

ENDOCRINOLOGY

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PITUITARY GLANDS

◉ Anterior pituitary hormones

■ GH

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

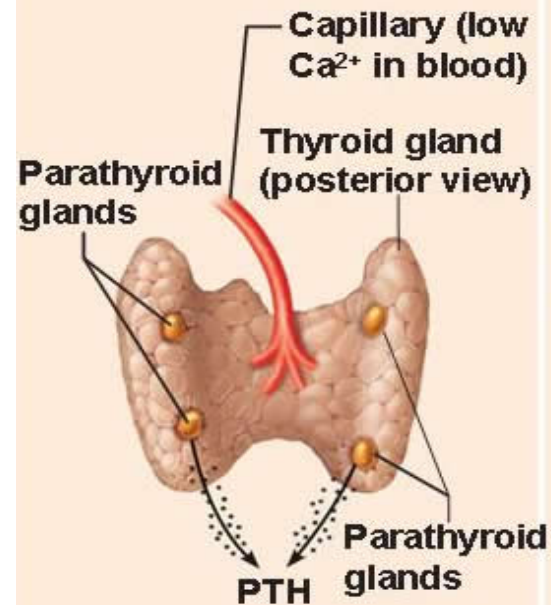
■ Prolactin

- Physiological functions
- Regulation of prolactin secretion

ENDOCRINE GLAND STIMULI MAY BE HUMORAL, NEURAL, OR HORMONAL.

(a) Humoral Stimulus

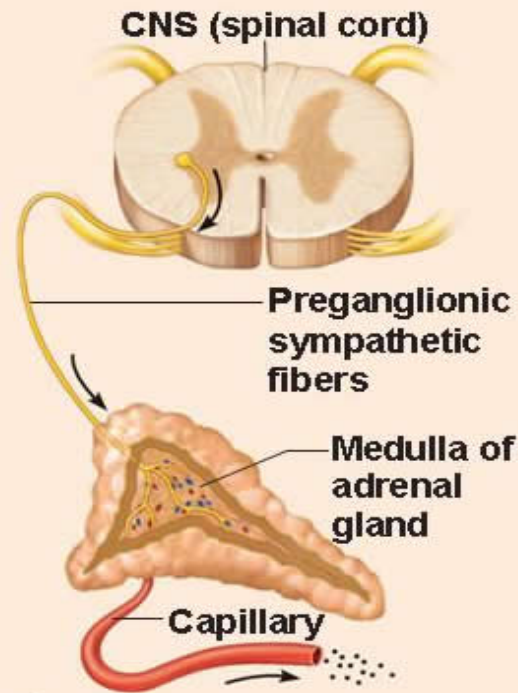
① Capillary blood contains low concentration of Ca^{2+} , which stimulates...



② ...secretion of parathyroid hormone (PTH) by parathyroid glands*

(b) Neural Stimulus

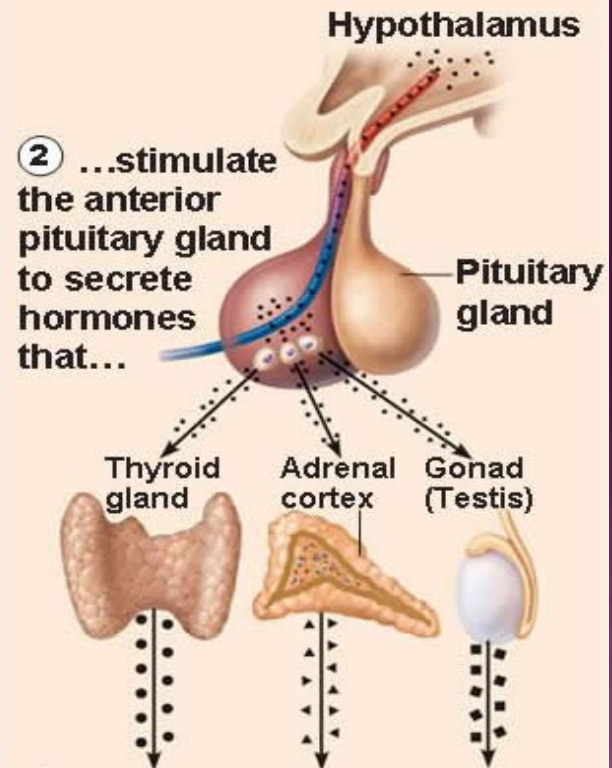
① Preganglionic sympathetic fibers stimulate adrenal medulla cells...



② ...to secrete catecholamines (epinephrine and norepinephrine)

(c) Hormonal Stimulus

① The hypothalamus secretes hormones that...

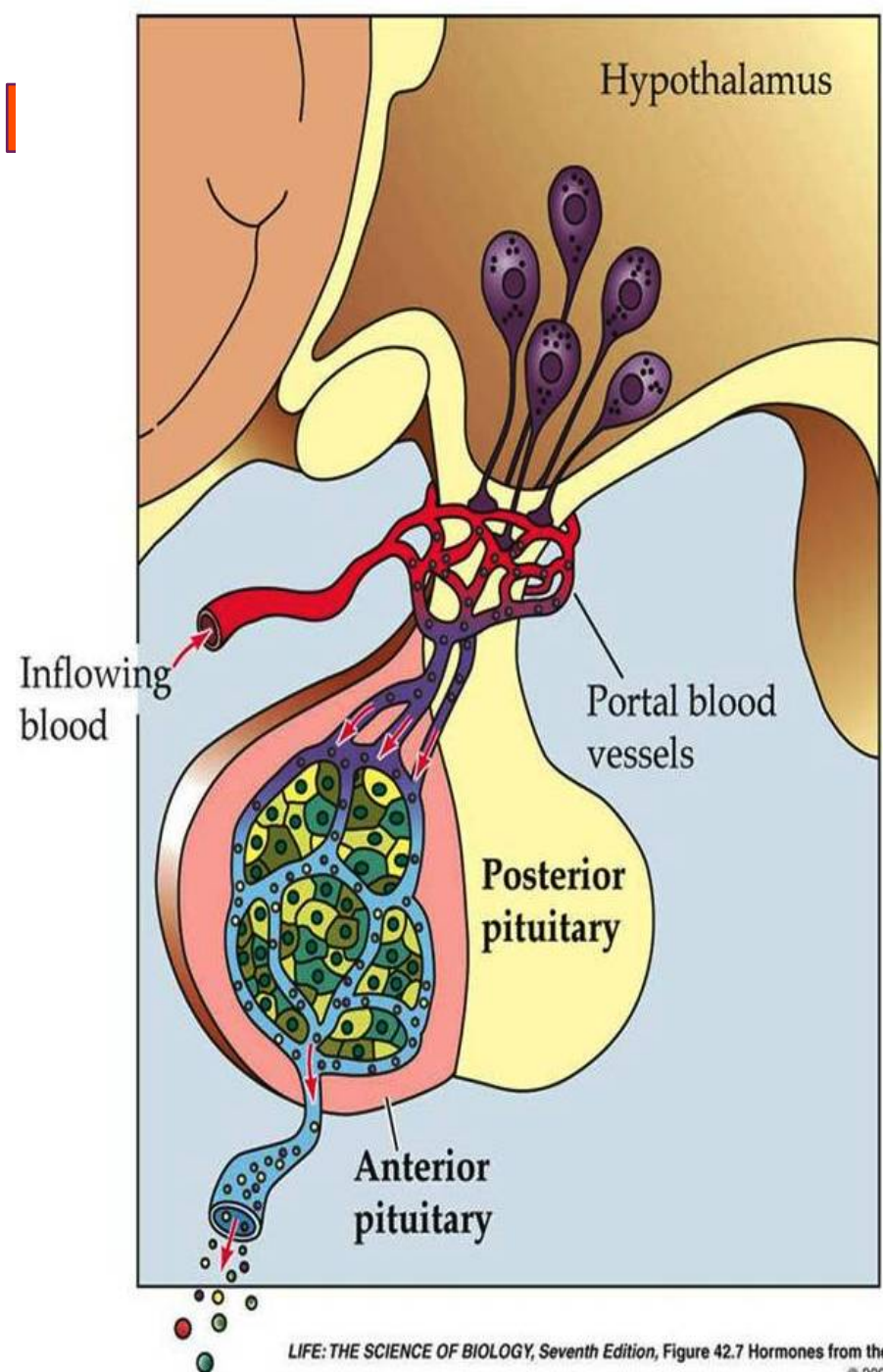


② ...stimulate the anterior pituitary gland to secrete hormones that...

③ ...stimulate other endocrine glands to secrete hormones

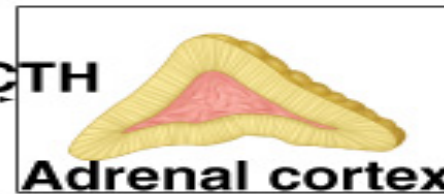
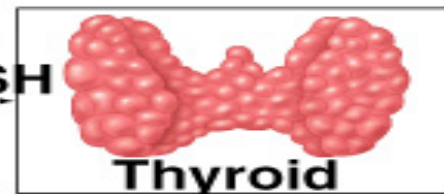
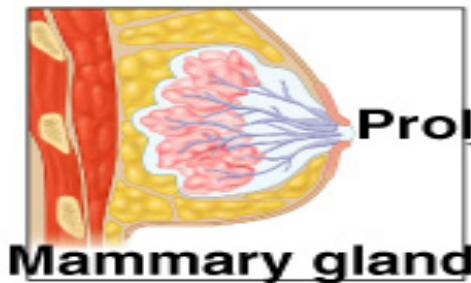
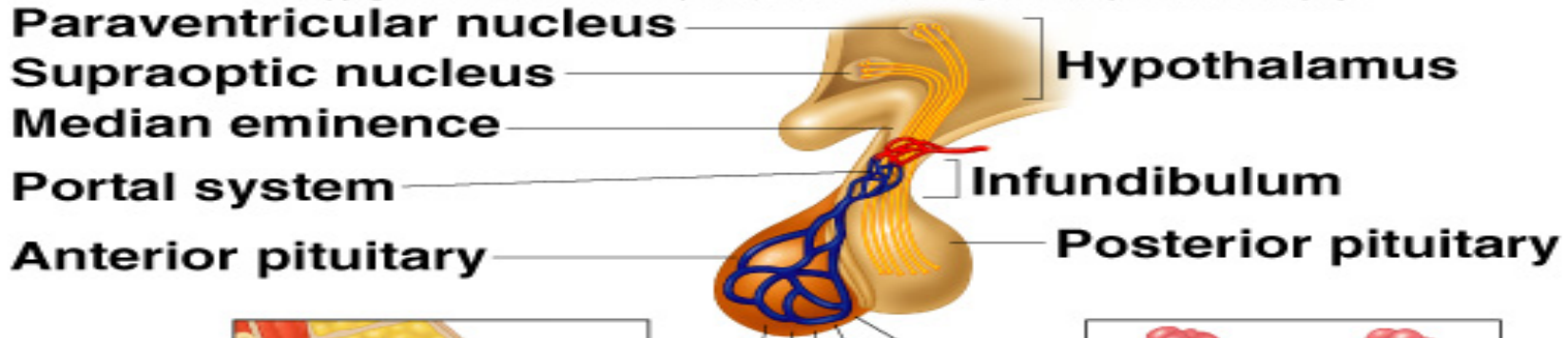
(ADENOHYPOPHYSI

- Anterior pituitary gland (adenohypophysis) is connected to hypothalamus by portal system: “hypothalamic-hypophysial portal vessels”.



ANTERIOR PITUITARY HORMONES

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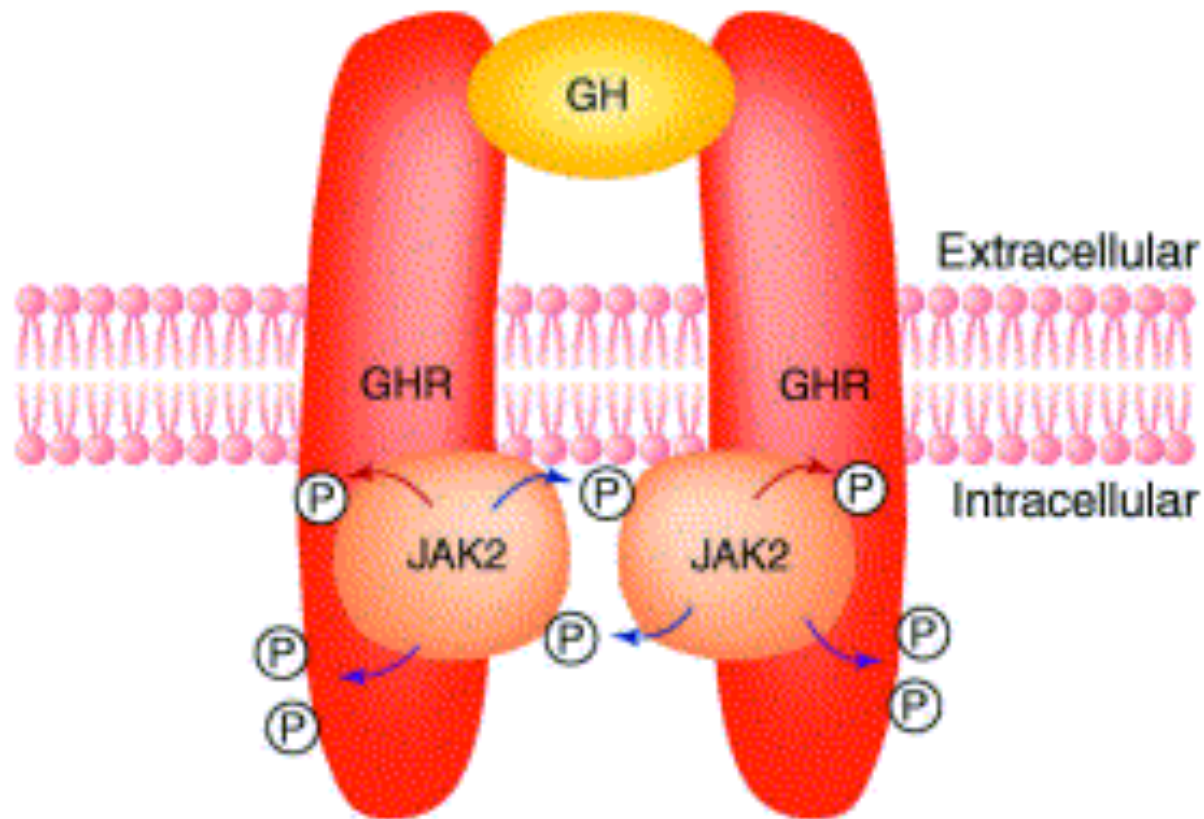
Gonadotropins



GROWTH HORMONE

(Somatotropin)

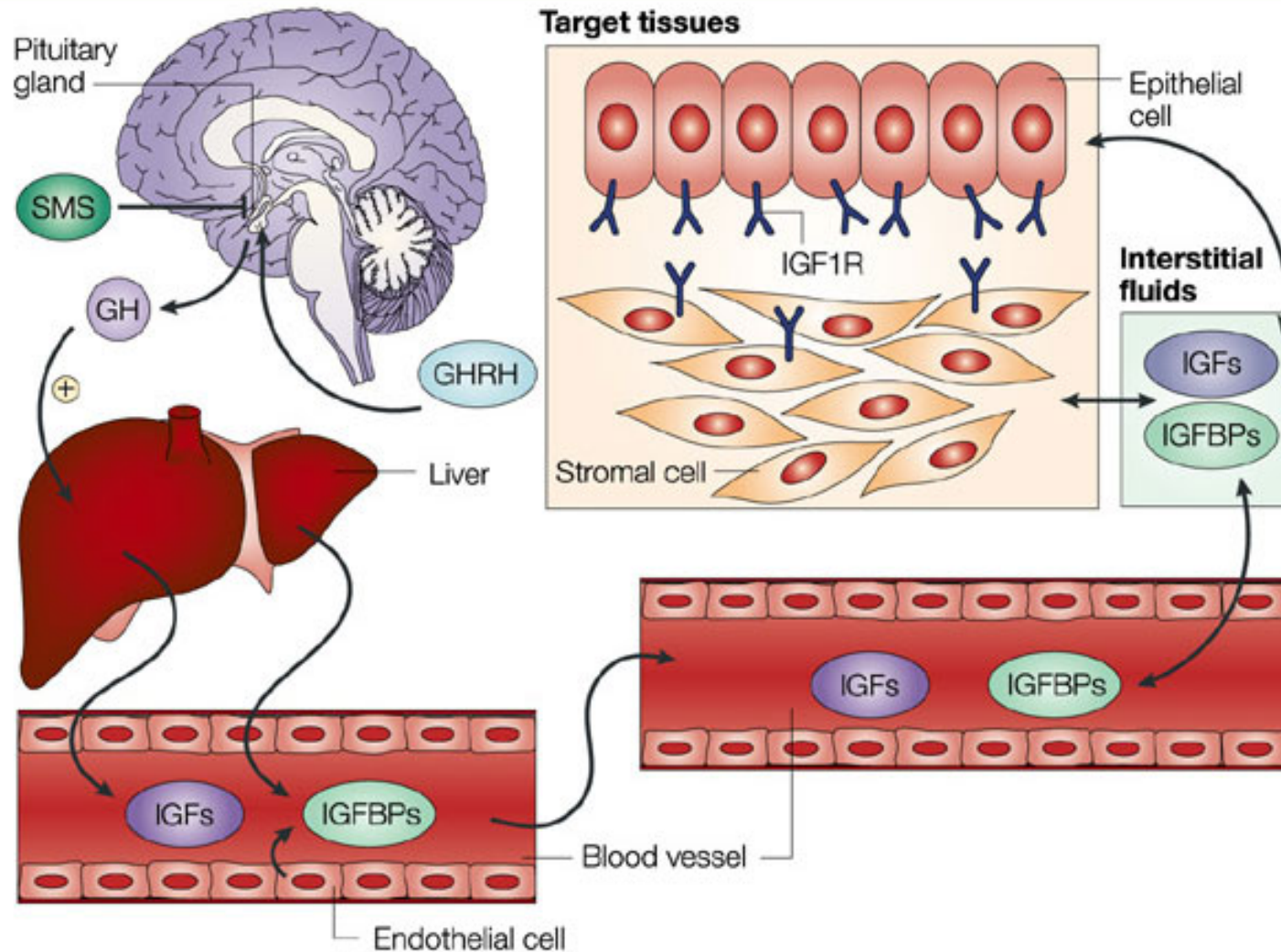
MECHANISM OF ACTION DIRECT EFFECT



INDIRECT EFFECT SOMATOMEDINS

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FUNCTIONS OF GROWTH HORMONE:

A) Long term effect

Promotion of growth:

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

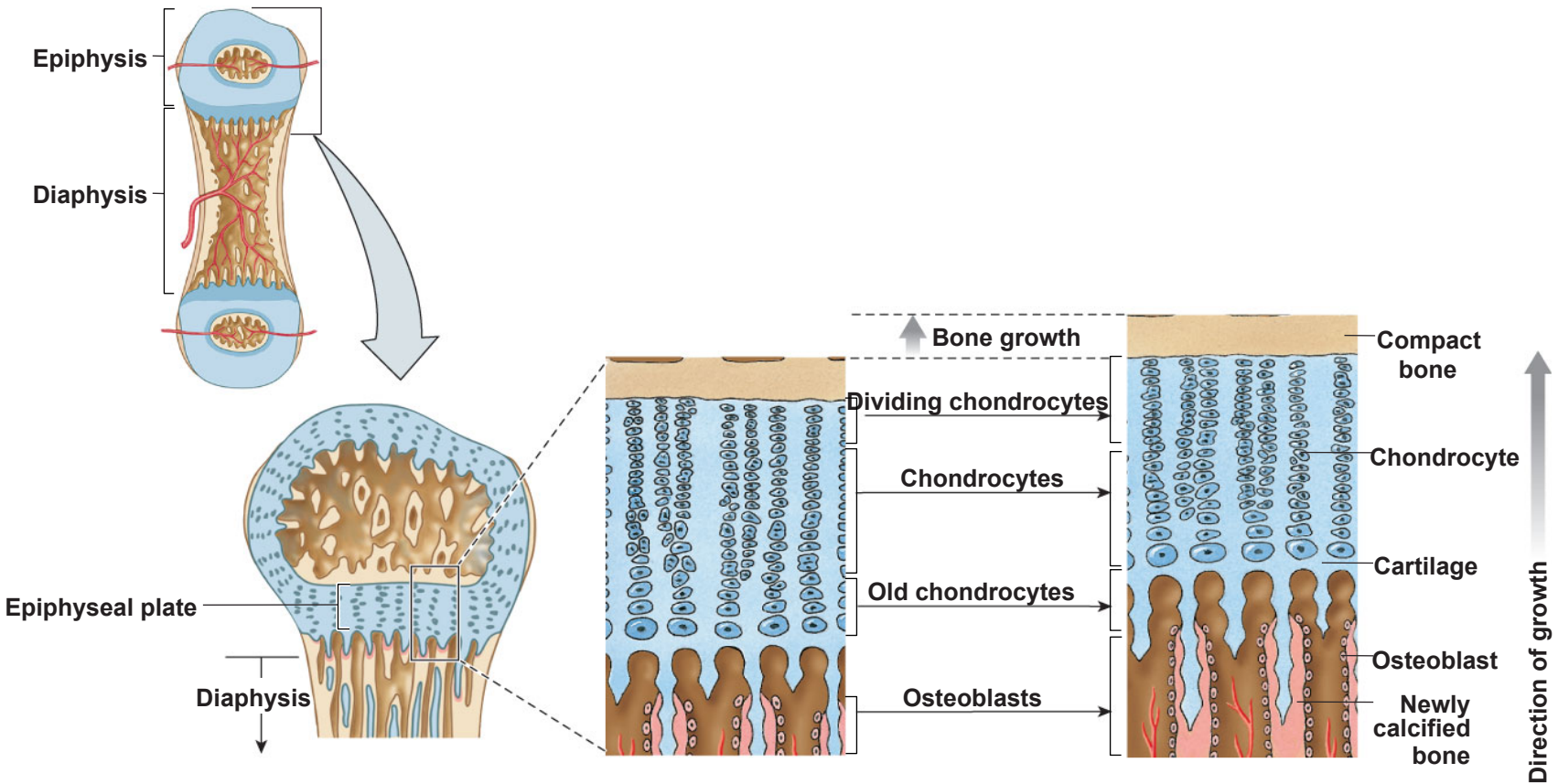
Indirect effect

Depends on somatomedin 'insulin- like growth factor [IGF-I& II] secreted by the liver, which is responsible for effect of GH on bone & cartilage growth and increase the synthesis of protein in skeletal muscles.

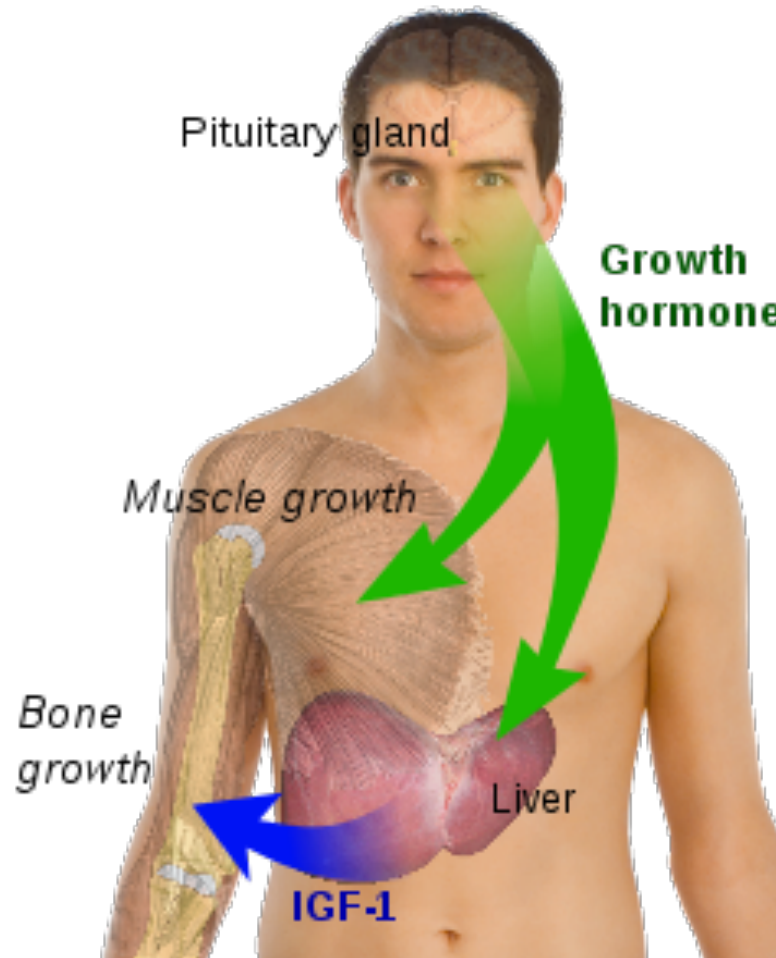
MECHANISMS OF BONE GROWTH

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.

BONE GROWTH



PROMOTION OF GROWTH



FUNCTIONS OF GROWTH HORMONE:

B. Short term

Metabolic effects:

□ Protein metabolism (Anabolic)

↑ 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”

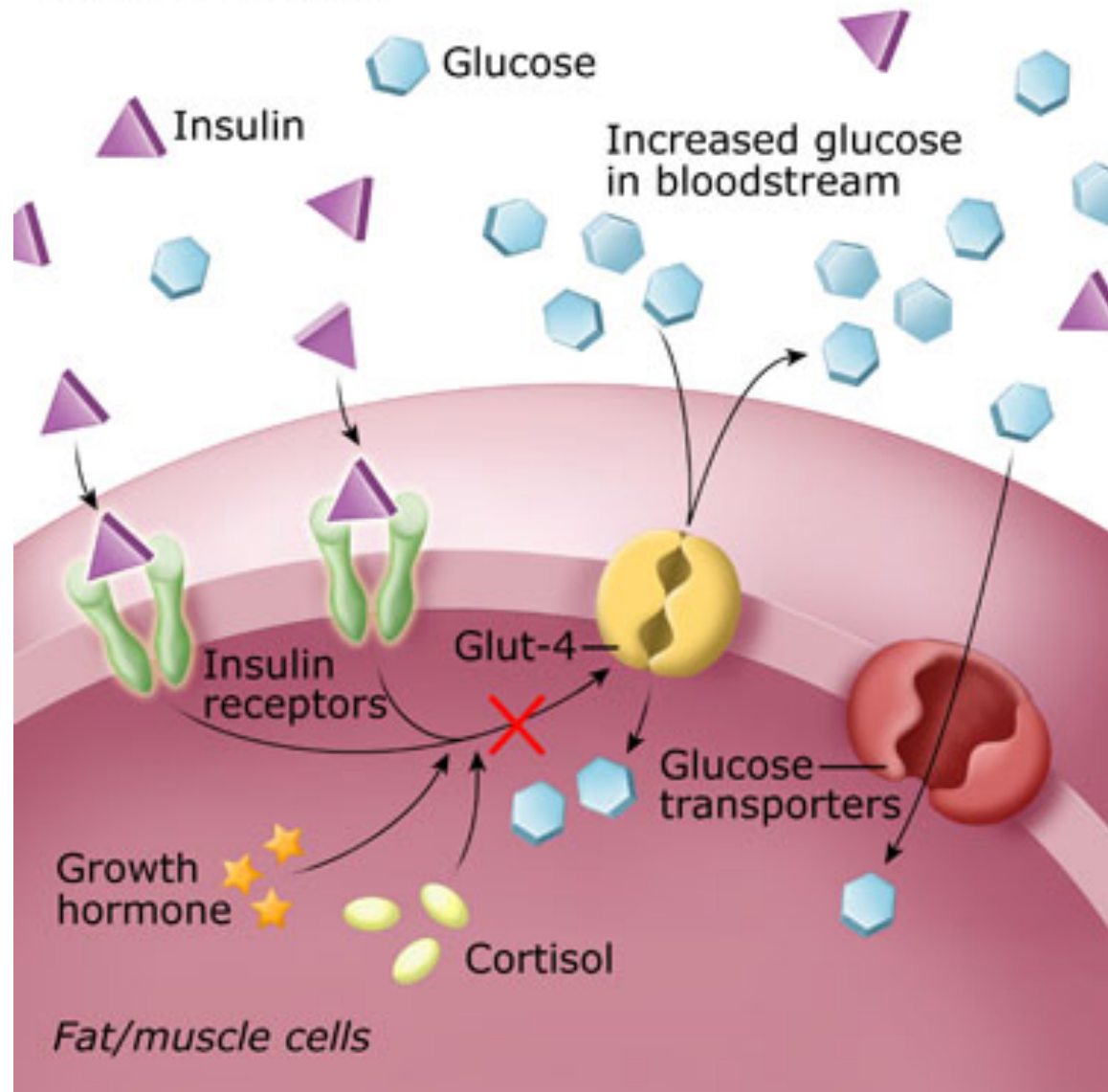
FUNCTIONS OF GROWTH HORMONE:

- ❑ **Fat metabolism: Catabolic**
 - ↑ mobilization of FFAs from adipose tissue stores
 - Conversion of FFT to acetyl CoA to provide energy

FUNCTIONS OF GROWTH HORMONE:

- CHO metabolism: **Hyperglycemic**
 - ↓ glucose uptake by tissues (skeletal muscles and fat).
 - ↓ rate of glucose utilization throughout the body
 - ↑ glucose production by the liver (↑ **gluconeogenesis**)
 - ↑ insulin resistance (↑ FFA)
(**diabetogenic**)

Glucose Counter-regulatory Hormones: Effect on Fat and Muscle Cells



OTHER EFFECTS OF GROWTH HORMONE:

- ◉ Increases **calcium** absorption from GIT
- ◉ Strengthens and increases the **mineralization of bone**
- ◉ Retention of **Na⁺** and **K⁺**
- ◉ 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:

a. GHRH \rightarrow \uparrow GH secretion.

b. GHIH (somatostatin) \rightarrow \downarrow GH secretion

2. Hypoglycemia (fasting) \rightarrow \uparrow GH secretion.

(N.B. glucose intake \rightarrow \downarrow GH secretion).

3. \downarrow FFAs \rightarrow \uparrow GH secretion

\uparrow FFAs \rightarrow \downarrow GH secretion

CONTROL OF GH SECRETION:

4. Intake of protein or amino acids → ↑ GH secretion (after meals).
5. Starvation & protein deficiency ↑ GH
6. During sleep → ↑ more in children.
7. Stress conditions, e.g. trauma or emotions → ↑ GH secretion.
8. Ghrelin (stomach) → ↑ GH secretion.
9. Muscular exercise → ↑ GH secretion.

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 ↑
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Anterior Pituitary Hormones

Growth hormone (GH)
(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

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



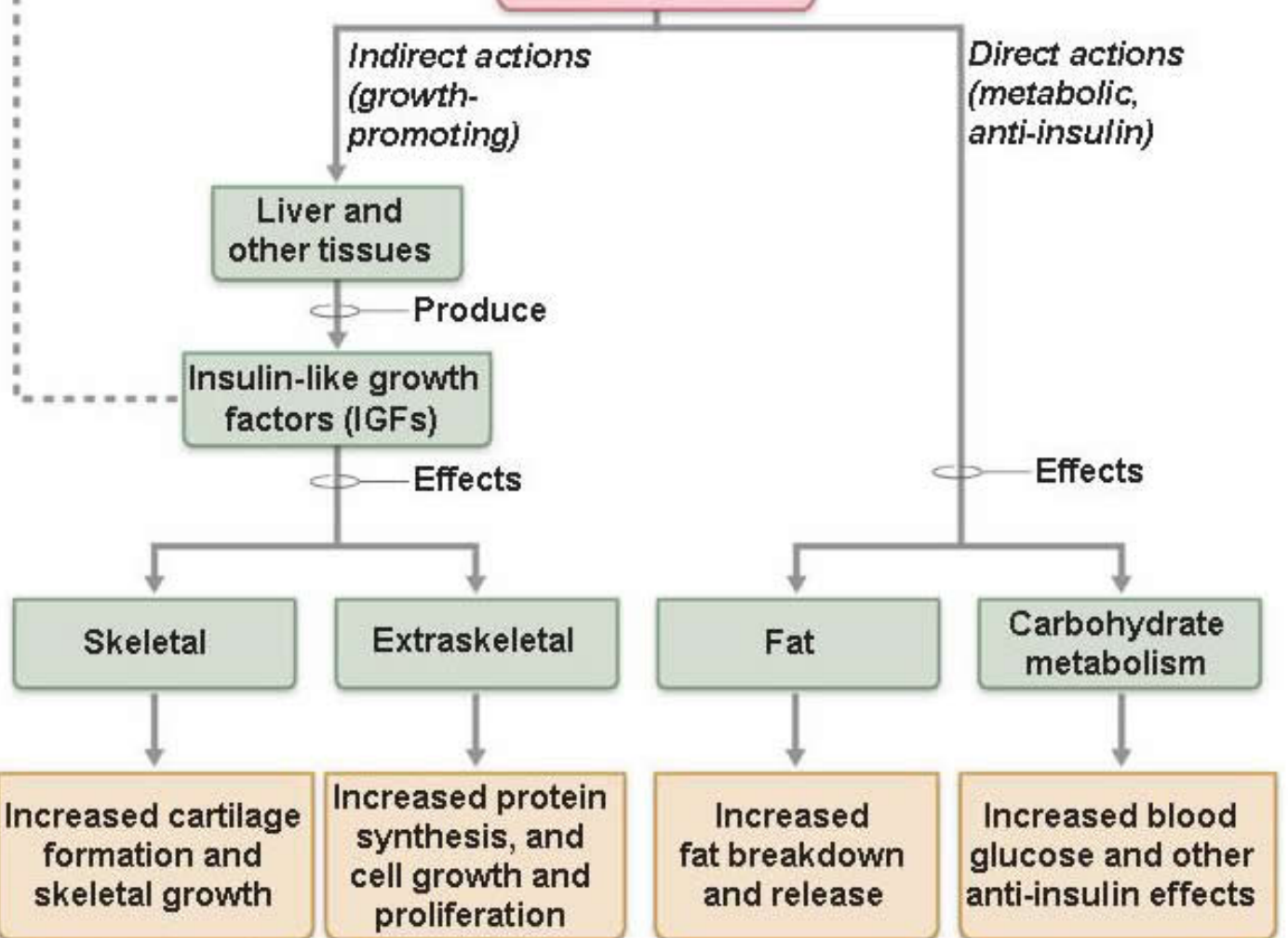
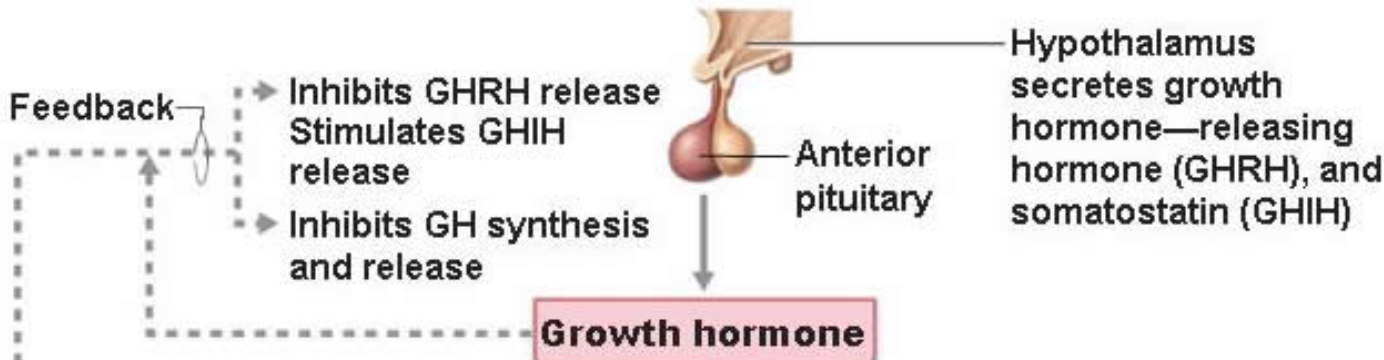
Liver, muscle, bone, cartilage, and other tissues: anabolic hormone; stimulates somatic growth; mobilizes fats; spares glucose

Growth-promoting effects mediated indirectly by IGFs

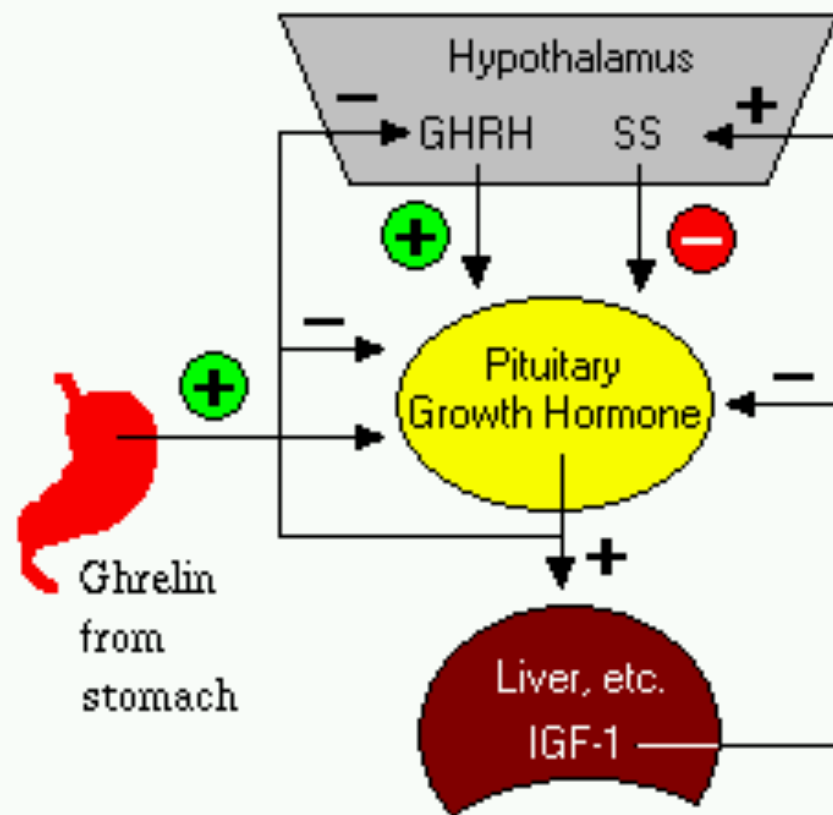
↓ Pituitary dwarfism in children
↑ Gigantism in children; acromegaly in adults

*Indicates hypothalamic releasing and inhibiting hormones:

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



- ← Increases, stimulates
- ← - - - Reduces, inhibits
- Initial stimulus
- Physiological response
- Result



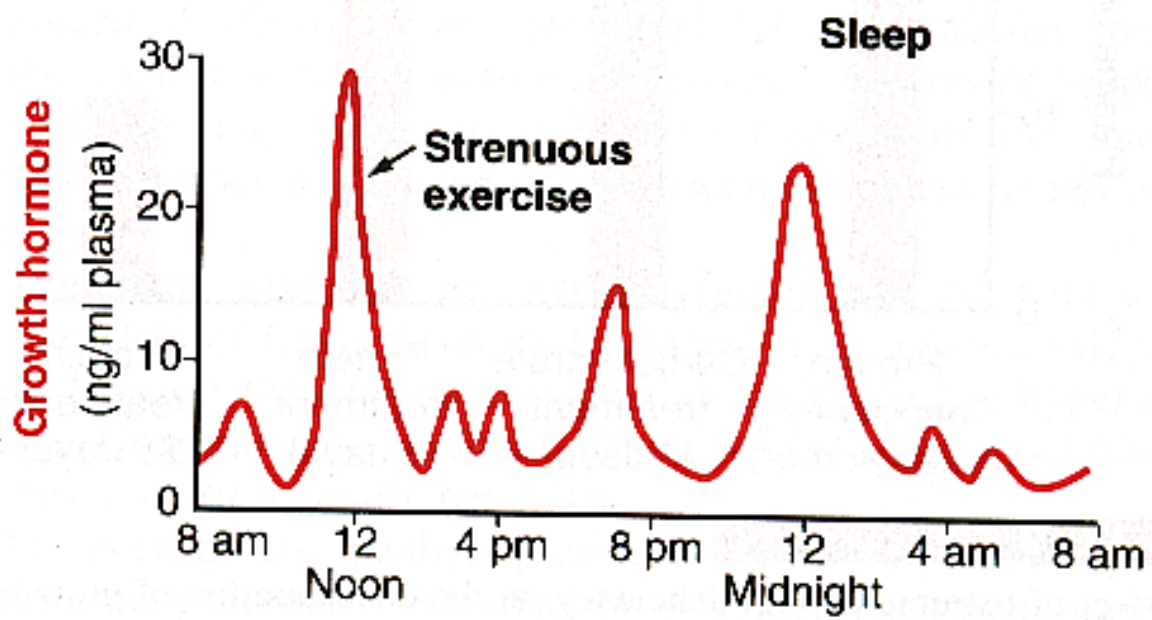


FIGURE 75 - 6

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.

ABNORMALITIES OF GH SECRETION

↑ GH SECRETION:

- Signs & symptoms
'in childhood':

Gigantism,

- as all body tissues grow rapidly, including bones.

Height ↑ as it occurs before epiphyseal fusion of long bones with their shafts.

Hyperglycemia (diabetes).

- Signs & symptoms
'in adults':

Acromegally,

person can't grow taller, BUT soft tissue continue to grow in thickness (skin, tongue, liver, kidney, ...)

- Enlargement of bones of hands & feet.

- Enlargement of membranous bones including cranium, nose, forehead bones, supraorbital ridges.

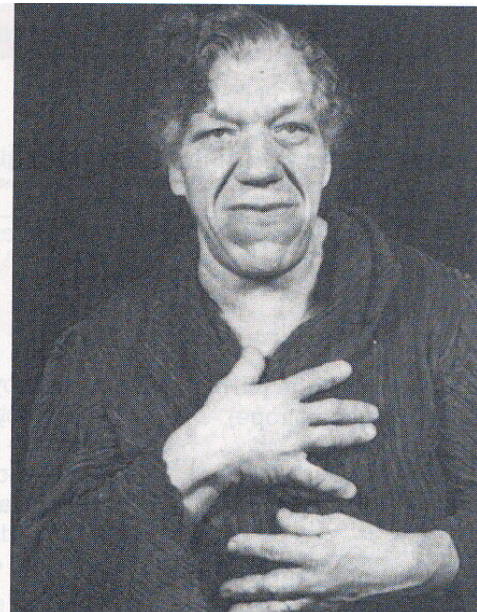
- Protrusion of lower jaw.

- Hunched back (kyphosis) (enlargement of vertebrae).

↑ GH IN CHILDREN



↑ GH IN AN ADULT



↓ GH = PITUITARY DWARFISM



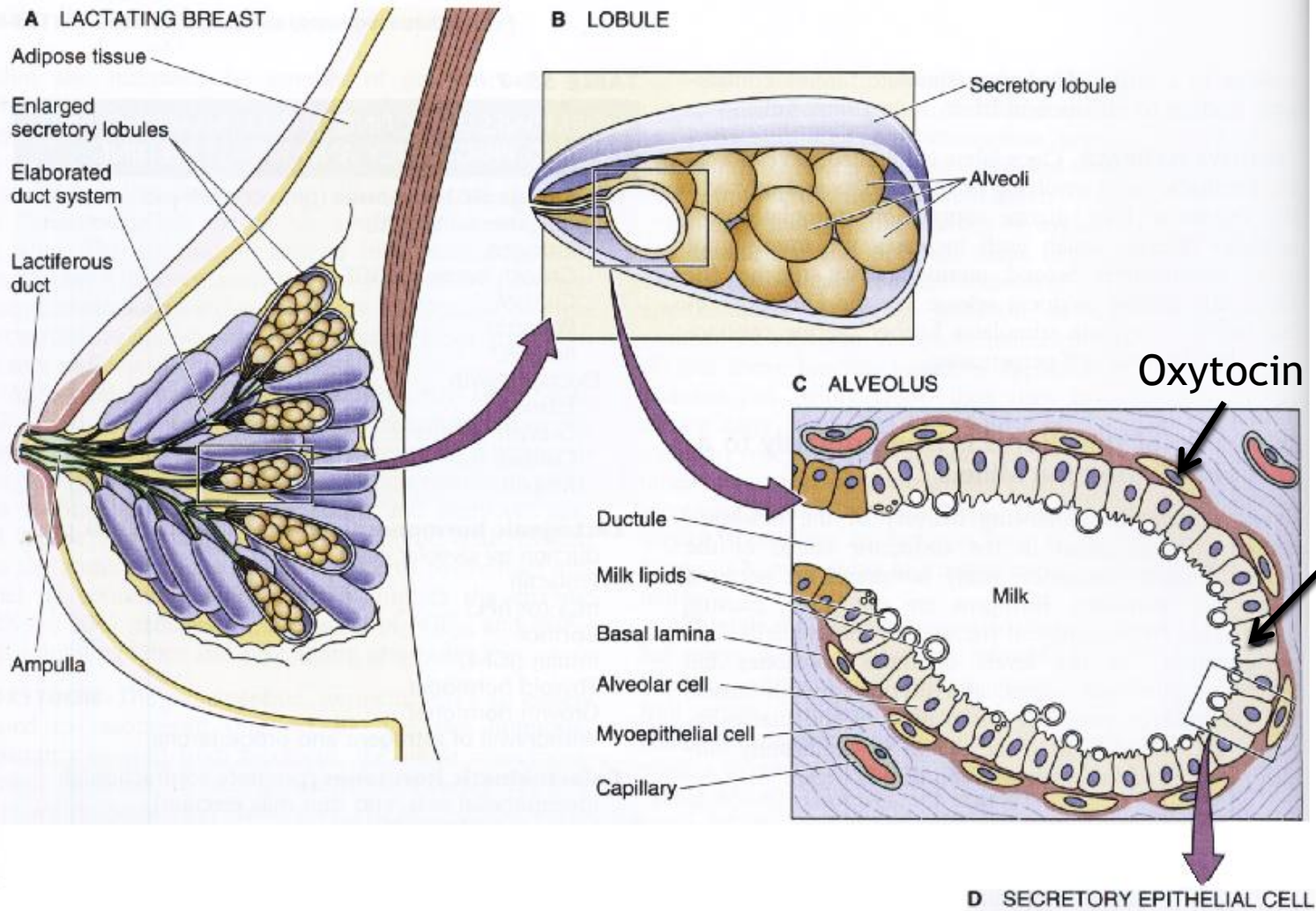
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PROLACTIN

FUNCTIONS OF PROLACTIN

- The major function of prolactin is milk production
- Release is inhibited by PIH (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

⦿ Other effects

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

CONTROL OF SECRETION

- ⊙ Inhibition of PL secretion
 - PIH (Dopamine)
- ⊙ Stimulation of PL secretion
 - Exercise
 - Surgical & psychological stress
 - Stimulation of the nipple
 - Sleep
 - Pregnancy
 - TRH

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Thank you