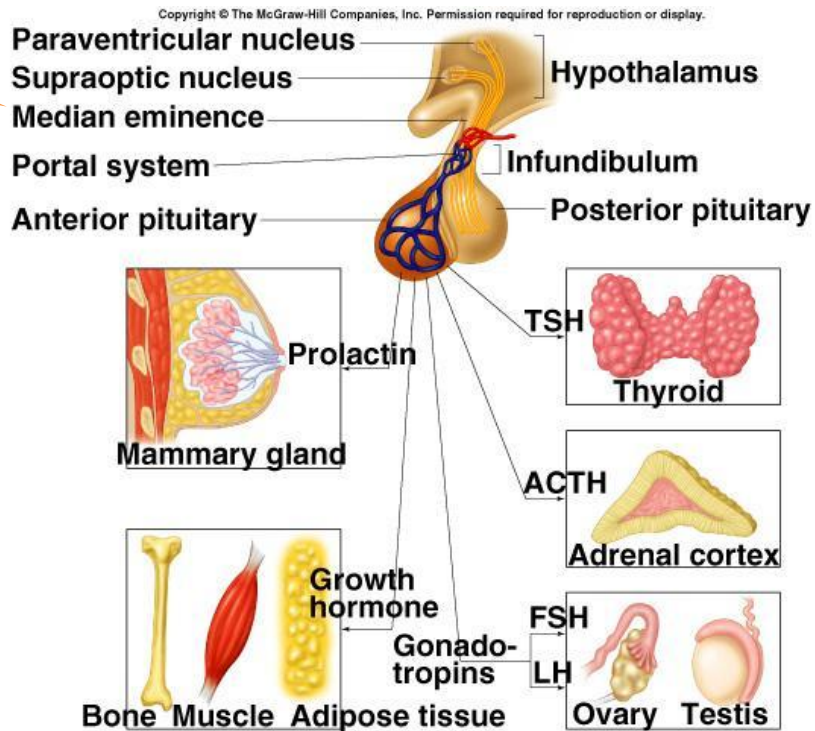
**LH**

**ACTH= Adrenocorticotrophic hormone.**

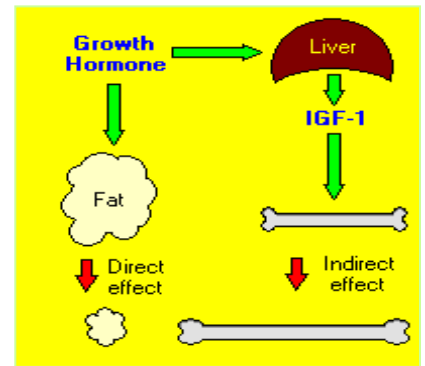
**TSH=Thyroid-stimulating hormone**

**Prolactin**

**growth hormone:** "in contrast to other hormones it does not function through a target gland but exerts its effects on all or almost all tissues of the body" GUYTON & HALL



# Growth Hormone (Somatotropin)



## Mechanism of action:

### Direct effect

Growth hormone binds to its receptors and produces its action.

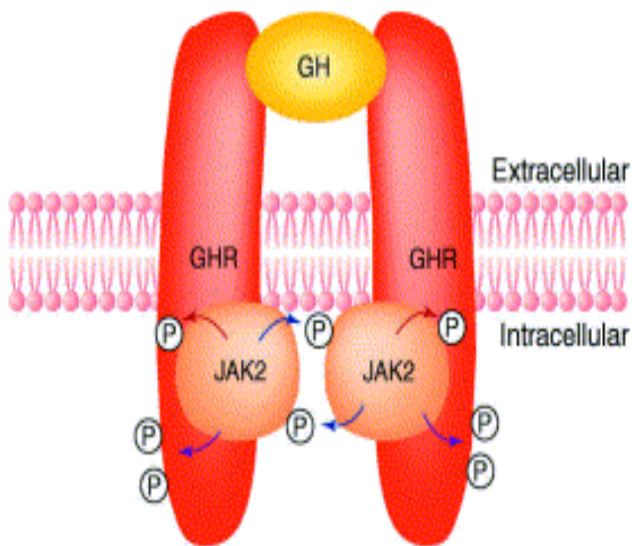
e.g. Fats & Carbohydrates

### Indirect effect

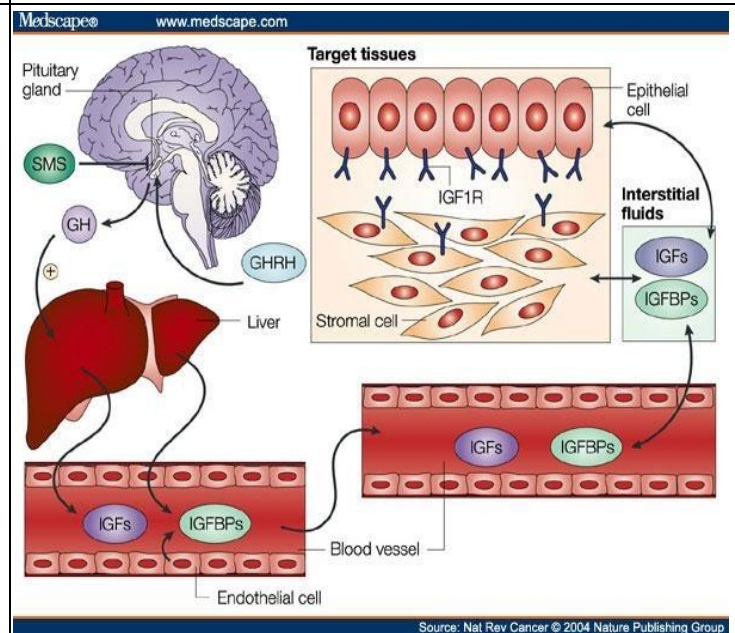
Indirect effect:

Depends on **somatomedin C** (insulin-like growth factor 1)

IGF-1 is secreted by the liver, which is responsible for effect of GH on bone & cartilage growth and increase the synthesis of protein in skeletal muscles.



TRENDS in Endocrinology & Metabolism



## Functions of GH:

### A) Long term effects (Promotion of growth): (takes years to occur)

- Increase cellular sizes & mitosis
- Increase tissue growth & organ size

### (Increased Chondrogenesis and Increased Osteoblastic activity)

When growth hormone is supplied directly to cartilage chondrocytes outside the body, proliferation or enlargement of the chondrocytes usually fails to occur. In brief it has been found that growth hormone causes the liver to form somatomedin that have potent effect of increasing all aspects of bone growth. GUYTON & HALL

**Bone growth:**  
**Mechanisms of bone growth**

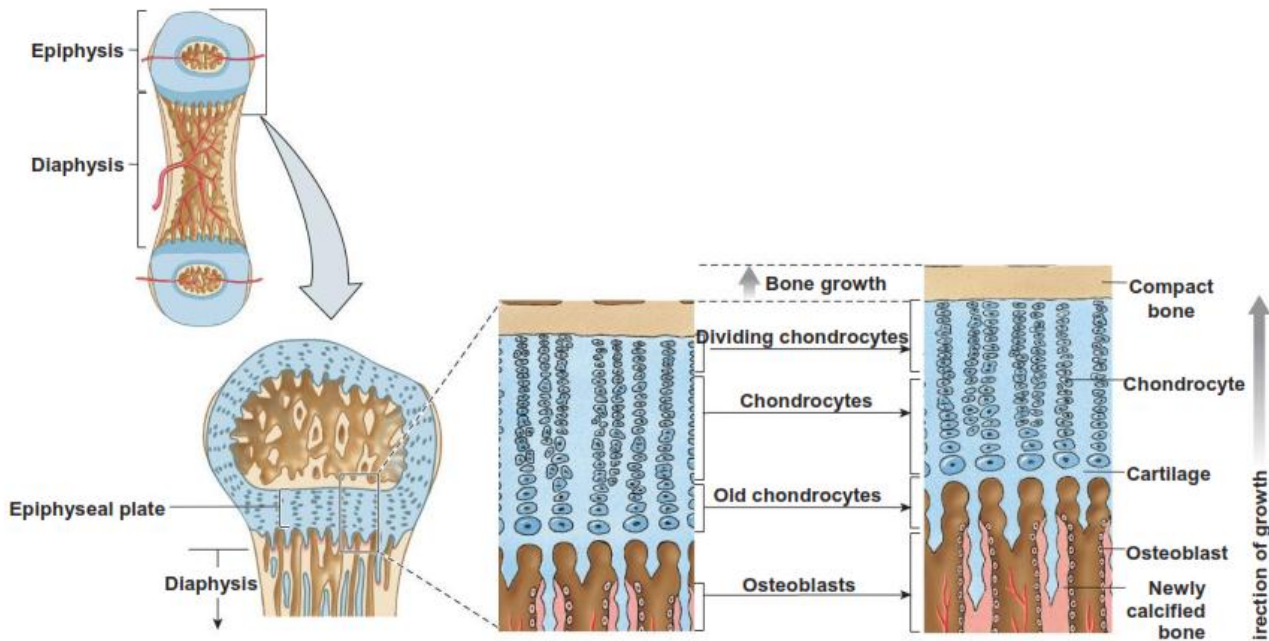
1. Linear growth of long bones:

- Long bones grow in length at epiphyseal cartilages, causing deposition of **New Cartilage** (↑ collagen synthesis) followed by its conversion into bone.
- When bony fusion occurs between shaft & epiphysis at each end, no further lengthening of long bone occur.

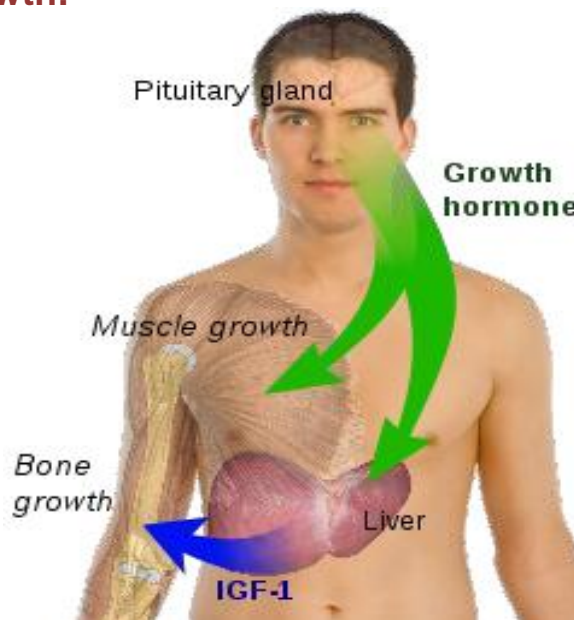
2. Deposition of **New Bone** (↑ cell proliferation)

On surfaces of older bone & in some bone cavities, ↑ thickness of bone.

- Occurs in membranous bones, e.g. jaw, & skull bones.



**Promotion of growth:**



## B. Short term: (occurs daily)

### Metabolic effects:

- **Protein metabolism: (Anabolic) = building up**
  - ↑ rate of protein synthesis in all cells through:
    - ↑ amino acids transport into cells
    - ↑ DNA transcription = RNA synthesis
    - ↑ RNA translation = protein synthesis
    - ↓ protein catabolism “protein sparer”

• **Positive Nitrogen and Phosphorus Balance:**  
  
(Increase the stores of protein)

• **Increase in lean body mass:**  
  
(Body mass without fat)

- **Fat metabolism: (Catabolic) = breaking down**
  - ↑ mobilization of FFAs from adipose tissue stores
  - Conversion of FFA to acetyl CoA to provide energy
  - Stimulate triglyceride breakdown and oxidation in adipocytes

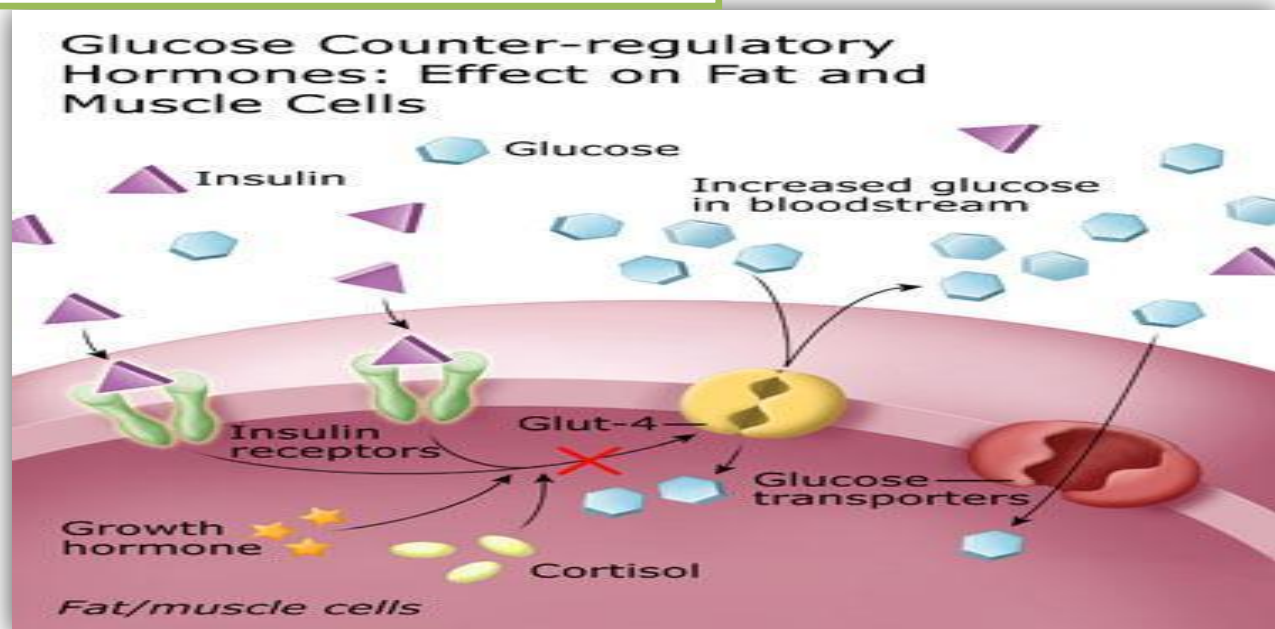
**Provides Fats as a Major Energy Source (Ketogenic effect)**

- **CHO metabolism: (Hyperglycemic)**
  - ↓ glucose uptake by tissues (skeletal muscles and fat).
  - ↓ rate of glucose utilization throughout the body
  - ↑ glucose production by the liver  
(↑ **gluconeogenesis**) = formation of glucose from non-glucose substances like amino acids.
  - ↑ insulin resistance (↑ FFA) (**anti-insulin activity**)  
some studies found that this resistance is because of free fatty acids.

### **Conservation of Glucose for Glucose dependant Tissues (Diabetogenic effect)**

It increases the level of glucose within the normal range  
Further increase will cause (diabetogenic effect)

e.g. The brain



• **Other effects of growth hormone:**

- Increases **calcium** absorption from GIT
- Strengthens and increases the **mineralization of bone**
- Retention of **Na<sup>+</sup>** and **K<sup>+</sup>**
- Increases **muscle** mass
- Stimulates the growth of all internal organs **excluding the brain**
- Contributes to the maintenance and function of **pancreatic islets**
- Stimulates the **immune system**

**Control of GH secretion:**

1. **The hypothalamus:**

- GHRH : increase GH secretion. (**Somatoliberin**)
- GHIH (somatostatin): decrease GH secretion

2. **Hypoglycemia (fasting):** ↑ GH secretion.  
(N.B. glucose intake : ↓ GH secretion).

3. **Muscular exercise :** ↑ GH secretion.

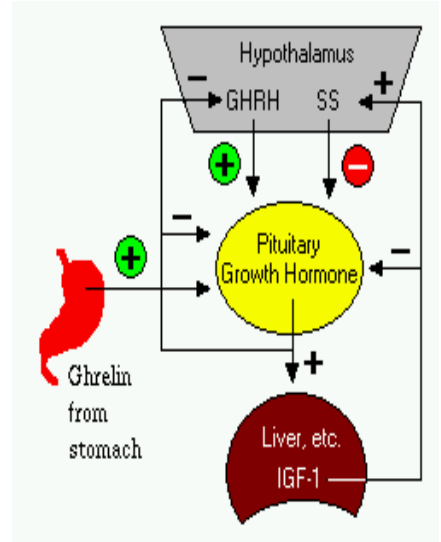
4. **Deep sleep:** more in children.

5. **Stress conditions,** e.g. trauma or emotions ↑ GH secretion.

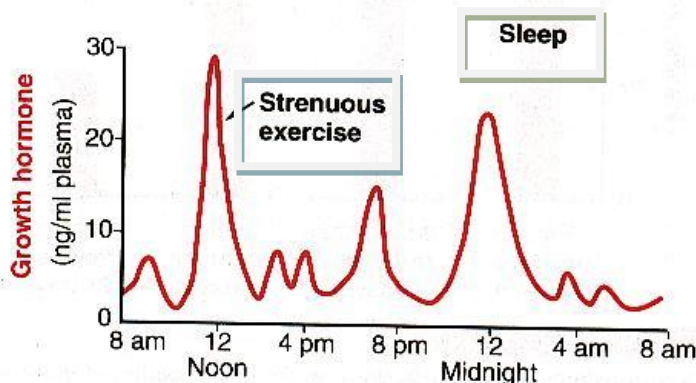
6. **Testosterone & estrogen** increase GH secretion.

7. **FFAs:** ↓ GH secretion

8. **Grelin (stomach):** ↑ GH secretion. **Grelin** is a hormone secreted by the stomach.

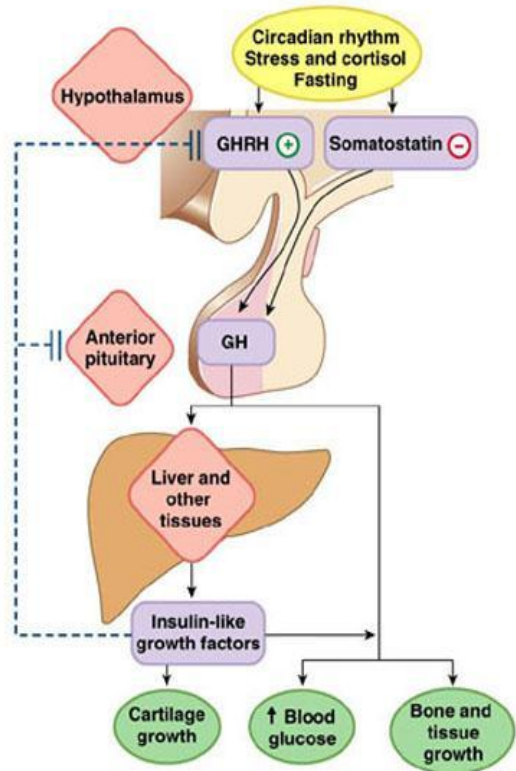


**GHRH:** growth hormone releasing hormone  
**GHIH:** growth hormone inhibiting hormone



**FIGURE 75-6**



Typical variations in growth hormone secretion throughout the day, demonstrating the especially powerful effect of strenuous exercise and also the high rate of growth hormone secretion that occurs during the first few hours of deep sleep.



**Fig. 23-16**

# Summary

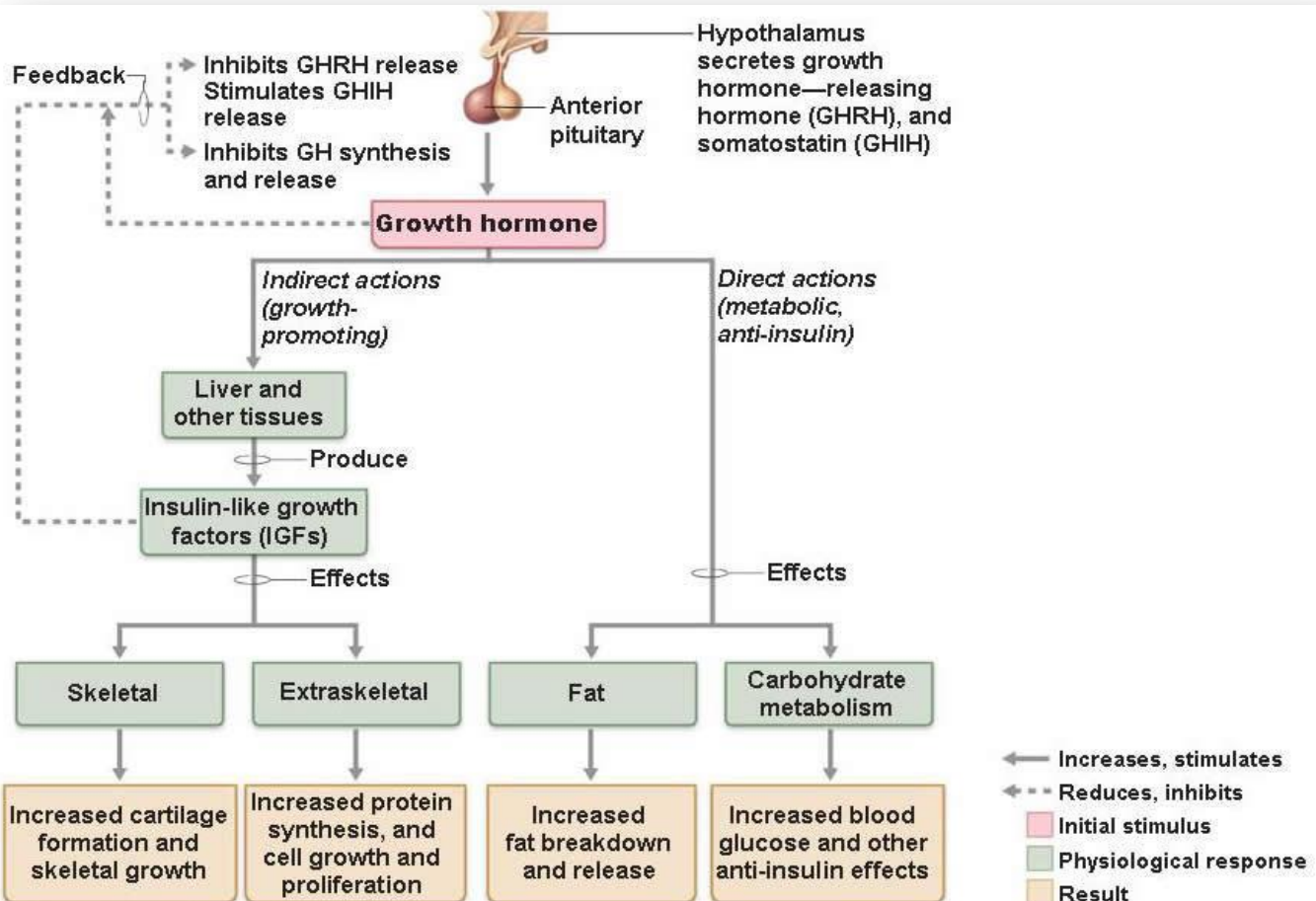
**TABLE 16.1 Pituitary Hormones: Summary of Regulation and Effects**

HORMONE (CHEMICAL STRUCTURE AND CELL TYPE)	REGULATION OF RELEASE	TARGET ORGAN AND EFFECTS	EFFECTS OF HYPOSECRETION ↓ AND HYPERSECRETION ↑
<b>Anterior Pituitary Hormones</b>			
 <b>Growth hormone (GH)</b> (Protein, somatotroph)	Stimulated by GHRH* release, which is triggered by low blood levels of GH as well as by a number of secondary triggers including hypoglycemia, increases in blood levels of amino acids, low levels of fatty acids, exercise, other types of stressors, and estrogens	 Liver, muscle, bone, cartilage, and other tissues: anabolic hormone; stimulates somatic growth; mobilizes fats; spares glucose  Growth-promoting effects mediated indirectly by IGFs	↓ Pituitary dwarfism in children ↑ Gigantism in children; acromegaly in adults
	Inhibited by feedback inhibition exerted by GH and IGFs, and by hyperglycemia, hyperlipidemia, obesity, and emotional deprivation via either increased GHIH* (somatostatin) or decreased GHRH* release		

\*Indicates hypothalamic releasing and inhibiting hormones:

GHRH = growth hormone-releasing hormone; GHIH = growth hormone-inhibiting hormone

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## Abnormalities of GH secretion

### 1) Increase GH Secretion:

Signs & symptoms 'in childhood': <b>Gigantism</b>	Signs & symptoms 'in adults': <b>Acromegally</b> <i>After disappearance of Epiphyseal plates</i>
<p>As all body tissues grow rapidly, including bones.</p> <ul style="list-style-type: none"> <li>Height↑ as it occurs before epiphyseal fusion of long bones with their shafts.</li> </ul> <p><b>Hyperglycemia (diabetes).</b></p>	<p>person can't grow taller, BUT soft tissue continue to grow in thickness (skin, tongue, liver, kidney, ...)</p> <ul style="list-style-type: none"> <li>- Enlargement of bones of hands &amp; feet.</li> <li>- Enlargement of membranous bones including cranium, nose, forehead bones, supraorbital ridges.</li> <li>- Protrusion of lower jaw.</li> <li>- Hunched back (kyphosis) (enlargement of vertebrae).</li> </ul>
	

### 2) Decrease GH secretion:

- Pituitary Dwarfism:

There is no effect on the brain so no mental retardation will occur in contrast to the thyroid hormone, which is important to the brain growth.

#### Laron dwarfism (GH Normal & IGF-I is markedly reduced):

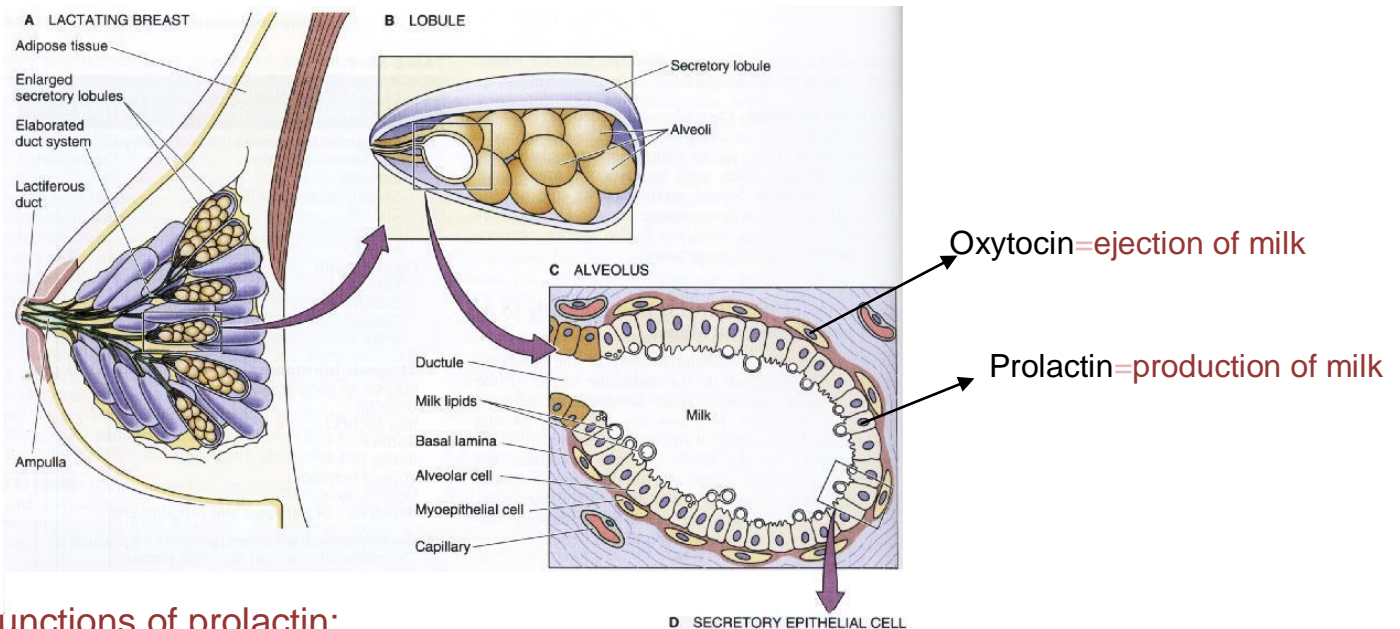
autosomal recessive disorder characterized by an insensitivity to growth hormone (GH), caused by a variant of the growth hormone receptor. It causes short stature and a resistance to diabetes and cancer



# Prolactin

The major function of prolactin is **milk production** and promotes mammary gland development

- Release is inhibited by PIH **prolactin inhibitory hormone** (dopamine)
- Suckling response inhibits PIH release



## Functions of prolactin:

### Effect on the breast:

- Increases mRNA
- Increases production of casein and lactalbumin
- Inhibits the effects of gonadotropins (LH and FSH) so no ovulation will happen.

### Other effects

Stimulates the secretion of dopamine in median eminence (inhibits its own secretion)

## Control of prolactin:

- PIH (Dopamine) inhibit its secretion
- Exercise increases PRL secretion
- Surgical & psychological stress increases PRL secretion
- Stimulation of the nipple increases PRL secretion
- Prolactin level rises during sleep
- Prolactin level rises during pregnancy
- TRH (**Thyrotropin releasing hormone**) increases PRL secretion

## Summary

- Growth hormone causes growth of almost all tissues of the body that are capable of growing. It promotes increased sizes of the cells and increased mitosis, with development of greater numbers of cells and specific differentiation of certain types of cells such as bone growth cells and early muscle cells.
- growth hormone has multiple specific metabolic effects, including :
  - (1) Increased rate of protein synthesis in most cells of the body;
  - (2) increased mobilization of fatty acids from adipose tissue, increased free fatty acids in the blood, and increased use of fatty acids for energy; and
  - (3) Decreased rate of glucose utilization throughout the body.Thus, in effect, growth hormone enhances body protein, uses up fat stores, and conserves carbohydrates
- Growth hormone enhances almost all facets of amino acid uptake and protein synthesis by cells, while at the same time reducing the breakdown of proteins
- **Panhypopituitarism:** This term means decreased secretion of all the anterior pituitary hormones. The decrease in secretion may be congenital (present from birth), or it may occur suddenly or slowly at any time during life, most often resulting from a pituitary tumor that destroys the pituitary gland
- Growth hormone is needed for physical growth

Questions:

1-all of the following hormones are secreted by the anterior pituitary gland EXCEPT:

a-GH

B-oxytocin

C-LH

D-FSH

2-The anabolic effect of GH is on:

a-adipose tissues

b-calcium

c-iron

d-protein

3- In a condition of hypoglycemia:

a-Prolactin is increased

b-GH is decreased

c- LH is decreased

d-GH is increased

4-A young married female with a high prolactin level which one is not a possible explanation:

a-tumor in the pituitary gland

b-breast-feeding

c-stress

d-Hypoglycemia

answers:B-D-D-D