

Endocrine 2

Endocrine glands

E. Endocrine System The hypophysis (pituitary)

Pituitary(Hypophysis)

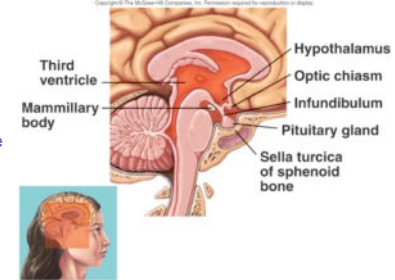
!Location!

Inferior to the hypothalamus, in the sella turcica.

Remember; the hypothalamus serves as a bridge between the "mind and the body"

Infundibulum

A stalk of tissue which joins the hypothalamus to the hypophysis. Contains blood vessels and nerves.



E. Endocrine System The hypophysis (pituitary)

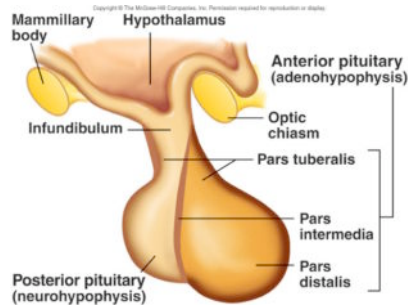
2 major parts

1) Adenohypophysis, anterior pituitary

7 different hormones are made and secreted here.

2) Neurohypophysis, posterior pituitary (Pars nervosa)

Hormones secreted here are made in the hypothalamus..



E. Endocrine System The hypophysis (pituitary)

Adenohypophysis

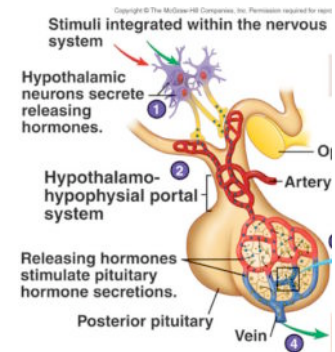
Structure

a) Hypothalamic-hypophysial portal system

Network of small veins. Carry blood from the hypothalamus. Delivers hormone control factors.

b) 3 parts of the adenohypophysis
i- Pars tuberalis

A tube-like structure around the infundibulum. Connects to the adenohypophysis.



E. Endocrine System The hypophysis (pituitary)

Adenohypophysis

Structure

b) 3 parts of the adenohypophysis

ii- Pars distalis

Main bulk of the adenohypophysis.

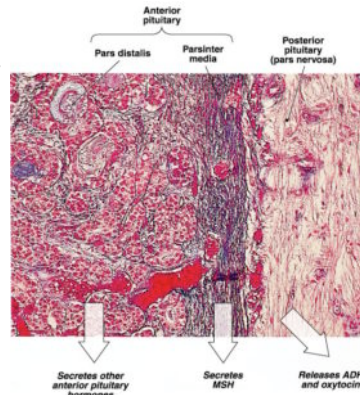
Makes and releases 6 hormones.

iii- Pars intermedia

Limited in humans.

Makes Melanocyte-stimulating hormone (MSH).

Not a significant hormone in humans.



E. Endocrine System The hypophysis (pituitary)

Hormones of the adenohypophysis (7)

Control of the pituitary

The adenohypophysis is controlled by the hypothalamus.

This releases stimulating and inhibiting factors.

Tropins

Are hormones which control other endocrine glands.

Example:

TSH or thyroid stimulating hormone.

Also called thyrotropin.

E. Endocrine System The hypophysis (pituitary) Adenohypophysis

1) Human **growth hormone (hGH), somatotropins**

a) Control factors from the hypothalamus

Growth hormone releasing hormone (GHRH)

Growth hormone inhibiting hormone (GHIH)

These control factors stimulate or inhibit the release of hGH from the adenohypophysis.

b) Function

i) Stimulates body growth- by 2 mechanisms

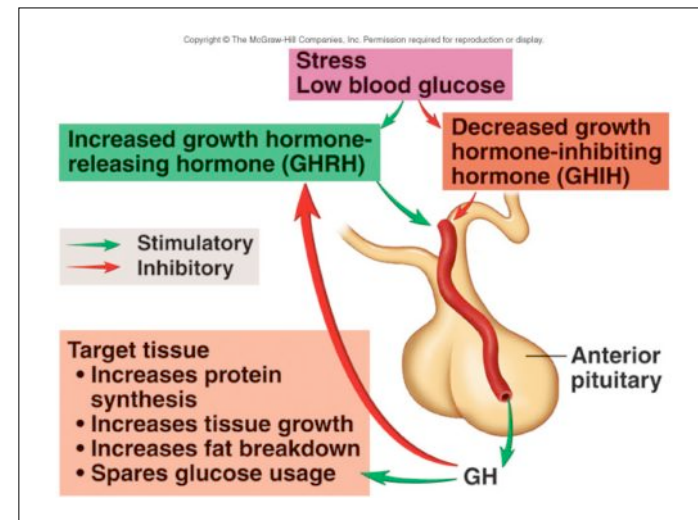
1- somatomedins (insulin-like growth factors)

Made by the liver.

Simulate protein synthesis in a number of cells; muscle.

2- cell differentiation

Cause stem cells to develop into different types of cells; cells "mature" or differentiate.



E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

b) Function

ii) Metabolic effects

1- Glucose sparing effects

GH causes fat to break down and release fatty acids.

Cells use fatty acids instead of glucose.

With GH, tend to lose fat stores.

2- Diabetogenic effects

GH also causes the release of glucose from glycogen in the liver.

Creates a "diabetic-like" elevation of blood glucose levels.

Have similar health risks as those associated with diabetes mellitus.

E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

c) Disorders of GH

i) Hyposecretion

Under secretion of GH.

Hyposecretion before puberty can result in....

pituitary dwarfism or pituitary growth failure

Short limbs.

Larger fat tissue reserves.

Generally normal trunk and head size.

Treatment: with hGH made by genetically modified bacteria which carry the human GH gene.

E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

c) Disorders of GH

ii) Hypersecretion

Over secretion of GH.

Hypersecretion before puberty can result in....

1- gigantism

Increases in height, weight and muscle mass. >7 ft

2- acromegaly

Continued hypersecretion after epiphyseal plate fusion.

Increased thickness in bones and cartilage.

Abnormal jaw, skull, hands, feet, etc.



Acromegaly results from the over-production of growth hormone after the epiphyseal cartilages have fused. Bone shapes change and cartilaginous areas of the skeleton enlarge. Notice the broad facial features and the enlarged lower jaw.

E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

2) Thyroid-stimulating hormone (TSH) or thyrotropin*!see thyroid

TSH stimulates the thyroid to release thyroid hormone (TH)

3) Adrenocorticotrophic hormone (ACTH)*!see adrenal

ACTH stimulates the adrenal gland to release adrenal cortical steroids.

4) Follicle stimulating hormone (FSH)*!falloitropin see reproduction

FSH stimulates the ovarian follicle development in the female.

Stimulates sperm development in the male.

E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

5) Lutenizing hormone(LH)*!lutropin!see reproduction

Induces ovulation and stimulates the secretion of ovarian hormones.

In males, stimulates production of testosterone.

6) Prolactin (PRL)*mammotropin see reproduction
lactogenic hormone

Stimulates milk production in mammary tissue.

E. Endocrine System The hypophysis (pituitary)
Adenohypophysis

7) Melanocyte-stimulating hormone (MSH), melanotropin
made by the pars intermedia

In humans, the pars is indistinct and MSH has very little effect.

melanocytes

In other animals, melanocytes (pigment cells) are sensitive to MSH and cause changes in the skin color .

E. Endocrine System The hypophysis (pituitary)
Neurohypophysis

**Neurohypophysis, posterior
pituitary,Pars nervosa**

The hypothalamic-hypophyseal tract

Found in the infundibulum.

Consists of ...
nerve fibers
that extend from the hypothalamus
to the neurohypophysis.

Carry hormones made in the
hypothalamus.

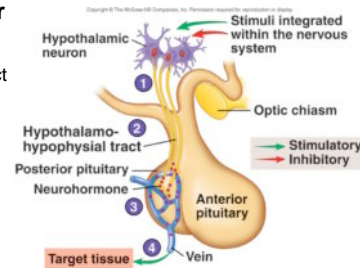
no vascular connections

No stimulatory factors are sent from
the hypothalamus.

secretory granules...

containing hormones travel down the nerve tract and deliver the hormones to the neurohypophysis.

Nerve impulses trigger the release of the hormones from the neurohypophysis.



E. Endocrine System The hypophysis (pituitary)
Neurohypophysis

1)Oxytocin (OT)*see reproduction

Produced in the hypothalamus.

Released in the neurohypophysis.

Stimulates smooth muscle contraction in mammary glands.

Triggers milk ejection.

2)Antidiuretic hormone(ADH)*see urinary
vasopressin

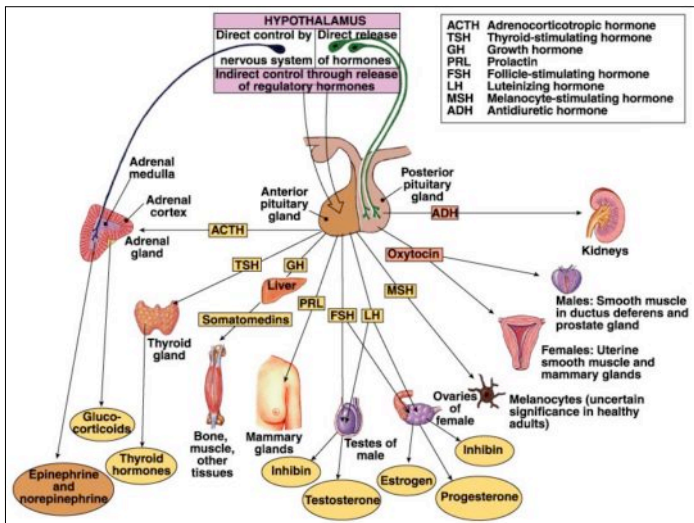
Causes the kidneys to retain water.

Helps produce a small volume of concentrated urine.

diabetes insipidus

Hyposecretion causes excessive urine output.

This also results in a loss of electrolytes, which may lead to shock or death.



F. Endocrine System The Thyroid Gland

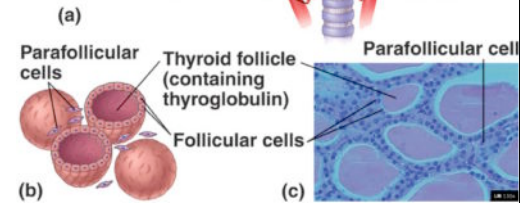
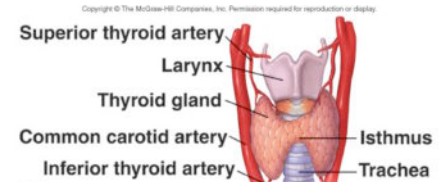
Thyroid

Location

Ant. To the trachea.
 Inf. To the larynx.

Structure

lateral lobes
 2 lateral lobes.
 Connected by a narrow...
 isthmus



F. Endocrine System The Thyroid Gland

Follicles

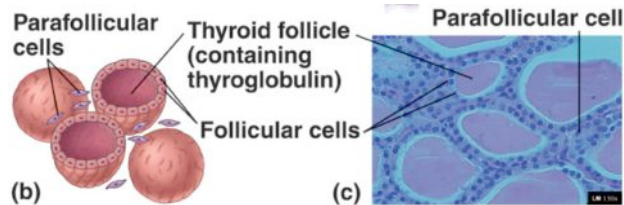
The thyroid is made of many follicles:
 These consist of a single layer of cells, surrounding an internal space.

Follicular cells-cuboidal The cell layer is a simple cuboidal epithelium.

Follicular cavity

The internal space is filled with a proteinaceous material called...

Colloid Which consists of the protein thyroglobulin.



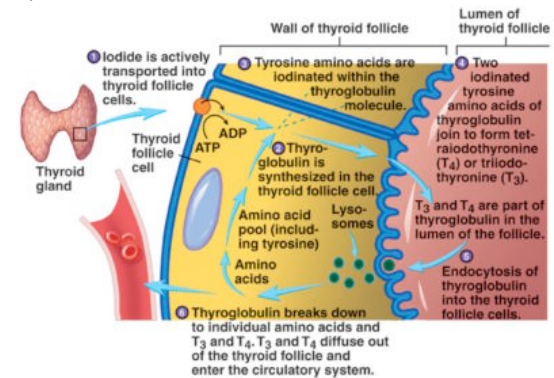
F. Endocrine System The Thyroid Gland

How thyroid hormones (TH) are made.

Thyroglobulin... is iodinated; I- is added to the tyrosine residues (amino acids)

T₄ A type of TH with 4 I- per molecule: inactive form. 90% of TH is secreted as T₄.

T₃ 3 I- per molecule: active form. 10% of secreted TH.



F. Endocrine System The Thyroid Gland

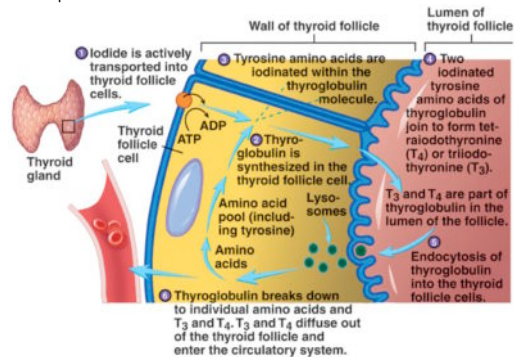
How thyroid hormones (TH) are made.

Thyroglobulin

TSH Stimulates I-transport, increases TH synthesis and secretion

T4 is converted to T3 In the peripheral tissues; TH becomes active

gene transcription I_s turned on and increases the basal metabolic rate.



F. Endocrine System The Thyroid Gland

Control factors

TRH- thyrotropin releasing hormone

Released from the hypothalamus when BMR falls.

Triggers the release of TSH from the hypophysis

TSH- thyroid stimulating hormone

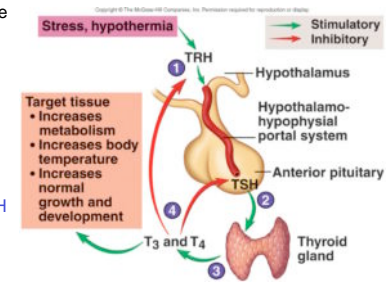
Is released into the blood,

Travels to the thyroid.

Stimulates the thyroid to release TH (T₃ and T₄)

T₄, T₃ and increased BMR feeds

back to the hypothalamus to decrease TRH.



F. Endocrine System The Thyroid Gland

Function

results in increase of basal metabolic rate (BMR)

The rate of many metabolic functions increase.

This causes increased use of glucose and oxygen for cell respiration.

Body temp rises and more carbon dioxide is produced.

Also, heart rate and blood pressure rise.

effect on carbohydrate metabolism

Carbo metab increases to generate more glucose for ATP synth.

Carbo levels in the body decline.

Blood glucose levels rise.

effect on fat metabolism

Fat metab also increases.

Fat stores are broken down to fatty acids, which are used by cells to generate ATP.

F. Endocrine System The Thyroid Gland

Disorders

Cretinism

hypothyroidism during development

"low thyroid"

failure of growth and mental retardation

causes

Most common: lack of iodine in the diet.

Remedy: iodine supplements (iodinized salt).

Myxedema

Hypothyroidism in the adult.

Symptoms: lethargy, low BP, low body temp,

In some cases a goiter forms (next page).

F. Endocrine System The Thyroid Gland

Hypothyroidism

In this condition, defective or low TH causes the BMR to fall.
The thyroid increases in size as it tries to make more TH.

Goiter

Also called thyromegaly.
Generally two types of goiter:

Simple hypothyroidism

Caused by a lack of iodine, produces a simple(enlarged thyroid) goiter.

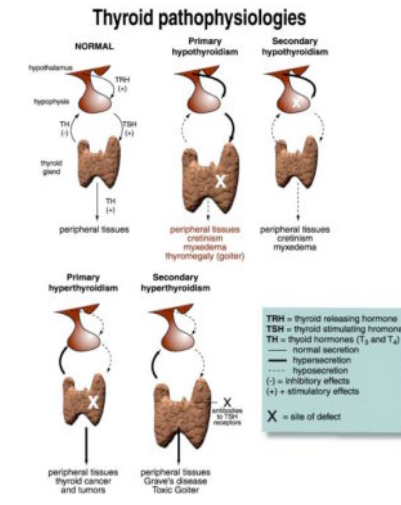
Exophthalmic(toxic)

... goiter is caused by a thyroid making too much TH, when stimulated by too much TSH or when antibodies mimic TSH.
This causes inc heart rate, BP, body temp and protruding eyes (exophthalmosis.)

F. Endocrine System The Thyroid Gland

hypersecretion

...of TH, which causes toxic goiter, is also called **hyperthyroidism**.



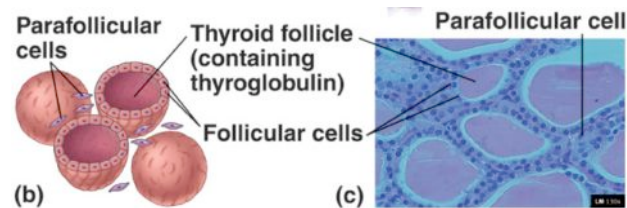
F. Endocrine System The Thyroid Gland

Parafollicular cells

...or C cells are found between the the thyroid follicles. Make the hormone...

Calcitonin

...which lowers blood Ca²⁺
This is not a major Ca²⁺ regulation mechanism.
Parathyroids (next page) have a stronger effect.



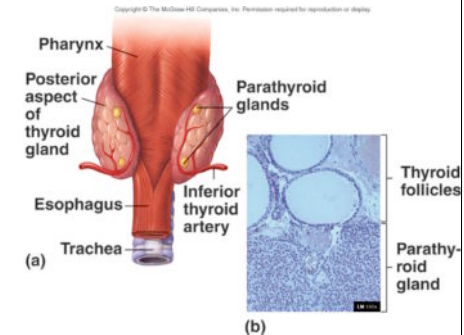
F. Endocrine System The Parathyroid Glands

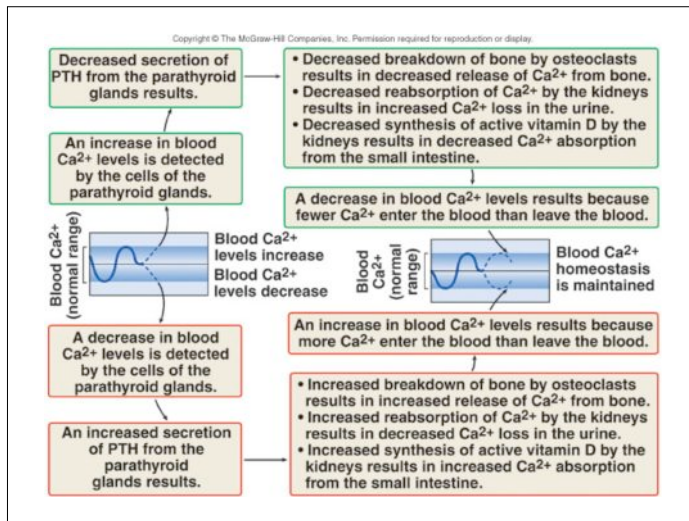
Parathyroids! Anatomy

Parathyroids are located within the lateral lobes of the thyroid.
3-4 on either side.

Hormones parathyroid hormones (PTH)

PTH raises blood calcium levels.
Increases osteoclast activity and bone erosion.





F. Endocrine System The Parathyroid Glands

Homeostasis of Ca^{2+} and phosphate!

PTH raises calcium and lowers phosphate levels in the blood and bone

1) Osteoclasts

Which erode bone and release calcium, are stimulated by PTH.

2) Osteoblasts

Which build bone and absorb calcium, are inhibited by PTH. Hypersecretion can cause osteoporosis.

3) Blood Ca^{2+}

Calcium diffuses into the blood from bone and is used to regulate cell signaling.

4) Urinary Ca^{2+}

...levels fall as calcium is reabsorbed back into the blood.

F. Endocrine System The Parathyroid Glands

Disorder

A thyroidectomy (surgical removal of the thyroid) can cause damage to the parathyroids.

This may cause a drop in PTH levels and then a fall in blood calcium

tetany

Occurs when calcium falls too low to regulate proper nerve transmission to muscles.

The muscles then contract uncontrollably, causing tetany.