

The Endocrine System

BOOKLET 1

Learner outcomes...

What you need to know!

- identify the principal endocrine glands of humans; i.e., the hypothalamus/pituitary complex, thyroid, parathyroid, adrenal glands and islet cells of the pancreas
- compare the endocrine and nervous control systems and explain how they act together; *e.g., stress and the adrenal gland*

Terms you need to know

Hypothalamus

Anterior Pituitary

Posterior Pituitary

Receptor Site

Target Tissue

Dynamic Equilibrium

Protein hormones

Steroid Hormones

Tropic Hormones

Non-Tropic Hormones

Endocrine

Exocrine

Pancreas

Terms you need to know

Negative Feedback Loop

Hyposecretion

Hypersecretion

ADH

Diabetes Insipidus

Oxytocin

TSH

ACTH

hGH

FSH

LH

PRL

Terms you need to know

Thyroxine

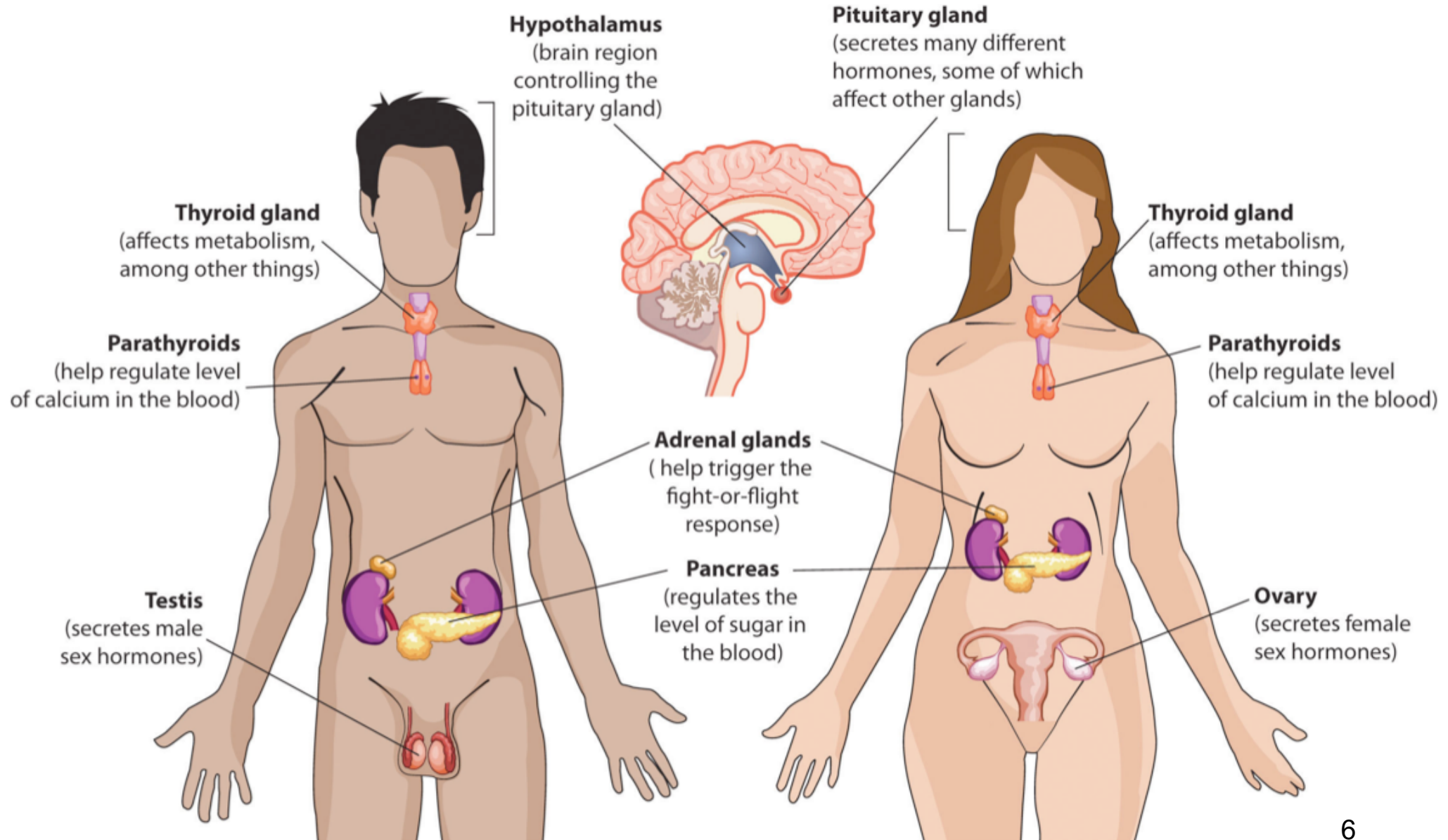
Adrenal Cortex

Adrenal Medulla

Acromegaly

Parts of the Endocrine System

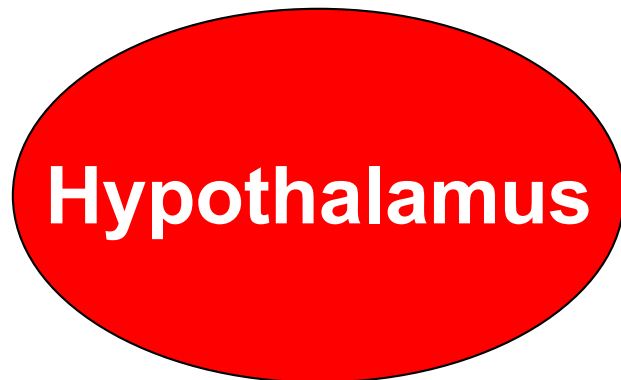
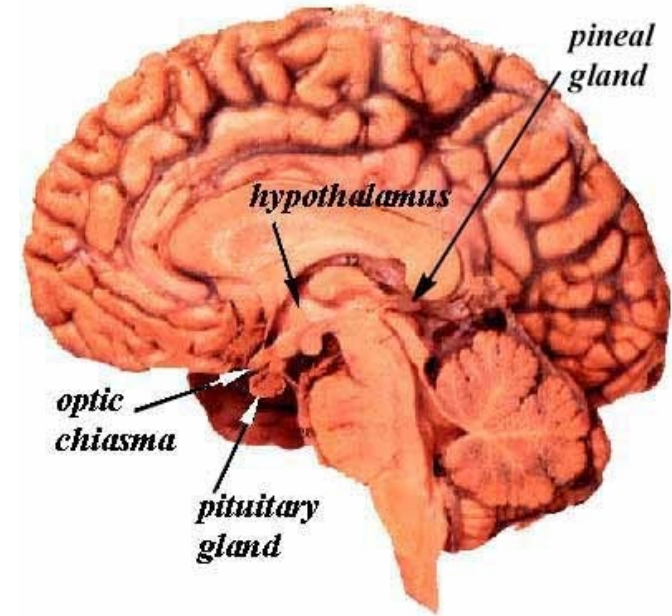
KNOW THEIR LOCATION



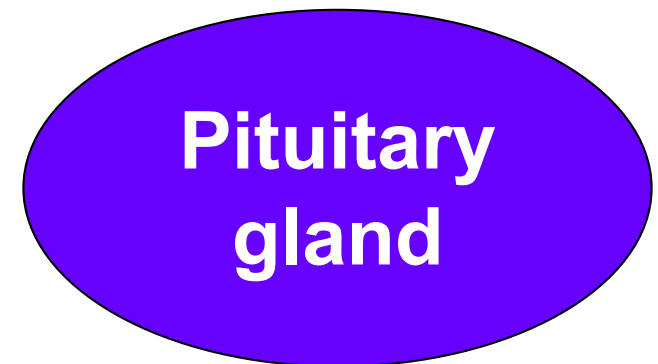
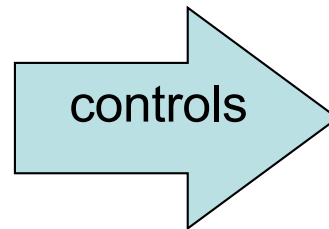
Comparison of Nervous System and Endocrine System

Nervous System	Endocrine System
Produces neurotransmitters	Produces hormones
Direct cell to cell communication	Hormones travel through blood to their target
Fast acting	Speed varies
Short duration	Long lasting
Cause muscle contraction and glandular secretion	Influence growth, development and metabolic activities

- The nervous system is tied into the endocrine system...
 - The **hypothalamus** (brain) controls the **pituitary gland** which is the **master gland** of the endocrine system.



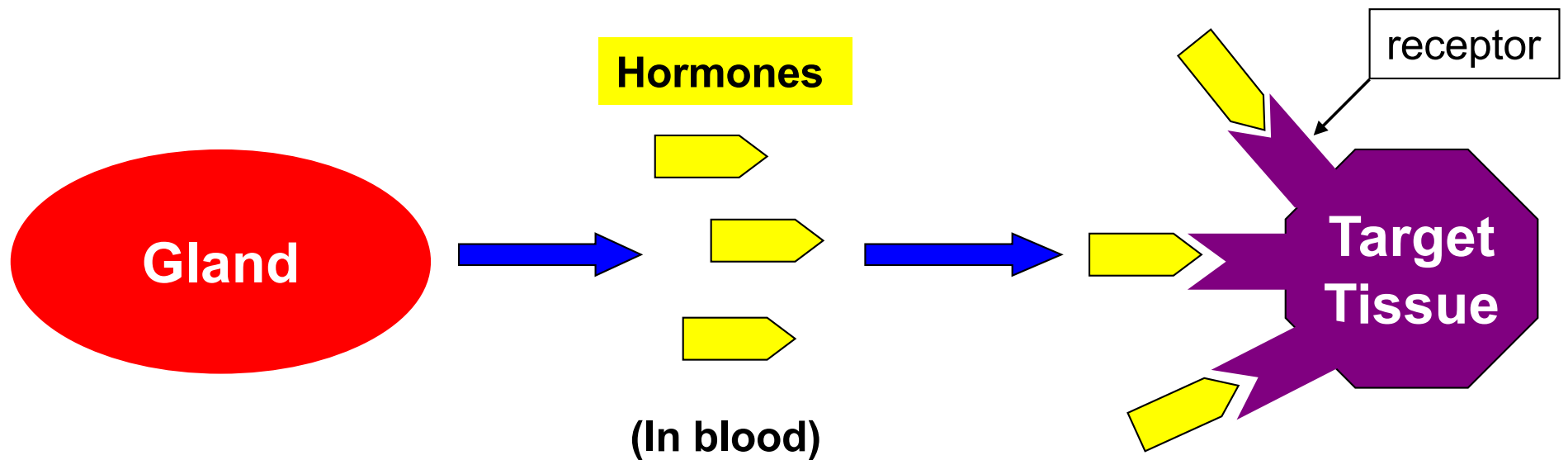
Nervous System



Endocrine System

Endocrine System

How hormones work...



Endocrine System

- Hormones are **carried by the blood** throughout the entire **body, yet they affect only certain cells.**
- The specific cells that respond to a given hormone have **receptor sites** for that hormone.
- This is like a **lock and key mechanism.**
- If a hormone and a receptor site do not match, then there is no reaction.
- All the cells that have receptor sites for a given hormone make up the **target tissue** for that hormone.



Endocrine system and target tissue:

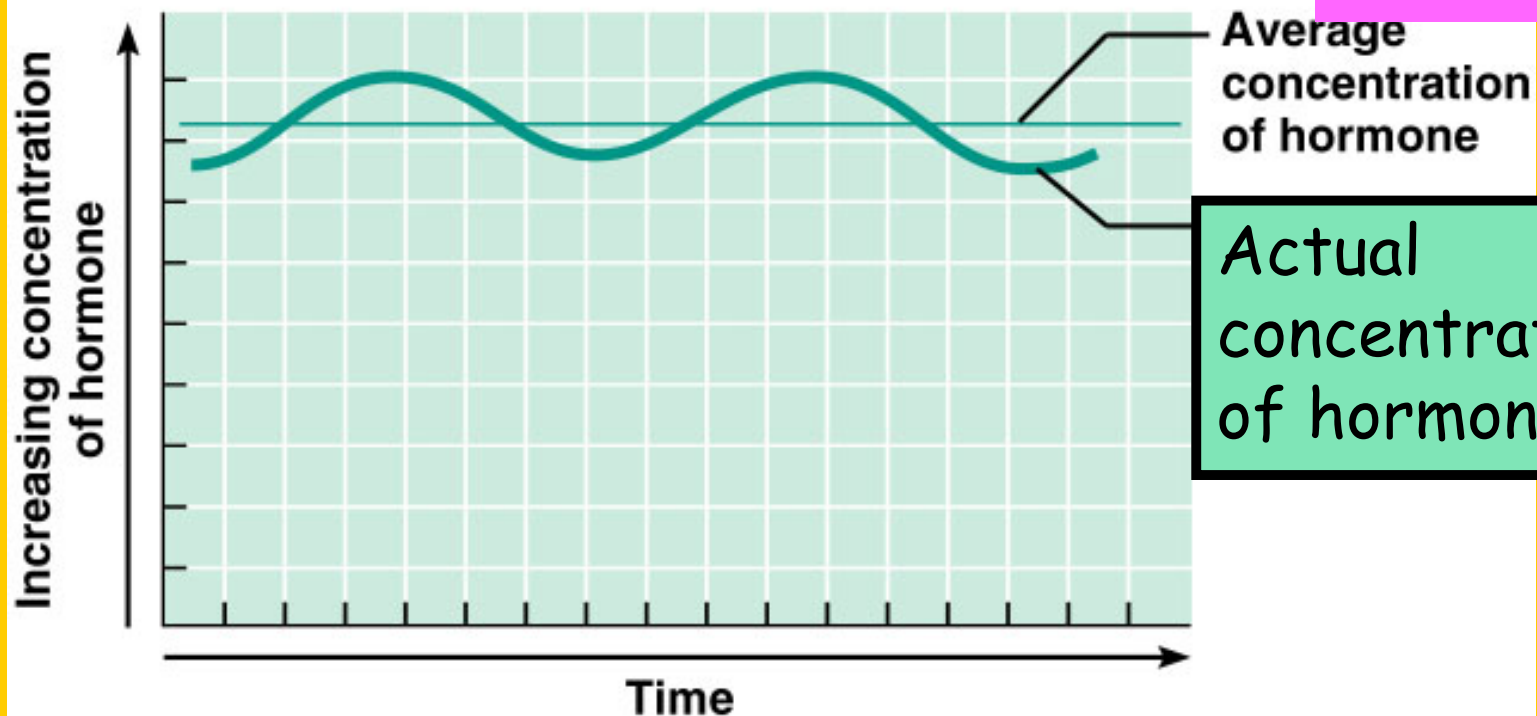
http://www.youtube.com/watch?v=HrMi4GikWwQ&safety_mode=true&safe=active¹⁰

Our body has “set points” for each chemical produced that controls metabolic reactions.

Hormones levels are maintained at a certain level.

Dynamic Equilibrium = Homeostasis

Concentration of Hormones in the Body



Characteristics of Hormones

Each hormone produced by the body is unique.

Each one is different in its **chemical composition, structure, and action**, however there are some similarities as well.

Hormones can be classified as
either...PROTEINS **or** **STEROIDS**
(water soluble) **(lipid/fat soluble)**

(eg) Insulin
Growth Hormone
Epinephrine(adrenaline)

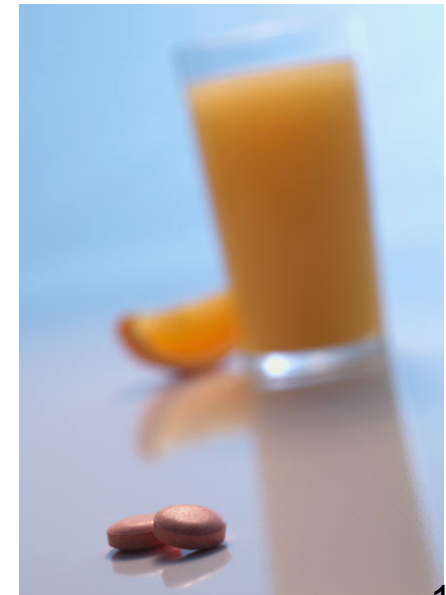
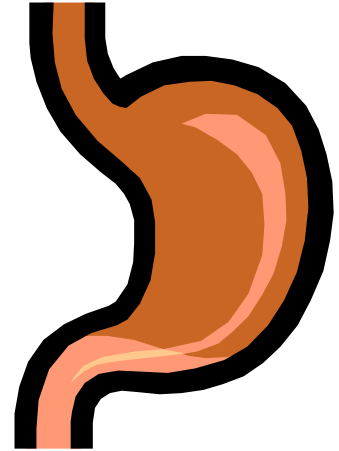
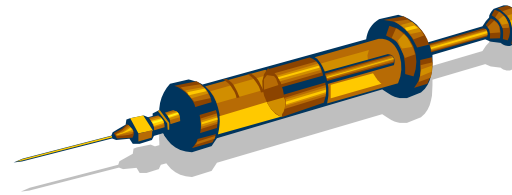
(eg) Testosterone
Estrogen & Progesterone
Cortisol

Most of the hormones in the human body, are **proteins** or protein derivatives. This means that their building blocks are **amino acids**.

Protein and Steroid Hormones

Protein hormones(water soluble)
cannot be taken by mouth
(orally) because they are **quickly
inactivated by the acid and
pepsin in the stomach.**

These hormones must be
administered by **injection.**

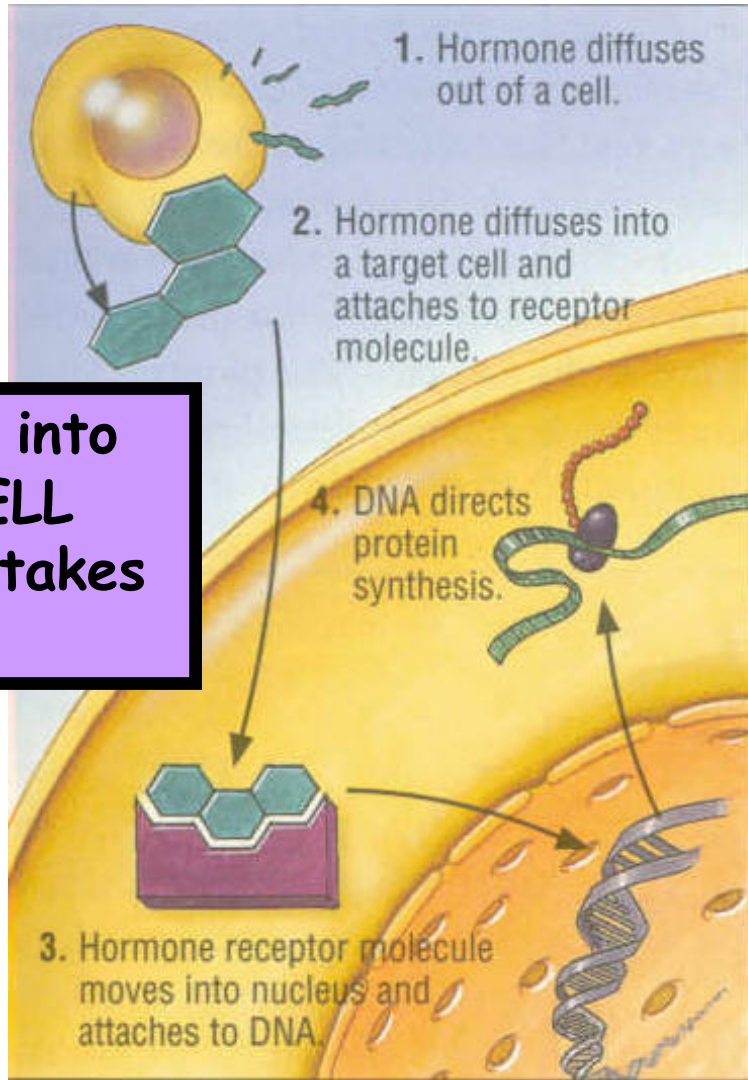


Steroid Hormones

(Lipid soluble)

SLOW

Moves into the **CELL** which takes time!

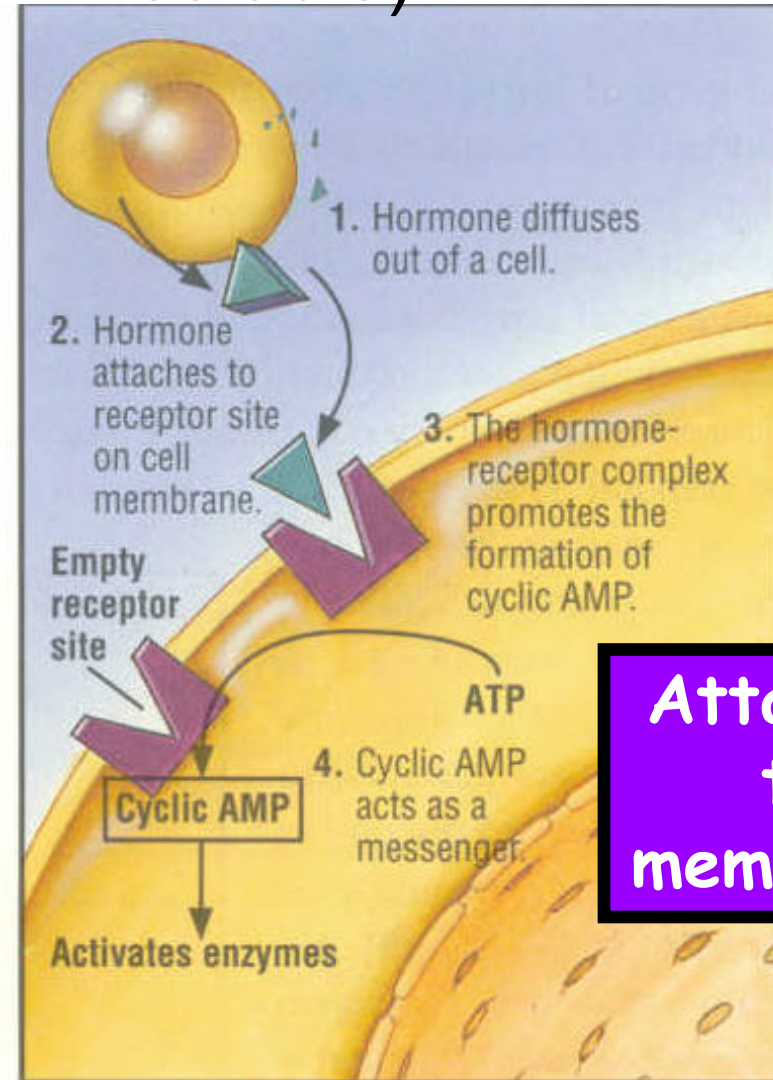


Protein Hormones

(water soluble)

PROMPT

Attaches to membrane



Tropic vs. Non-tropic Hormones

Tropic Hormones

made in pituitary

Affects or targets another gland

which in turn...

causes secretion of
other hormones

FSH, LH, ACTH, TSH (**FLAT**)

We will get to
what these are in
a bit...

Non-Tropic Hormones

from glands

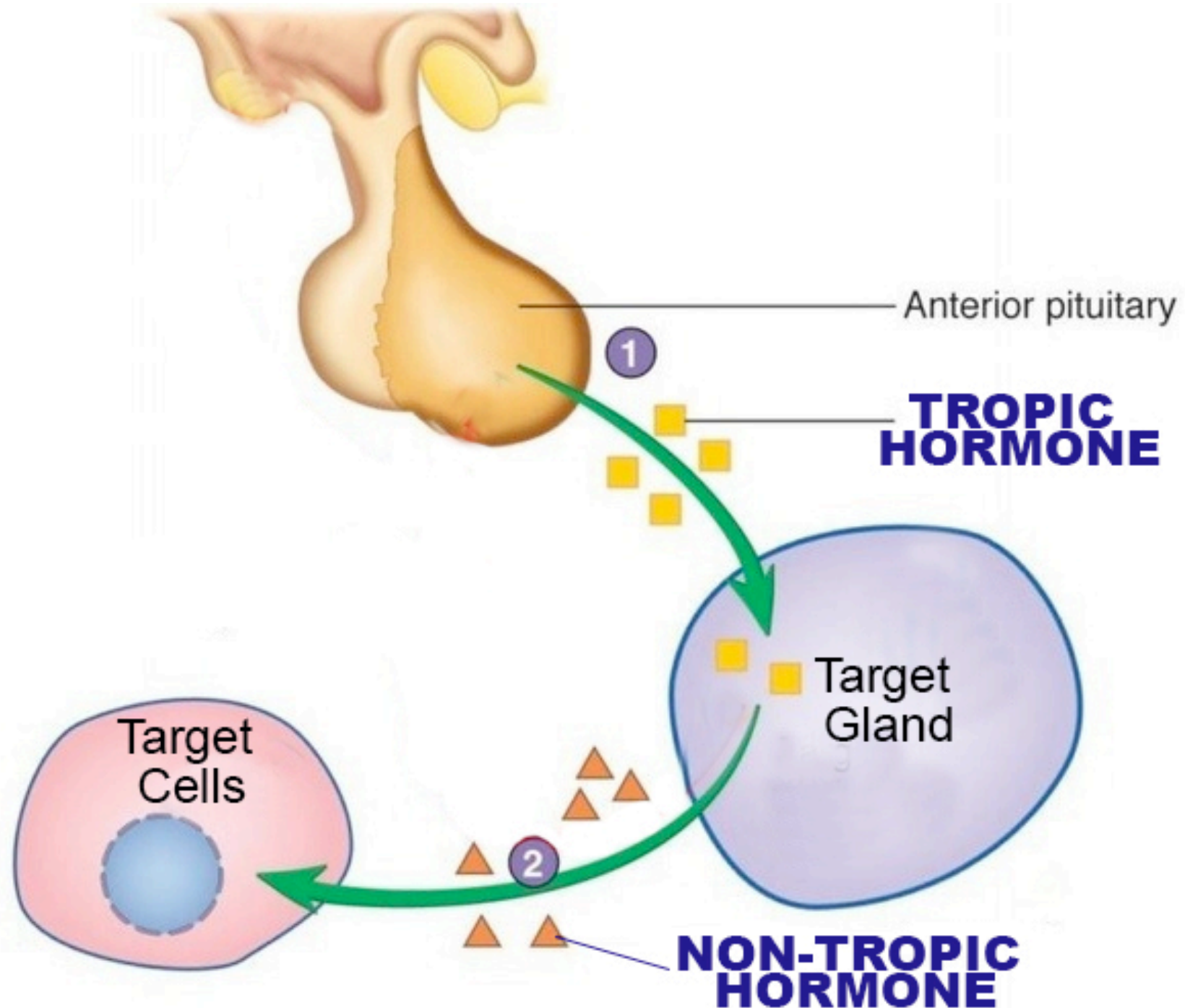
Do NOT affect other glands,
but instead...

affect specific body cells or tissues

hGH
PRL

Are made in pituitary but don't
cause others glands to secrete
other hormones

Tropic and Non-Tropic Hormones



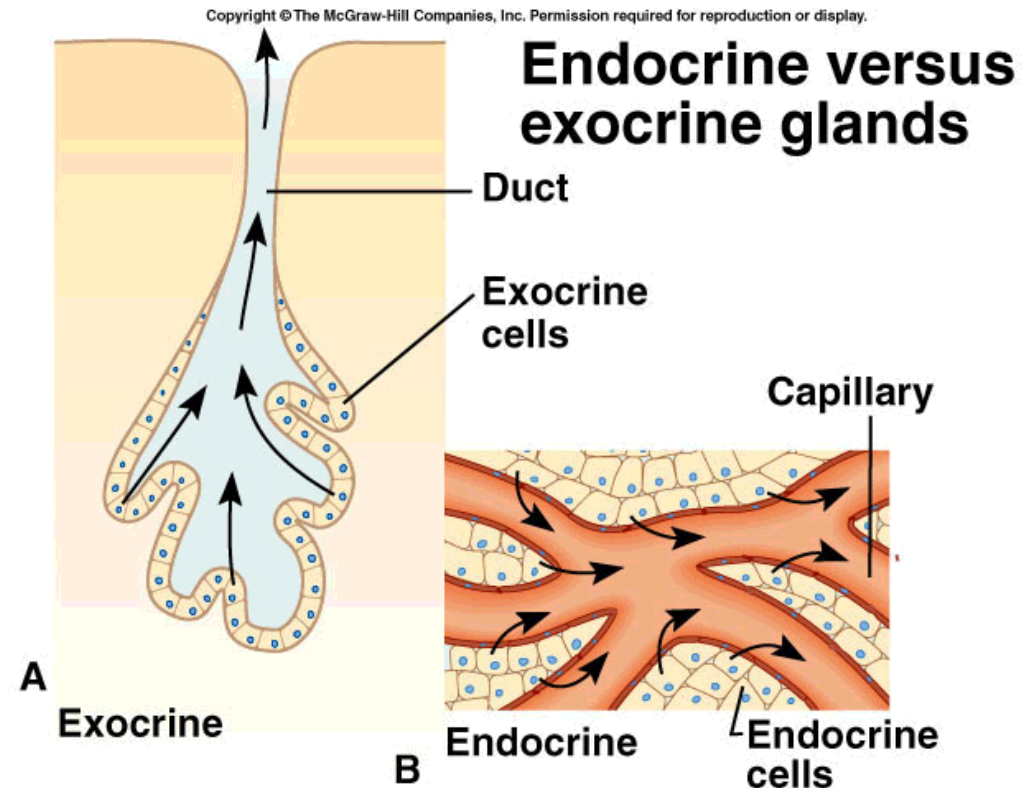
Endocrine vs. Exocrine glands

Endocrine glands

- Release substances into the blood directly
 - Ex. Pituitary gland

Exocrine glands

- Release substances into **ducts**
 - Ex. Salivary glands and sweat glands



Pancreas

The **pancreas** is an endocrine and an exocrine gland.

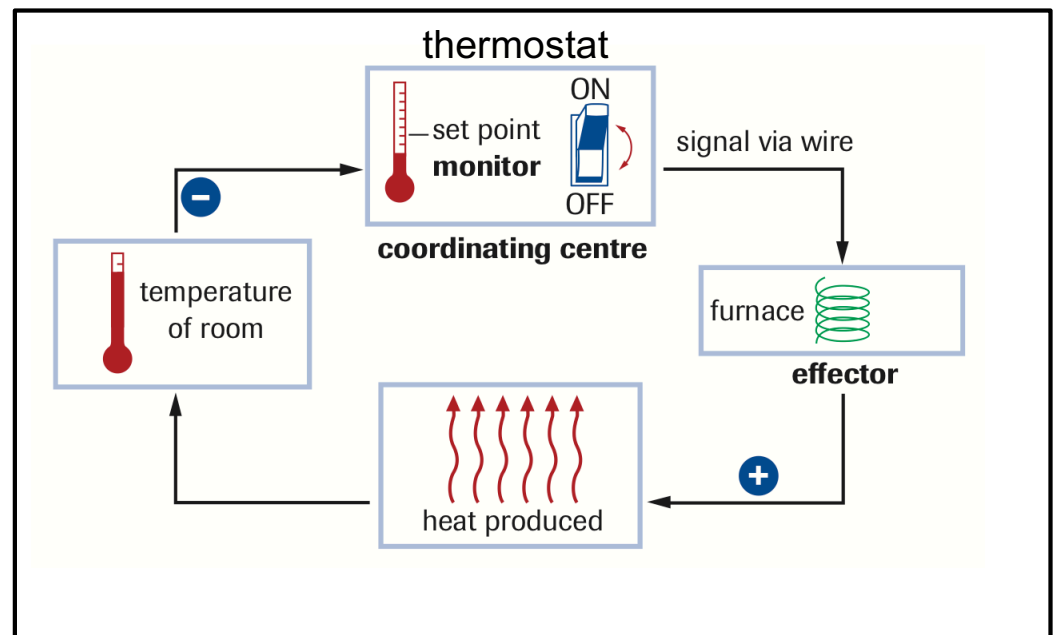
Exocrine - Secretion of **digestive enzymes** into small intestine

Endocrine - Secretion of **hormones** (eg. insulin and glucagon) directly into blood.

Feedback Loops

NEGATIVE FEEDBACK LOOP (not a bad thing)

- mechanisms that make adjustments to bring the body back into an acceptable range
- a control mechanism is used to counteract further change (ie. the thermostat prevents the furnace from staying on once the temp. has been hit)
- our bodies mostly use this type of feedback



Negative Feedback Loop

Feedback Loops

NEGATIVE FEEDBACK EXAMPLES

The following are all trying to get back to a “NORMAL”

Body temperature - The hypothalamus of a human responds to temperature fluctuations and responds accordingly. If the temperature drops, the body shivers to bring up the temperature and if it is too warm, the body will sweat to cool down due to evaporation.

Blood pressure - When blood pressure increases, signals are sent to the brain from the blood vessels. Signals are sent to the heart from the brain and heart rate slows down, thus helping blood pressure to return to normal.

Blood Sugar- When blood sugar rises, insulin sends a signal to the liver, muscles and other cells to store the excess glucose. Some is stored as body fat and other is stored as glycogen in the liver and muscles.

Production of human red blood cells (erythropoiesis) - A decrease in oxygen is detected by the kidneys and they secrete erythropoietin. This hormone stimulates the production of red blood cells which will increase oxygen.

Feedback Loops

Yes there is a positive feedback loop but more rare!!

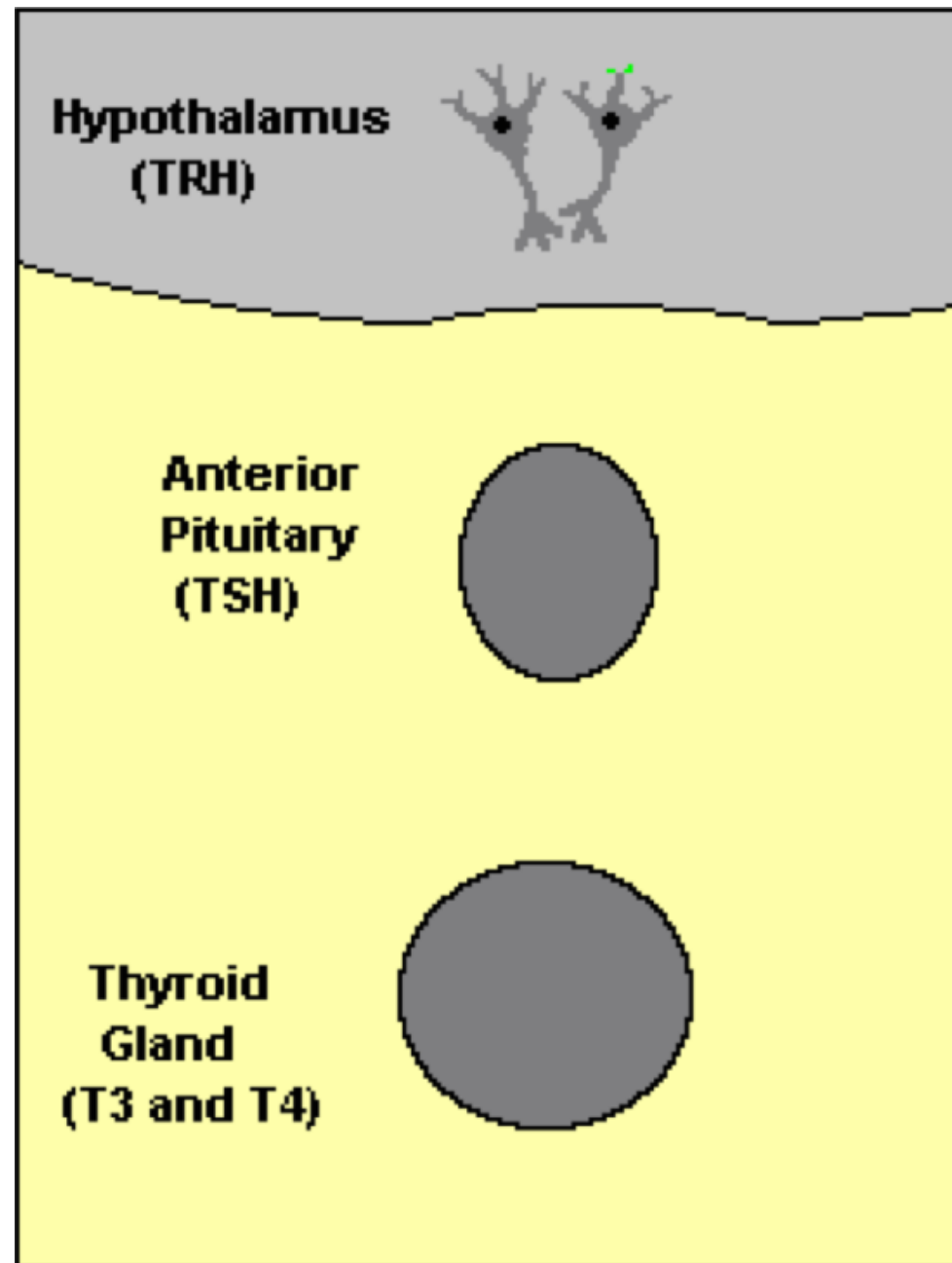
POSITIVE FEEDBACK LOOP

-a small effect is **amplified** until the desired effect is accomplished

(eg) giving birth (oxytocin keeps on being released into the body until the baby is born)

(eg) body keeps sending more and more platelets to clot a bleeding cut until the cut is sealed

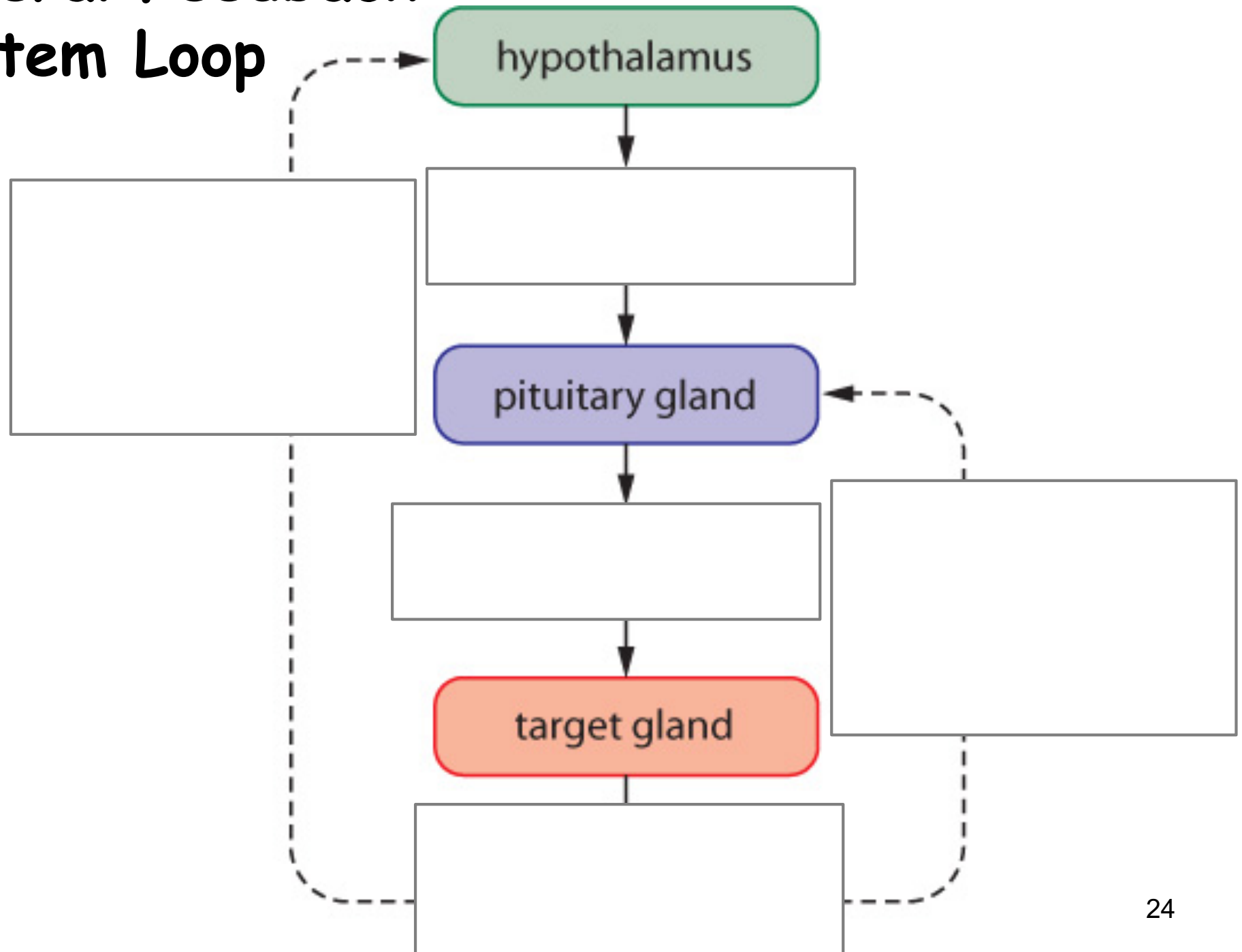
Negative Feedback Loop



Negative feedback or feedback inhibition

- Prevents **chemical imbalances** in the body
- Once a hormone produces the desired effect, hormone production must **decrease**
- Important in maintaining **homeostasis**
- The feedback that inhibits the release of a hormone can be:
 - an inhibiting hormone (ie)
 - » inhibin used to stop production of testosterone
 - receptors that sense a change (ie.)
 - » Change in blood pressure
 - » Change in blood glucose

General Feedback System Loop



1. Hypothalamus

2. Pituitary Gland

3. Thyroid gland

4. Parathyroid

***5. Liver (stores glucose)**

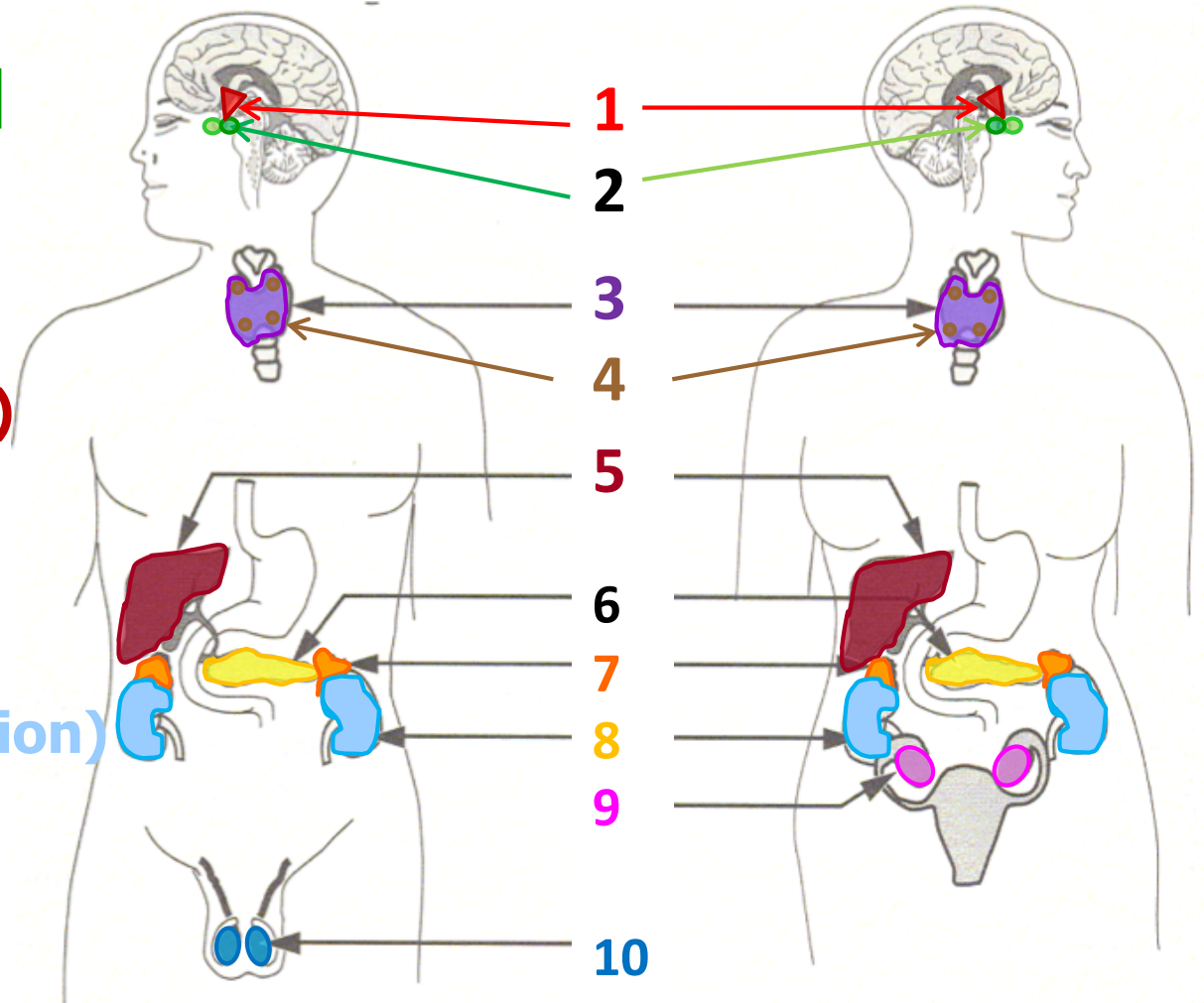
6. Pancreas

7. Adrenal Gland

***8. Kidney (water regulation)**

9. Ovary

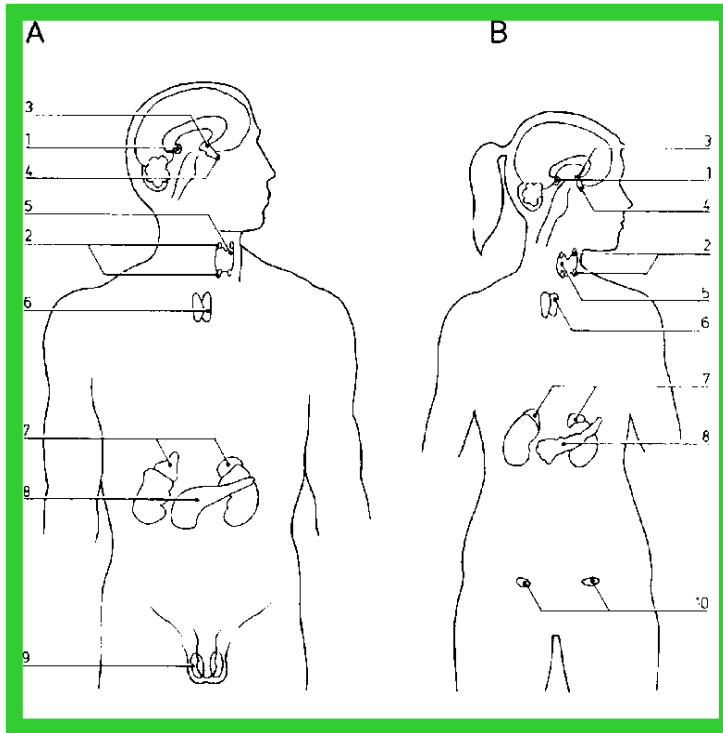
10. Testes



*** Are not endocrine glands, but are target tissue for hormones.**

Check Your Understanding

- 1) How is the endocrine system like a “lock and key” mechanism?
- 2) What are two categories hormones can be classified as?
- 3) Compare TROPIC vs NON-TROPIC
- 4) What is a “negative feed back loop”?
- 5) Compare exocrine vs endocrine?
- 6) What organ has both exocrine and endocrine function?



Do the
Flash Cards Activity
in your workbook.

Endocrine System Video- bozeman

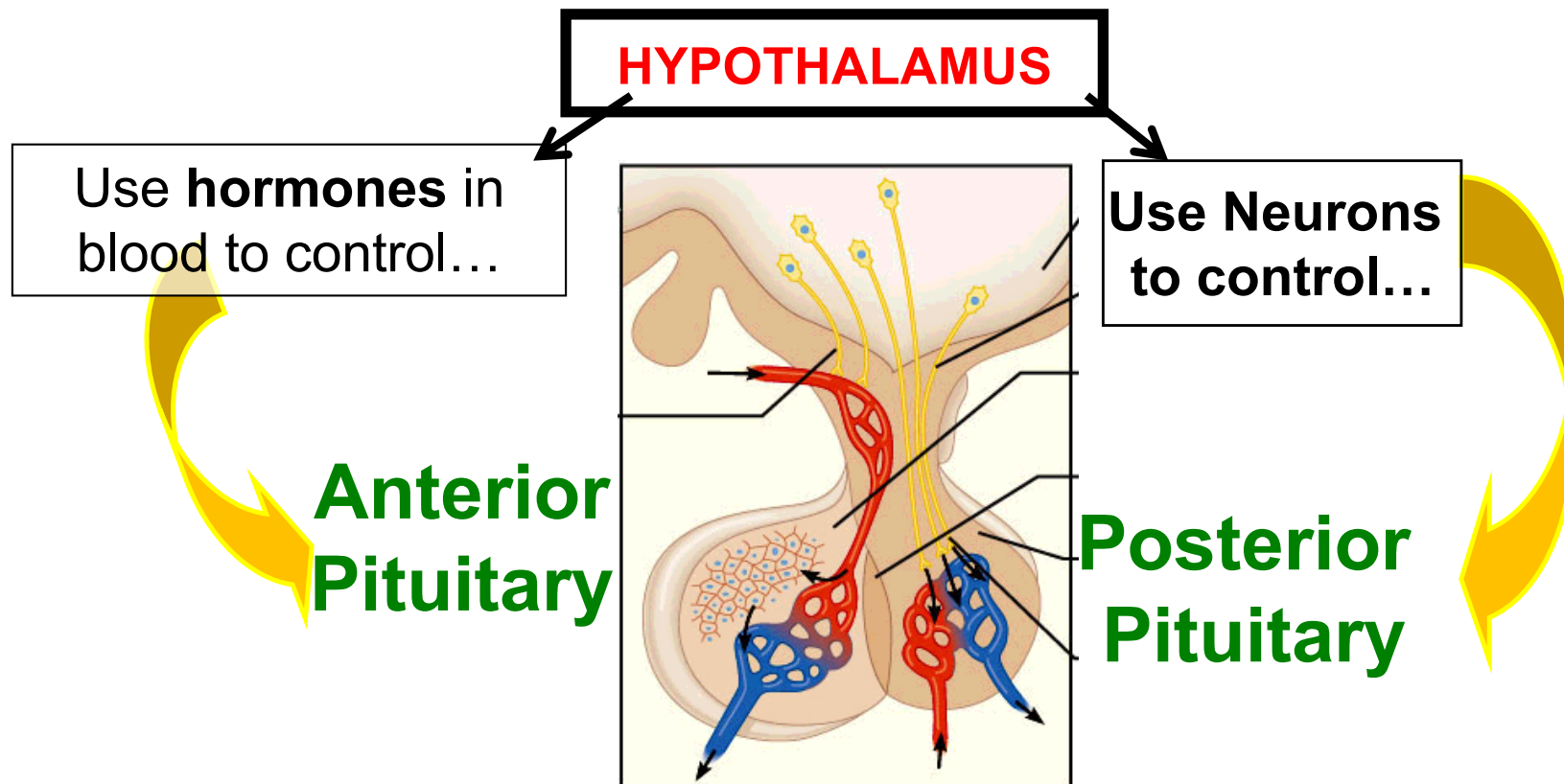
(Disregard info on Pineal gland. Do not need to know that.)

http://www.youtube.com/watch?v=-S_vQZDH9hY&safety_mode=true

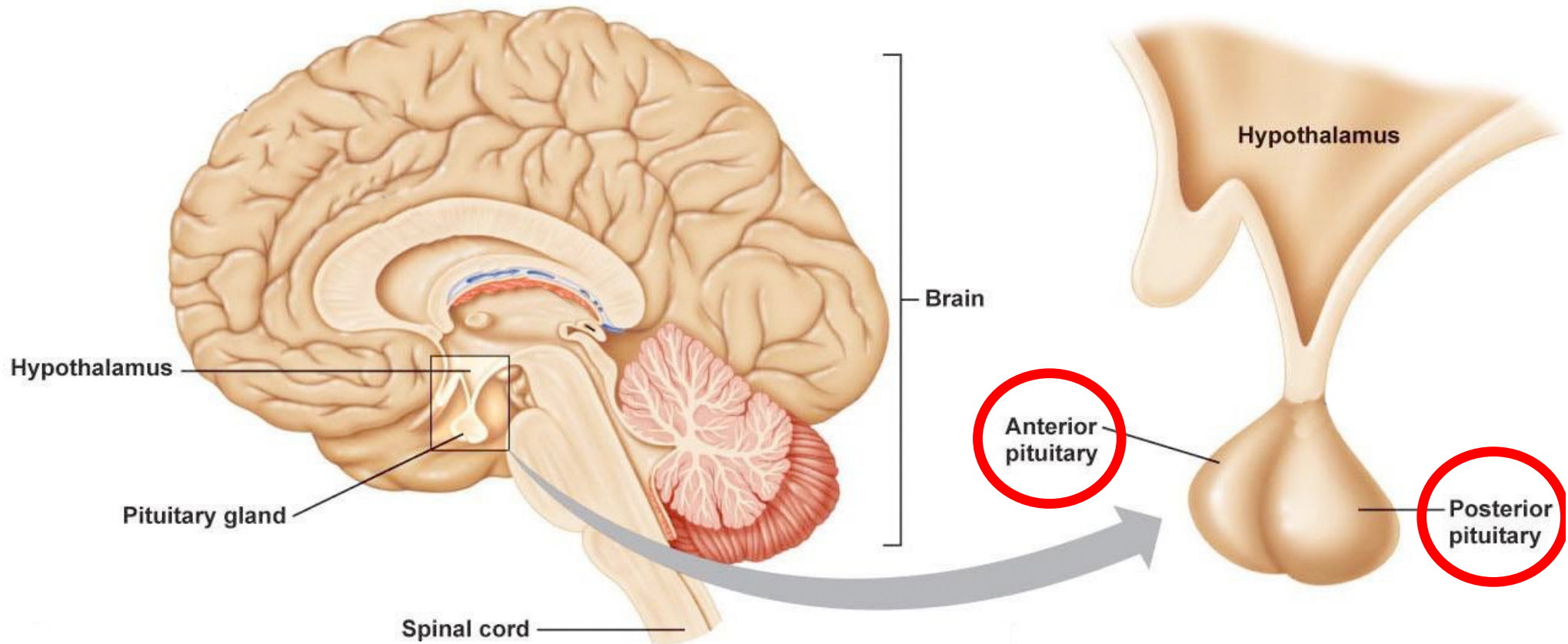
The Hypothalamus and Pituitary

The hypothalamus controls the release of hormones from TWO LOBES:

- a) **posterior** pituitary by nerve impulses
- b) **anterior** pituitary by Releasing Hormones (RH or RF)
aka (releasing factors) and also **inhibiting factors (IF)**



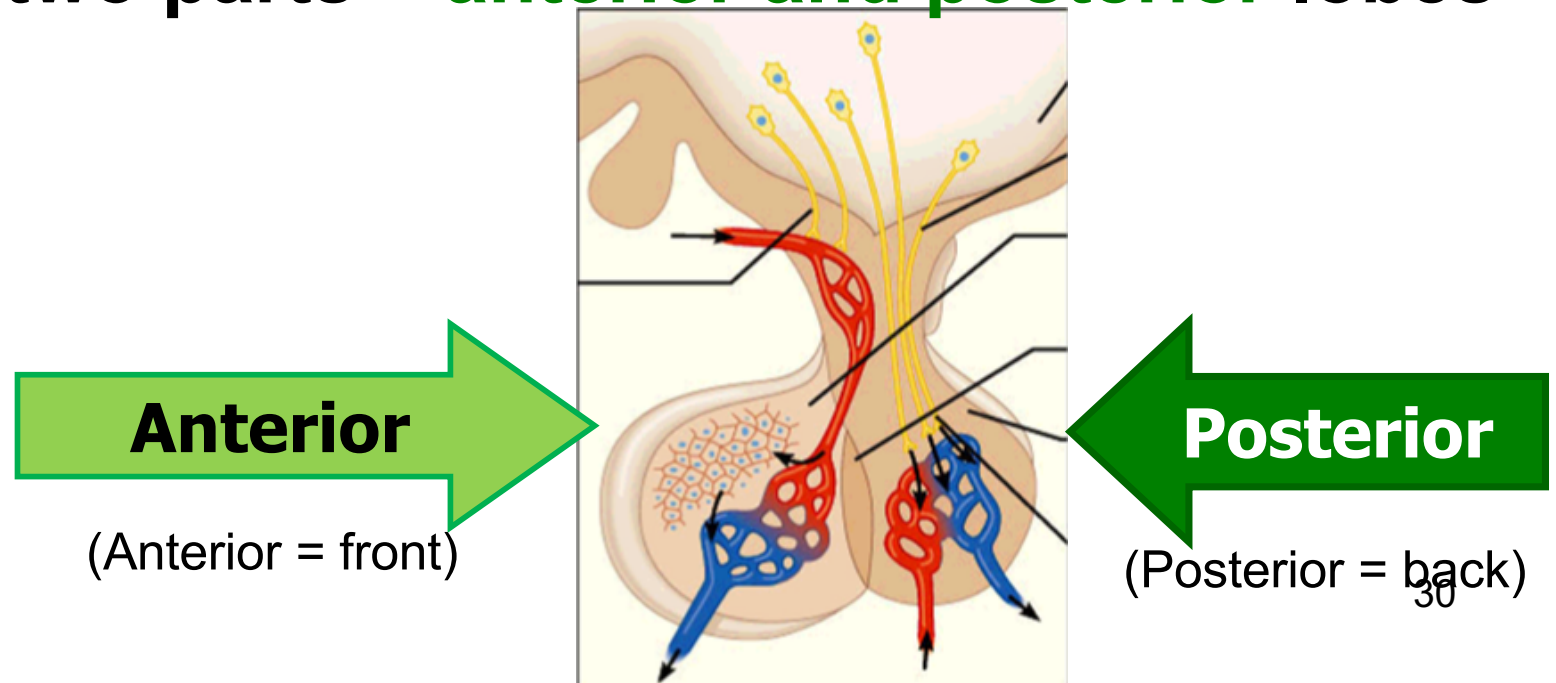
The pituitary gland



The pituitary gland

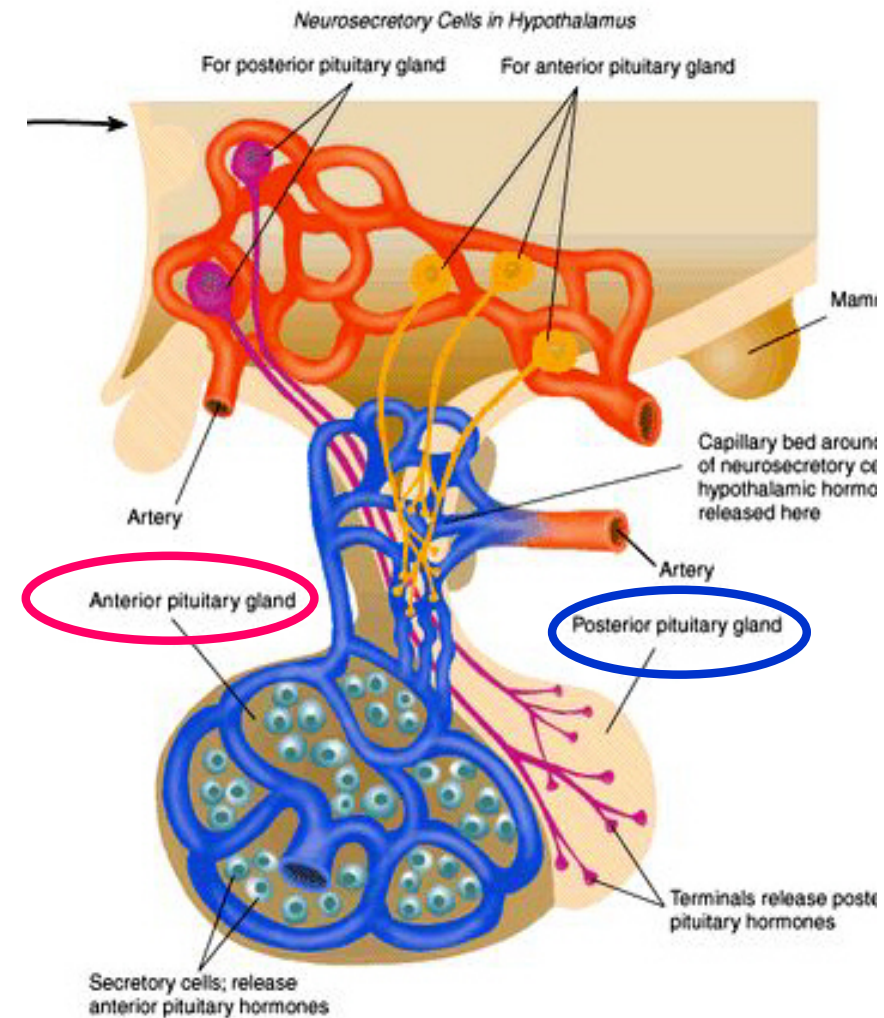
- The **pituitary gland** **controls most of the other glands** in the body
 - By sending out hormones that affect those glands, in other words
it releases **tropic hormones!!!**

Made up of two parts – **anterior and posterior** lobes



The pituitary gland

- **Anterior lobe produces 6 hormones**, which are released into the blood stream
- **Posterior lobe stores 2 hormones** (produced in hypothalamus) which are released into the blood stream
 - 1) **Antidiuretic hormone (ADH)**
 - 2) **Oxytocin**



Generally our body wants to keep that perfect balance of hormones but sometimes things may go awry...

HYPosecretion VS HYPERsecretion

Hyposecretion: production of too little of a hormone
-results in lack of target cell response
(cells don't respond enough)

Hypersecretion: production of too much of a hormone

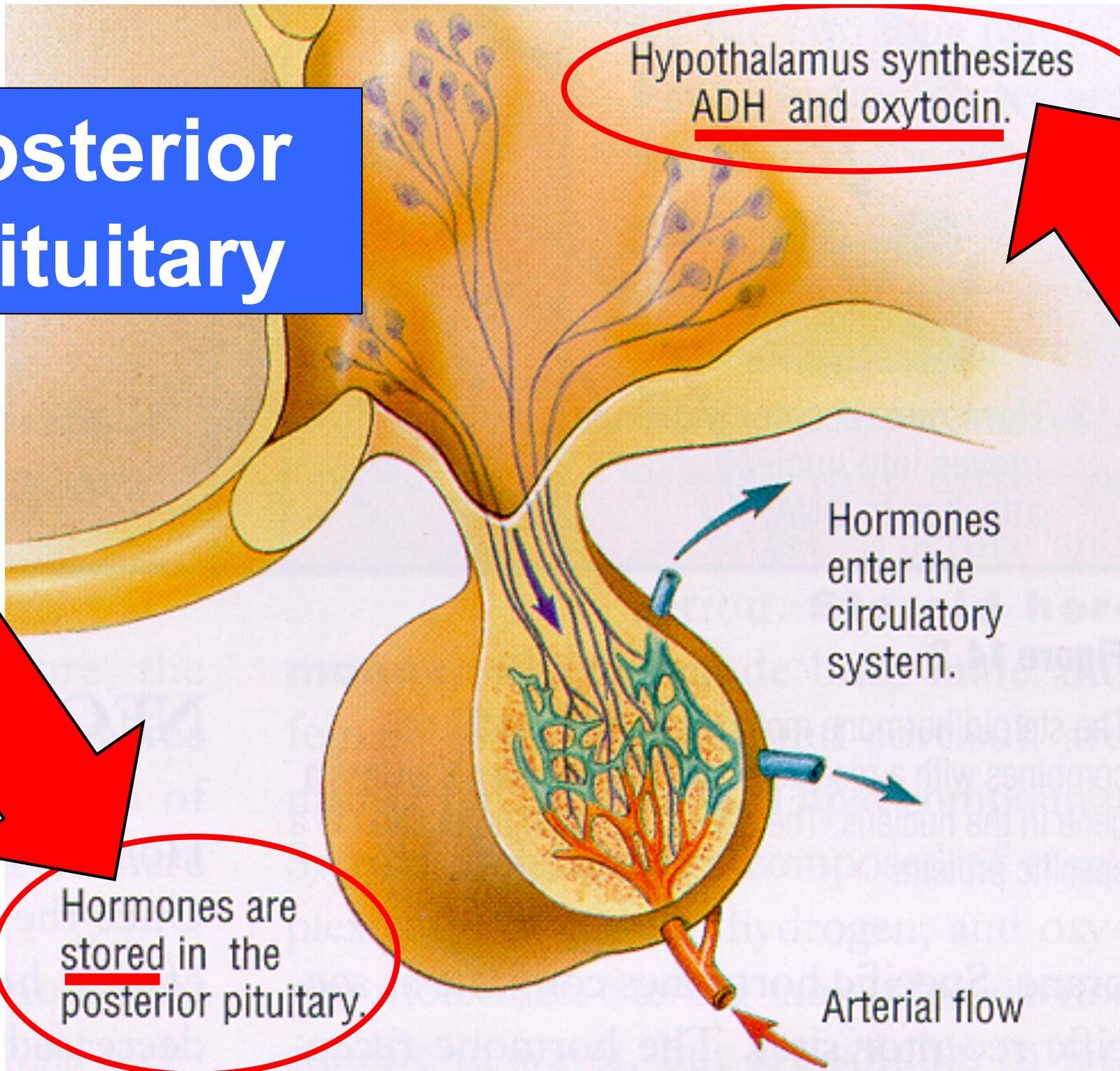
Posterior Pituitary

Hypothalamus synthesizes ADH and oxytocin.

Hormones enter the circulatory system.

Hormones are stored in the posterior pituitary.

Arterial flow



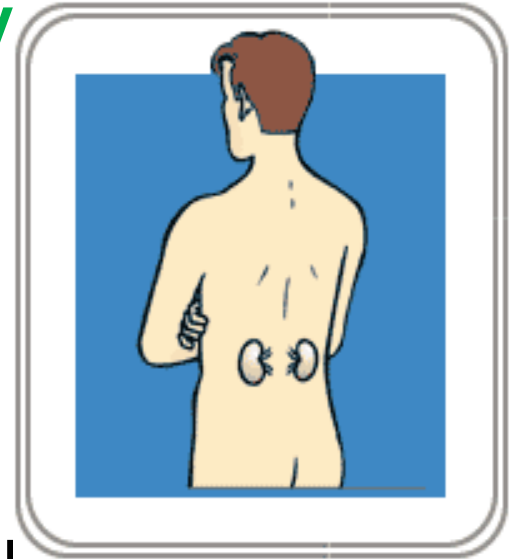
Posterior lobe – **ADH** (Antidiuretic hormone)

- Released in response to **dehydration (thirsty)** (**ADH released when blood plasma too thick**)
- Production site: **hypothalamus**
(stored in the posterior pituitary)
- Target: **kidneys** (and blood vessels)
- Function: **increases water reabsorption** by the kidneys, to increase **blood pressure**

Other Effects: Urine output **DECREASES**

Urine concentration **INCREASES**

Blood solute concentration **DECREASES**
(stuff in the fluid)



-
- **Hypersecretion**: (too much) abnormal water retention
 - **Hyposecretion**: (too little) **diabetes insipidus** (urinate more often)

Posterior Lobe - Diabetes insipidus

(this is NOT the diabetes associated with blood sugar)

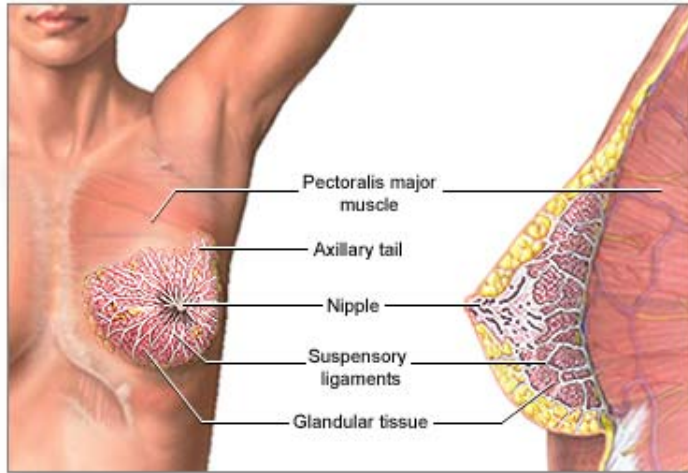
- Caused by **decreased** secretion of **ADH** or incorrect receptors for ADH in kidney.
- **Symptoms:**
 - excessive urination (up to 16 liters a day)
 - excessive thirst



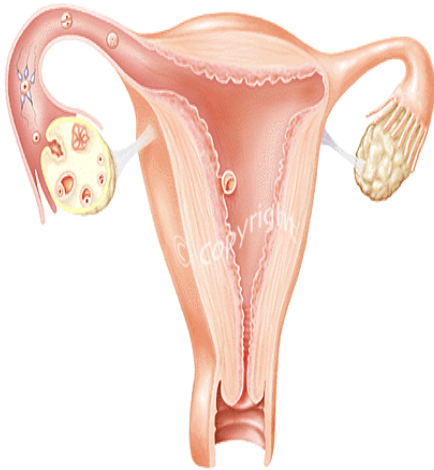
Diabetes insipidus is a disorder in which the body fails to produce sufficient ADH. One symptom of this disorder that is directly related to ADH secretion is

- ☒ A. the production of large amounts of dilute urine
- ☐ B. a decrease in the glucose concentration in the blood
- ☐ C. an increase in the glucose concentration in the urine
- ☐ D. the production of small amounts of concentrated urine

Posterior lobe - OXYTOCIN



adam.com



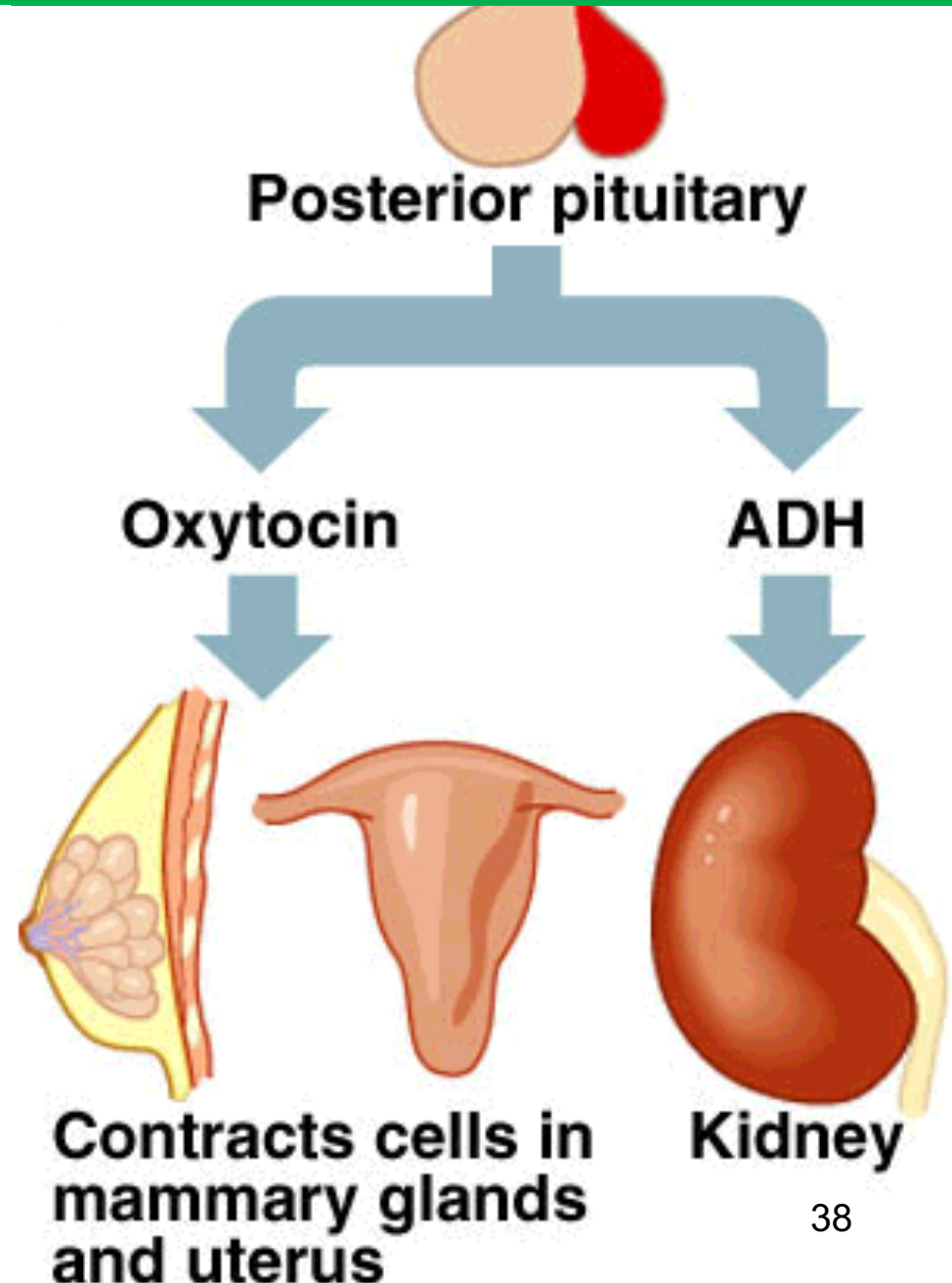
- Production site: hypothalamus (stored in the posterior pituitary)
 - Targets: uterus and mammary glands
 - Functions: initiates contractions
-

- Hyposecretion: prolonged or difficult birth
- Hypersecretion: inappropriate ejection of milk

SUMMARY Posterior Pituitary

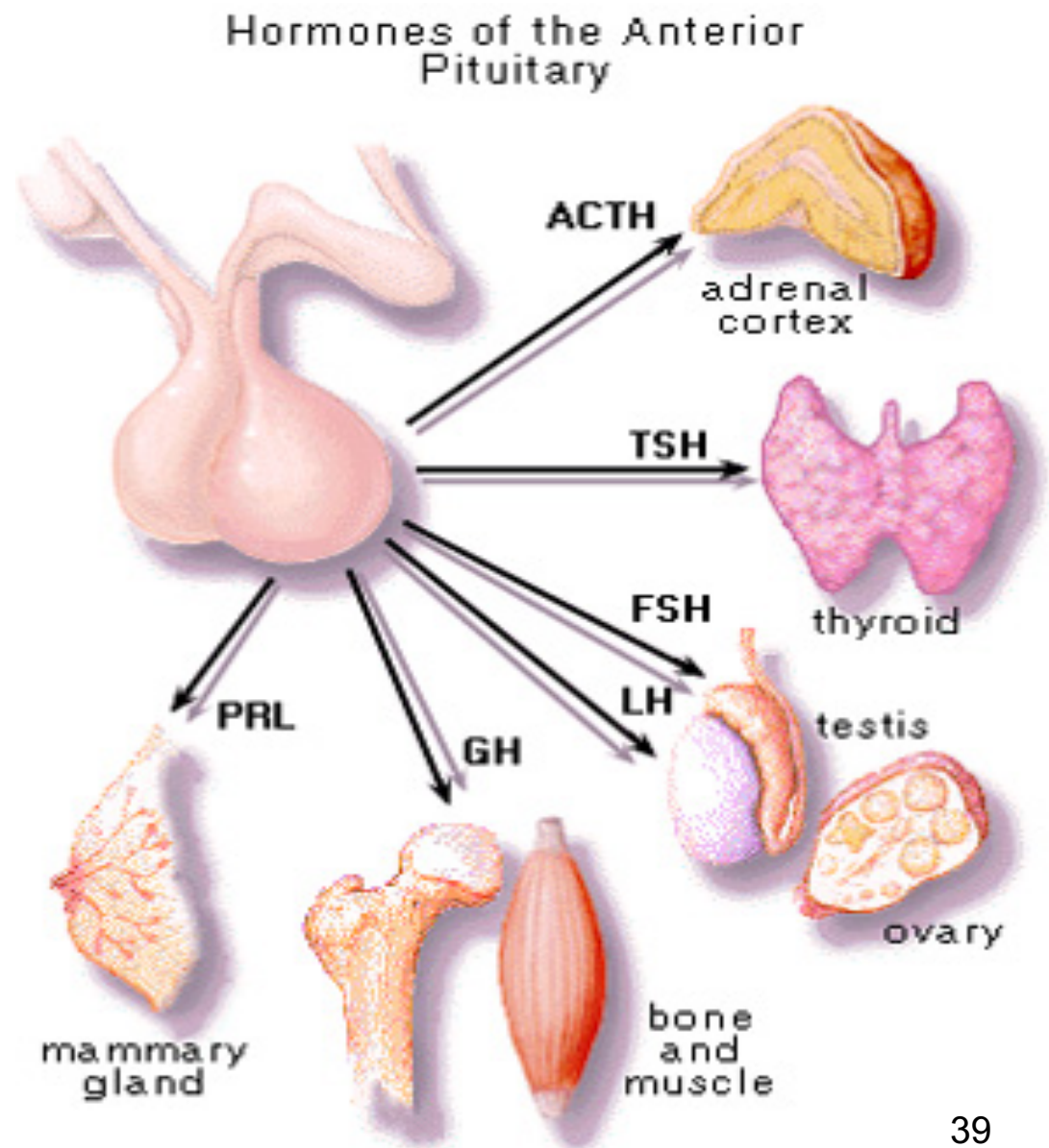
Remember:

- 1: what the **hormones** are,
- 2: **where** they are produced,
- 3: **target organ**, and
- 4: **function** (what they do)



ANTERIOR PITUITARY

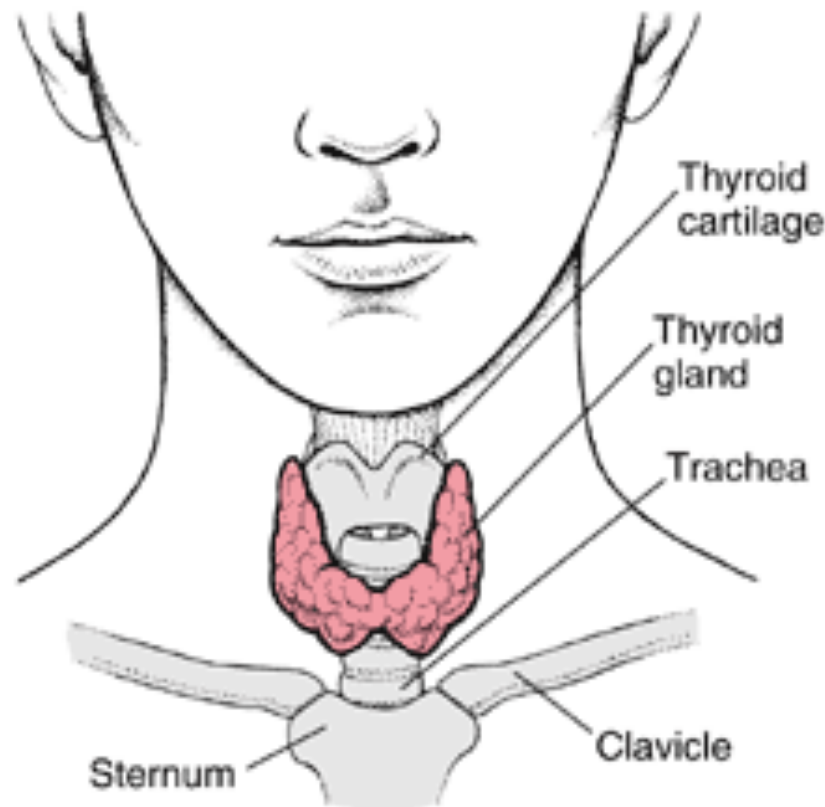
- Produces its own hormones (6 of them)
 - TSH
 - ACTH
 - STH or hGH
 - FSH
 - LH
 - PRL
- **BUT**, regulated by the hypothalamus



ANTERIOR PITUITARY

Thyroid stimulating hormone (TSH)

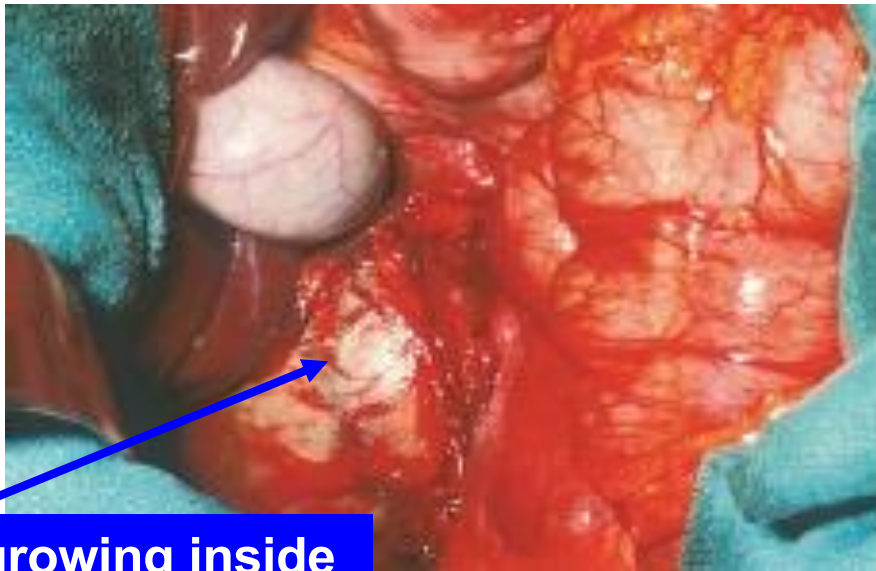
- Production site: anterior pituitary
- Targets the **thyroid gland**
- stimulates thyroid gland to produce **thyroxine**
(increases metabolism and regulates growth)



ANTERIOR PITUITARY

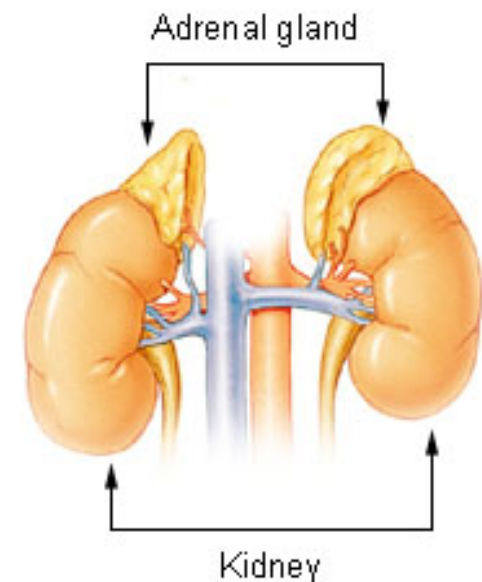
Adrenocorticotrophic hormone (ACTH)

- Production site: anterior pituitary
- Targets the **adrenal cortex**
- stimulates the release of stress hormones **aldosterone** (water retention) & **cortisol** (provide blood glucose to deal with elevated energy requirements)



Tumor growing inside the adrenal cortex

Adrenal Gland



ANTERIOR PITUITARY

human growth hormone (hGH) aka somatotropin

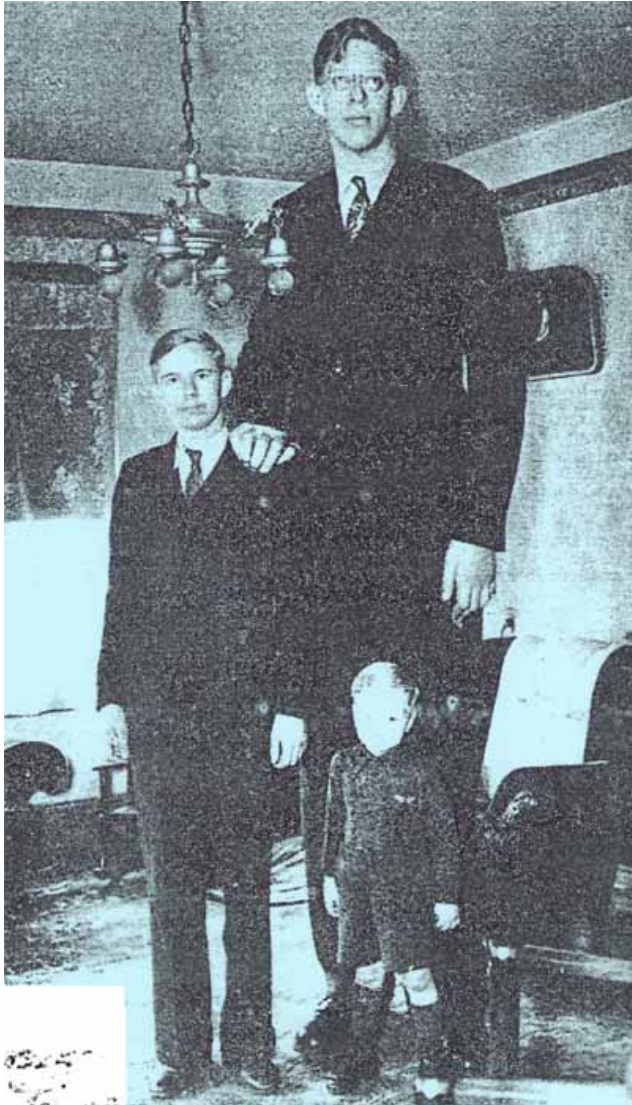
- Production site: anterior pituitary
- Targets most cells
(bones and muscles)
- Promotes growth

-
- Hyposecretion: dwarfism
 - Hypersecretion: gigantism
(child) or acromegaly (adult)



ANTERIOR PITUITARY Gigantism

Due to the continuous production or over production of the growth hormone



<https://www.youtube.com/watch?v=5McWw03Ryrs>



**“General Tom Thumb”
and
Livia Warren**

ANTERIOR PITUITARY human growth hormone (hGH)

- Can affect cartilage and bone cells
- **ACROMEGALY** is broadening of facial features, hands and feet
 - excess hGH can **no longer cause an increase in height**, so the bones and soft tissues of the body widen. Thus, over time, the face widens, the ribs thicken and the feet and hands enlarge. There are also some health consequences due to acromegaly.



A



B



C



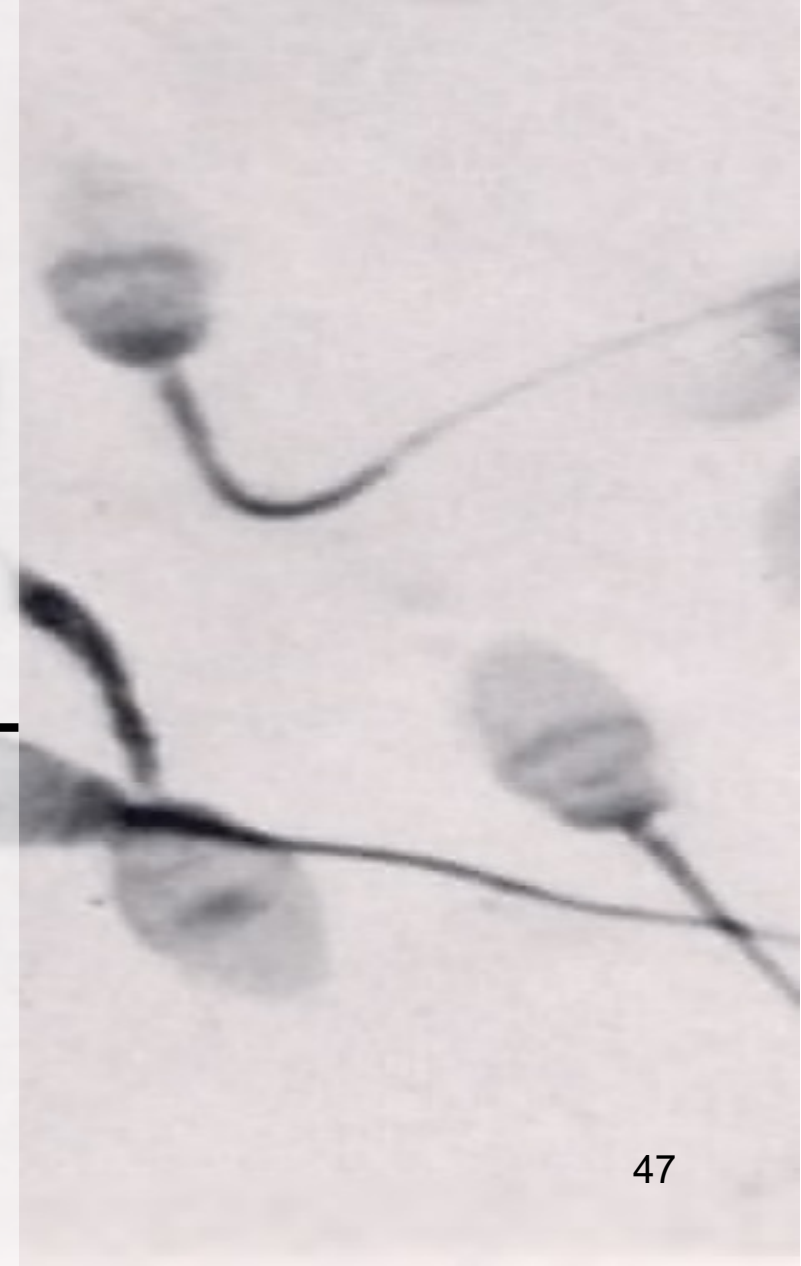
Kosen is 31 years old, and hails from Turkey. Dangi is 75 and comes from Nepal.

Sultan Kosen, a towering 8 feet, three inches tall (2.5m) shook hands with Chandra Bahadur Dangi, just 21.5 inches tall (55 cm)

ANTERIOR PITUITARY

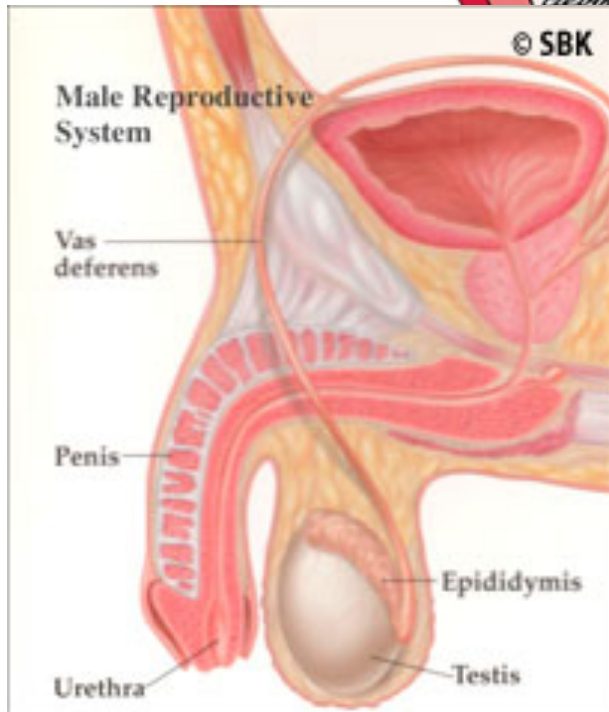
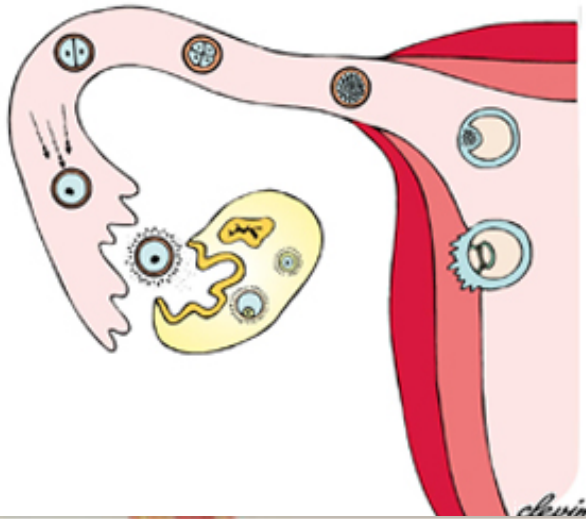
Follicle stimulating hormone (FSH)

- **Production site:** anterior pituitary
 - **Targets** the ovaries and testes
 - **Function:** Stimulates follicle development (**maturation of eggs**) and **estrogen production in ovaries;**
-sperm development in testes
-
- **Hyposecretion:** inhibits sexual development, causes **sterility**



ANTERIOR PITUITARY

Luteinizing hormone (LH)

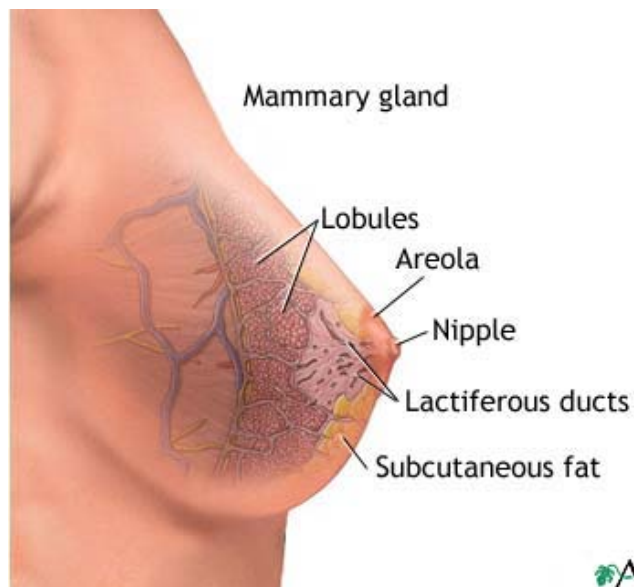
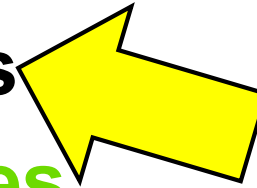


- Production site: anterior pituitary
 - Targets the **ovaries and testes**
 - Functions: Stimulates **ovulation** (release of egg) and **progesterone and estrogen** production in females and **testosterone** production in males
-
- Hyposecretion: inhibits sexual development, causes **sterility**

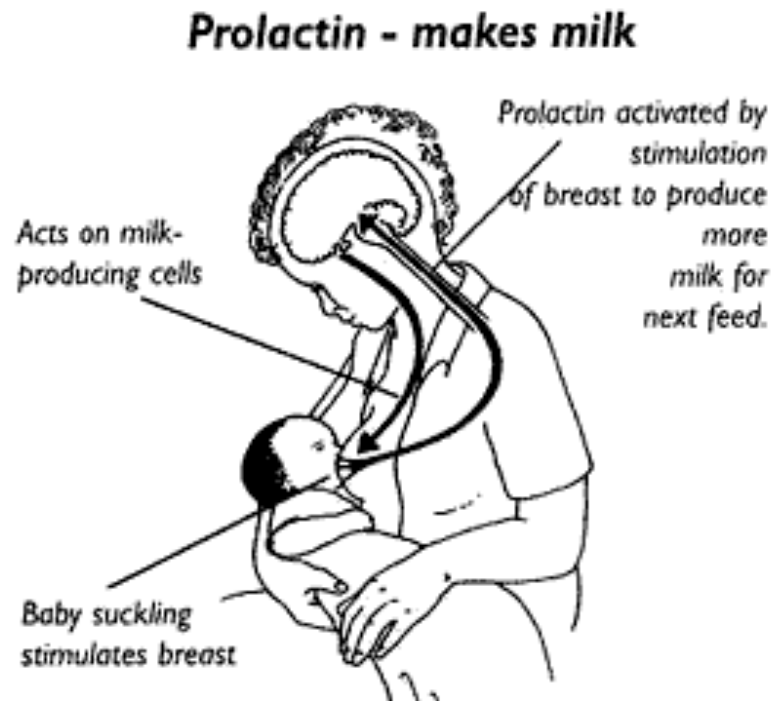
ANTERIOR PITUITARY

Prolactin (PRL)

- Production site: anterior pituitary
- Stimulated by baby suckling on breast
- Targets the **mammary glands**
- Function: stimulates and maintains **milk production in females**



ADAM.



How to Remember the Pituitary Hormones:

GH

Posterior
pituitary {

Oxytocin

ADH

TSH

FSH

LH

ACTH

PRL (prolactin)

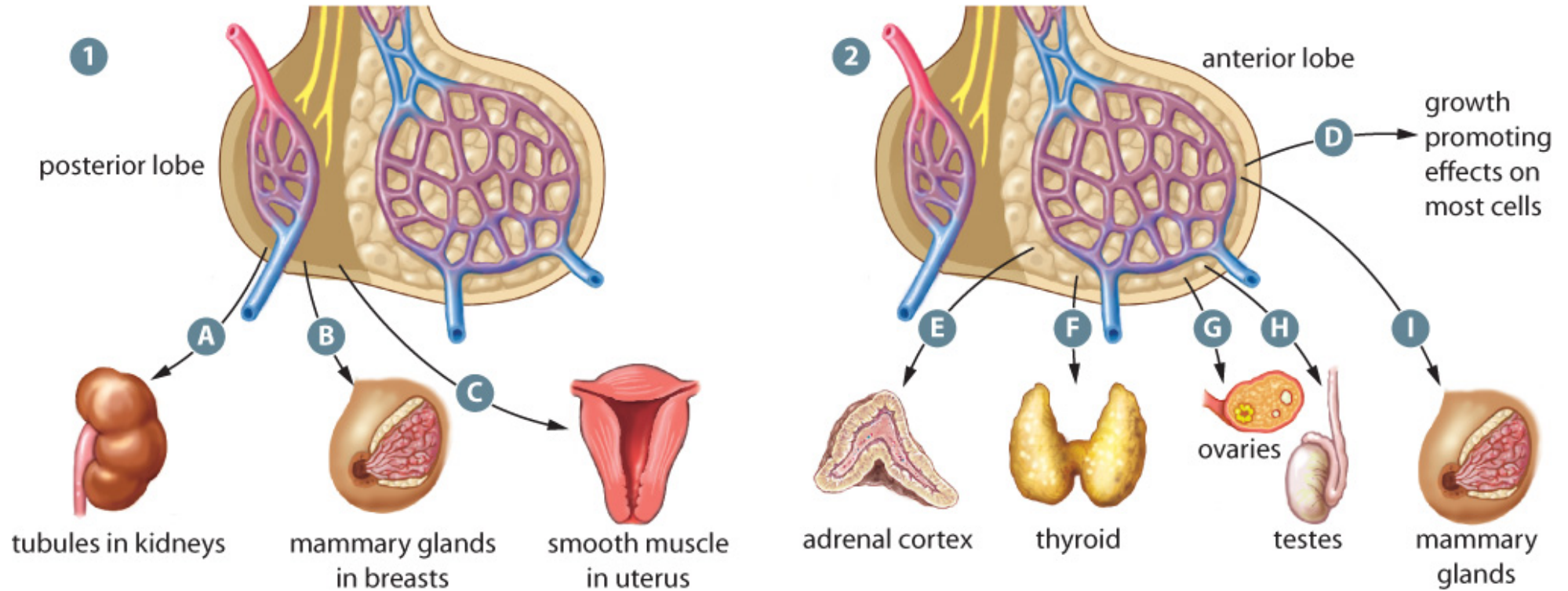


Hormone	Target	Primary Function
Anterior Lobe		
Thyroid Stimulating Hormone (TSH)	Thyroid gland	Stimulates release of thyroxine from thyroid. Thyroxine regulates cell metabolism
AdrenoCorticotropic Hormone (ACTH)	Adrenal cortex	Stimulates the release of hormones involved in stress responses.
human Growth Hormone (h GH)	Most cells	Promotes growth.
Follicle Stimulating Hormone (FSH)	Ovaries, testes	In females, stimulates follicle development in ovaries. In males, promotes the development of sperm cells in tissues

Hormone	Target	Primary Function
Anterior Lobe		
Luteinizing Hormone (LH)	Ovaries, testes	In females, stimulates ovulation and formation of the corpus luteum. In males, stimulates production of the sex hormone, testosterone.
Prolactin (PRL)	Mammary glands	Stimulates and maintains milk production in females

Hormone	Target	Primary Function
Posterior Lobe		
Oxytocin	Uterus Mammary glands	Initiates strong contractions. Triggers milk production.
AntiDiuretic Hormone (ADH)	Kidney	Increases water reabsorption by kidneys.

Pituitary Hormone Review



A: ADH
B: Oxytocin
C: Oxytocin
D: hGH

E: ACTH
F: TSH
G: FSH & LH
H: FSH & LH

I: PRL

Check your understanding

1. What part controls the pituitary?
2. The Pituitaries lobes are each controlled a different way. Explain.
3. Where is the posterior pituitary in relation to the anterior pituitary?
4. What are the hormones of the posterior pituitary?
5. What are the hormones of the anterior pituitary?
6. What is a releasing hormone and where does it come from?
7. Compare hypo-secretion vs hyper-secretion.