BOOKLET 2

TARGET GLANDS

1) Thyroid gland
2) Parathyroid gland
3) Adrenal gland

Learner outcomes…
What you need to know!

- describe the function of the hormones of the principal endocrine glands, i.e., thyroid-stimulating hormone (TSH)/thyroxine, calcitonin/parathyroid hormone (PTH), adrenocorticotropic hormone (ACTH)/cortisol, glucagon/insulin, human growth hormone (hGH), antidiuretic hormone (ADH), epinephrine, aldosterone, and describe how they maintain homeostasis through feedback

Learner outcomes…
What you need to know!

- explain the metabolic roles hormones may play in homeostasis; i.e., thyroxine in metabolism; insulin, glucagon and cortisol in blood sugar regulation; hGH in growth; ADH in water regulation; aldosterone in sodium ior regulation
- explain how the endocrine system allows humans to sense their internal environment and respond appropriately; *e.g., calcium balance, osmotic pressure of blood*

Terms you need to know

Thyroxine
Calcitonin
Hyperthyroidism
Graves Disease
Hypothyroidism
Cretinism
Goiter
Thyroid
Parathyroid

Terms you need to know

PTH
Adrenal Medulla
Adrenal Cortex
Epinephrine
Aldosterone
Cortisol
Cushing Syndrome
Addisons disease

THYROID GLAND

- Located at the base of the **neck**, in front of the trachea
- Stimulated by **TSH** from the **anterior pituitary**

Produces 2 important hormones:

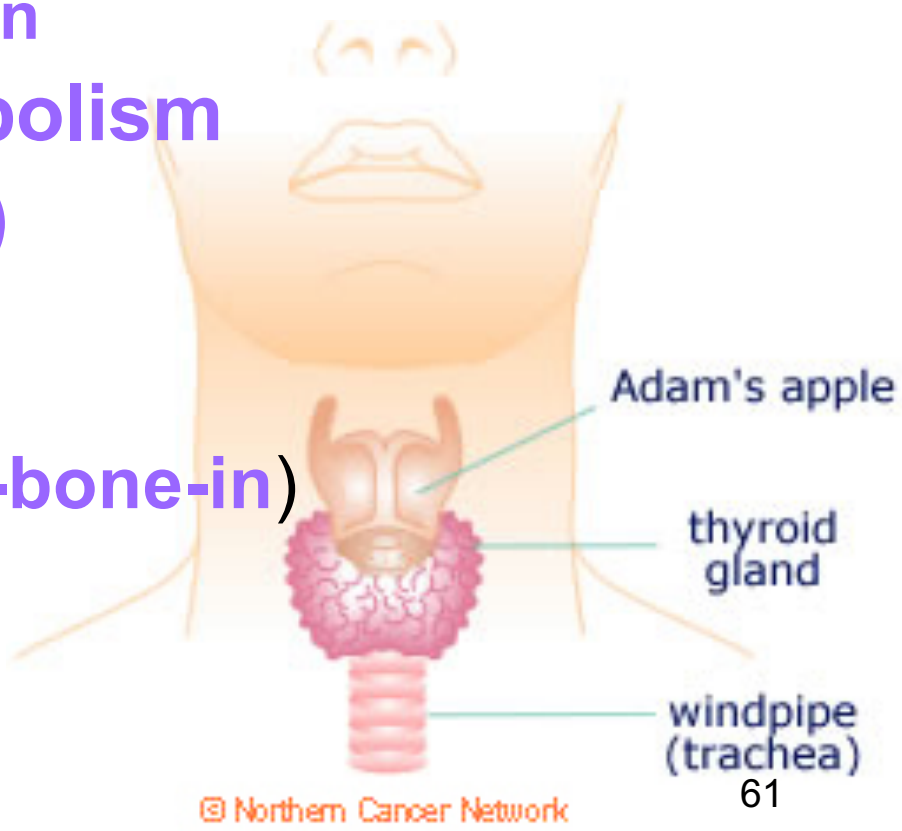
- **Thyroxine (T^4)** and **calcitonin**

1) Thyroxin **increases metabolism**

(how fast we **burn calories**)

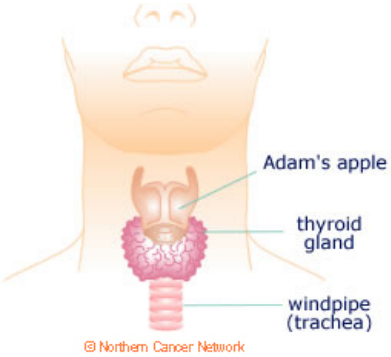
-stimulated by TSH

2) Calcitonin (rhymes with **calci-bone-in**) lowers blood calcium by putting calcium **into** bones



THYROID GLAND

Thyroxine (T_4)



Target: the **body cells**

Function: increases rate of **metabolism,** which is the rate at which the body **converts glucose into energy**

= cellular respiration

oxygen + glucose → carbon dioxide + water + ATP

**Would thyroxine increase or decrease blood glucose?

It would **decrease** it because it is converting it into ATP!!!

THYROID GLAND- DISORDERS

Thyroxine (T_4)

- **Hypersecretion**: **Hyperthyroidism** – high metabolic rate, can't sit still, always warm, and tend to be thin , **Grave's** disease

Grave's Disease: a severe state of **hyperthyroidism** that results in the thyroid gland **to produce too much thyroxine.**

- Some symptoms include: anxiety, irritability, heat sensitivity, weight loss, goiter, bulging eyes

- **Hyposecretion: Hypothyroidism** – low metabolic rate, less energy, intolerant of cold, dry skin and gain weight,

  cretinism – children with hypothyroidism can be short, stocky and have mental development delays

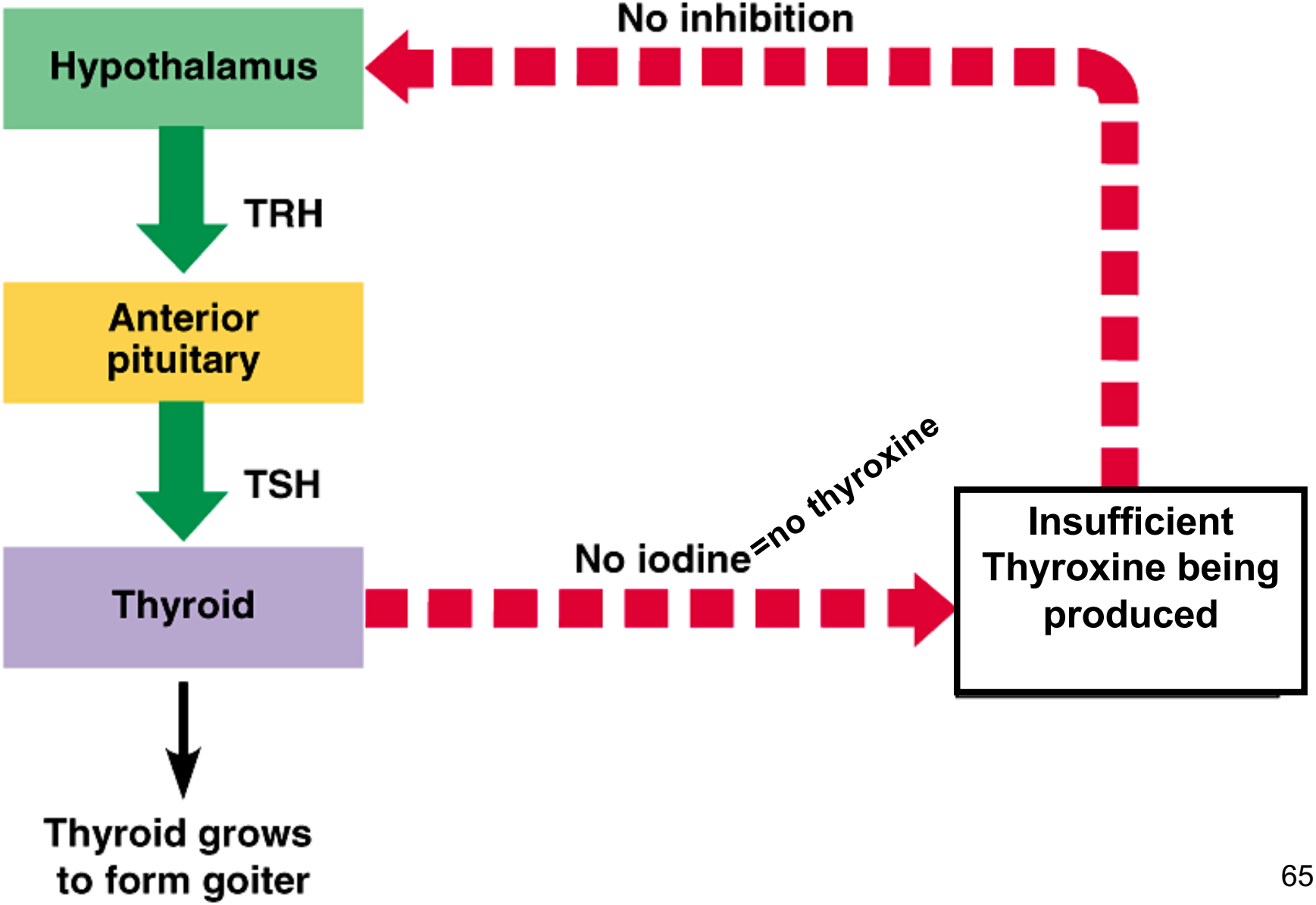
THYROID GLAND
Disorder: Goiter (insufficient dietary iodine)

- **The body uses iodine to make thyroxine**
- Iodine is found in fish and salt
- Goiter = enlargement of the thyroid gland due to no thyroxine being produced
- The pituitary continues to make TSH so that thyroxine can be produced

Excess TSH overstimulating the Thyroid makes it enlarge

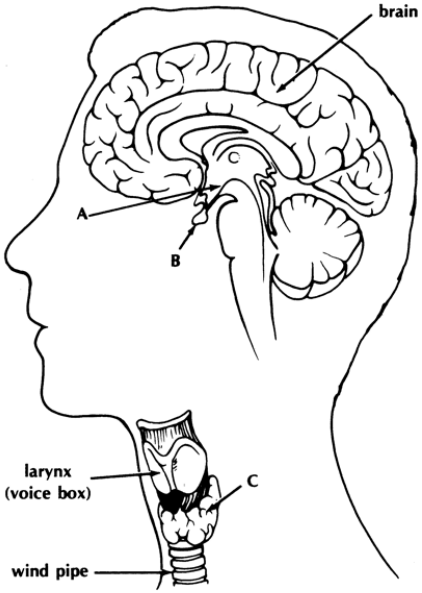
- In this case, the negative feedback system is not working properly

Goiter Formation



THYROID GLAND

Negative feedback for TSH



1 **Stimulus:**
Metabolic rate decreases

2 **Hypothalamus**

TSH-RF (Releasing Factor)

Anterior Pituitary

TSH

Thyroid gland

Thyroxine

(-)

Metabolism increases

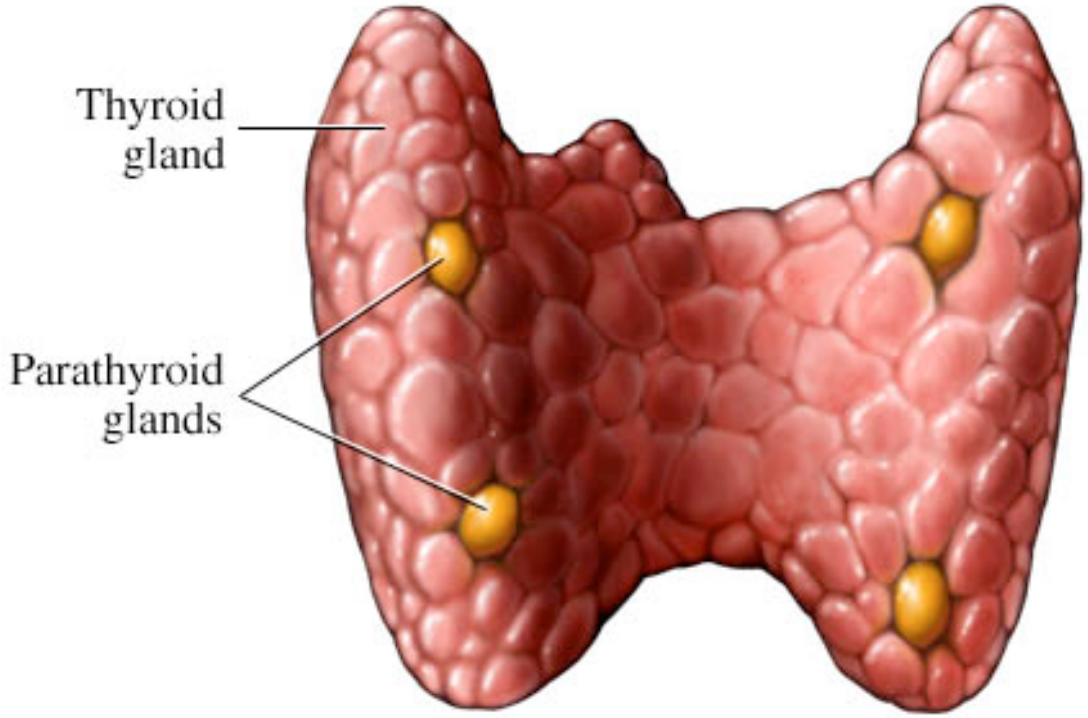
If Ava is missing half her thyroid gland, how would this affect her thyroxin levels?

What about her TSH levels?

a. Thyroxin levels would be not as high
b. TSH levels would go up because body senses not enough thyroxin being produced

THYROID and PARATHYROID GLAND

- The thyroid gland is also involved in regulating **calcium** levels in the blood
- The **thyroid** and **parathyroid** gland are separate structures that function closely together to control calcium



Control of Calcium

Calcitonin

- **Production site**: thyroid gland
- **Targets: bones, kidneys and small intestine**
- **Function:**

decreases blood calcium by **depositing calcium in bones**

- Excess Ca^{2+} is excreted in urine

(PTH) Parathyroid hormone

- **Production site**: parathyroid gland
- **Targets: bones, kidneys and small intestine**
- **Function: increases blood calcium by**

removing calcium from bones

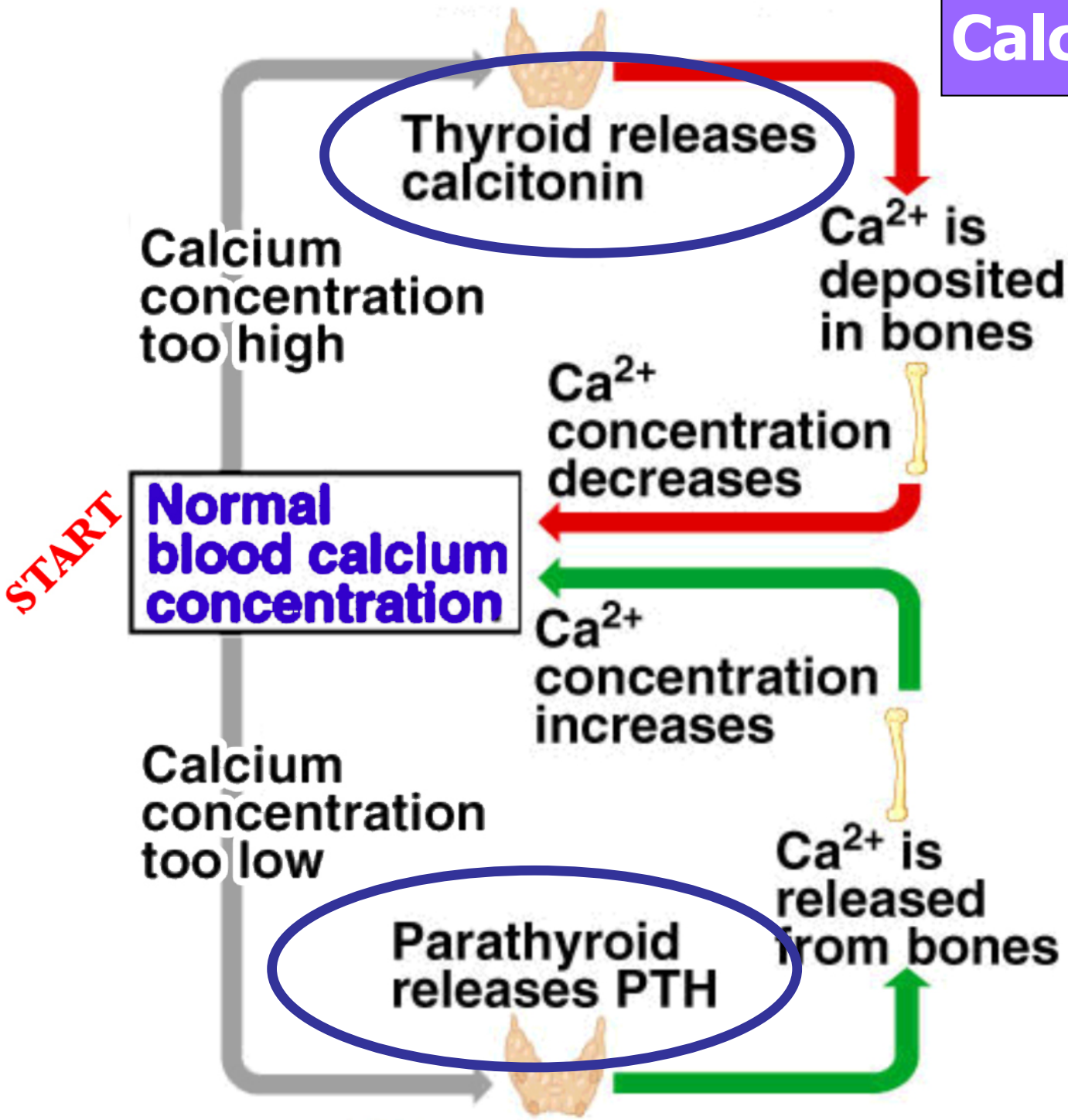
- Lactation stimulates the release of **PTH** (milk contains calcium)

Bones are like a "bank vault" of calcium

PTH is the key needed to make Ca^{+} withdrawals

Calcitonin needed to make deposits

Calcium Regulation



also…

Ca^{2+} is excreted by kidneys

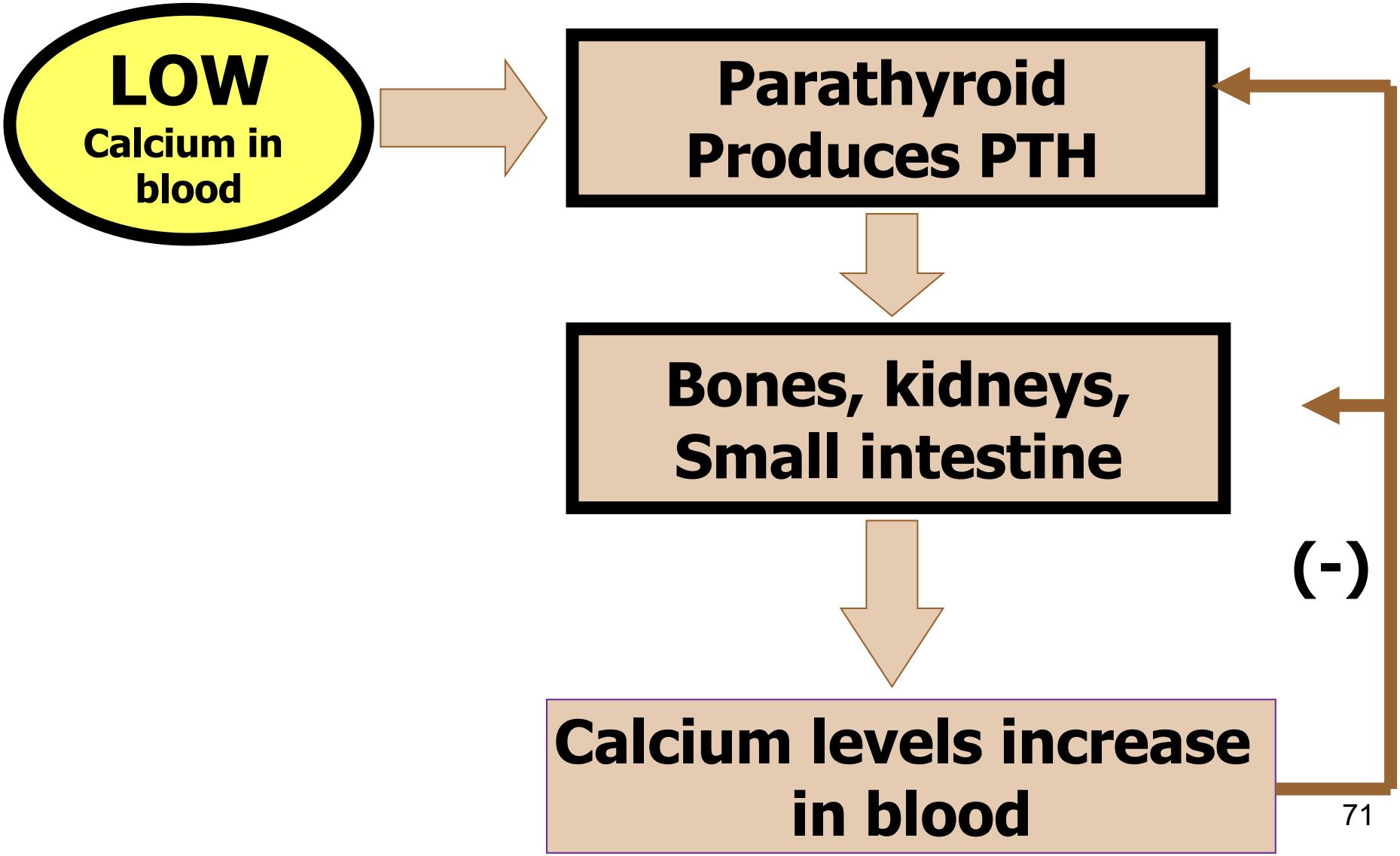
Absorption of Ca^{2+} is reduced in intestines

also…

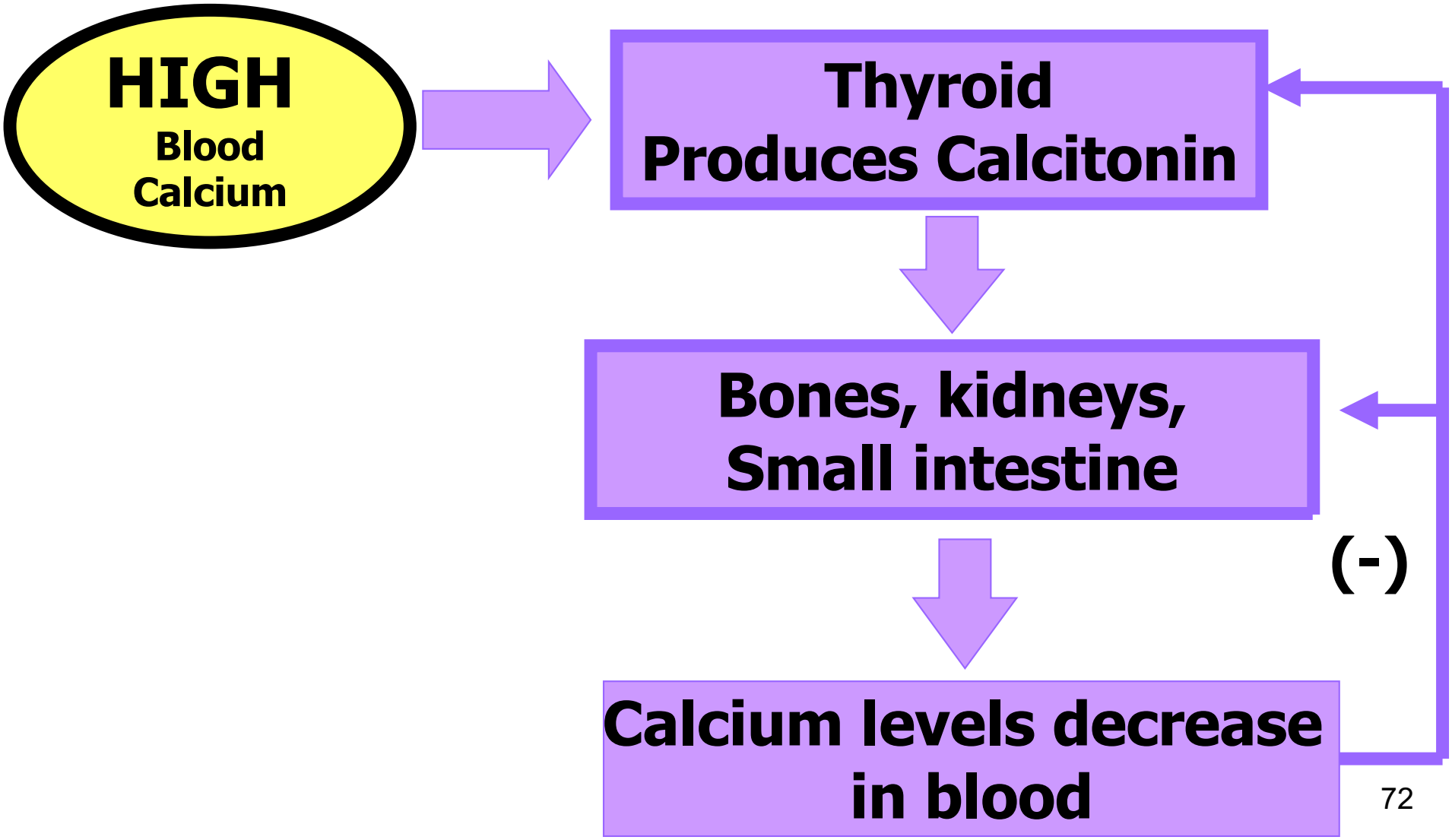
Ca^{2+} is conserved in kidneys

Ca^{2+} is absorbed by intestines

Feedback Loop for Parathyroid Hormone



Feedback Loop For Calcitonin



Low levels of calcium ions in the blood cause

A. decreased secretion of PTH and increased deposition of calcium in the bones

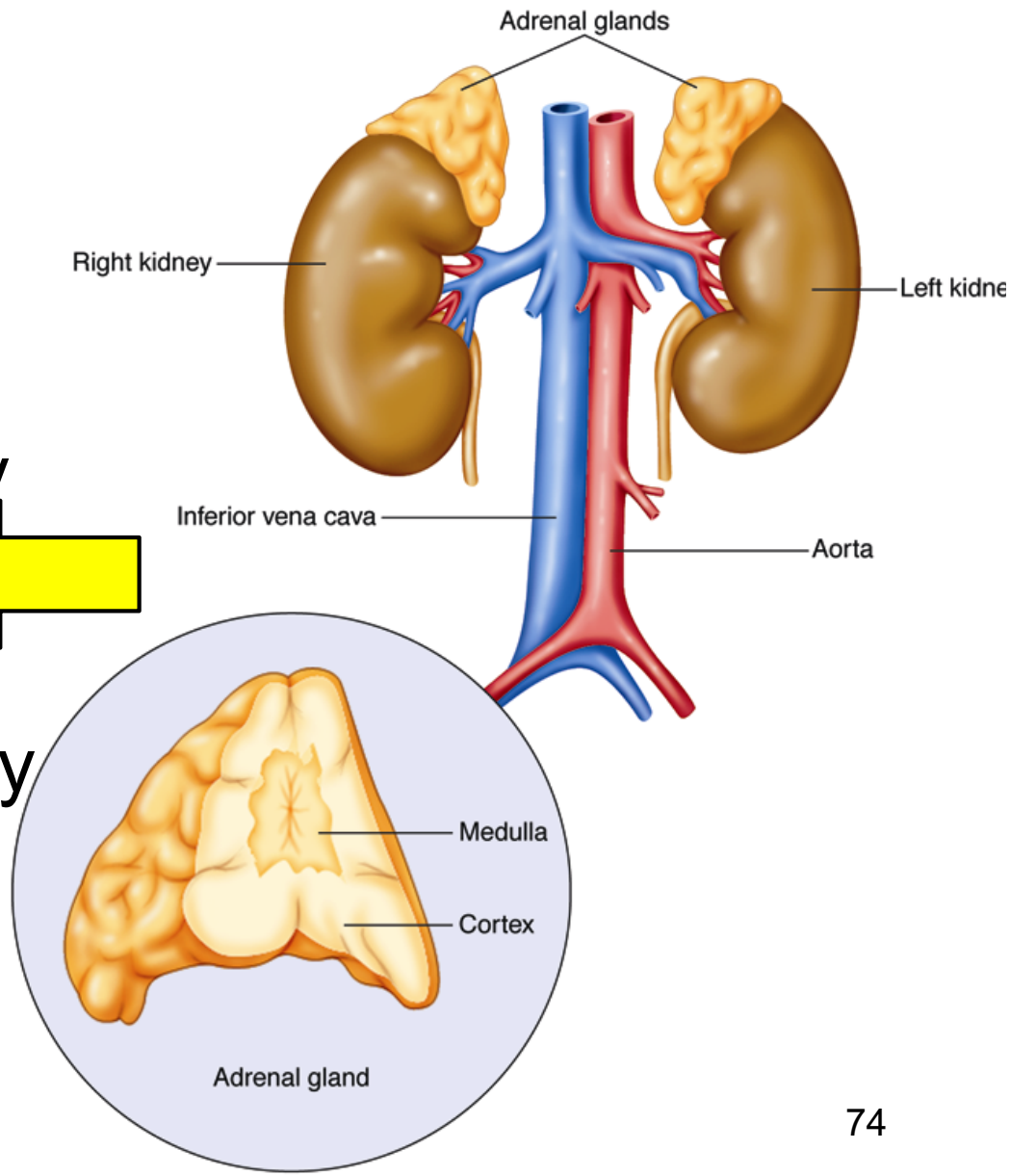
B. decreased secretion of calcitonin and increased deposition of calcium in the bones

C. increased secretion of PTH and movement of calcium from the bones to the blood

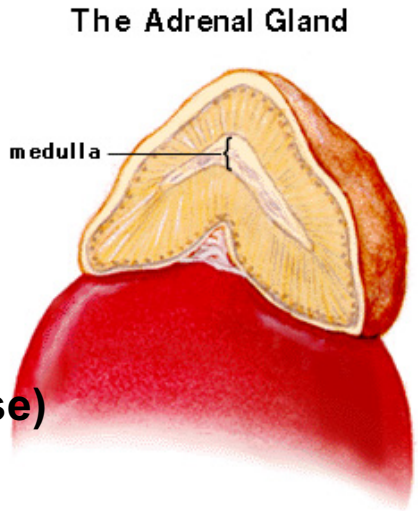
D. increased secretion of calcitonin and movement of calcium from the bones to the blood

THE ADRENAL GLAND

- **Above each kidney**
- The **adrenal gland** Is made up of **2 glands**
  - **Adrenal medulla (middle)** – regulated by the **nervous system**
  - **Adrenal cortex (outside)** – regulated by **hormones**



Adrenal MEDULA



- activated by the **sympathetic nervous system**
- **Adrenal medulla** produces 2 hormones **during immediate stress** **(initiates the fight-or-flight response)**
- **1) Epinephrine** (adrenaline)
- 2) **Norepinephrine** (noradrenaline)

Short term Stress

- Increase blood glucose by converting **glycogen to glucose**
- Increase **heart rate**
- Increase **breathing rate**
- Blood vessels **dilate** (get bigger)
- Pupils **dilate**

Adrenal CORTEX

Aldosterone

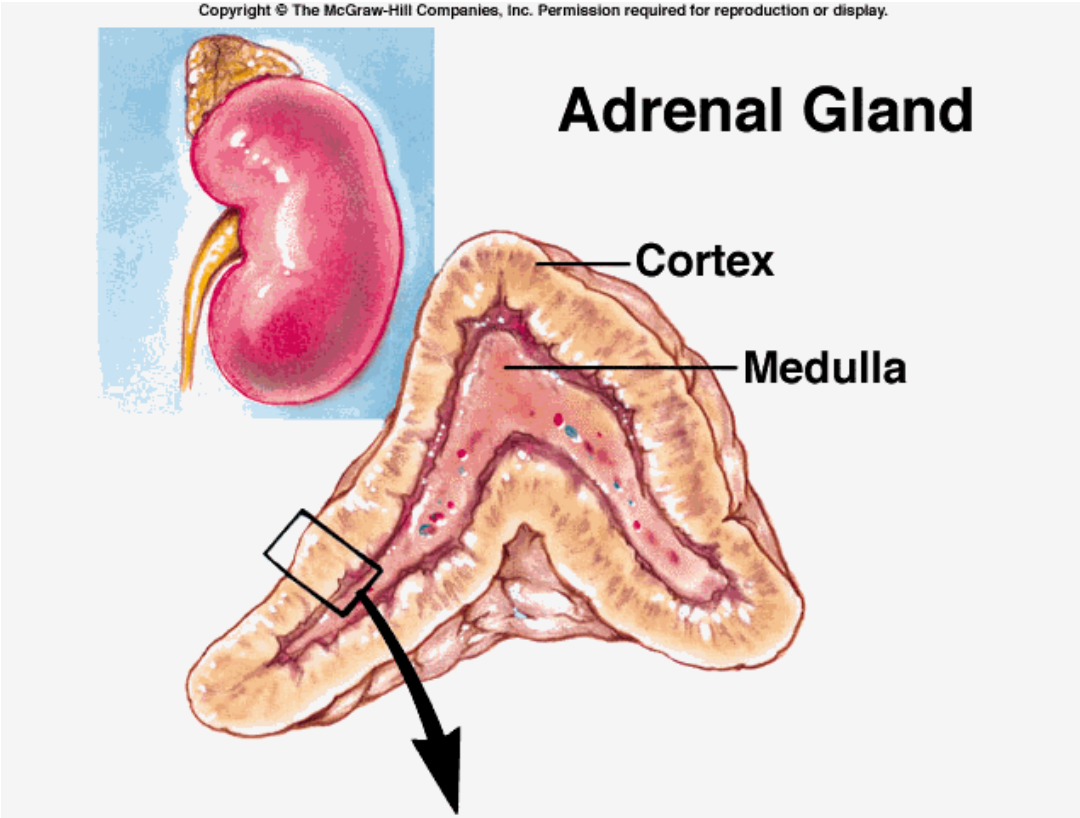
Cortisol

-Activated by the pituitary

Adrenal CORTEX produces 2 hormones

- **1) Aldosterone**
- 2) **Cortisol**

Stimulated by **ACTH** from the anterior pituitary



Adrenal CORTEX -Cortisol-

Long term stress

- **Targets:** Liver and muscles
- **Function:** increases levels of **amino acids** which are then converted to glucose by liver = **more energy**
  - **Anti-inflammatory and immune suppressan**
  - **Does cortisol increase or decrease blood glucose?

It increases it.

Why would your body suppress your immune system in times of stress?

Hyposecretion: Addison's disease

Hypersecretion: Cushing's Syndrome

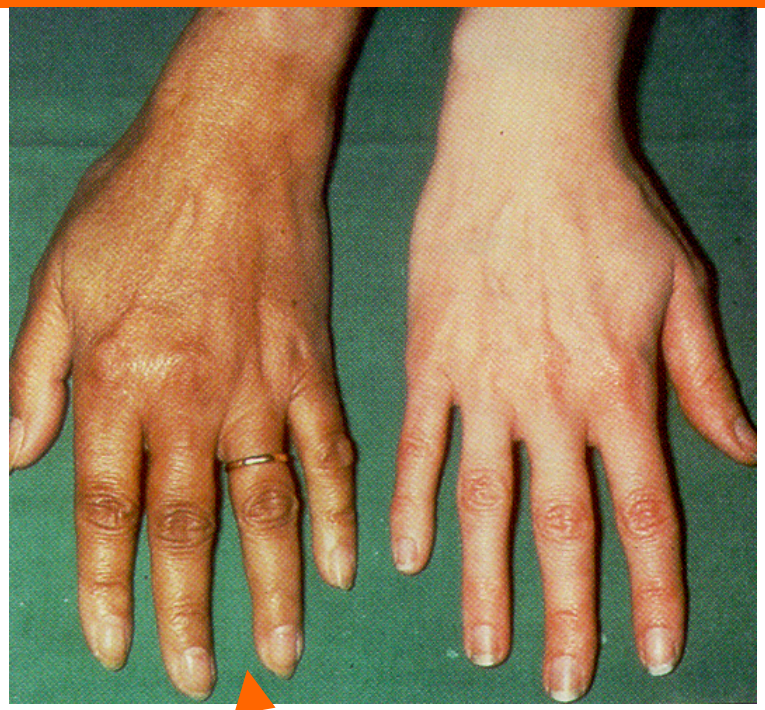
Can Stress Actually Kill You? //www.youtube.com/watch?v=vzrjEP5MOT4&safety_mode=true

Adrenal CORTEX

Too little Cortisol: Addison's Disease

Symptoms:

Weight loss, low energy, low blood pressure, occasionally areas of hyper-pigmentation



Bronzing of the skin

Adrenal CORTEX

Long term stress

Too much Cortisol: Cushings Syndrome

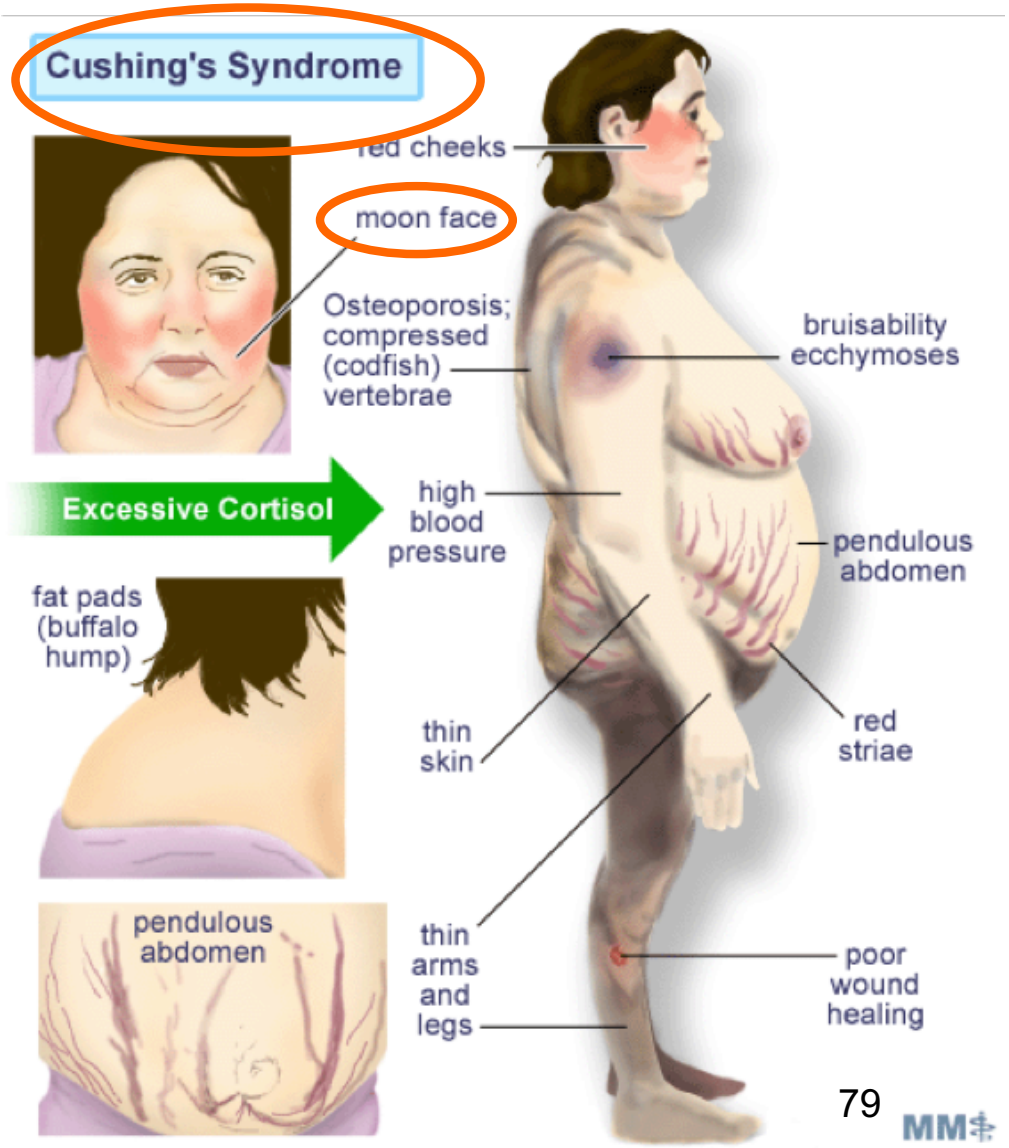
Symptoms :

-moon face,

-osteoporosis,

-pendulous abdomen,

-bruise easily



Adrenal CORTEX

Too much Cortisol: Cushing Syndrome

Due to **hypersecretion** of **cortisol** in the adrenal cortex

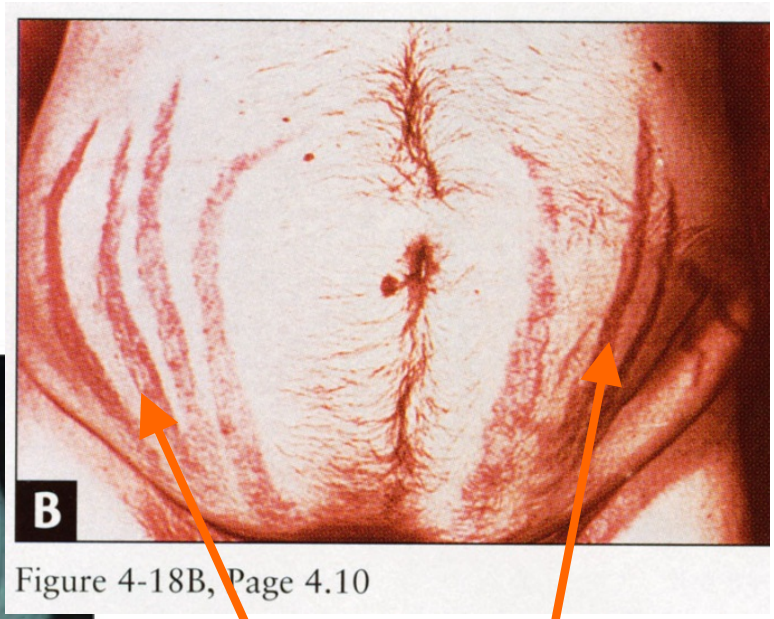
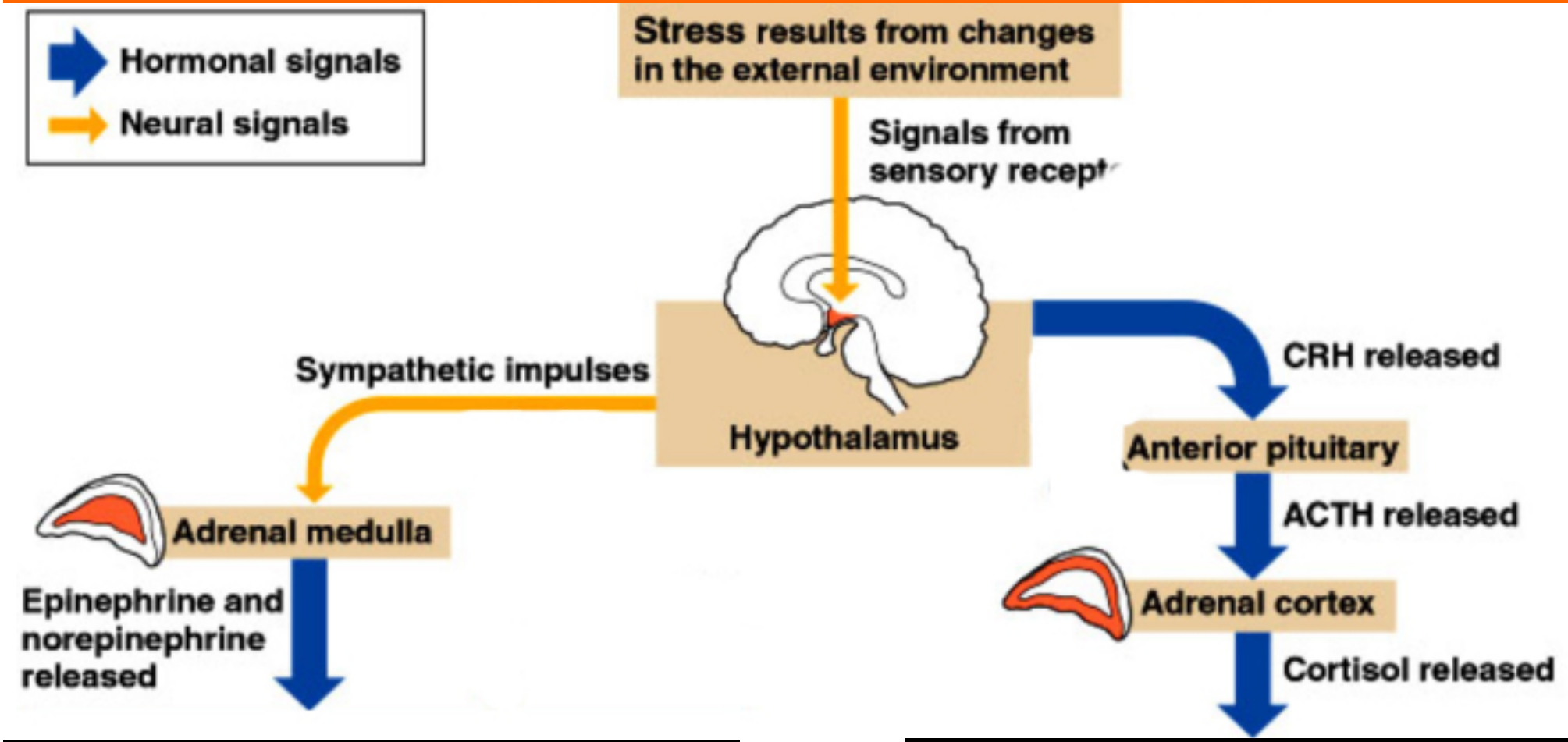


Figure 4-18B, Page 4.10

Moon face

Red striae

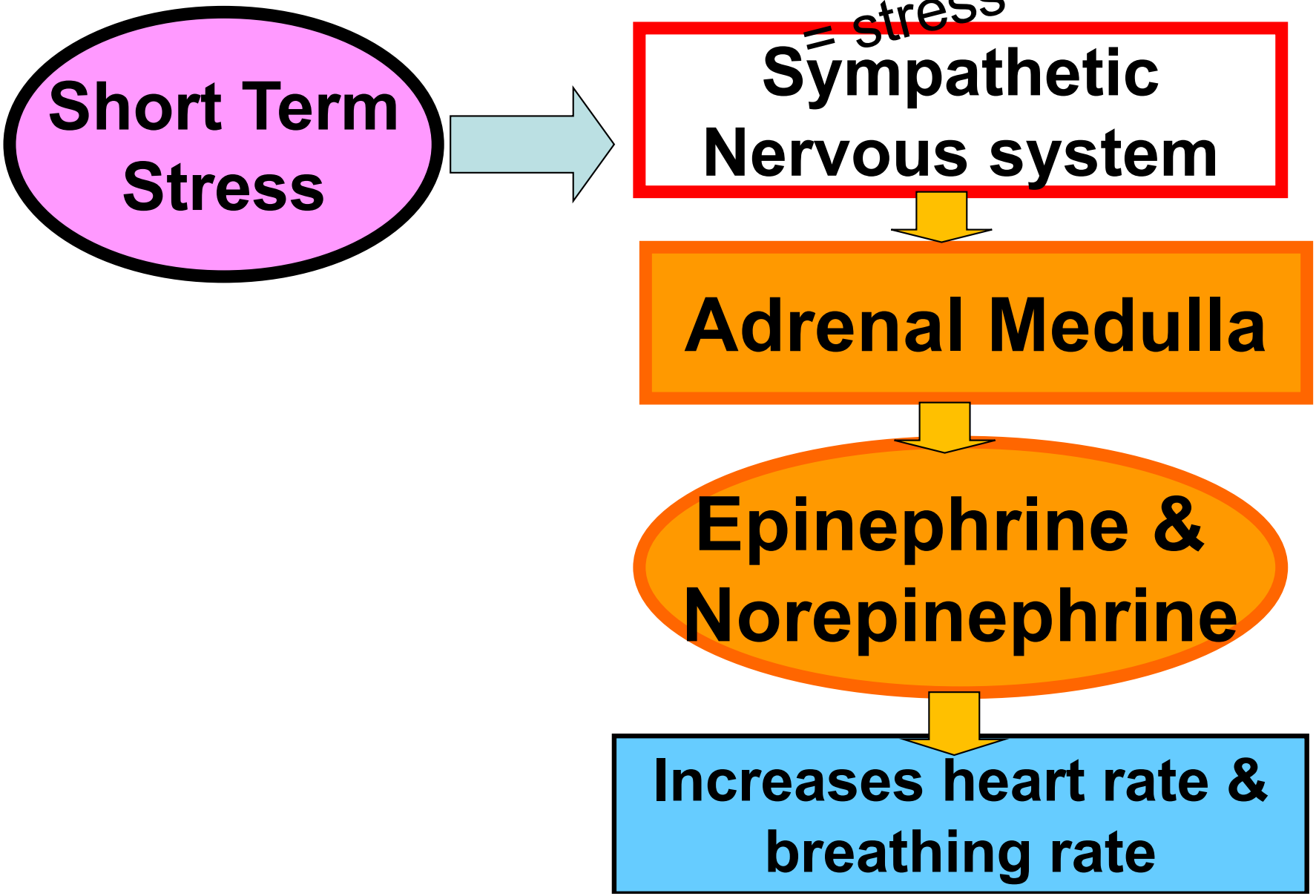
ADRENAL: Cortex vs Medulla



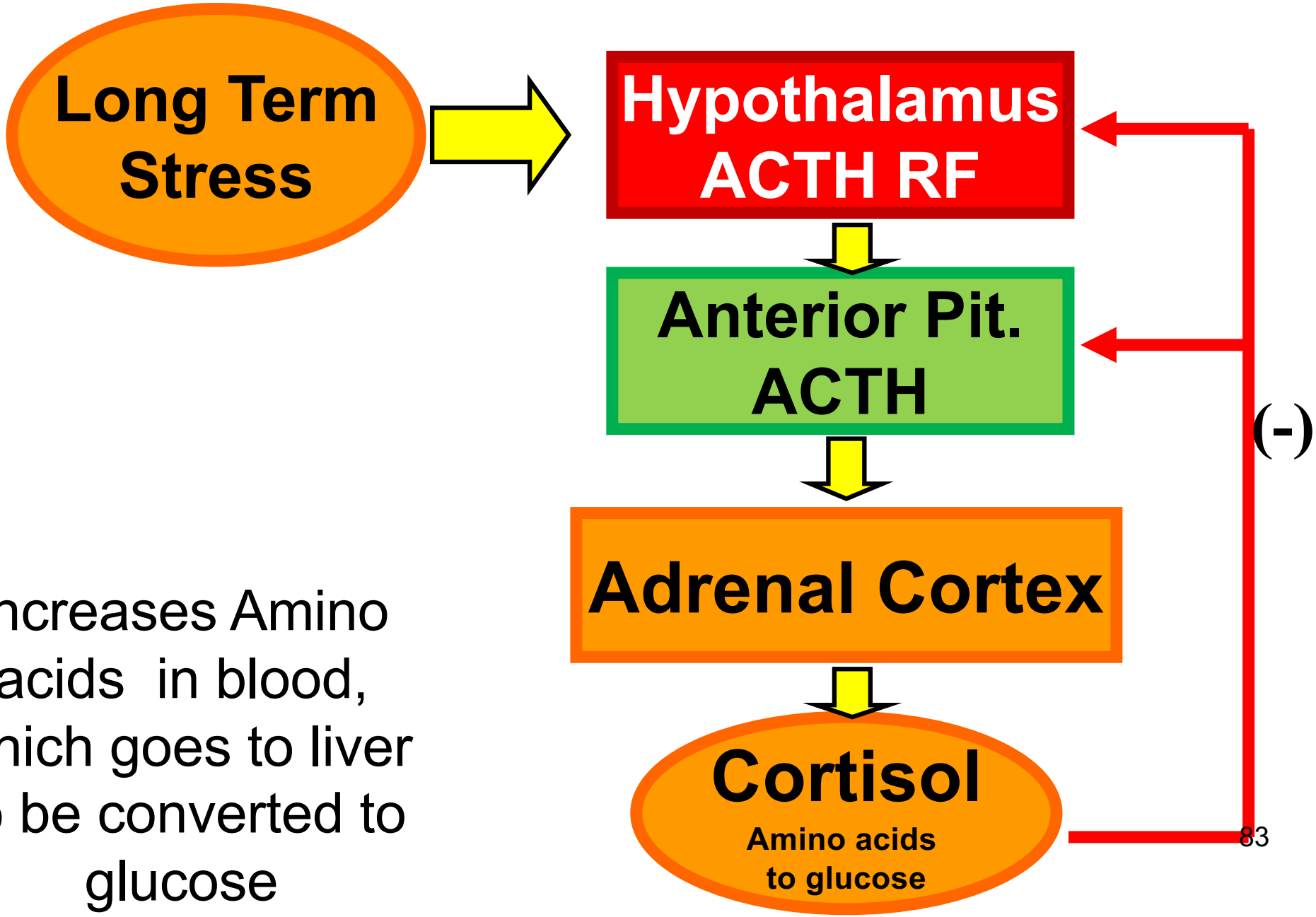
SHORT TERM STRESS
"fight or flight"

LONG TERM STRESS
-increased glucose from amino acids

Flow Chart For Epinephrine
(and norepinephrine)



Feedback Loop For Cortisol



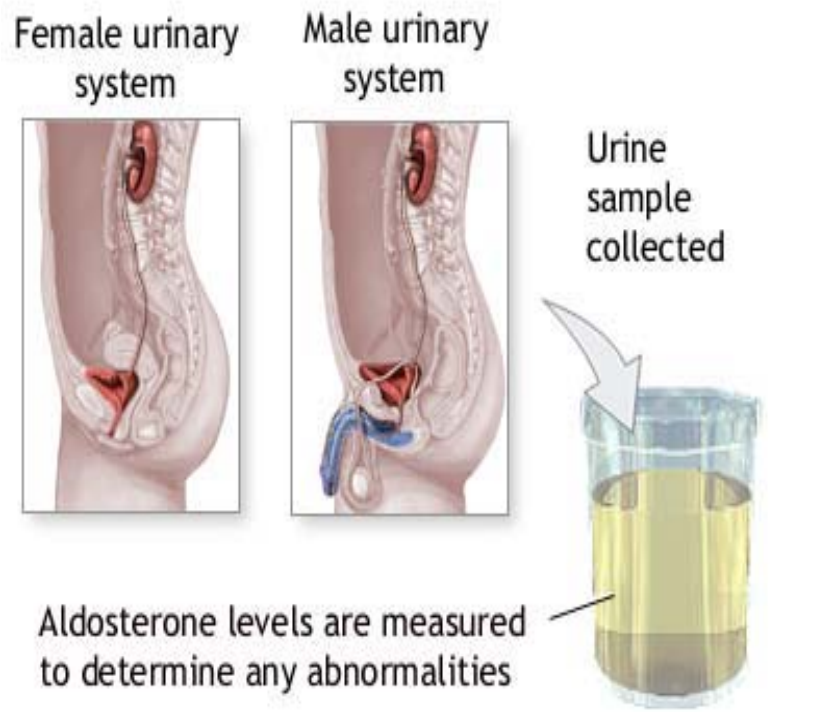
Increases Amino acids in blood, which goes to liver to be converted to glucose

Adrenal CORTEX -Aldosterone-

WATER RETENTION

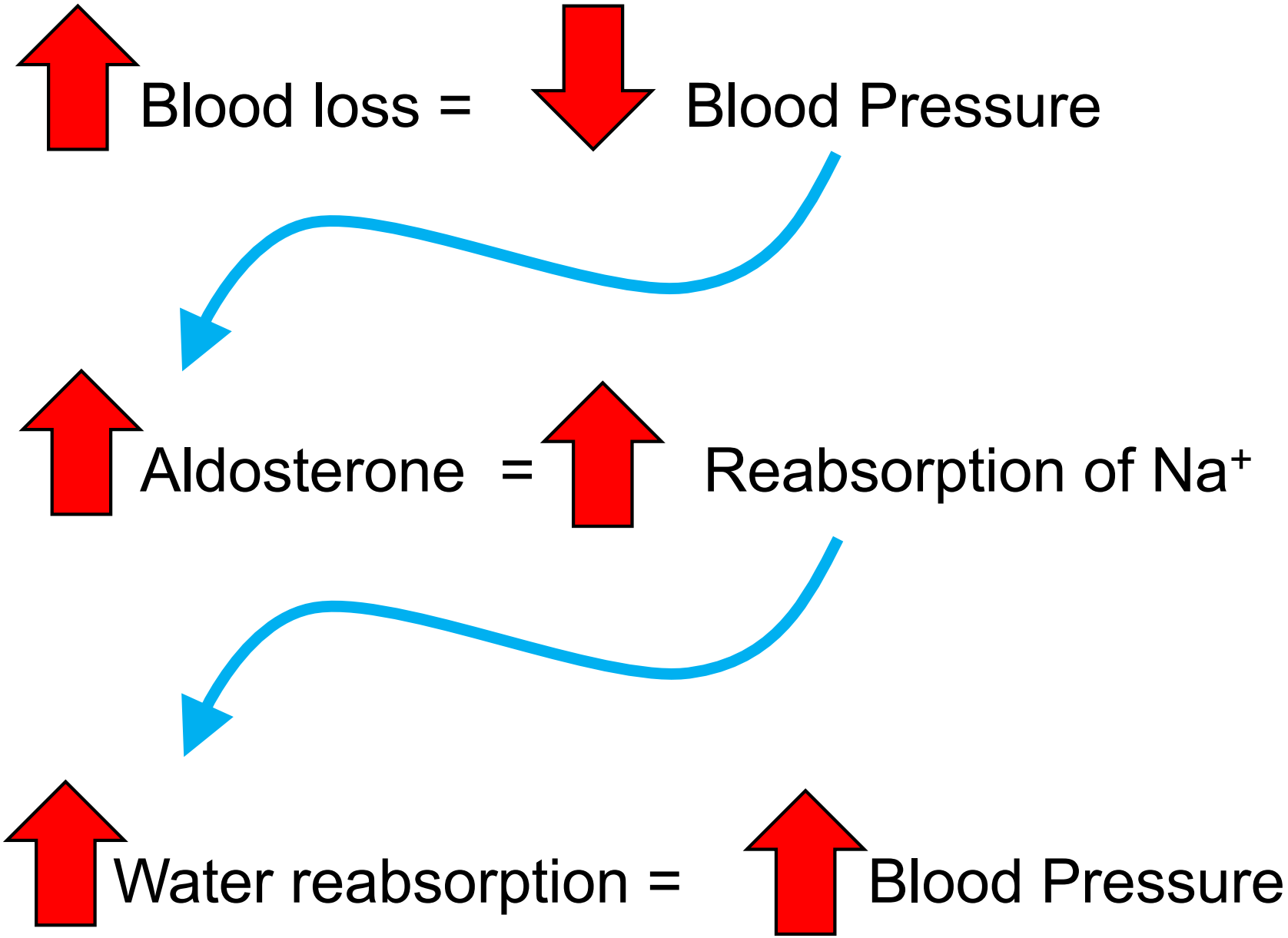
- Production site: adrenal cortex
- **Target: the kidneys**
- **Function**: increases **sodium (Na^+) retention and with it water** though **osmosis**
- -essentially increases blood volume and therefore blood pressure

(similar to ADH → Increases blood pressure)



- **Hyposecretion: water loss or dehydration**
- **Hypersecretion: increased water retention**

Aldosterone and blood pressure



Aldosterone vs. ADH

ADH released in response to **dehydration (lack of water)**

Aldosterone is released in response to low **blood pressure or low volume (loss of fluid like diarrhea or hemorrhage)**.

What happens if you stop drinking water?

http://www.youtube.com/watch?v=zCheAcpFkL8&safe=active&safety_mode=true

Check your understanding…

How does Calcitonin get its job done?

It lowers blood calcium levels by placing calcium in bones

What will an increase of thyroxine do?

Increase glucose use which increases metabolism

A Goiter is formed by too much TSH present. Why did the body not stop the production of TSH?

Not enough iodine is present so no thyroxine can be produced. Although the hypothalamus directed metabolism to increase, it is not because throxine is not present to do its job. Hypothalamus keeps directing the thyroid but nothing keeps happening.

A rare disorder is artificially lowering the amount of calcium in the blood. How would the body correct this low amount of calcium?

PTH secreted to increase levels

What are 3 ways the body is able to increase calcium levels through the use of PTH?

Absorb more in intestines from food, kidneys retain more, extract from bones

You nearly get into a car accident. Your heart rate goes up sharply. What part of the adrenal gland was just activated?

Adrenal MEDULLA

How is the adrenal cortex different from the adrenal medulla as far as how they are controlled?

It medulla controlled by nerves…cortex controlled by hormones

Which hormone increases the amount of sodium? Aldosterone

Which of the following rows identifies the source of cortisol, the hormone that stimulates the release of cortisol, and an effect of cortisol?

Row	Source	Hormone	Effect
A.	Adrenal gland	ACTH	Increased conversion of amino acids to glucose
B.	Pituitary gland	ACTH	Increased protein synthesis
C.	Adrenal gland	ADH	Increased conversion of glycogen to glucose
D.	Pituitary gland	ADH	Increased water reabsorption

Use the following information to answer the next two questions.

Thyroid cancer can develop slowly over many months or even years. Because the symptoms are frequently overlooked, diagnosis is often delayed. However, thyroid cancer is usually treated successfully with a combination of surgery, radioactive iodine, and thyroid medication.

Surgical removal of the thyroid gland results in

A. a decrease in thyroxine levels and TSH levels
B. an increase in thyroxine levels and TSH levels
C. an increase in thyroxine levels and a decrease in TSH levels
D. a decrease in thyroxine levels and an increase in TSH levels

The release of thyroxine from the thyroid is directly regulated by

A. TSH
B. TRH
C. iodine
D. thyroxine

A characteristic symptom of hyperthyroidism is

A. lethargy
B. weight loss
C. intolerance to cold
D. slowed mental processes