- notes -

شابّر حلو و سَوكِي مؤلوف

حطيت فيديوهات لتوضيح وَلاخِيكي

+ 100 سؤال و منعم سنوات

إن شاء الله تفلحوا كلاماً

best luck

by raneem Al-sygouf

PHYSIOLOGY

FACULTY OF PHARMACEUTICAL SCIENCES

DR. AMJAAD ZUHIER ALROSAN

LECTURE 13- ENDOCRINE SYSTEM

Objectives

Endocrine
within to secrete

1. Discuss **comparison of control by the nervous and endocrine systems.**

2. Describe **pituitary gland - anterior and posterior.**

3. Explore **thyroid gland, adrenal cortex and, medulla, parathyroid and, calcium homeostasis, and endocrine pancreas and insulin disorders.**

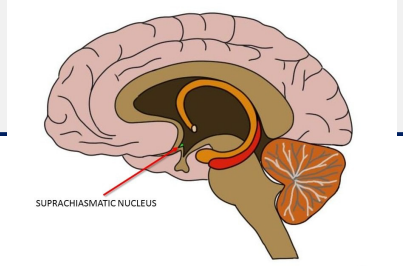
(Pages 615- 646, 654-656 of the reference)

https://youtu.be/zJu6CsuFSpg?si=vhtGz9xf8jcODSi7 → intro to the Endocrine system

THE ENDOCRINE SYSTEM

- Multitudes of hormones help maintain homeostasis on a daily basis. They regulate the activity of smooth muscle,[1] cardiac muscle,[2] and some glands;[3] alter metabolism; influence reproductive processes; and participate in circadian (daily) rhythms established by the suprachiasmatic nucleus of the hypothalamus.

فوق الحواسا



THE ENDOCRINE SYSTEM

- **A hormone** is a mediator molecule that is released in one part of the body but regulates the activity of cells in other parts of the body.
- Most hormones enter interstitial fluid and then the bloodstream.
- The circulating blood delivers hormones to cells throughout the body.
- Both neurotransmitters and hormones exert their effects by binding to receptors on or in their "target" cells.
- **Responses of the endocrine system often are slower than responses of the nervous system**; although some hormones act within seconds, most take several minutes or more to cause a response.

THE ENDOCRINE SYSTEM

موجزة أكثر

- **The effects of nervous system activation** are generally briefer than those of the endocrine system. The nervous system acts on specific muscles and glands.

أوسع

- The influence of the endocrine system is much broader; it helps regulate virtually all types of body cells.

https://youtu.be/b6m35PlH7t8?si=n8zceHKqCSl20RaR

easy explanation

TABLE 18.1

Comparison of Control by the Nervous and Endocrine Systems

CHARACTERISTIC	NERVOUS SYSTEM	ENDOCRINE SYSTEM
Mediator molecules	Neurotransmitters released locally in response to nerve impulses.	Hormones delivered to tissues throughout body by blood.
Site of mediator action	Close to site of release, at synapse; binds to receptors in postsynaptic membrane.	Far from site of release (usually); binds to receptors on or in target cells.
Types of target cells	Muscle (smooth, cardiac, and skeletal) cells, gland cells, other neurons.	Cells throughout body.
Time to onset of action	Typically within milliseconds (thousandths of a second).	Seconds to hours or days.
Duration of action	Generally briefer (milliseconds).	Generally longer (seconds to days).

Which of the following is FALSE regarding the comparison of control by the nervous and endocrine systems? :

1. ○ The influence of the endocrine system is much broader as it helps regulate virtually all types of body cells.
2. ○ Responses of the endocrine system often are slower than responses of the nervous system.
3. ● The effects of endocrine system activation are generally briefer than those of the nervous system.
4. ○ None, all of the above are TRUE.

2- compere between the nervous system and endocrine system (endo effect the distal cell ,nervous the near cell)

FUNCTIONS OF HORMONES

بالمنطق كل حاي الوظائف بدها hormone

FUNCTIONS OF HORMONES

1. Help regulate:
   - Chemical composition and volume of internal environment (interstitial fluid).
   - Metabolism and energy balance.
   - Contraction of smooth and cardiac muscle fibers.
   - Glandular secretions.
   - Some immune system activities.
2. Control growth and development.
3. Regulate operation of reproductive systems.
4. Help establish circadian rhythms.

ENDOCRINE GLANDS

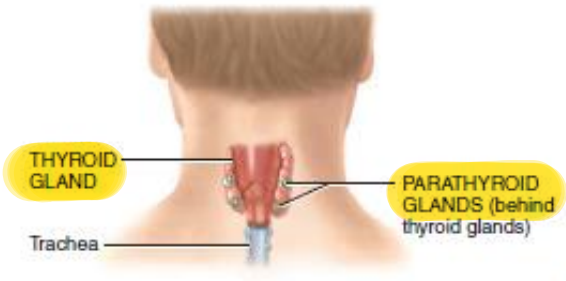
- **Exocrine glands** secrete their products into ducts that carry the secretions into body cavities, into the lumen of an organ, or to the outer surface of the body. Exocrine glands include sudoriferous (sweat), sebaceous (oil), mucous, and digestive glands.

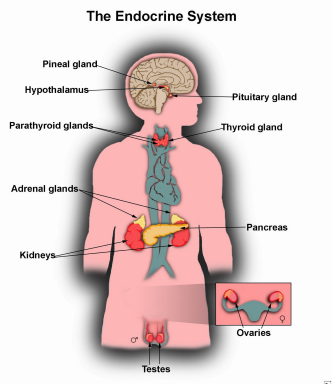
- **Endocrine glands** secrete their products (hormones) into the interstitial fluid surrounding the secretory cells rather than into ducts.

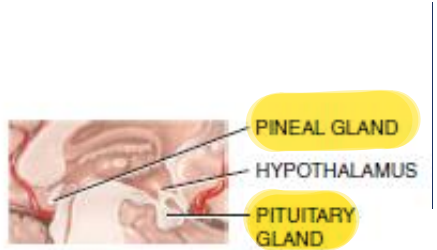
release hormones into blood strem

نفس الأناوهي لومتوكريس

The endocrine glands include the pituitary, thyroid, parathyroid, adrenal, and pineal glands. In addition, several organs and tissues are not exclusively classified as endocrine glands but contain cells that secrete hormones. These include the hypothalamus, thymus, pancreas, ovaries, testes, kidneys, stomach, liver, small intestine, skin, heart, adipose tissue, and placenta. **Taken together, all endocrine glands and hormone-secreting cells constitute the endocrine system.**

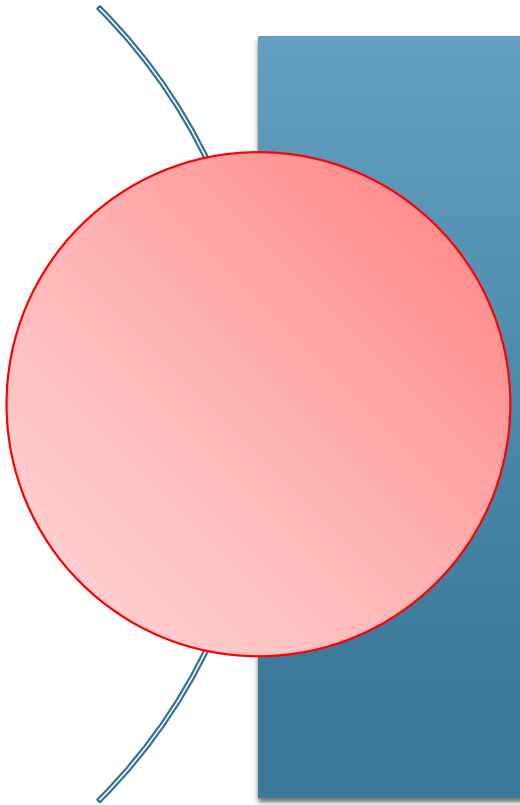






HORMONE ACTIVITY

specific hormone ○ bind ⊃ specific receptor

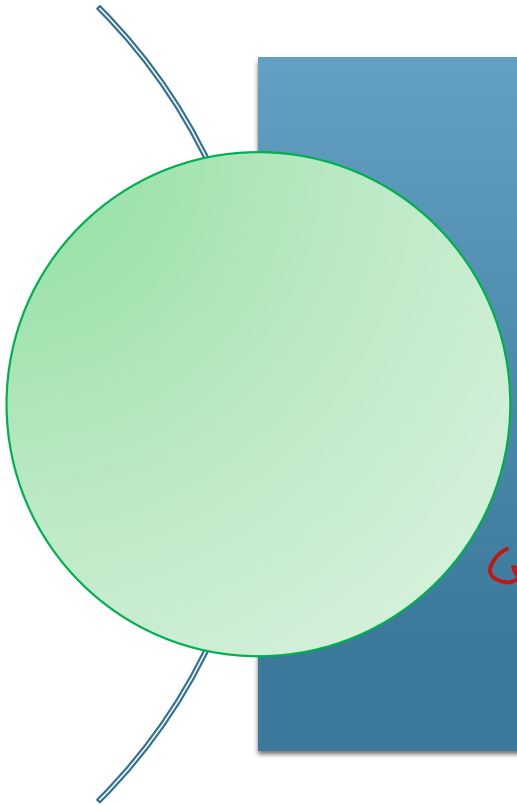


The role of hormone receptors:

Although a given hormone travels throughout the body in the blood, it affects only specific target cells.

Only the target cells for a given hormone have receptors that bind and recognize that hormone. For example, thyroid-stimulating hormone (TSH) binds to receptors on cells of the thyroid gland, but it does not bind to cells of the ovaries because ovarian cells do not have TSH receptors.

HORMONE ACTIVITY



If a hormone is present in excess, the number of target-cell receptors may decrease— an effect called down-regulation. For example, when certain cells of the testes are exposed to a high concentration of luteinizing hormone (LH), the number of LH receptors decreases. Downregulation makes a target cell less sensitive to a hormone. In contrast, when a hormone is deficient, the number of receptors may increase. This phenomenon, known as up-regulation, makes a target cell more sensitive to a hormone.

down regulation

- exess hormone
- receptors number decrease

target cell

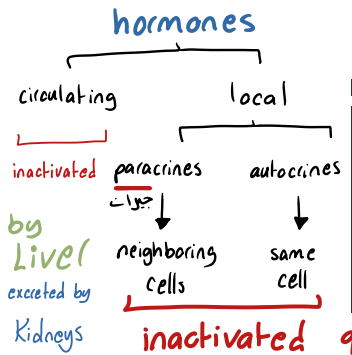
less sensetive to harmone

up regulation

- deficent hormone
- receptors number increase

target cell

more sensetive to hormone



CIRCULATING AND LOCAL HORMONES

- Most endocrine hormones are **circulating hormones**—they pass from the secretory cells that make them into interstitial fluid and then into the blood.
- Other hormones, termed **local hormones**, act locally on neighboring cells or on the same cell that secreted them without first entering the bloodstream.
- **Local hormones that act on neighboring cells** are called **paracrines**, and **those that act on the same cell that secreted them** are called **autocrines**.
- **Local hormones usually are inactivated quickly**; **circulating hormones may linger in the blood and exert their effects for a few minutes or occasionally for a few hours**. In time, **circulating hormones are inactivated by the liver and excreted by the kidneys. In cases of kidney or liver failure, excessive levels of hormones may build up in the blood.**

Paracrine hormones are:

1. ○ Hormones that act on the same cell that secreted them. autocrine hormones
2. ○ Hormones which pass from the secretory cells that make them into the blood. circulating hormones
3. ● Hormones that act on neighboring cells. paracrine hormone
4. ○ Hormones that linger in the blood and exert their effects for a few minutes or occasionally for a few hours.

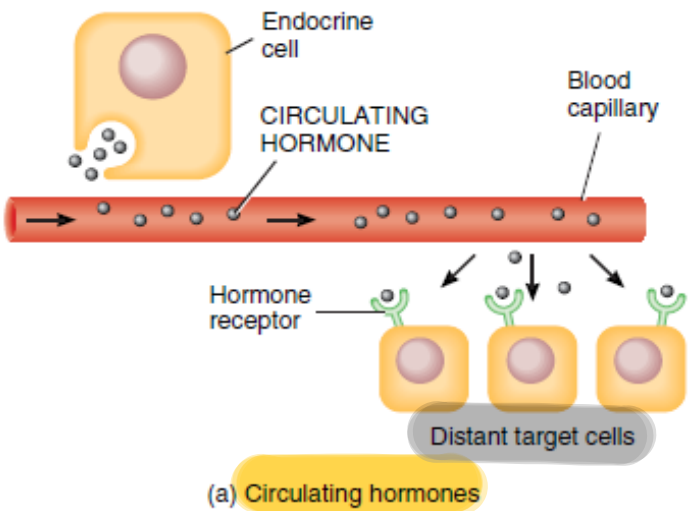
circulating hormone

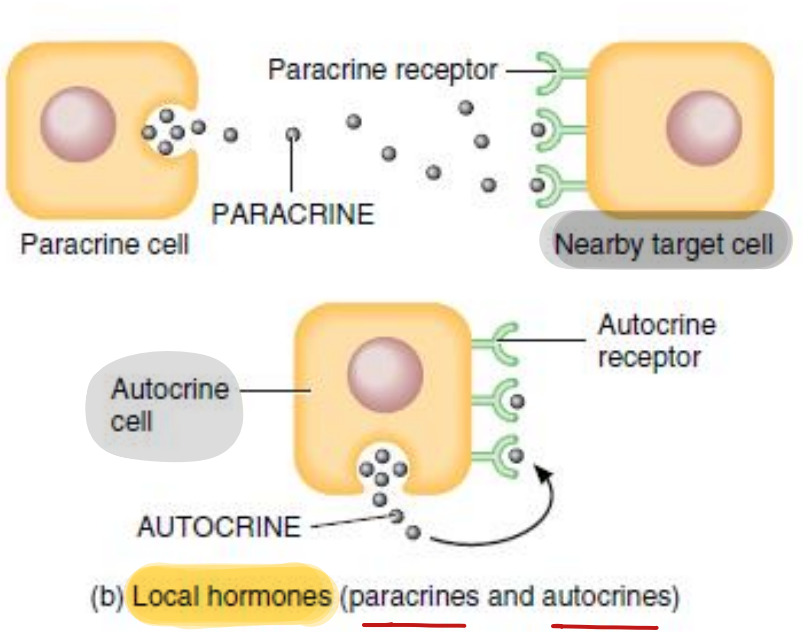
Next

CIRCULATING AND LOCAL HORMONES

Figure 18.2 **Comparison between circulating hormones and local hormones (autocrines and paracrines).**

Circulating hormones are carried through the bloodstream to act on distant target cells. Paracrines act on neighboring cells, and autocrines act on the same cells that produced them.





CHEMICAL CLASSES OF HORMONES

Chemically, **hormones can be divided into two broad classes:** those that are soluble in lipids, and those that are soluble in water. This chemical classification is also useful functionally because the two classes exert their effects differently.

LIPID-SOLUBLE HORMONES

The lipid-soluble hormones include steroid hormones, thyroid hormones, and nitric oxide.

1. **Steroid hormones** are derived from cholesterol. Each steroid hormone is unique due to the presence of different chemical groups attached at various sites on the four rings at the core of its structure. These small differences allow for a large diversity of functions.
2. **Two thyroid hormones (T3 and T4)** are synthesized by attaching iodine to the amino acid tyrosine. The presence of two benzene rings within a T3 or T4 molecule makes these molecules very lipid-soluble.
3. **The gas nitric oxide (NO)** is both a hormone and a neurotransmitter. Its synthesis is catalyzed by the enzyme nitric oxide synthase.

Question 31 / 40

All of the following are true regarding the lipid-soluble hormones that are secreted by hormone-secreting cells in the endocrine system, EXCEPT :

1. Steroid hormones are derived from cholesterol.
2. The gas nitric oxide is both a hormone and a neurotransmitter.
3. Two thyroid hormones are synthesized by attaching iodine to the amino acid tyrosine.
4. The nitric oxide has a large diversity of functions.

Next

WATER-SOLUBLE HORMONES

The **water-soluble hormones** include amine hormones, peptide and protein hormones, and eicosanoid hormones.

1. **Amine hormones** are synthesized by decarboxylating (removing a molecule of CO_2) and otherwise modifying certain amino acids. They are called amines because they retain an amino group. The catecholamines—epinephrine, norepinephrine, and dopamine—are synthesized by modifying the amino acid tyrosine. Histamine is synthesized from the amino acid histidine by mast cells and platelets. Serotonin and melatonin are derived from tryptophan.

WATER-SOLUBLE HORMONES

أقل 100 < amino acid

أكثر 100 > amino acid

2. **Peptide hormones and protein hormones** are amino acid polymers. The smaller peptide hormones consist of chains of 3 to 49 amino acids; the larger protein hormones include 50 to 200 amino acids. **Examples of peptide hormones** are antidiuretic hormone and oxytocin; **protein hormones** include human growth hormone and insulin. Several of the protein hormones, such as thyroid-stimulating hormone, have attached carbohydrate groups and thus are glycoprotein hormones.

WATER-SOLUBLE HORMONES

3. **The eicosanoid hormones** are derived from arachidonic acid, a 20-carbon fatty acid. The two major types of eicosanoids are prostaglandins (PGs) and leukotrienes (LTs). The eicosanoids are important local hormones, and they may act as circulating hormones as well.

water soluble hormones

Amine hormones

↳ decarboxylating and modifying amino acids

Catecholamines

EP / NOR EP → tyrosine

dopamine → tyrosine

Histamine → histidine

serotonin and melatonin → tryptophan

peptide and protein

(3-49) (50-200)

peptide hormones:

- ADH
- oxytocin

protein hormones:

- GH growth hormone
- insulin

+ carbohydrate group

glycoprotein hormones

- TSH

thyroid stimulating hormone

eicosanoid hormone

↳ arachidonic acid

(20 carbon fatty acid)

prostaglandins

Leukotrienes

HORMONE TRANSPORT IN THE BLOOD

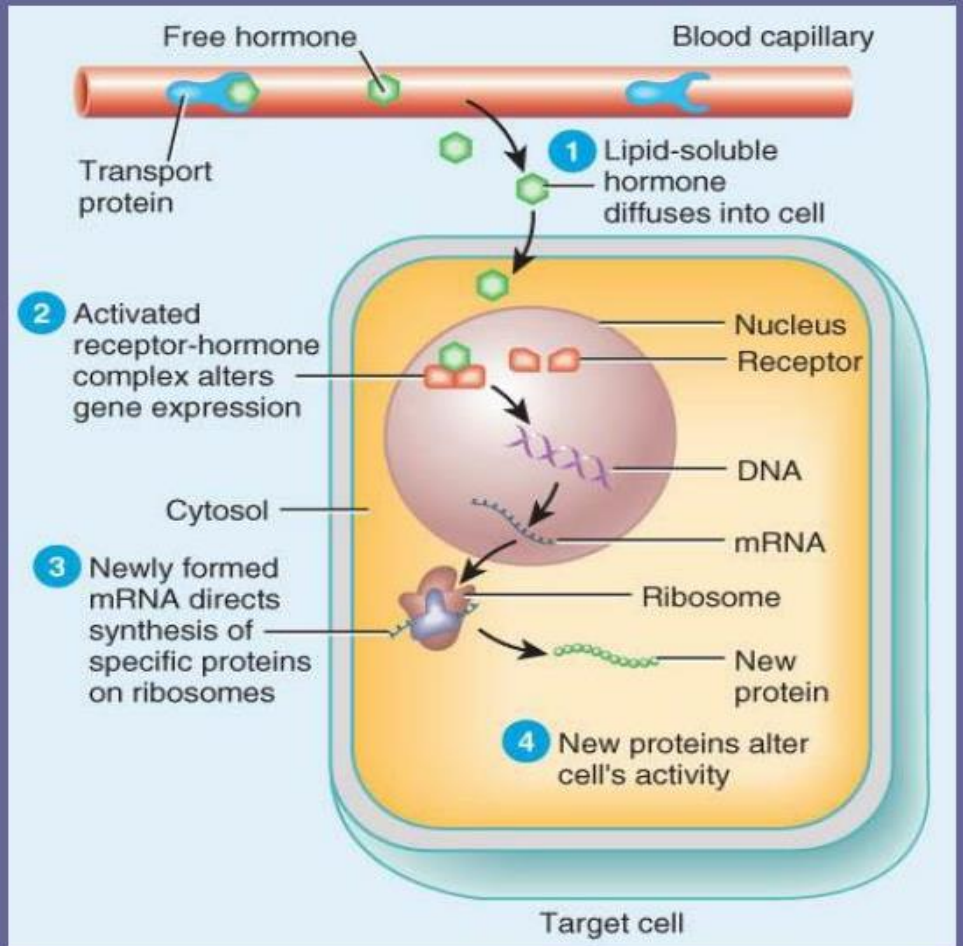
Most water-soluble hormone molecules circulate in the water blood plasma in a "free" form (not attached to other molecules) but **most lipid-soluble hormone molecules are bound to transport proteins. The transport proteins, which are synthesized by cells in the liver, have three functions:**

- **1. They make lipid-soluble hormones temporarily water-soluble**, thus increasing their solubility in blood.
- **2. They retard passage of small hormone molecules through the filtering mechanism in the kidneys**, thus slowing the rate of hormone loss in the urine.
- **3. They provide a ready reserve of hormone, already present in the bloodstream.**

MECHANISMS OF HORMONE ACTION

- **The response to a hormone depends on both the hormone itself and the target cell.** Various target cells respond differently to the same hormone. Insulin, for example, stimulates synthesis of glycogen in liver cells and synthesis of triglycerides in adipose cells.
- **The receptors for lipid soluble hormones** are located inside target cells.
- **The receptors for water-soluble hormones** are part of the plasma membrane of target cells.

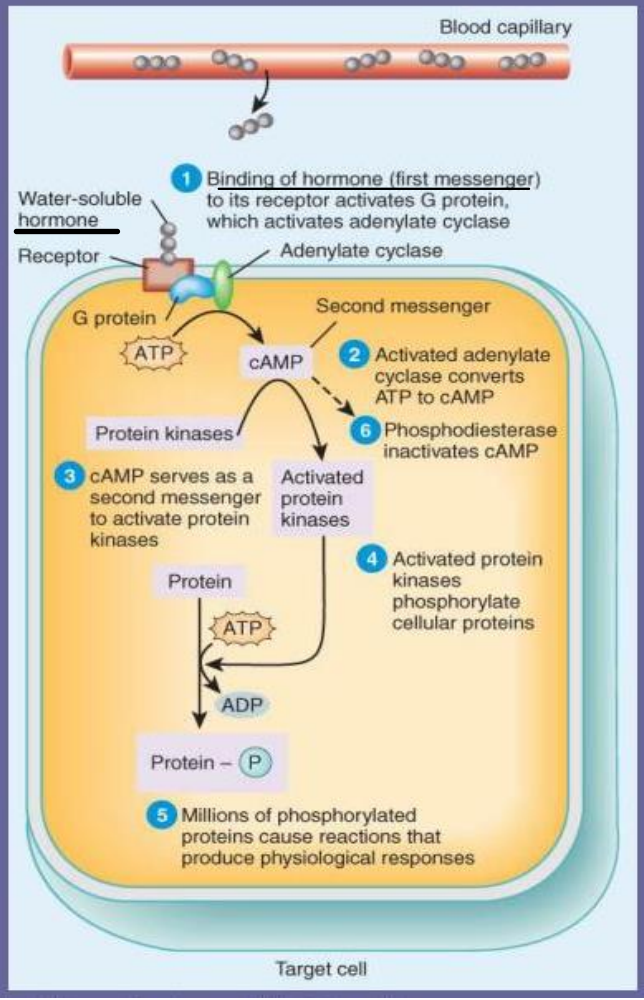
Action of Lipid-Soluble Hormones



- Hormone diffuses through phospholipid bilayer & into cell
- Binds to receptor turning on/off specific genes
- New mRNA is formed & directs synthesis of new proteins
- New protein alters cell's activity

Lipid-soluble hormones, including steroid hormones and thyroid hormones, bind to receptors within target cells.

Water-soluble Hormones = membrane receptors



- Cyclic AMP is the 2nd messenger
  - kinases in the cytosol speed up/slow down physiological responses
- Phosphodiesterase inactivates cAMP quickly
- Cell response is turned off unless new hormone molecules arrive

Because amine, peptide, protein, and eicosanoid hormones are not lipid-soluble, they cannot diffuse through the lipid bilayer of the plasma membrane and bind to receptors inside target cells.

HORMONE INTERACTIONS

- **The responsiveness of a target cell to a hormone depends on (1) the hormone's concentration in the blood, (2) the abundance of the target cell's hormone receptors, and (3) influences exerted by other hormones.**
- Target cell responds more vigorously when the level of a hormone rises or when it has more receptors (upregulation).
- In addition, the actions of some hormones on target cells require a simultaneous or recent exposure to a second hormone. In such cases, the second hormone is said to have a **permissive effect**.
- When the effect of two hormones acting together is greater or more extensive than the effect of each hormone acting alone, the two hormones are said to have a **synergistic effect**.
- When one hormone opposes the actions of another hormone, the two hormones are said to have **antagonistic effects**.

Hormones interactions

permissive effect

- require a stimultaneous OR recent exposure to second hormone

synergistic effect

effect of 2 hormones acting together > effect of each one acting alone

stronger

antagonistic effect

one hormone opposes the actions of another hormone

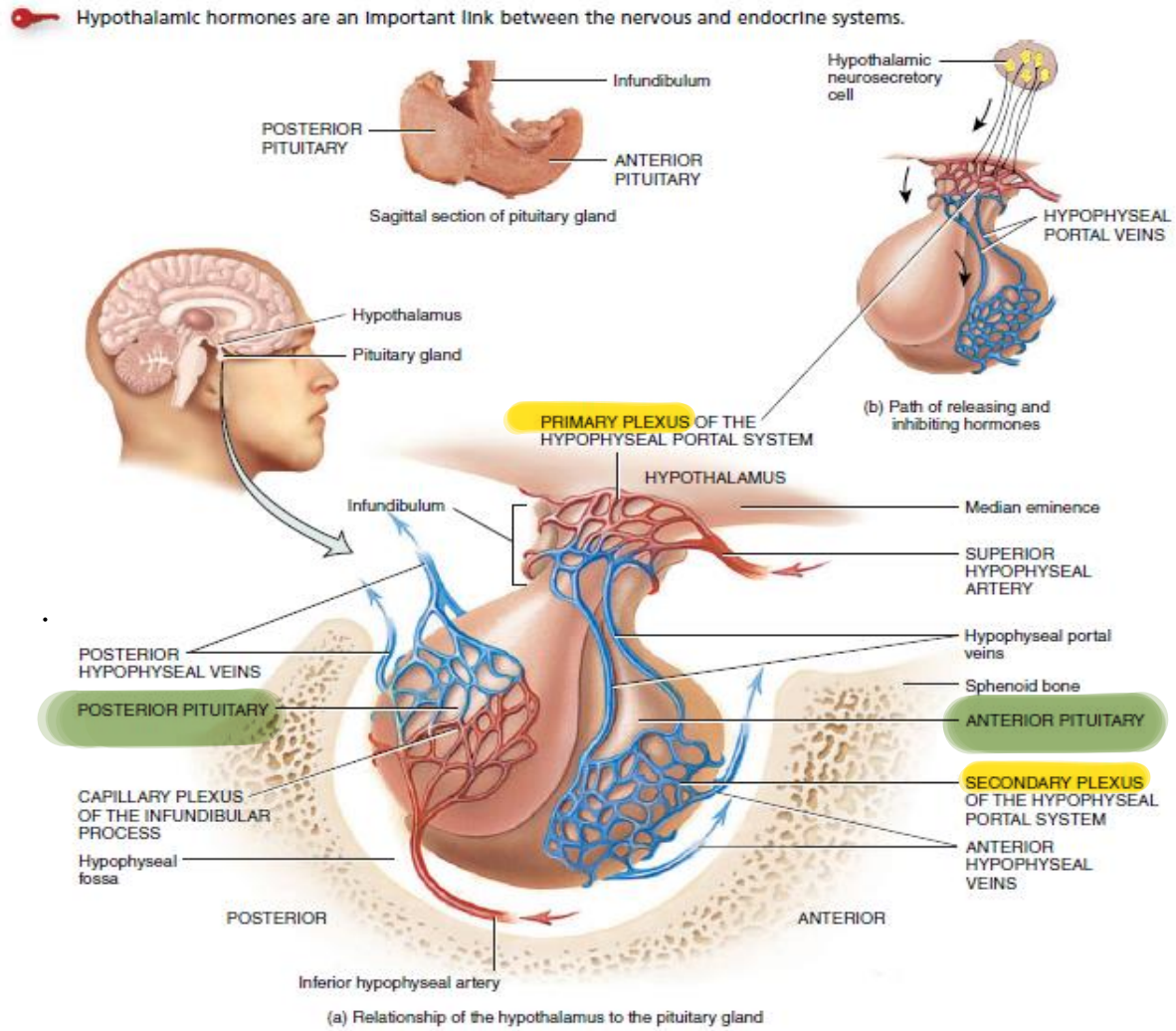
HYPOTHALAMUS AND PITUITARY GLAND

- For many years, the pituitary gland or hypophysis was called the "master" endocrine gland because it secretes several hormones that control other endocrine glands.
- The pituitary gland itself has a master—the hypothalamus.
- Cells in the hypothalamus synthesize at least nine different hormones, and the pituitary gland secretes seven. Together, these hormones play important roles in the regulation of virtually all aspects of growth, development, metabolism, and homeostasis.

HYPOTHALAMUS AND PITUITARY GLAND

- **Releasing and inhibiting hormones synthesized by hypothalamic neurosecretory cells are transported within axons and released at the axon terminals.**

- **The hormones diffuse into capillaries of the primary plexus of the hypophyseal portal system and are carried by the hypophyseal portal veins to the secondary plexus of the hypophyseal portal system for distribution to target cells in the anterior pituitary.**



TYPES OF ANTERIOR PITUITARY CELLS AND THEIR HORMONES

1. **Somatotrophs**, secrete human growth hormone (hGH), also known as somatotropin. Human growth hormone in turn stimulates several tissues to secrete insulin-like growth factors (IGFs), hormones that stimulate general body growth and regulate aspects of metabolism.

growth hormone hGH = somatotropin
insulin growth factors IGFs = somatomedian

2. **Thyrotrophs**, secrete thyroid-stimulating hormone (TSH), also known as thyrotropin. TSH controls the secretions and other activities of the thyroid gland.

غدد تناسلية

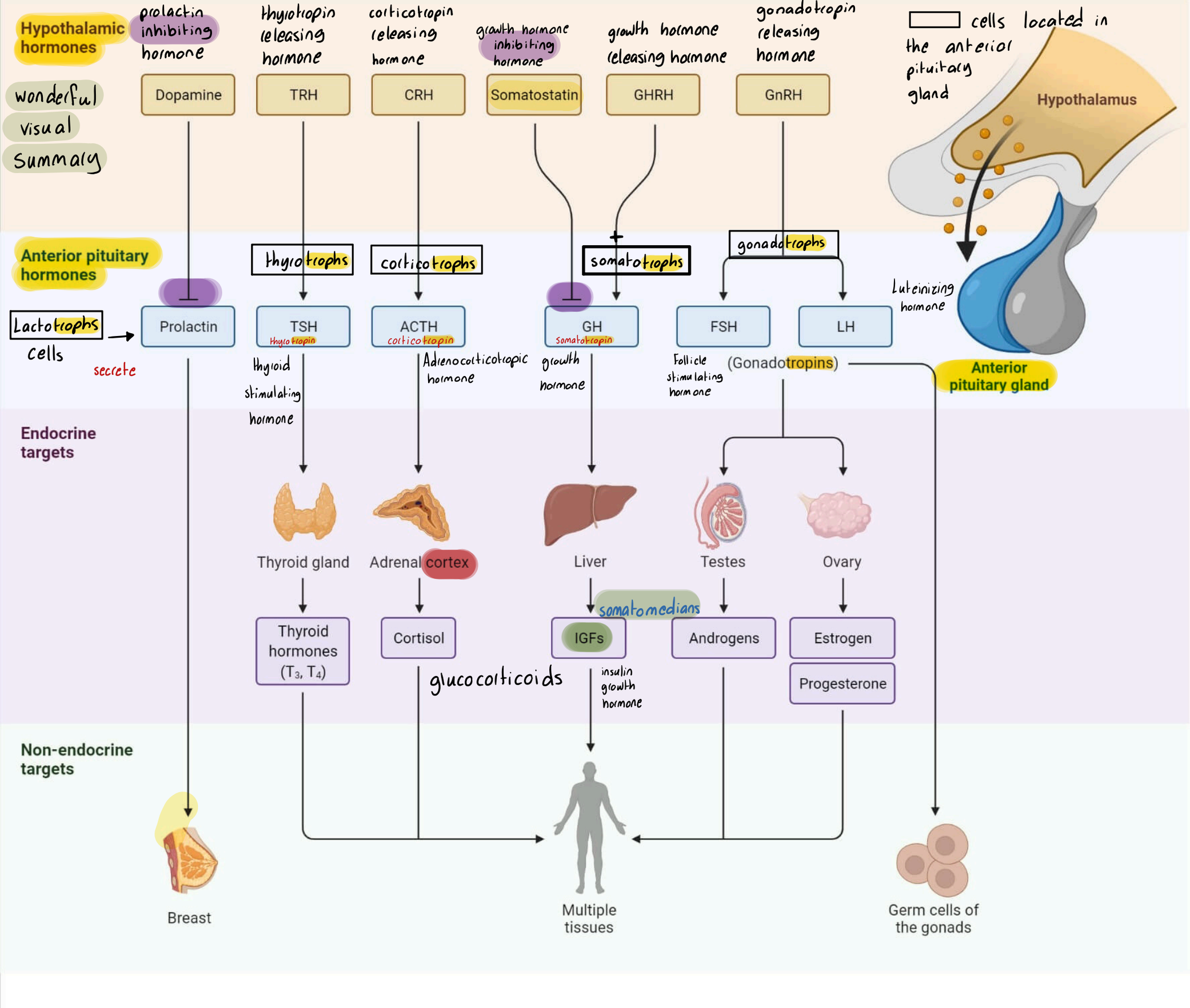
3. **Gonadotrophs**, secrete two gonadotropins: follicle-stimulating hormone (FSH) and luteinizing hormone. FSH and LH both act on the gonads. They stimulate secretion of estrogens and progesterone and the maturation of oocytes in the ovaries, and they stimulate sperm production and secretion of testosterone in the testes.

TYPES OF ANTERIOR PITUITARY CELLS AND THEIR HORMONES

4. **Lactotrophs**, secrete prolactin (PRL), which initiates milk production in the mammary glands.

5. **Corticotrophs**, secrete adrenocorticotropic hormone (ACTH), also known as corticotropin, which stimulates the adrenal cortex to secrete glucocorticoids such as cortisol.

glucose — cortex (adrenal gland) — steroid


Hypothalamic hormones
prolactin inhibiting hormone
thyrotropin releasing hormone
corticotropin releasing hormone
growth hormone inhibiting hormone
growth hormone releasing hormone
gonadotropin releasing hormone
cells located in the anterior pituitary gland
wonderful visual Summary
Dopamine
TRH
CRH
Somatostatin
GHRH
GnRH
Hypothalamus
Anterior pituitary hormones
thyrotrophs
corticotrophs
somatotrophs
gonadotrophs
Lactotrophs cells secrete
Prolactin
TSH
thyrotropin
ACTH
corticotropin
GH
somatotropin
FSH
LH
Luteinizing hormone
thyroid stimulating hormone
Adrenocorticotropic hormone
growth hormone
Follicle stimulating hormone
(Gonadotropins)
Anterior pituitary gland
Endocrine targets
Thyroid gland
Adrenal cortex
Liver
Testes
Ovary
somatomedians
Thyroid hormones (T_3, T_4)
Cortisol
IGFs
Androgens
Estrogen
Progesterone
glucocorticoids
insulin growth hormone
Non-endocrine targets
Breast
Multiple tissues
Germ cells of the gonads

CONTROL OF SECRETION BY THE ANTERIOR PITUITARY

TABLE 18.3

Hormones of the Anterior Pituitary 7

HORMONE	SECRETED BY	HYPOTHALAMIC RELEASING HORMONE (STIMULATES SECRETION)	HYPOTHALAMIC INHIBITING HORMONE (SUPPRESSES SECRETION)
Human growth hormone (hGH), also known as somatotropin	Somatotrophs.	Growth hormone–releasing hormone (GHRH), also known as somatocrinin.	Growth hormone–inhibiting hormone (GHIH), also known as somatostatin.
Thyroid-stimulating hormone (TSH), also known as thyrotropin	Thyrotrophs.	Thyrotropin-releasing hormone (TRH).	Growth hormone–inhibiting hormone (GHIH).
Follicle-stimulating hormone (FSH)	Gonadotrophs.	Gonadotropin-releasing hormone (GnRH).	—
Luteinizing hormone (LH)	Gonadotrophs.	Gonadotropin-releasing hormone (GnRH).	—
Prolactin (PRL)	Lactotrophs.	Prolactin-releasing hormone (PRH).*	Prolactin-inhibiting hormone (PIH), which is dopamine.
Adrenocorticotropic hormone (ACTH), also known as corticotropin	Corticotrophs.	Corticotropin-releasing hormone (CRH).	—
Melanocyte-stimulating hormone (MSH)	Corticotrophs.	Corticotropin-releasing hormone (CRH).	Dopamine.

*Thought to exist, but exact nature is uncertain.

HUMAN GROWTH HORMONE AND INSULIN-LIKE GROWTH FACTORS

- **Somatotrophs are the most numerous cells in the anterior pituitary, and human growth hormone (hGH) is the most plentiful anterior pituitary hormone.**

- **The main function of hGH** is to promote synthesis and secretion of small protein hormones called insulin-like growth factors or somatomedins.

IGFs

grows out
soma (body)

↳ mediator

- **In response to human growth hormone**, cells in the liver, skeletal muscles, cartilage, bones, and other tissues **secrete IGFs**, which may either enter the bloodstream from the liver or act locally in other tissues as autocrines or paracrines.

THE FUNCTIONS OF IGFS INCLUDE THE FOLLOWING:

1. IGFs **cause cells to grow and multiply** by increasing uptake of amino acids into cells and accelerating protein synthesis. Due to these effects of the IGFs, human growth hormone **increases the growth rate of the skeleton and skeletal muscles during childhood and the teenage years.** In adults, human growth hormone and IGFs help **maintain the mass of muscles and bones and promote healing of injuries and tissue repair.**

2. IGFs also **enhance lipolysis in adipose tissue**, which **results in increased use of the released fatty acids for ATP production by body cells.**

3. Human growth hormone and IGFs influence carbohydrate metabolism by **decreasing glucose uptake, which decreases the use of glucose for ATP production by most body cells**.

Functions of IGFs & hGH

causes cells to grow and multiply

How ?!

- By increasing amino acids ↑ into cells

+ Accelerating protein synthesis

hGH → increase the GR of skeleton / skeletal muscles] childhood teenage years

hGH / IGFs → maintain the mass of muscles and bones
- promote healing of injuries and tissue repair] Adult

enhance lipolysis in adipose tissue

= increased use of Fatty acid for ATP production

influence carbohydrate metabolism

How?

- decrease glucose uptake

↳ decrease use of glucose for ATP production

=

ارتفاع elevation of blood glucose concentration

THE FUNCTIONS OF IGFS INCLUDE THE FOLLOWING:

- **Somatotrophs in the anterior pituitary release bursts of human growth hormone every few hours, especially during sleep.**

- **Their secretory activity is controlled mainly by two hypothalamic hormones:** (1) growth hormone–releasing hormone (GHRH) promotes secretion of human growth hormone, and (2) growth hormone–inhibiting hormone (GHIH) suppresses it.

- A major regulator of GHRH and GHIH secretion is the blood glucose level.

وسؤال عن اي من العوامل يثبط شغل human growth hormone

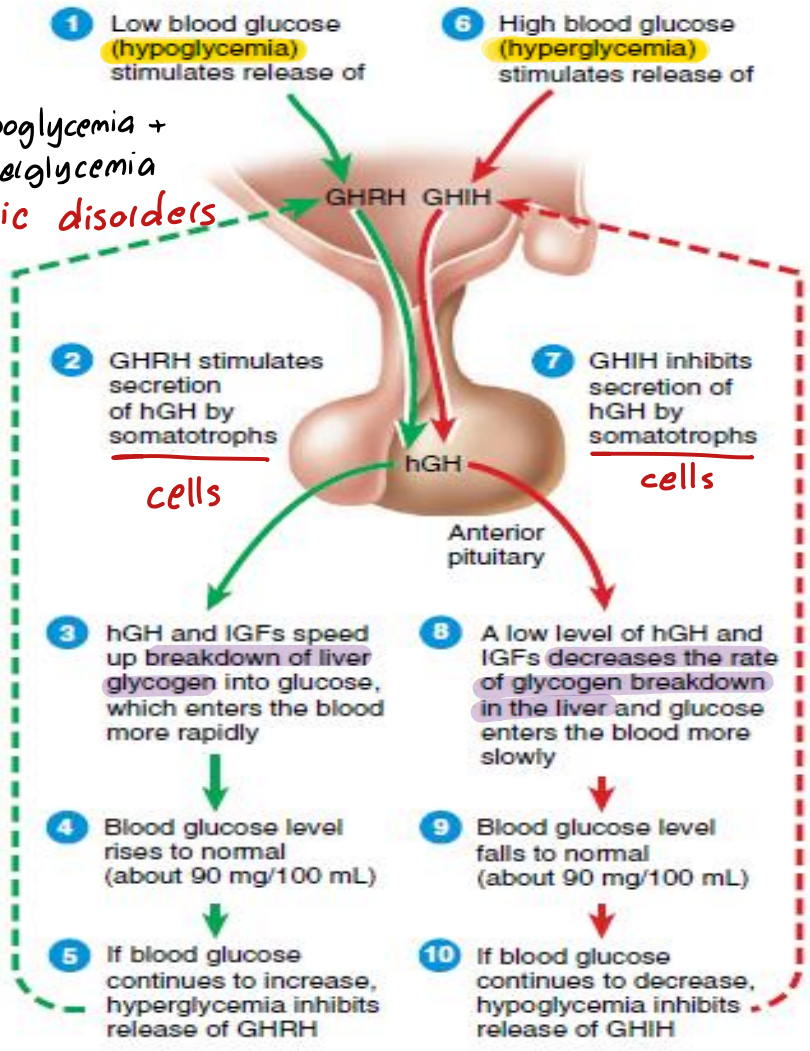
جوابه somatostatin اللي هو GHIH

NEGATIVE FEEDBACK REGULATION OF HYPOTHALAMIC NEUROSECRETORY CELLS AND ANTERIOR PITUITARY CORTICOTROPHS

Secretion of hGH is stimulated by growth hormone–releasing hormone (GHRH) and inhibited by growth hormone–inhibiting hormone (GHIH).

hypoglycemia + hyperglycemia

pancreatic disorders



OTHER STIMULI THAT PROMOTE SECRETION OF HUMAN GROWTH HORMONE

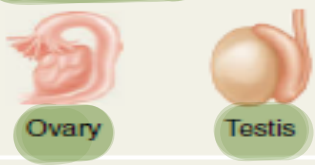
1. Decreased fatty acids and increased amino acids in the blood. Fat ↓ Amino ↑
2. Deep sleep (stages 3 and 4 of non-rapid eye movement sleep).
3. Increased activity of the sympathetic division of the autonomic nervous system, such as might occur with stress or vigorous physical exercise.
4. Other hormones, including glucagon, estrogens, cortisol, and insulin.

FACTORS THAT INHIBIT HUMAN GROWTH HORMONE SECRETION

1. Increased levels of fatty acids and decreased levels of amino acids in the blood.
2. Rapid eye movement sleep.
3. Emotional deprivation.
4. Obesity.
5. Low levels of thyroid hormones and human growth hormone itself (through negative feedback).
6. Growth hormone–inhibiting hormone (GHIH), alternatively known as somatostatin, also inhibits the secretion of human growth hormone.

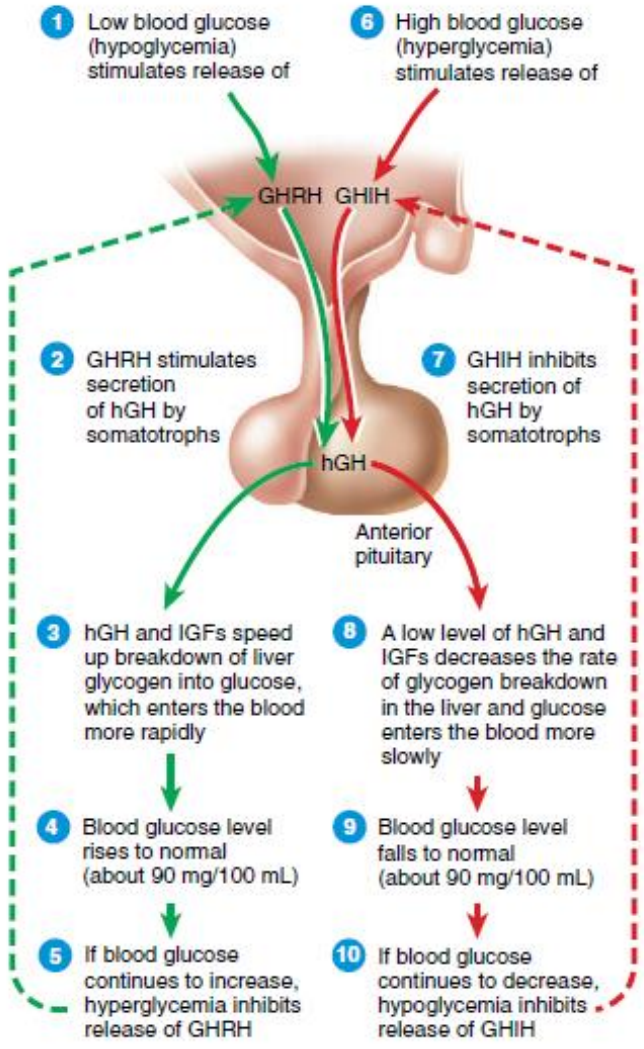
TABLE 18.4

Summary of the Principal Actions of Anterior Pituitary Hormones

HORMONE	TARGET TISSUES	PRINCIPAL ACTIONS
Human growth hormone (hGH), also known as somatotropin	 Liver (and other tissues)	Stimulates liver, muscle, cartilage, bone, and other tissues to synthesize and secrete insulinlike growth factors (IGFs); IGFs promote growth of body cells, protein synthesis, tissue repair, lipolysis, and elevation of blood glucose concentration.
Thyroid-stimulating hormone (TSH), also known as thyrotropin	 Thyroid gland	Stimulates synthesis and secretion of thyroid hormones by thyroid gland.
Follicle-stimulating hormone (FSH)	 Ovary, Testis	In females, initiates development of oocytes and induces ovarian secretion of estrogens. In males, stimulates testes to produce sperm.
Luteinizing hormone (LH)	 Ovary, Testis	In females, stimulates secretion of estrogens and progesterone, ovulation, and formation of corpus luteum. In males, stimulates testes to produce testosterone.
Prolactin (PRL)	 Mammary glands	Together with other hormones, promotes milk production by mammary glands.
Adrenocorticotropic hormone (ACTH), also known as corticotropin	 Adrenal cortex	Stimulates secretion of glucocorticoids (mainly cortisol) by adrenal cortex.
Melanocyte-stimulating hormone (MSH)	 Brain	Exact role in humans is unknown but may influence brain activity; when present in excess, can cause darkening of skin.

EFFECTS OF HUMAN GROWTH HORMONE (HGH) AND INSULIN-LIKE GROWTH FACTORS (IGFS)

Secretion of hGH is stimulated by growth hormone–releasing hormone (GHRH) and inhibited by growth hormone–inhibiting hormone (GHIH).



Does not synthesize hormones.

Releases the following hormones:

1. Oxytocin
2. Antidiuretic Hormone (ADH) = Vasopressin

POSTERIOR PITUITARY

معلومة جديدة كليك؟ Nope

- **Although the posterior pituitary or neurohypophysis does not synthesize hormones**, it does store and release two hormones (oxytocin (OT) and antidiuretic hormone (ADH), also called vasopressin). synthesized in the hypothalamus

- After their production in the cell bodies of neurosecretory cells, **oxytocin and antidiuretic hormone are packaged into secretory vesicles**, which move by fast axonal transport to the axon terminals in the posterior pituitary, where they are stored until nerve impulses trigger exocytosis and release of the hormone.

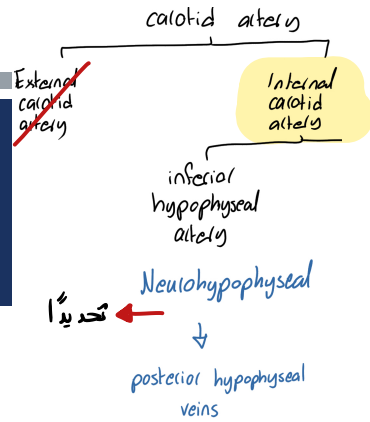
19- ADH and Oxytocin relase from the (posterior pituitary gland)

14. From where are antidiuretic hormone and oxytocin released?

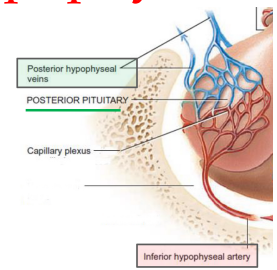
A. the anterior pituitary
B. the posterior pituitary
C. the adrenal cortex
D. the adrenal medulla

Answer is B: ADH & OT are produced in the hypothalamus and transported to the posterior pituitary.

POSTERIOR PITUITARY



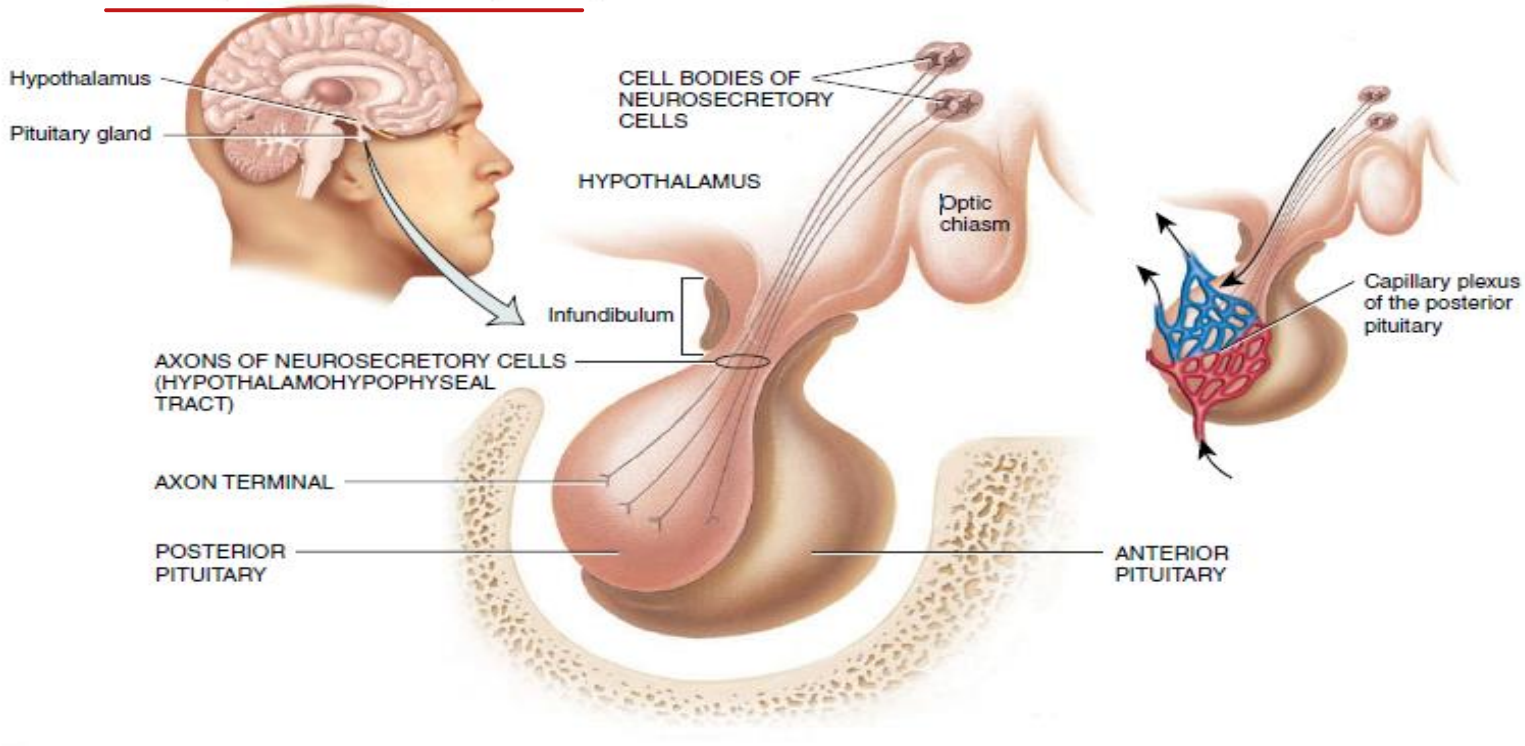
- Blood is supplied to the posterior pituitary by the inferior hypophyseal arteries, which branch from the internal carotid arteries.
- **In the posterior pituitary**, the inferior hypophyseal arteries drain into the capillary plexus of the infundibular process, a capillary network that receives secreted oxytocin and antidiuretic hormone.
- From this plexus, hormones pass into the posterior hypophyseal veins for distribution to target cells in other tissues.



THE HYPOTHALAMOHYPOPHYSEAL TRACT

Figure 18.8 **The hypothalamohypophyseal tract.** Axons of hypothalamic neurosecretory cells form the hypothalamohypophyseal tract, which extends from the paraventricular and supraoptic nuclei to the posterior pituitary. Hormone molecules synthesized in the cell body of a neurosecretory cell are packaged into secretory vesicles that move down to the axon terminals. Nerve impulses trigger exocytosis of the vesicles, thereby releasing the hormone.

Oxytocin and antidiuretic hormone are synthesized in the hypothalamus and released into the capillary plexus of the infundibular process in the posterior pituitary.



CONTROL OF SECRETION BY THE POSTERIOR PITUITARY

TABLE 18.5

Summary of Posterior Pituitary Hormones

HORMONE AND TARGET TISSUES	CONTROL OF SECRETION	PRINCIPAL ACTIONS
Oxytocin (OT)  Uterus  Mammary glands	Neurosecretory cells of hypothalamus secrete OT in response to uterine distension and stimulation of nipples.	Stimulates contraction of smooth muscle cells of uterus during childbirth; stimulates contraction of myoepithelial cells in mammary glands to cause milk ejection.
Antidiuretic hormone (ADH) or vasopressin  Kidneys  Sudoriferous (sweat) glands  Arterioles	Neurosecretory cells of hypothalamus secrete ADH in response to elevated blood osmotic pressure, dehydration, loss of blood volume, pain, or stress; inhibitors of ADH secretion include low blood osmotic pressure, high blood volume, and alcohol.	Conserves body water by decreasing urine volume; decreases water loss through perspiration; raises blood pressure by constricting arterioles.

dehydration
water↓ Na↑
osmolarity↑
BV↓

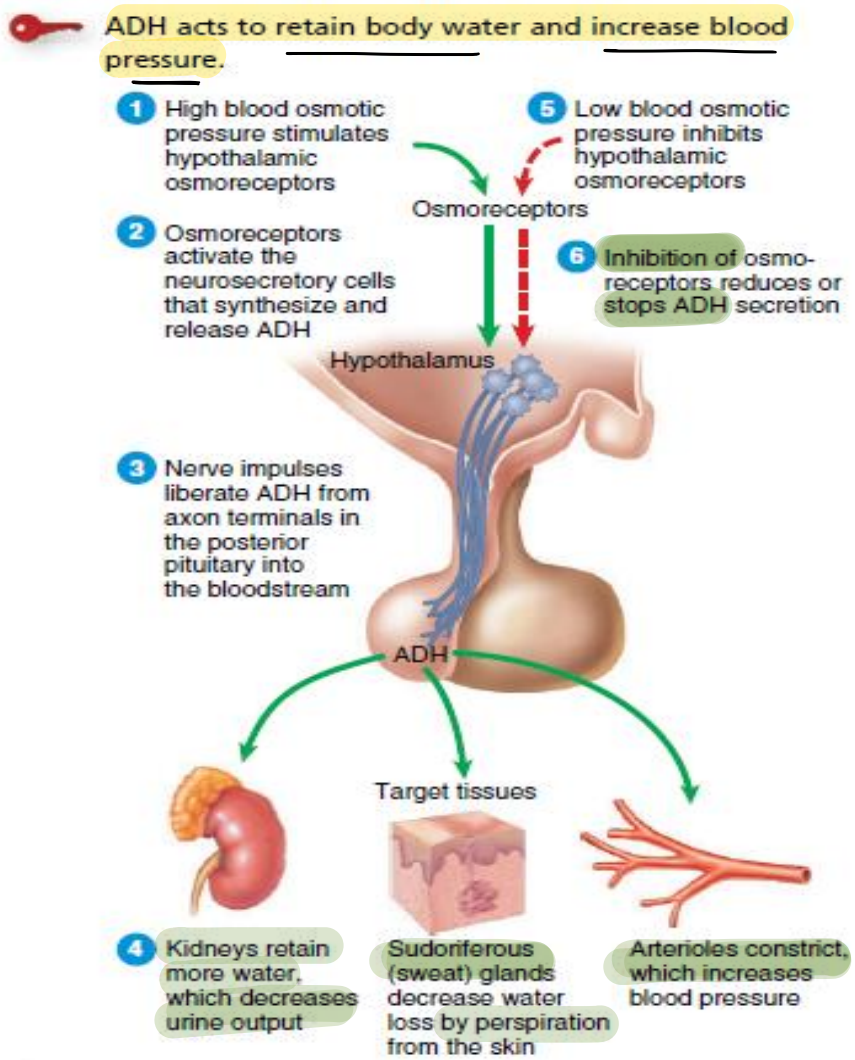
يعزز بقاي الطاقات

BP ↑

وظيفة

REGULATION OF SECRETION AND ACTIONS OF ANTIDIURETIC HORMONE (ADH).

Figure 18.9 Regulation of secretion and actions of antidiuretic hormone (ADH).



THYROID GLAND

- **The butterfly-shaped thyroid gland** is located just inferior to the larynx (voice box).

- The thyroid gland is the only endocrine gland that stores its secretory product in large quantities—normally about a 100-day supply.

STEPS IN THE SYNTHESIS AND SECRETION OF THYROID HORMONES.

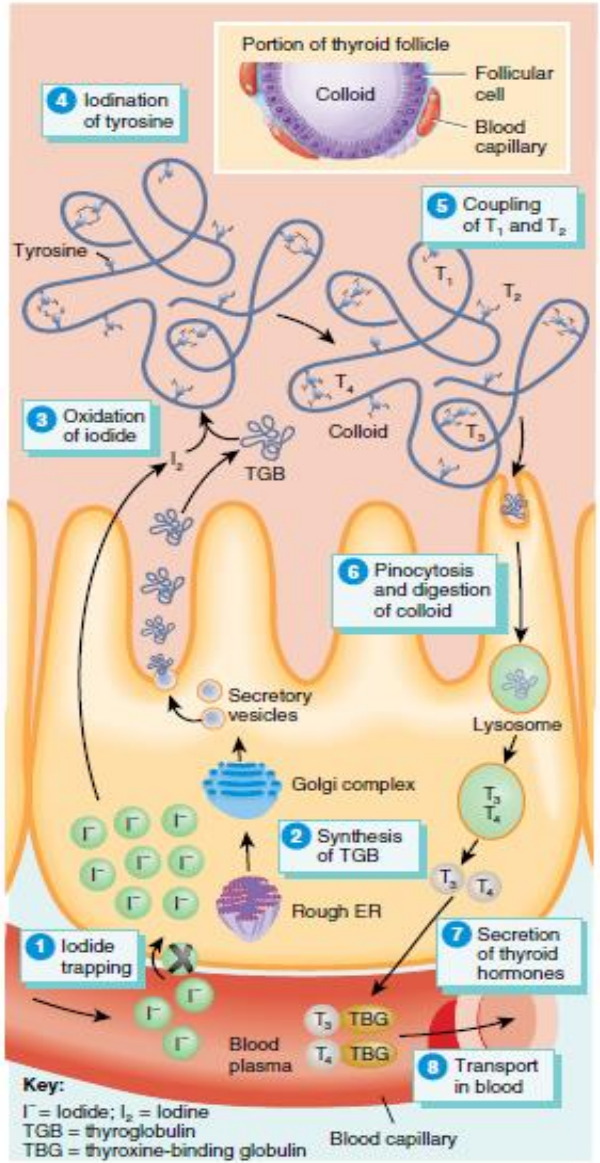
8 steps

I^-

- **Iodide trapping**: Thyroid follicular cells trap iodide ions by actively transporting them from the blood into the cytosol. As a result, the thyroid gland normally contains most of the iodide in the body.
- **Synthesis of thyroglobulin**: While the follicular cells are trapping iodide ions, they are also synthesizing thyroglobulin (TGB), a large glycoprotein that is released into the lumen of the follicle.
- **Oxidation of iodide**: Some of the amino acids in TGB are tyrosines that will become iodinated. However, negatively charged iodide ions cannot bind to tyrosine until they undergo oxidation (removal of electrons) to iodine large glycoprotein that is released into the lumen of the follicle. As the iodide ions are being oxidized, they pass through the membrane into the lumen of the follicle.

I^- + tyrosine ✗

↳ oxidation ⟶ I_2 + tyrosine ✓



STEPS IN THE SYNTHESIS AND SECRETION OF THYROID HORMONES.

- **Iodination of tyrosine**: As iodine molecules (I_2) form, they react with tyrosines that are part of thyroglobulin molecules. Binding of one iodine atom yields monoiodotyrosine (T_1), and a second iodination produces diiodotyrosine (T_2). The TGB with attached iodine atoms, a sticky material that accumulates and is stored in the lumen of the thyroid follicle, is termed colloid.

1 I_2 bind → T_1
2 I_2 bind → T_2

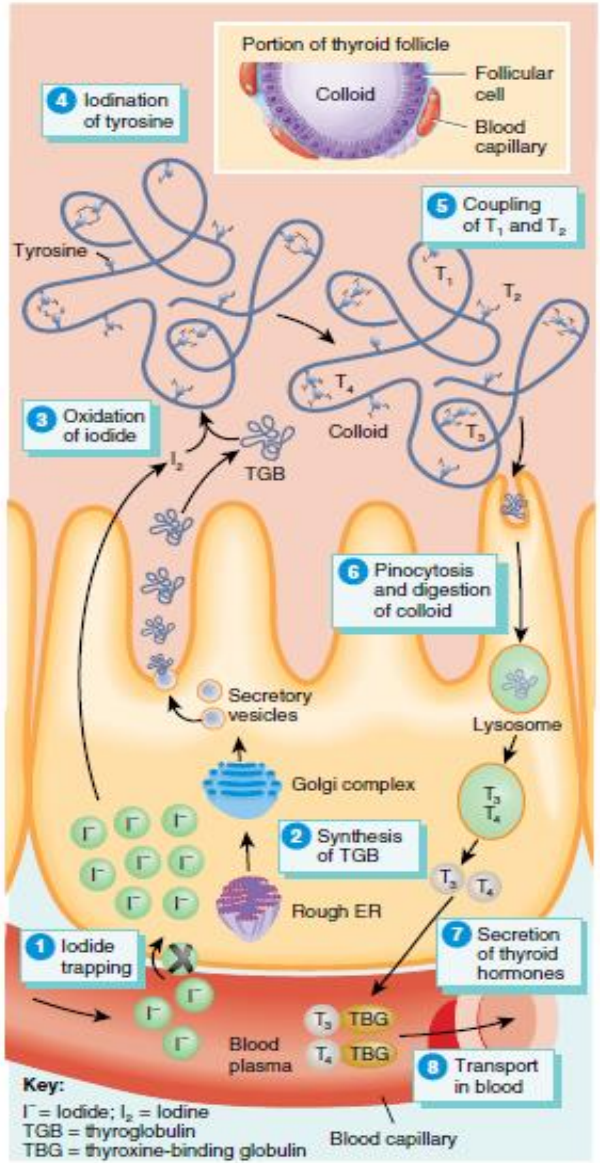
- **Coupling of T_1 and T_2**: During the last step in the synthesis of thyroid hormone, two T_2 molecules join to form T_4, or one T1 and one T_2 join to form T_3.

$$T_2 + T_2 = T_4$$
$$T_1 + T_2 = T_3$$

easy math

- **Pinocytosis and digestion of colloid**: Droplets of colloid reenter follicular cells by pinocytosis and merge with lysosomes. Digestive enzymes in the lysosomes break down TGB, cleaving off molecules of T_3 and T_4.

release

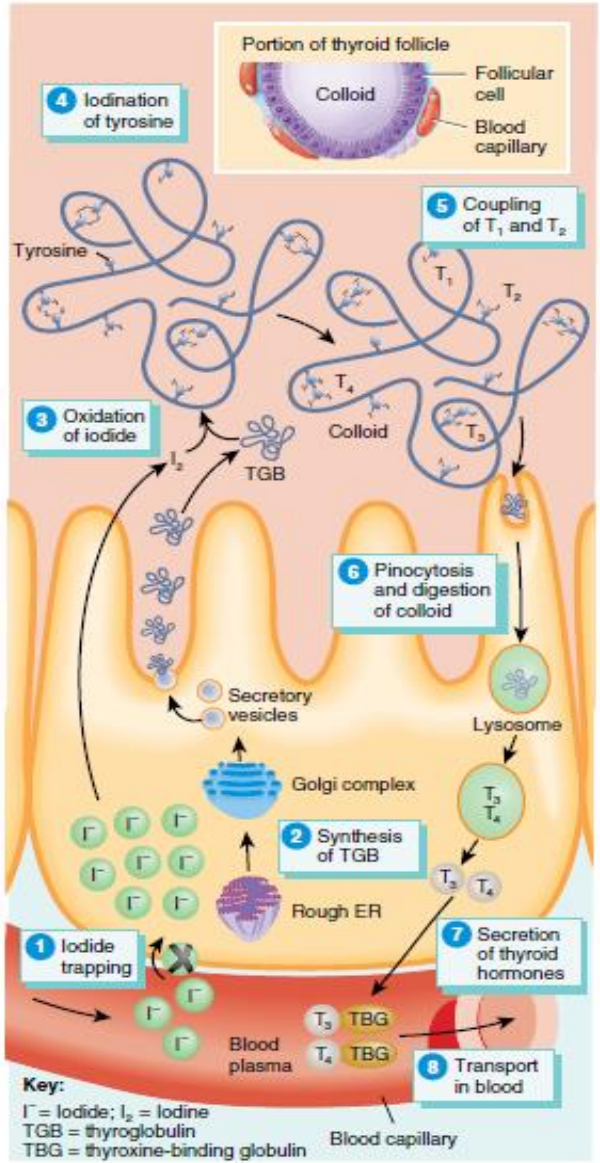


STEPS IN THE SYNTHESIS AND SECRETION OF THYROID HORMONES.

- **Secretion of thyroid hormones**: Because T_3 and T_4 are lipid soluble, they diffuse through the plasma membrane into interstitial fluid and then into the blood. T_4 normally is secreted in greater quantity than T3, but T3 is several times more potent. Moreover, after T4 enters a body cell, most of it is converted to T3 by removal of one iodine.

active Form

- **Transport in the blood**: More than 99% of both the T3 and the T4 combine with transport proteins in the blood, mainly thyroxine-binding globulin (TBG).



4. What hormone does the thyroid produce?

   A. thyroid stimulating hormone
   B. calcitriol
   C. thyroxine
   D. parathyroid hormone

   Answer is C: Thyroxine (or tetra-iodothyronine) is converted to tri-iodothyronine in target tissues.

ACTIONS OF THYROID HORMONES

T_3 / T_4

1. Thyroid hormones **increase basal metabolic rate (BMR), the rate of oxygen consumption under standard or basal conditions (awake, at rest, and fasting)**, by stimulating the use of cellular oxygen to produce ATP. **When the basal metabolic rate increases, cellular metabolism of carbohydrates, lipids, and proteins increases**.

BMR ↑ → oxygen use ↑ → ATP production ↑ → carbs, Fats, proteins metabolism ↑

2. Second major effect of thyroid hormones is **to stimulate synthesis of additional sodium–potassium pumps,** which use large amounts of ATP to continually eject sodium ions from the cytosol into the extracellular fluid and potassium ions from the extracellular fluid into the cytosol.

3. Thyroid hormones play an important role in **the maintenance of normal body temperature**. Normal mammals can survive in freezing temperatures, but those whose thyroid glands have been removed cannot.

ACTIONS OF THYROID HORMONES

4. In the regulation of metabolism, **the thyroid hormones stimulate protein synthesis and increase the use of glucose and fatty acids for ATP production.** They also **increase lipolysis** and **enhance cholesterol excretion**, thus **reducing blood cholesterol level**.

protein synthesize ↑ use of glucose/fatty acids ↑ cholesterol excretion ↑ cholesterol levels in blood ↓

5. The thyroid hormones **enhance some actions of the catecholamines (norepinephrine and epinephrine) because they upregulate beta receptors**. For this reason, **symptoms of hyperthyroidism include increased heart rate, more forceful heartbeats, and increased blood pressure**.

HR ↑ BP ↑ contraction ↑ كلهم يزيد ∀

6. Together with human growth hormone and insulin, thyroid hormones **accelerate body growth, particularly the growth of the nervous and skeletal systems. Deficiency of thyroid hormones during fetal development, infancy, or childhood causes severe mental retardation and stunted bone growth**.

TH + hGH + IGFs —> accelerate body growth (Nervous Skeletal systems) بطء توقف

Question 34 / 40

All of the following are true regarding thyroid gland and its hormones, EXCEPT:

1. ○ Thyroid hormones play an important role in the maintenance of normal body temperature. ✓
2. ○ Together with human growth hormone and insulin, thyroid hormones accelerate body growth, particularly the growth of the nervous and skeletal systems.
3. ○ The thyroid gland is the only endocrine gland that stores its secretory product in large quantities. ✓
4. ● Thyroid hormones decrease basal metabolic rate

Next

CONTROL OF THYROID HORMONE SECRETION

Figure 18.12 **Regulation of secretion and actions of thyroid hormones.** TRH = thyrotropin-releasing hormone, TSH = thyroid-stimulating hormone, T_3 = triiodothyronine, and T_4 = thyroxine (tetraiodothyronine).

TSH promotes release of thyroid hormones (T_3 and T_4) by the thyroid gland.

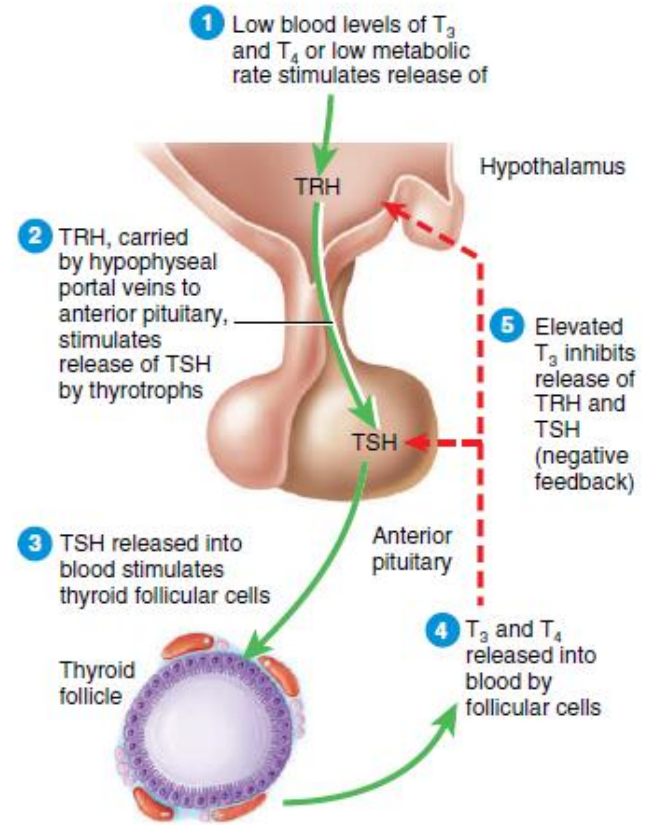
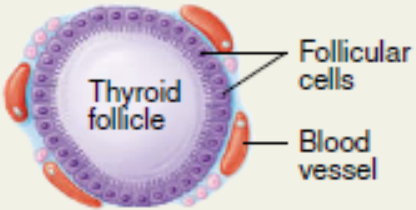
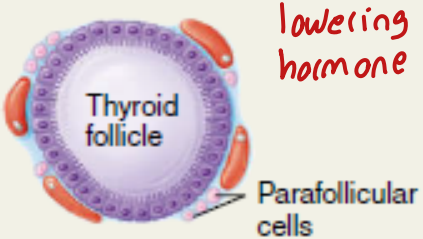


TABLE 18.6

Summary of Thyroid Gland Hormones

HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
T_3 (triiodothyronine) and **T_4 (thyroxine)** or thyroid hormones from follicular cells 	Secretion is increased by thyrotropin-releasing hormone (TRH), which stimulates release of thyroid-stimulating hormone (TSH) in response to low thyroid hormone levels, low metabolic rate, cold, pregnancy, and high altitudes; TRH and TSH secretions are inhibited in response to high thyroid hormone levels; high iodine level suppresses T_3/T_4 secretion.	Increase basal metabolic rate; stimulate synthesis of proteins; increase use of glucose and fatty acids for ATP production; increase lipolysis; enhance cholesterol excretion; accelerate body growth; contribute to development of nervous system.
Calcitonin (CT) from parafollicular cells 	High blood Ca^{2+} levels stimulate secretion; low blood Ca^{2+} levels inhibit secretion.	Lowers blood levels of Ca^{2+} and HPO_4^{2-} by inhibiting bone resorption by osteoclasts and by accelerating uptake of calcium and phosphates into bone extracellular matrix.

BMR ↑

calcium lowering hormone

C cells

Ca^+ ↑ → calcitonin is released

Ca^+ ↓ → calcitonin is inhibited

PARATHYROID GLANDS

chef cells
oxyphil cells
PTH

Microscopically, **the parathyroid glands contain two kinds of epithelial cells**. The more numerous cells, called **chief cells or principal cells**, **produce parathyroid hormone (PTH)**, also called parathormone. The function of the other kind of cell, called an **oxyphil cell**, **is not known in a normal parathyroid gland. However, its presence clearly helps to identify the parathyroid gland histologically due to its unique staining characteristics. Furthermore, in a cancer of the parathyroid glands, oxyphil cells secrete excess PTH.**

PARATHYROID HORMONE

- Parathyroid hormone is the **major regulator of the levels of calcium, magnesium, and phosphate ions in the blood.**
- The specific action of PTH is **to increase the number and activity of osteoclasts**. The result is **elevated bone resorption, which releases ionic calcium and phosphates into the blood**.
- PTH also **acts on the kidneys**:
  - ✓ First, it **slows the rate at which calcium and magnesium are lost from blood into the urine**.
  - ✓ Second, it **increases loss of phosphates from blood into the urine**. Because more phosphates is lost in the urine than is gained from the bones, **PTH decreases blood phosphates level and increases blood calcium and magnesium levels.**
  - ✓ A third effect of PTH on the kidneys is to **promote formation of the hormone calcitriol**, **the active form of vitamin D. Calcitriol, also known as 1,25-dihydroxyvitamin D3, increases the rate of calcium, phosphates and magnesium absorption from the gastrointestinal tract into the blood.**

Ca^{+2} lowering hormone

increase Ca^{+2} absorption of gi

gure 18.14 The roles of calcitonin (green arrows), parathyroid hormone (blue arrows), and calcitriol (orange arrows) in calcium homeostasis.

parafollicular cells

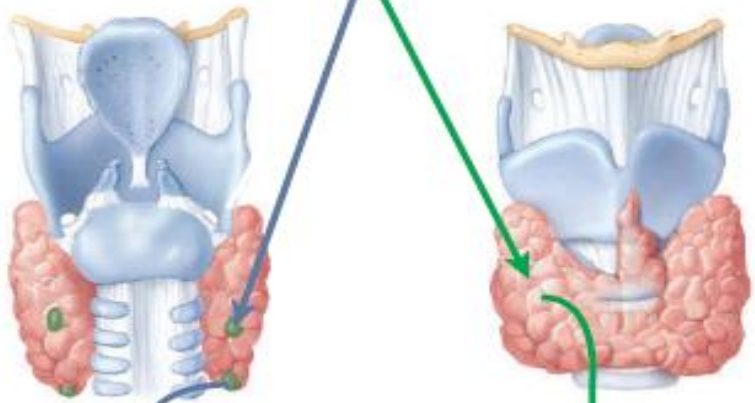
With respect to regulation of blood Ca^{2+} level, calcitonin and PTH are antagonists.

↳ secreted of chief cells of parathyroid gland

secreted by C cells in thyroid gland

1 High level of Ca^{2+} in blood stimulates thyroid gland parafollicular cells to release more CT.

3 Low level of Ca^{2+} in blood stimulates parathyroid gland chief cells to release more PTH.



6 CALCITRIOL stimulates increased absorption of Ca^{2+} from foods, which increases blood Ca^{2+} level.

5 PTH also stimulates the kidneys to release CALCITRIOL.

4 PARATHYROID HORMONE (PTH) promotes release of Ca^{2+} from bone extracellular matrix into blood and slows loss of Ca^{2+} in urine, increasing blood Ca^{2+} level.

2 CALCITONIN (CT) inhibits osteoclasts, decreasing blood Ca^{2+} level.

What are the primary target tissues for PTH, CT, and calcitriol?

TABLE 18.7

Summary of Parathyroid Gland Hormone

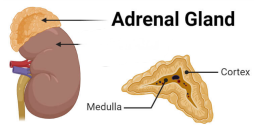
HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
 **Parathyroid hormone (PTH)** from chief cells	Low blood Ca^{2+} levels stimulate secretion; high blood Ca^{2+} levels inhibit secretion.	Increases blood Ca^{2+} and Mg^{2+} levels and decreases blood HPO_4^{2-} level; increases bone resorption by osteoclasts; increases Ca^{2+} reabsorption and HPO_4^{2-} excretion by kidneys; promotes formation of calcitriol (active form of vitamin D), which increases rate of dietary Ca^{2+} and Mg^{2+} absorption.

وظيفتها promote calcitriol formation
↳ increase Ca^{+2}

ADRENAL GLANDS

cortex
medulla

- During embryonic development, the **adrenal glands differentiate into two structurally and functionally distinct regions:** a large, peripherally located **adrenal cortex**, comprising 80–90% of the gland, and a small, centrally located **adrenal medulla**.



- The **adrenal cortex** produces **steroid hormones** that are essential for life (i.e. **mineralocorticoids** which they affect **mineral homeostasis**, **glucocorticoids** primarily **cortisol**, so named because they affect **glucose homeostasis**). **Complete loss of adrenocortical hormones leads to death due to dehydration and electrolyte imbalances in a few days to a week, unless hormone replacement therapy begins promptly**.

- **The adrenal medulla produces three catecholamine hormones—norepinephrine, epinephrine, and a small amount of dopamine**.

NOR EP

EP

MINERALOCORTICOIDS

where ever sodium goes water follows

minerals

cortex

steroid

increase blood volume BV↑ BP↑

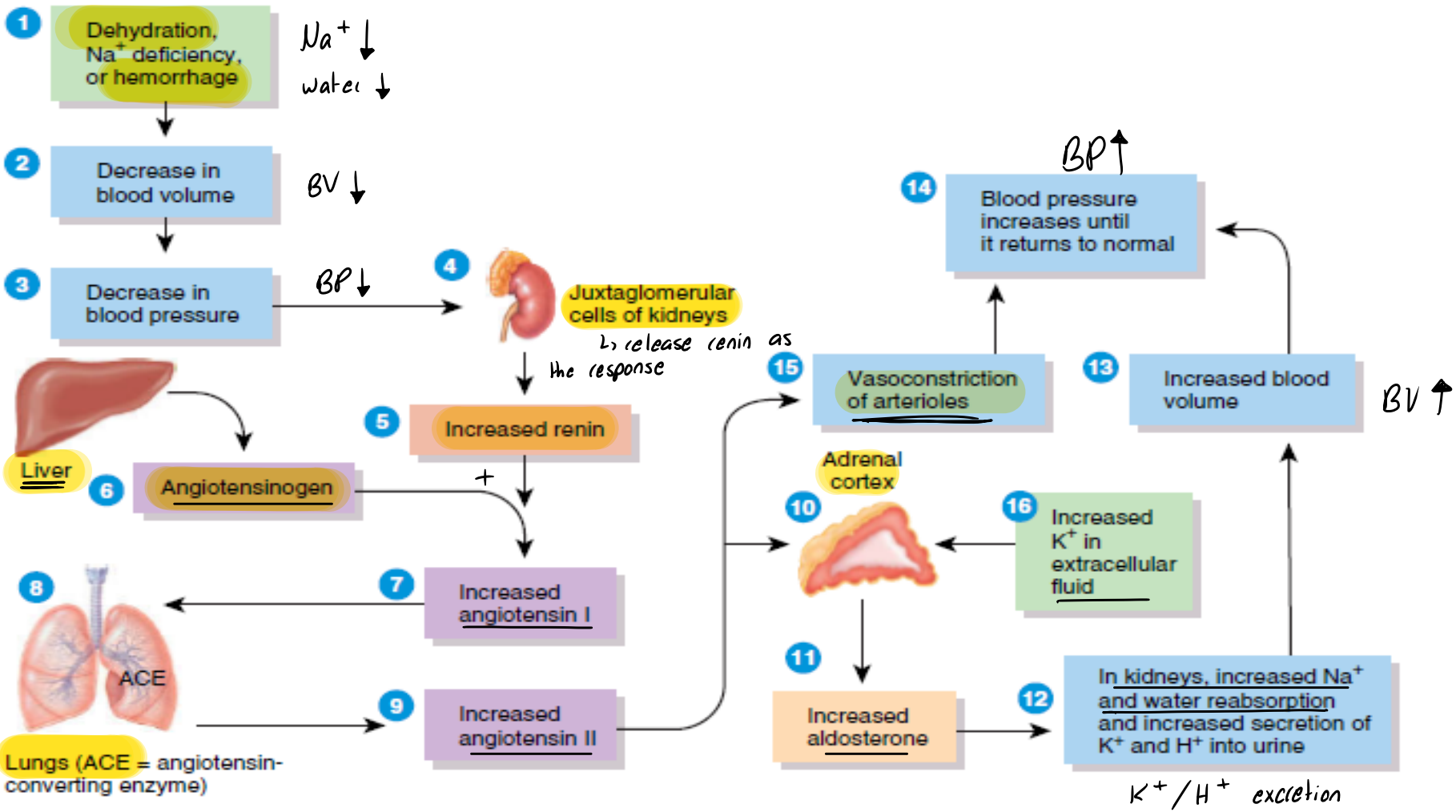
Aldosterone is the major mineralocorticoid. It **regulates homeostasis of two mineral ions—namely, sodium ions and potassium ions**—and **helps adjust blood pressure and blood volume**. Aldosterone also **promotes excretion of hydrogen ions in the urine; this removal of acids from the body can help prevent acidosis (blood pH below 7.35).**

H^+

RAAS system

Figure 18.16 Regulation of aldosterone secretion by the renin–angiotensin–aldosterone (RAA) pathway.

Aldosterone helps regulate blood volume, blood pressure, and levels of Na^+, K^+, and H^+ in the blood.



4-function the aldosterone (absorption the Na in the kidney)

stress اعتبره هرمون الـ

GLUCOCORTICOIDS = cortisol

glucose / cortex / steroid

- The glucocorticoids, which **regulate metabolism and resistance to stress**, include **cortisol (also called hydrocortisone), corticosterone, and cortisone**.

- **Glucocorticoids have the following effects:** (6)

1. **Protein breakdown**: Glucocorticoids increase the rate of protein breakdown, mainly in muscle fibers, and thus increase the liberation of amino acids into the bloodstream. The amino acids may be used by body cells for synthesis of new proteins or for ATP production.
2. **Glucose formation**: On stimulation by glucocorticoids, liver cells may convert certain amino acids or lactic acid to glucose, which neurons and other cells can use for ATP production. Such conversion of a substance other than glycogen or another monosaccharide into glucose is called gluconeogenesis.

Gluconeogenesis is:

> The formation of glucose from substances that are **not carbohydrates** (not glycogen and not simple sugars).

monosaccharide

GLUCOCORTICOIDS

- **Glucocorticoids have the following effects:**

3. **Lipolysis**: Glucocorticoids stimulate lipolysis, the breakdown of triglycerides and release of fatty acids from adipose tissue into the blood.
4. **Resistance to stress**: The additional glucose supplied by the liver cells provides tissues with a ready source of ATP to combat a range of stresses, including exercise, fasting, fright, temperature extremes, high altitude, bleeding, infection, surgery, trauma, and disease.
5. **Anti-inflammatory effects**: Glucocorticoids inhibit white blood cells that participate in inflammatory responses. Unfortunately, glucocorticoids also retard tissue repair; as a result, they slow wound healing. Although high doses can cause severe mental disturbances, glucocorticoids are very useful in the treatment of chronic inflammatory disorders such as rheumatoid arthritis.

GLUCOCORTICOIDS

- **Glucocorticoids have the following effects:**

6. **Depression of immune responses: High doses of glucocorticoids depress immune responses. For this reason, glucocorticoids are prescribed for organ transplant recipients to retard tissue rejection by the immune system.**

متلقي

very interesting ↗ يبطأ

Which of the following is a function of glucocorticoids?

1. ⊘ Increased blood glucose.
2. ○ Increased inflammatory response.
3. ○ Decreased lipolysis.
4. ○ Increased stresses.

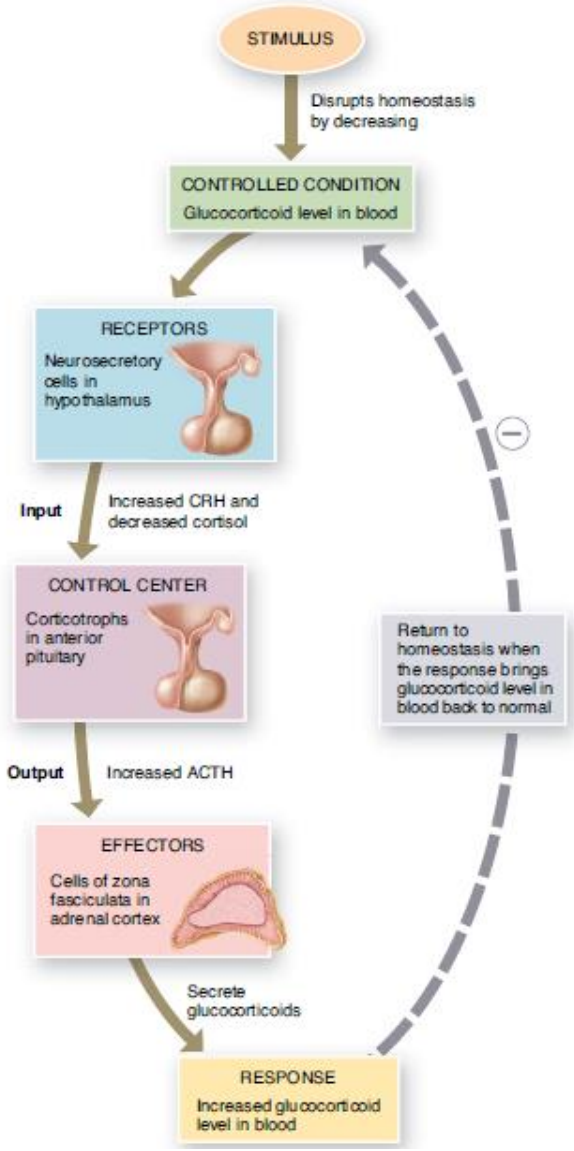
NEGATIVE FEEDBACK REGULATION OF GLUCOCORTICOID SECRETION

- A high level of corticotropin-releasing hormone (CRH) and a low level of glucocorticoids promote the release of adrenocorticotropic (ACTH), which stimulates glucocorticoid secretion by the adrenal cortex.

- hypothalamus hormone

by corticotrophs cells

anterior pituitary hormone



CONTROL OF GLUCOCORTICOID SECRETION

- **Androgens:** secreted by
  - testes: main source in males
  - adrenal glands: small amount to both

- In both males and females, **the adrenal cortex secretes small amounts of weak androgens**. **The major androgen secreted by the adrenal gland is dehydroepiandrosterone (DHEA).**

- After puberty in males, the androgen testosterone is also released in much greater quantity by the testes. Thus, **the amount of androgens secreted by the adrenal gland in males is usually so low that their effects are insignificant**. **In females, however, adrenal androgens play important roles.** They ① promote libido (sex drive) and ② are converted into estrogens (feminizing sex steroids) by other body tissues. After menopause, when ovarian secretion of estrogens ceases, all female estrogens come from conversion of adrenal androgens. to estrogens

يتوقف

12-the dehydroeplandrosterone and testosterone bind with the receptor in target cell (True)

Lipid soluble hormones

ADRENAL MEDULLA

nervous system تبع ⟹ EP / NOR EP
80% 20%

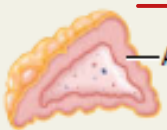
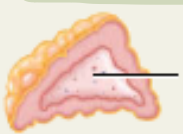
- The inner region of the adrenal gland, the adrenal medulla, is a modified sympathetic ganglion of the autonomic nervous system (ANS).

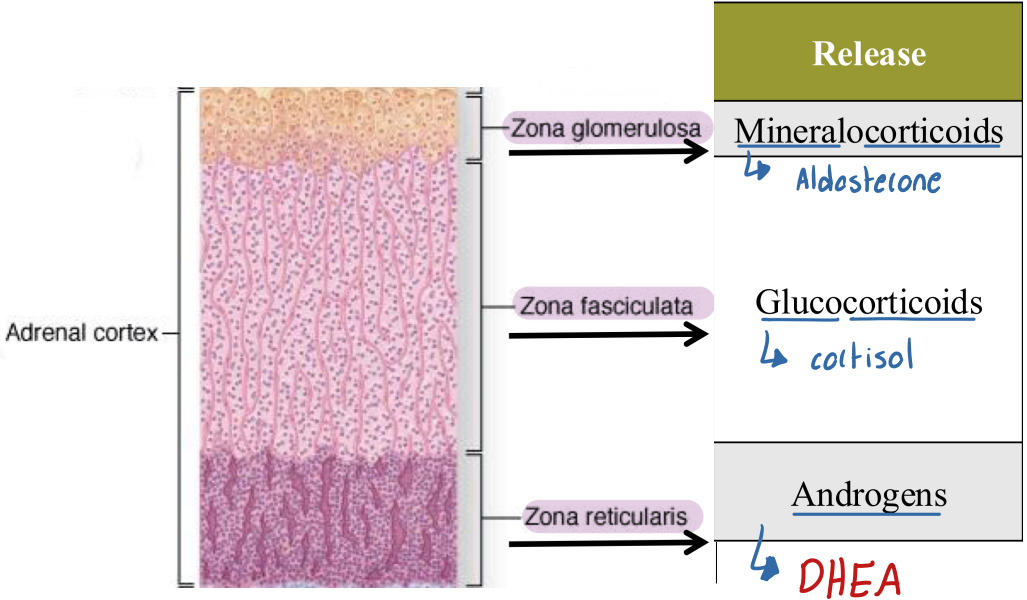
- **The cells of the adrenal medulla secrete hormones. The hormone-producing cells, called chromaffin cells, are innervated by sympathetic preganglionic neurons of the ANS. Because the ANS exerts direct control over the chromaffin cells, hormone release can occur very quickly.**

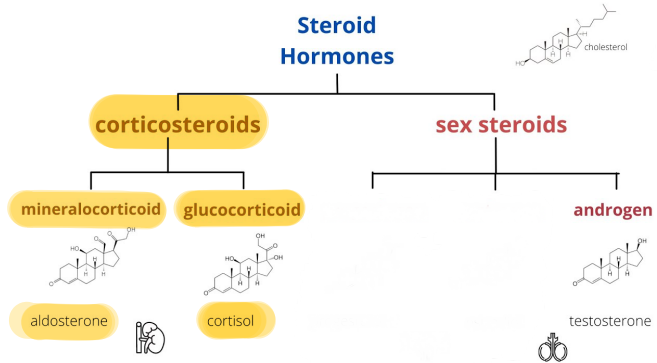
- **The two major hormones synthesized by the adrenal medulla are epinephrine and norepinephrine (NE), also called adrenaline and noradrenaline, respectively.** The chromaffin cells of the adrenal medulla **secrete an unequal amount of these hormones—about 80% epinephrine and 20% norepinephrine.** The hormones of the adrenal medulla intensify sympathetic responses that occur in other parts of the body.

TABLE 18.8

Summary of Adrenal Gland Hormones

HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
ADRENAL CORTEX HORMONES	→ Na↓ water↓ BV↓ BP↓ RAAS system	
Mineralocorticoids (mainly aldosterone) from zona glomerulosa cells	Increased blood K^+ level and angiotensin II stimulate secretion.	Increase blood levels of Na^+ and water; decrease blood level of K^+.
Glucocorticoids (mainly cortisol) from zona fasciculata cells	ACTH stimulates release; corticotropin-releasing hormone (CRH) promotes ACTH secretion in response to stress and low blood levels of glucocorticoids.	Increase protein breakdown (except in liver), stimulate gluconeogenesis and lipolysis, provide resistance to stress, dampen inflammation, depress immune responses.
Androgens (mainly dehydroepiandrosterone, or DHEA) from zona reticularis cells	ACTH stimulates secretion.	Assist in early growth of axillary and pubic hair in both sexes; in females, contribute to libido and are source of estrogens after menopause.
 Adrenal cortex		
ADRENAL MEDULLA HORMONES		
Epinephrine and norepinephrine from chromaffin cells	Sympathetic preganglionic neurons release acetylcholine, which stimulates secretion.	Enhance effects of sympathetic division of autonomic nervous system (ANS) during stress.
 Adrenal medulla		


Release
Adrenal cortex
Zona glomerulosa
Zona fasciculata
Zona reticularis
Mineralocorticoids
Aldosterone
Glucocorticoids
cortisol
Androgens
DHEA


Steroid Hormones
cholesterol
corticosteroids
sex steroids
mineralocorticoid
glucocorticoid
androgen
aldosterone
cortisol
testosterone

PANCREATIC ISLETS

- The pancreas is both an endocrine gland and an exocrine gland.
- The first part of the small intestine, and consists of a head, a body, and a tail.
- Roughly 99% of the exocrine cells of the pancreas are arranged in clusters called acini.
- The acini produce digestive enzymes, which flow into the gastrointestinal tract through a network of ducts. Scattered among the exocrine acini are 1–2 million tiny clusters of endocrine tissue called pancreatic islets.

CELL TYPES IN THE PANCREATIC ISLETS

- Each pancreatic islet includes four types of hormone-secreting cells.

1. Alpha or A cells constitute about 17% of pancreatic islet cells and secrete glucagon.
2. Beta or B cells constitute about 70% of pancreatic islet cells and secrete insulin.
3. Delta or D cells constitute about 7% of pancreatic islet cells and secrete somatostatin.
4. F cells constitute the remainder of pancreatic islet cells and secrete pancreatic polypeptide.

Each pancreatic islet includes the following types of hormone-secreting cells, EXCEPT :

1. ○ Beta or B cells.
2. ○ F cells and delta cells.
3. ○ Alpha or A cells.
4. ● None, all of the above are TRUE.

Alpha

A cells

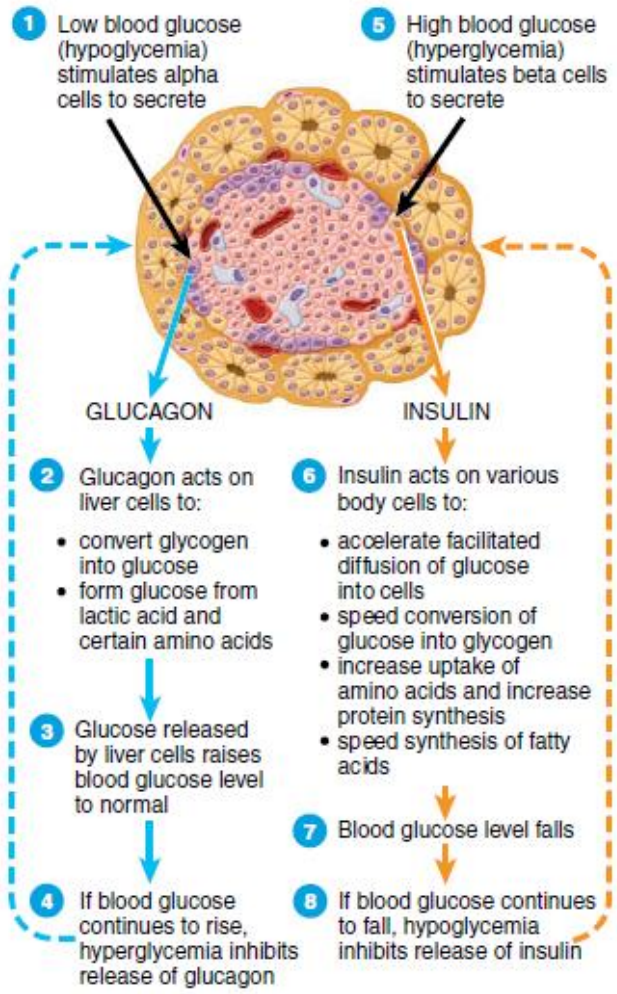
a cell release (glucagon)

NEGATIVE FEEDBACK REGULATION OF THE SECRETION OF GLUCAGON AND INSULIN

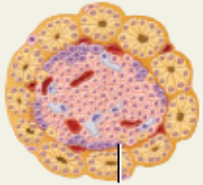
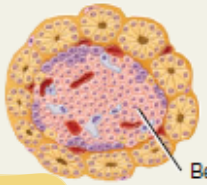
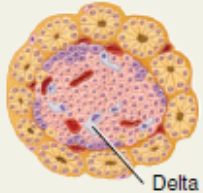
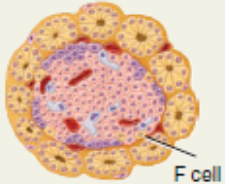
glucouse ↑
insulin is secreted
lower its levels

glucose ↓
glucagon is secreted
elevate its level

Low blood glucose stimulates release of glucagon; high blood glucose stimulates secretion of insulin.



Summary of Pancreatic Islet Hormones

HORMONE AND SOURCE	CONTROL OF SECRETION	PRINCIPAL ACTIONS
Glucagon from alpha cells of pancreatic islets 	Decreased blood level of glucose, exercise, and mainly protein meals stimulate secretion; somatostatin and insulin inhibit secretion.	Raises blood glucose level by accelerating breakdown of glycogen into glucose in liver (glycogenolysis), converting other nutrients into glucose in liver (gluconeogenesis), and releasing glucose into blood.
Insulin from beta cells of pancreatic islets 	Increased blood level of glucose, acetylcholine (released by parasympathetic vagus nerve fibers), arginine and leucine (two amino acids), glucagon, GIP, hGH, and ACTH stimulate secretion; somatostatin inhibits secretion.	Lowers blood glucose level by accelerating transport of glucose into cells, converting glucose into glycogen (glycogenesis), and decreasing glycogenolysis and gluconeogenesis; increases lipogenesis and stimulates protein synthesis.
Somatostatin from delta cells of pancreatic islets 	Pancreatic polypeptide inhibits secretion.	Inhibits secretion of insulin and glucagon; slows absorption of nutrients from gastrointestinal tract.
Pancreatic polypeptide from F cells of pancreatic islets 	Meals containing protein, fasting, exercise, and acute hypoglycemia stimulate secretion; somatostatin and elevated blood glucose level inhibit secretion.	Inhibits somatostatin secretion, gallbladder contraction, and secretion of pancreatic digestive enzymes.

18- the relationship between insulen and glucagon (الجلاكوجين بزيد نسبة الجلوكوز في الدم and glucagonesis)

Formation of glucose

2. Which hormones are soluble in blood?

   A. Steroid hormones
   B. Hormones produced by the adrenal cortex
   C. The sex hormones
   D. Those released by the pituitary gland

   Answer is D: The pituitary gland releases peptide hormones which are soluble in blood. The other choices refer to steroid hormones which are insoluble

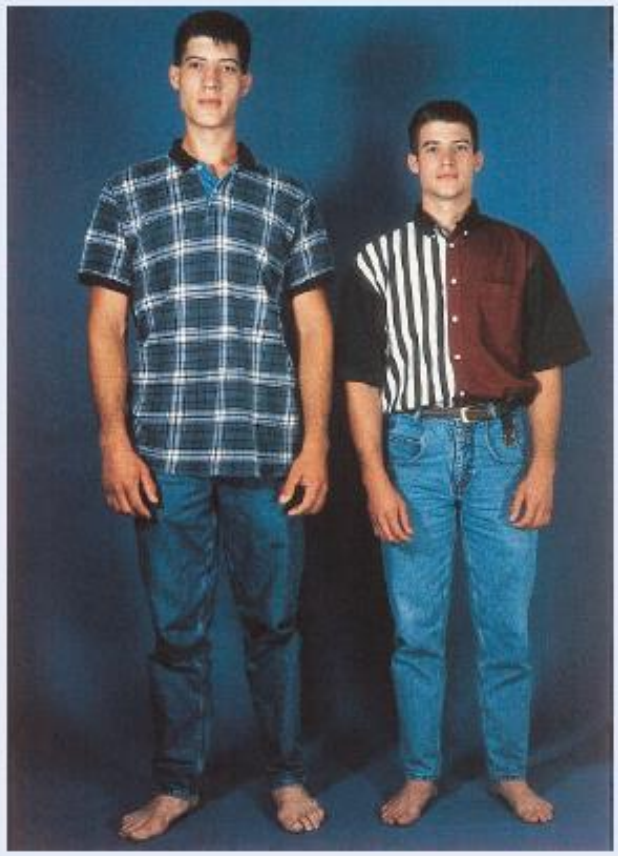
45. What is the role of glucagon and insulin?

A. glucagon raises blood glucose level and inhibits gluconeogenesis.
B. glucagon lowers blood glucose level and stimulates glycogenolysis.
C. insulin raises blood glucose level and stimulates gluconeogenesis
D. insulin lowers blood glucose level inhibits glycogenolysis.

Answer is D: Insulin promotes the uptake of glucose into cells from the blood. Hence it lowers blood glucose. It also inhibits glycogenolysis so less glucose is released from the glycogen store.

Figure 18.22 **Various endocrine disorders.**

Disorders of the endocrine system often involve hyposecretion or hypersecretion of hormones.



(a) A 22-year-old man with pituitary giantism shown beside his identical twin

(b) Acromegaly (excess hGH during adulthood)

(c) Goiter (enlargement of thyroid gland)

(d) Exophthalmos (excess thyroid hormones, as in Graves disease)

(e) Cushing's syndrome (excess glucocorticoids)

excessive urine ↑ / tasteless

DIABETES INSIPIDUS

- The most common abnormality associated with dysfunction of the posterior pituitary is diabetes insipidus (DI).
- This disorder is due to defects (خلل) in antidiuretic hormone (ADH) receptors or an inability to secrete ADH.
- Neurogenic diabetes insipidus results from hyposecretion of ADH, usually caused by a brain tumor, head trauma, or brain surgery that damages the posterior pituitary or the hypothalamus.
- Nephrogenic diabetes insipidus, the kidneys do not respond to ADH. The ADH receptors may be non-functional, or the kidneys may be damaged.
- A common symptom of both forms of DI is excretion of large volumes of urine, with resulting dehydration and thirst.

DIABETES INSIPIDUS

- Treatment of neurogenic diabetes insipidus involves hormone replacement, usually for life.

- Treatment of nephrogenic diabetes insipidus is more complex and depends on the nature of the kidney dysfunction.

THYROID GLAND DISORDERS

- Thyroid gland disorders affect all major body systems and are among the most common endocrine disorders.
- Congenital hypothyroidism, hyposecretion of thyroid hormones that is present at birth, has devastating consequences if not treated promptly.
- At birth, the baby typically is normal because lipid-soluble maternal thyroid hormones crossed the placenta during pregnancy and allowed normal development.
- Most states require testing of all newborns to ensure adequate thyroid function. If congenital hypothyroidism exists, oral thyroid hormone treatment must be started soon after birth and continued for life.

THYROID GLAND DISORDERS

- The most common form of hyperthyroidism is Graves disease, which occurs seven to ten times more often in females than in males, usually before age 40.
- Graves disease is an autoimmune disorder in which the person produces antibodies that mimic the action of thyroid-stimulating hormone (TSH).
- The antibodies continually stimulate the thyroid gland to grow and produce thyroid hormones.
- Treatment may include surgical removal of part or all of the thyroid gland (thyroidectomy), the use of radioactive iodine to selectively destroy thyroid tissue, and the use of antithyroid drugs to block synthesis of thyroid hormones.

PARATHYROID GLAND DISORDERS

PTH ↓ Ca^{+2} ↓

- **Hypoparathyroidism: too little parathyroid hormone—leads to a deficiency of blood calcium, which causes neurons and muscle fibers to depolarize and produce action potentials spontaneously.**

تشنجات

- **This leads to twitches, spasms, and tetany (maintained contraction) of skeletal muscle.**
- **The leading cause of hypoparathyroidism is accidental damage to the parathyroid glands or to their blood supply during thyroidectomy surgery.**

PARATHYROID GLAND DISORDERS

PTH ↑ Ca^{+2} ↑

- **Hyperparathyroidism:** an elevated level of parathyroid hormone, most often is due to a tumor (ورم) of one of the parathyroid glands
- An elevated level of PTH causes excessive resorption of bone matrix, raising the blood levels of calcium and phosphate ions and causing bones to become soft and easily fractured.
- High blood calcium level promotes formation of kidney stones.
- Fatigue, personality changes, and lethargy (خمول) are also seen in patients with hyperparathyroidism.

PANCREATIC ISLET DISORDERS

- **Hyperinsulinemia.**
- **Hyperglycemia.**
- **Hypoglycaemia.**

The major pancreatic islet disorders are :

1. ○ Hyperinsulinemia.
2. ○ Hyperglycemia.
3. ○ Hypoglycaemia.
4. ◉ All the above are TRUE.

DIABETES MELLITUS

- It caused by an inability to produce or use insulin.
- Because insulin is unavailable to aid transport of glucose into body cells, blood glucose level is high and glucose "spills" into the urine (glucosuria).
- Hallmarks of diabetes mellitus are the three "polys": polyuria, excessive urine production due to an inability of the kidneys to reabsorb water; polydipsia, excessive thirst; and polyphagia, excessive eating.
- Both genetic and environmental factors contribute to onset of the two types of diabetes mellitus—type 1 and type 2—but the exact mechanisms are still unknown.

TYPE 1 DIABETES IDDM

- It is previously known as insulin-dependent diabetes mellitus (IDDM), occurs because the person's immune system destroys the pancreatic beta cells.
- As a result, the pancreas produces little or no insulin. B cells → produce insulin
- Type 1 diabetes usually develops in people younger than age 20 and it persists throughout life. By the time symptoms of type 1 diabetes arise, 80–90% of the islet beta cells have been destroyed.
- Because insulin is not present to aid the entry of glucose into body cells, most cells use fatty acids to produce ATP. Stores of triglycerides in adipose tissue are catabolized to yield fatty acids and glycerol.
- The by-products of fatty acid breakdown—organic acids called ketones or ketone bodies—accumulate. Buildup of ketones causes blood pH to fall, a condition known as ketoacidosis. Unless treated quickly, ketoacidosis can cause death.

PH ↓

TYPE 1 DIABETES

- **Type 1 diabetes is treated through self-monitoring of blood glucose level (up to 7 times daily), regular meals containing 45–50% carbohydrates and less than 30% fats, exercise, and periodic insulin injections (up to 3 times a day).**

TYPE 2 DIABETES NIDDM

- It is formerly known as non-insulin-dependent diabetes mellitus (NIDDM), is much more common than type 1, representing more than 90% of all cases.

- Type 2 diabetes most often occurs in obese people who are over age 35. However, the number of obese children and teenagers with type 2 diabetes is increasing.

خفيفة

- Clinical symptoms are mild, and the high glucose levels in the blood often can be controlled by diet, exercise, and weight loss. Sometimes, drugs such as glyburide and metformin are used to stimulate secretion of insulin by pancreatic beta cells. B cells

HYPERINSULINISM

- Most often results when a diabetic injects too much insulin.
- The main symptom is hypoglycaemia, decreased blood glucose level, which occurs because the excess insulin stimulates too much uptake of glucose by body cells.
- The resulting hypoglycaemia stimulates the secretion of epinephrine, glucagon, and human growth hormone.

EP / glucagon / hGH

- As a consequence, anxiety, sweating, tremor, increased heart rate, hunger, and weakness occur.

HR ↑

1. Which statement below about hormones is true?

   A. Hormones are enzymes that catalyse reactions
   B. Hormones are released into the blood circulation
   C. Hormones affect all cells of the body
   D. Hormones are released by neurones at synapses

   Answer is B: Hormones are circulating messengers that are transported in blood. A particular hormone does not necessarily affect every cell in the body. Some (but not all) hormones are released by neurones, for example in the hypothalamus.

2. Which hormones are soluble in blood?

   A. Steroid hormones
   B. Hormones produced by the adrenal cortex
   C. The sex hormones
   D. Those released by the pituitary gland

   Answer is D: The pituitary gland releases peptide hormones which are soluble in blood. The other choices refer to steroid hormones which are insoluble in blood. They require transport via plasma proteins.

3. Which statement about the hypothalamus is correct?

   A. The hypothalamus is connected to the brain by the infundibulum
   B. The hypothalamus is composed of glandular epithelial tissue
   C. The hypothalamus secretes “releasing hormones”
   D. The hypothalamus secretes epinephrine and norepinephrine

   Answer is C: The hypothalamus is part of the brain so is composed of neural tissue. Epinephrine and norepinephrine are released from the adrenal medulla.

4. What hormone does the thyroid produce?

   A. thyroid stimulating hormone
   B. calcitriol
   C. thyroxine
   D. parathyroid hormone

   Answer is C: Thyroxine (or tetra-iodothyronine) is converted to tri-iodothyronine in target tissues.

5. What hormone(s) does the adrenal medulla produce?

   A. aldosterone
   B. epinephrine and norepinephrine
   C. corticosteroids
   D. glucocorticoids

   Answer is B: Epinephrine and norepinephrine are produced in the adrenal medulla (the deep or inside part). Aldosterone is a mineralocorticoid, which like corticosteroids & glucocorticoids, as the "cortico" in the name suggests, are all produced in the adrenal cortex.

6. What is produced by the beta cells of the pancreas?

   A. angiotensin converting enzyme
   B. glucocorticoids
   C. glucagon
   D. insulin

   Answer is D: Beta cells of the pancreatic islets produce insulin. The alpha cells produce glucagon.

7. Which gland or organ releases erythropoietin?

   A. The kidneys
   B. The adrenal glands
   C. The anterior pituitary
   D. The pancreas

   Answer is A: Kidneys produce erythropoietin (EPO) – which signals red bone marrow to increase production of rbc.

8. What effect does parathyroid hormone have?

   A. It increases plasma Ca^{2+} concentration
   B. It decreases plasma Ca^{2+} concentration
   C. It increases the rate of ATP formation
   D. It stimulates the thyroid gland to produce thyroxine

   Answer is A: PTH increases plasma Ca^{2+}. (calcitonin aids in lowering blood calcium).

9. Which one of the following is **NOT** part of the endocrine system?

   A. the islets of Langerhans (pancreatic islets)
   B. the thyroid gland
   C. the acini cells of the pancreas
   D. the parathyroid glands

   Answer is C: The acini cells produce digestive enzymes.

10. What is the difference between an exocrine gland and an endocrine gland?

    A. An endocrine gland secretes neurotransmitters (an exocrine gland does not).
    B. An endocrine gland secretes via a tube to the destination (an exocrine gland does not).
    C. An exocrine gland secretes into the blood (an endocrine gland does not).
    D. An endocrine gland secretes into the blood (an exocrine gland does not).

    Answer is D: Endocrine glands secrete "circulating" hormones, that is secrete into the blood.

11. By what term are hormones derived from tyrosine also known?

    A. amino acid derivatives
    B. peptide hormones
    C. steroid hormones
    D. corticosteroids

    Answer is A: Catecholamines (adrenaline, noradrenaline), dopamine and thyroid hormone are all derived from tyrosine.

12. Which hormones have their receptors inside their target cell?

    A. amino acid based hormones
    B. hormones with a membrane carrier mechanism or that are lipid soluble
    C. steroid hormones and peptide hormones of less than 50 amino acids
    D. lipid soluble hormones

    Answer is B: Choice D is also correct but B is the better answer as thyroid hormones cross membrane by a carrier mechanism.

13. Where in the body is the hypothalamus located?

    A. On the inferior surface of the brain
    B. In the cortex of the adrenal gland
    C. In the anterior pituitary gland
    D. On the dorsal surface of the thyroid gland

    Answer is A: The hypothalamus is below the thalamus, more or less on the "floor" of the brain, but above the pituitary gland.

14. From where are antidiuretic hormone and oxytocin released?

    A. the anterior pituitary
    B. the posterior pituitary
    C. the adrenal cortex
    D. the adrenal medulla

    Answer is B: ADH & OT are produced in the hypothalamus and transported to the posterior pituitary.

15. Which hormone has the element iodine as part of its molecule?

    A. calcitonin
    B. haemoglobin
    C. thyroxine
    D. parathyroid hormone

    Answer is C: Thyroxine or thyroid hormone contains iodine.

16. What effect does aldosterone have?

    A. It causes glucose to be absorbed from the blood
    B. It cause Na^+ to be absorbed in the kidneys
    C. It causes Ca^{++} to be absorbed from the gut
    D. It causes K^+ to be absorbed from the filtrate.

    Answer is B: Aldosterone cases reclamation of sodium ions from the filtrate, and potassium to be secreted in exchange.

17. Which of the following is a part of the endocrine system?

    A. the thalamus
    B. the pancreatic islets (islets of Langerhans)
    C. the renal glands
    D. the salivary glands

    Answer is B: The pancreatic islets secrete the hormones insulin and glucagon.

18. Which of the following is an amino acid derivative hormone?

    A. epinephrine
    B. tyrosine
    C. testosterone
    D. prostaglandin

    Answer is A: Epinephrine is derived from the amino acid tyrosine (so tyrosine is a wrong answer)

19. Which statement below is true of steroid hormones?

    A. they do not have a specific receptor to bind with.
    B. they are not lipid soluble do bind to receptor proteins on the cell membrane.
    C. they are lipid soluble so diffuse through the cell membrane.
    D. they cross the cell membrane via a carrier mechanism.

    Answer is C: Steroids are lipid soluble so diffuse through the plasma membrane to bind to a receptor within the cell.

20. Which structure controls the endocrine system and integrates the activities of the nervous and endocrine systems?

    A. the infundibulum
    B. the pituitary gland

C. the thalamus
D. the hypothalamus

Answer is D: Hypothalamus secretes regulatory hormones that control endocrine cells in the ant.pit. gland; produces ADH & oxytocin; contains "autonomic centres" that exert neural control over endocrine cells of the adrenal medullae.

21. One of the statements below is true. Which one?

A. the anterior pituitary produces testosterone from cholesterol and releases it when releasing hormones arrive from the hypothalamus.
B. the hypothalamus produces ADH and oxytocin which are stored in the posterior pituitary.
C. the posterior pituitary contains autonomic centres that exert neural control over the adrenal glands.
D. the thalamus produces ADH and oxytocin which are stored in the anterior pituitary

Answer is B: Testosterone is not produced in the pituitary, nor does the pituitary contain autonomic centres.

22. Iodine is an essential component of which hormone?

A. thyroid hormones
B. aldosterone
C. thyroid stimulating hormones
D. parathyroid hormone

Answer is A: Thyroid hormones T3 and T4 contain 3 & 4 iodine atoms respectively.

23. Which hormone(s) increases the reabsorption of Ca^{++} from the filtrate in the kidney tubule?

A. calcitonin
B. mineralocorticoids
C. parathyroid hormone
D. aldosterone

Answer is C: PTH causes increased calcium absorption and hence increases blood calcium level.

24. What effect does aldosterone have? It causes:

A. angiotensin to be formed from angiotensinogen
B. Na^{+} to be absorbed from the filtrate
C. Na^{+} and Ca^{++} to be absorbed from the filtrate and K^{+} to be secreted into the filtrate
D. Na^{+} to be absorbed from the filtrate and K^{+} to be secreted into the filtrate

Answer is D: Aldosterone promotes the absorption of sodium from the filtrate while potassium (also a positively charged ion) is secreted to maintain electrical neutrality.

C. Aldosterone and erythropoietin
D. Testosterone and estrogen

Answer is A: The medulla is the deeper part if the adrenal gland.

31. What is one mechanism of hormone action?

A. They act as second messengers in the cytoplasm
B. They act as enzymes for reactions
C. They act as receptor proteins
D. They activate genes in the nucleus

Answer is D: Some hormones (corticosteroids) determine which genes are transcribed in the nucleus.

32. What is the effect of ADH (antidiuretic hormone)?

A. allows walls of collecting duct to become permeable to water
B. inhibits the reabsorption of Na^+
C. causes an increase in the volume of urine produced
D. it promotes diuresis

Answer is A: ADH causes more aquaporins to be inserted into the collecting duct walls which allow water molecules to pass through along the osmotic gradient.

33. Which one of the following is **NOT** true of peptide hormones?

A. they are water soluble
B. they are derived from amino acids
C. their receptors are located in the cell cytoplasm
D. they are transported dissolved in blood

Answer is C: The receptors for peptide hormones are located on the plasma membrane as they are unable to penetrate the plasma membrane.

34. Which hormones are produced by the adrenal medulla?

A. gonadocorticoids
B. steroid hormones
C. mineralocorticoids
D. catecholamines

Answer is D: Epinephrine and norepinephrine (=catecholamines) are produced in the adrenal medulla.

35. How do steroid hormones differ from amino acid-based hormones?

A. steroid hormones are water soluble whereas amino acid based hormones are not.
B. the receptors for steroid hormones are only in the cytoplasm or the nucleus (and amino acid-based hormones are not)

C. steroid hormones are made only in the adrenal glands, while amino acid-based hormones are produced by a variety of glands.
D. steroid hormones activate a G-protein and exert their effect via "second messengers", but the action of amino acid-based hormones results directly on binding to their receptor.

Answer is B: Steroid hormones are lipid soluble so can enter the cell to bind to receptors located inside the cell. Amino acid-based hormones are not lipid soluble so their receptors are located outside the cell on the plasma membrane.

36. Which structure integrates the activities of the endocrine system and the nervous system?

A. the hypothalamus
B. the thalamus
C. the posterior pituitary
D. the anterior pituitary

Answer is A: The hypothalamus is located in the brain and also produces regulatory hormones.

37. Which structure produces ADH and oxytocin?

A. the thalamus
B. the anterior pituitary
C. the hypothalamus
D. the posterior pituitary

Answer is C: ADH and OT are then transported to the posterior pituitary for storage and release.

38. Which structure is composed of glandular epithelial tissue?

A. the thalamus
B. the anterior pituitary
C. the posterior pituitary
D. the hypothalamus

Answer is B: The anterior pituitary produces and releases 6 hormones.

39. Which hormone is the one made in greatest quantity by the thyroid gland?

A. calcitonin
B. thyroid stimulating hormone
C. tri-iodothyronine T_3
D. thyroxine T_4

T_4 greater quantity than T_3

Answer is D: thyroxine is about 90 % tetra-iodothyronine and 10 % tri-iodothyronine

40. Which of the following organ(s) are **NOT** endocrine organs?

A. renal
B. adrenal

C. thyroid
D. parathyroid

Answer is A: Renal gland is another name for the kidney.

41. To which group of hormones does aldosterone belong?

A. catecholamines
B. glucocorticoids
C. mineralocorticoids
D. gonadocorticoids

Answer is C: As aldosterone is concerned with the absorption of sodium ions, a "mineral" and it is produced by the adrenal **cort** ex, it is termed a mineralocorticoid.

42. Where are the receptors for almost all of the amino acid derived hormones located?

A. on the mitochondria
B. in the nucleus
C. on the outside of the plasma membrane
D. on the inside of the plasma membrane

Answer is C: Amino acid-derived hormones cannot get through the plasma membrane so they attach to receptors located on the outside of the membrane.

43. Which structure produces the hormones ADH and oxytocin?

A. the posterior pituitary
B. the anterior pituitary
C. the thalamus
D. the hypothalamus

Answer is D: ADH & OT are produced in the hypothalamus and are then transported to the posterior pituitary for release.

44. The hypothalamus produces "releasing hormones". What do these releasing hormones do?

A. They direct the posterior pituitary to release hormones.
B. They direct the anterior pituitary to release hormones.
C. They direct the gonads to release hormones.
D. They act as "second messengers" when hormones bind to their receptor site.

Answer is B: The anterior pituitary produces hormones that stimulate other endocrine organs, but the ant pit dos not release hormones until directed to the hypothalamus.

45. What is the role of glucagon and insulin?

A. glucagon raises blood glucose level and inhibits gluconeogenesis.
B. glucagon lowers blood glucose level and stimulates glycogenolysis.

C. insulin raises blood glucose level and stimulates gluconeogenesis
D. insulin lowers blood glucose level inhibits glycogenolysis.

Answer is D: Insulin promotes the uptake of glucose into cells from the blood. Hence it lowers blood glucose. It also inhibits glycogenolysis so less glucose is released from the glycogen store.

46. Which of the following hormones **CANNOT** cross the plasma membrane?

A. sex hormones
B. amino acid based hormones
C. thyroid hormones
D. steroids

Answer is B: amino acid-based hormones are water soluble but not lipid soluble, so cannot cross the plasma membrane.

47. Which of the following "controls" the endocrine system?

A. the posterior pituitary
B. the thalamus
C. the anterior pituitary
D. the hypothalamus

Answer is D: The hypothalamus secretes releasing h. & inhibitory hormones that stimulate the anterior pituitary gland to secrete hormones which in turn control the activities of endocrine cells in the thyroid; cortex of adrenal glands; & reproductive organs. The hypothalamus produces ADH & oxytocin which are stored and released into blood from post.pit. The hypothalamus exerts neural control over the adrenal medullae.

48. Which part of the pituitary gland is comprised of neural tissue?

A. the posterior pituitary
B. the pars intermedia
C. the adenohypophysis
D. the anterior pituitary

Answer is A: The posterior pituitary is part of the brain.

49. Complete the sentence correctly. Parathyroid hormone:

A. is produced by the parafollicular cells of the thyroid gland
B. decreases the concentration of Ca^{++} in the blood
C. releases Ca^{++} from the sarcoplasmic reticulum
M increases the concentration of Ca^{++} in the blood.

Answer is D: When the level of calcium in the blood is lower than required, PTH is released and causes the calcium concentration to increase.

50. The adrenal medulla produces which of the following?

A. weak androgens
B. mineralocorticoids

C. testosterone and oestrogen
D. epinephrine and norepinephrine

Answer is D: The adrenal cortex produces weak androgens and mineralocorticoids.

51. What effect does insulin have?

A. it increases metabolic rate
B. it causes the breakdown of glycogen to glucose
C. it lowers blood sugar level
D. it stimulates gluconeogenesis

Answer is C: Glucose stimulates enhanced membrane transport of glucose into body cells, and inhibits glycogenolysis and gluconeogenesis. This lowers blood glucose level.

52. Which of the following is a substantial difference between amino acid based hormones and steroid hormones?

A. endocrine glands release steroid hormones while amino acid hormones are released from exocrine glands.
B. amino acid hormones are circulating hormones while steroid hormones are local hormones.
C. amino acid hormones are fat soluble while steroid hormones are not.
D. steroid hormones can pass through the plasma membrane while amino acid hormones cannot.

Answer is D: Steroid hormones are fat soluble, AA-based hormones are water soluble (& not fat soluble).

53. What type of molecule is cAMP, or what role does it play?

A. a second messenger
B. an amino acid based hormone
C. a catecholamine
D. a steroid hormone

Answer is A: Cyclic AMP is a second messenger. That is, it is released from the inside of the plasma membrane when an AA-based hormone binds to its receptor.

54. Which one is **NOT** a mode of action of hormones on their target cell?

A. a hormone may stimulate the synthesis of an enzyme in the target cell.
B. a hormone may activate an enzyme by altering its shape.
C. a hormone may deactivate an enzyme by altering its structure.
D. some hormones are enzymes that promote a chemical reaction in a cell.

Answer is D: Hormones are not enzymes (but may cause enzymes to be formed).

55. What may be correctly said about oxytocin and antidiuretic hormone?

A. they are made and released from the posterior pituitary
B. they are made in the hypothalamus and stored and released from the posterior pituitary
C. they are made in the hypothalamus and stored and released from the anterior pituitary
D. they are made and released from the anterior pituitary

Answer is B: The hypothalamus produces ADH & OT. The posterior pituitary releases them.

56. Which hormones are produced by the adrenal medulla?

A. glucocorticoids
B. mineralocorticoids
C. adrenalin and noradrenalin
D. gonadocorticoids

Answer is C: Adrenalin and noradrenalin (also known as epinephrine and nor epinephrine). The other three choices all have "cortico" in their name indicating their adrenal cortex origin.

57. Which cells produce insulin?

A. the acini cells of the pancreas
B. parafollicular cells of the thymus
C. alpha cells of the islets of Langerhans
D. beta cells of the islets of Langerhans

Answer is D: Islets of Langerhans = pancreatic islets. Alpha cells produce glucagon.

58. What are the two parts of the pituitary gland known as?

A. the thalamus and the hypothalamus
B. anterior and posterior
C. alpha and beta cells
D. cortex and medulla

Answer is B: Anterior pituitary (epithelial tissue) and posterior pituitary (neural tissue)

59. Which of the following could be a definition of a hormone?

A. chemicals released to communicate between adjacent cells in contact.
B. a chemical messenger released into blood to coordinate activities in distant tissues.
C. a chemical messenger released by a neurone at a synapse.
D. a chemical messenger in the extracellular fluid between cells of a single tissue.

Answer is B: Hormones are also known as circulating hormones, meaning they are transported in the blood.

60. One of the following groups of hormones has their receptor inside the cell. Which one?

    A. steroid hormones
    B. catecholamines
    C. adrenalin and noradrenalin
    D. peptide hormones

    Answer is A: steroids are lipids, hence are lipid soluble so can enter the cell.

61. Which two hormones are stored in the posterior pituitary prior to their release?

    A. luteinising hormone and follicle stimulating hormone
    B. adrenalin and noradrenalin
    C. calcitonin and calcitriol
    D. oxytocin and antidiuretic hormone

    Answer is D: OT & ADH are produced in the hypothalamus before being transported to the posterior pituitary.

62. What is a function of calcitonin?

    A. accelerating Ca^{2+} release from bone
    B. stimulating Ca^{2+} excretion by the kidneys
    C. reducing Ca^{2+} deposition in bone
    D. stimulating the formation of calcitriol in the kidneys

    Answer is B: Calcitonin decreases the blood calcium concentration. B is the only choice compatible with this.

63. The hormones thyroxine and tri-iodothyronine contain which element?

    A. cobalt
    B. iron
    C. iodine
    D. manganese

    Answer is C: These thyroid hormones require iodine in their molecule.

64. What is produced in the adrenal cortex?

    A. cholesterol
    B. catecholamines
    C. adrenalin and noradrenalin
    D. corticosteroids

    Answer is D: “Cortico”steroids are made in the adrenal cortex. Choice B and C are the same – these hormones are made in the adrenal medulla.

65. What is the function of insulin?

    A. enhance the transport of glucose through the plasma membrane into the cell
    B. promote glycogenolysis

C. promote gluconeogenesis
D. to raise blood sugar level

Answer is A: Insulin lowers the level of glucose in the blood. The other three choices are about increasing the blood glucose level.

66. Which of the following statements about endocrine hormones is always true?

A. They are secreted by neurones
B. They are derived from amino acids
C. They are produced by exocrine glands
D. They are released into the bloodstream

Answer is D: Endocrine hormones are also known as circulating (in blood) hormones.

67. Which of the following statements about corticosteroids is true?

A. They may also act as neurotransmitters
B. They are transported dissolved in blood
C. They are produced by the adrenal gland
D. They are amino acid derivatives

Answer is C: They are produced by the adrenal cortex.

68. Which structure produces epinephrine and norepinephrine?

A. adrenal pelvis
B. the anterior pituitary
C. adrenal medulla
D. adrenal cortex

Answer is C: The medulla (interior) of the adrenal gland.

69. Which cells produce insulin?

A. the acini
B. the alpha cells
C. the beta cells
D. the islets of Langerhans

Answer is C: The beta cells of the islets of Langerhans.

70. What is the function of erythropoietin (EPO)?

A. stimulate bone marrow to produce red blood cells
B. decrease the plasma concentration of Ca^{++}
C. increase the plasma concentration of Ca^{++}
D. to raise blood sugar level

Answer is A: EPO is produced in the kidneys and stimulates active (red) marrow to produce blood cells.

71. Finish the sentence so that it is correct: A hormone may be defined as a chemical messenger that:

    A. is released into circulation in small quantities.
    B. facilitates communication between adjacent cells.
    C. moves through extracellular fluid between cells of a single tissue
    D. crosses the synaptic cleft and binds to a receptor.

    Answer is A: Hormones travel through the blood to all parts of the body and only small quantities are required.

72. Endocrine communication involves hormones of two types

    A. first messengers and second messengers
    B. steroid hormones and amino acid based hormones
    C. amino acid derivatives and peptide hormones
    D. peptide hormones and corticosteroids

    Answer is B: Hormones are of two structural types and this determines whether they are lipid soluble (can pass through the plasma membrane) or not.

73. Which of the following statements is **FALSE**?

    A. peptide hormones are not able to penetrate the cell membrane
    B. thyroid hormone can cross the membrane
    C. steroid hormones bind to receptors on the outside of the cell membrane
    D. catecholamines are not lipid soluble

    Answer is C: Steroid hormones are lipid soluble so their receptors are inside the cell as they can pass through the plasma membrane.

74. The posterior pituitary does which one of the following?

    A. produces growth hormone, prolactin and tropic hormones
    B. secretes regulatory hormones that control endocrine cells in the anterior pituitary
    C. exerts neural control over other endocrine glands
    D. stores and releases oxytocin and antidiuretic hormone

    Answer is D: OT & ADH are made in hypothalamus and passed along neurones to the posterior pituitary.

75. What does insulin do?

    A. it lowers blood sugar level
    B. it causes the breakdown of glycogen to glucose
    C. it increases metabolic rate
    D. it hydrolyses glucose into ATP

    Answer is A: Insulin stimulates the uptake of glucose into cells from the blood.

76. An amino acid based hormone binds to its receptor. This has the effect of:

    A. activating an enzyme to produce cAMP
    B. causing it to diffuse through the cell to trigger a cascade of reactions

C. activate a G-protein
D. allowing it to move along the membrane

Answer is C: After a hormone binds to its receptor, a G (for guanine) protein is activated as the first effect. The G-protein then moves along the membrane to activate an enzyme that produces – for example – cAMP, which is a "second messenger".

77. The structure that secretes regulatory hormones that control the pituitary gland is known as the:

A. hypothalamus
B. hypophysis
C. hypothyroid
D. hypothymus

Answer is A: Hypothalamus is structure. Hypophysis is another name for the pituitary gland.

78. Why are the receptors for amino acid-based hormones on the outside surface of the cell membrane?

A. cells can respond faster when the hormone does not need to enter the cell.
B. amino acid-based hormones cannot penetrate cell membranes.
C. lysosomes in the intracellular fluid digest amino acid-based hormones.
D. amino acid-based hormones have no role in activating genes in the nucleus.

Answer is B: Amino acid-based hormones are not lipid soluble.

79. What is the difference between endocrine glands and exocrine glands?

A. endocrine glands produce hormones whereas exocrine glands do not.
B. exocrine glands secrete into the blood stream whereas endocrine glands do not.
C. endocrine glands are controlled by the autonomic nervous system whereas exocrine glands are not.
D. exocrine glands secrete steroid hormones whereas endocrine glands secrete amino acid-based hormones.

Answer is A: By definition endocrine glands are part of the endocrine system and they produce hormones.

80. The pituitary gland has an anterior portion and a posterior portion. One difference between the two is:

A. the anterior portion releases hormones following a nervous stimulus while the posterior portion releases hormones following a hormonal stimulus.
B. the posterior portion is able to produce hormones while the anterior portion merely stores hormones made elsewhere.

C. the anterior portion releases antidiuretic hormone (ADH) while the posterior portion does not.
D. the posterior portion is neural tissue while the anterior portion is glandular tissue.

Answer is D: Choices A, B & C are the reverse of the true situation.

81. By what other name is adrenaline also known?

A. noradrenaline
B. epinephrine
C. androgen
D. ANP

Answer is B: Perhaps to diminish the perception that the adrenal gland only produces adrenaline.

82. Which hormones does the pancreas produce?

A. epinephrine and norepinephrine.
B. oxytocin and antidiuretic hormone.
C. glucagon and insulin.
D. glucocorticoids and aldosterone

Answer is C: The pancreatic islets produce these hormones which manage the concentration of glucose in the blood.

83. Which statement is **NOT CORRECT** about hormones:

A. They are chemical substances that alter cell activity
B. They regulate metabolic function of other cells in the body
C. Steroid hormones are amino acid-based and are synthesized from cholesterol
D. They are produced in glands and transported via the blood stream

Answer is C: Steroid hormones are not based on amino acids. They are lipids.

84. What does the anterior lobe of the pituitary gland synthesise and release?

A. Growth hormone-releasing hormone
B. Corticotropin-releasing hormone
C. Thyroid-stimulating hormone
D. Gonadotropin-releasing hormone

Answer is C: All the releasing hormones are produced in the hypothalamus.

85. How do calcitonin or parathyroid hormone control blood calcium levels?

A. Calcitonin acts to increase blood calcium levels
B. Parathyroid hormone release is inhibited by increased calcium levels
C. Parathyroid hormone stimulates bone resorbing cells to take up calcium
D. Calcitonin inhibits parathyroid hormone

Answer is B: PTH acts to increase blood calcium levels. Hence less is required when blood calcium level is high.

86. What controls the blood glucose level?

A. The action of insulin
B. The action of glucagon
C. The action of insulin and glucagon
D. The action of insulin, glucagon and glycogen

Answer is C: Insulin increases blood glucose, while glucagon decreases blood glucose. Glycogen is not a hormone, so it does not affect the level of glucose in the blood.

87. Complete the following sentence correctly: The hypothalamus:

A. Is the major link between the nervous and the endocrine systems.
B. Is situated in the brain superior to the thalamus.
C. Produces a hormone that stimulates the thyroid gland.
D. Does not produce anti-diuretic hormone (ADH).

Answer is A: The hypothalamus integrates the nervous and endocrine systems of body control.

88. Which of the following secretes growth hormone?

A. the adrenal glands
B. The thyroid gland
C. The posterior lobe of the pituitary gland
D. The anterior lobe of the pituitary gland

Answer is D: The anterior lobe produces and releases GH.

89. Blood calcium levels are controlled by hormones from which structures?

A. The parathyroid glands and the thyroid gland
B. The anterior lobe of the pituitary gland and the thyroid gland
C. The parathyroid glands and the anterior lobe of the pituitary gland
D. The adrenal cortex and the hypothalamus.

Answer is A: Parathyroid glands secrete parathyroid hormone (to increase blood Ca level) while the parafollicular cells of the thyroid produce calcitonin which aids in lowering blood Ca.

90. Which statement is **NOT CORRECT**?

A. Males and females produce testosterone and oestrogen respectively in their gonads.
B. Both male and females produce follicle stimulating hormone and luteinizing hormone.

C. Oxytocin is produced and released from the anterior lobe of the pituitary gland.
D. Production of testosterone and oestrogen inhibits the release of gonadotrophin releasing hormone from the hypothalamus.

Answer is C: Oxytocin is produced in the hypothalamus and released from the posterior lobe of the pituitary gland.

91. The hormones known as "catecholamines" (adrenaline, noradrenaline and dopamine) are not lipid soluble. Therefore their receptor sites are:

A. On the inside of the plasma membrane.
B. On the outside of the plasma membrane.
C. In the cell cytoplasm.
D. In the cell nucleus.

Answer is B: With the receptors on the outside of the membrane, catecholamines do not need to be able to penetrate the membrane.