BOOKLET 3

TARGET GLANDS

1) Pancreas
2) Estrogen
3) Progesterone
4) Testosterone

Learner outcomes…
What you need to know!

- describe, using an example, the physiological consequences of hormone imbalances; i.e., diabetes mellitus *(e.g., diabetes insipidus, gigantism, goitre, cretinism, Graves' disease).*

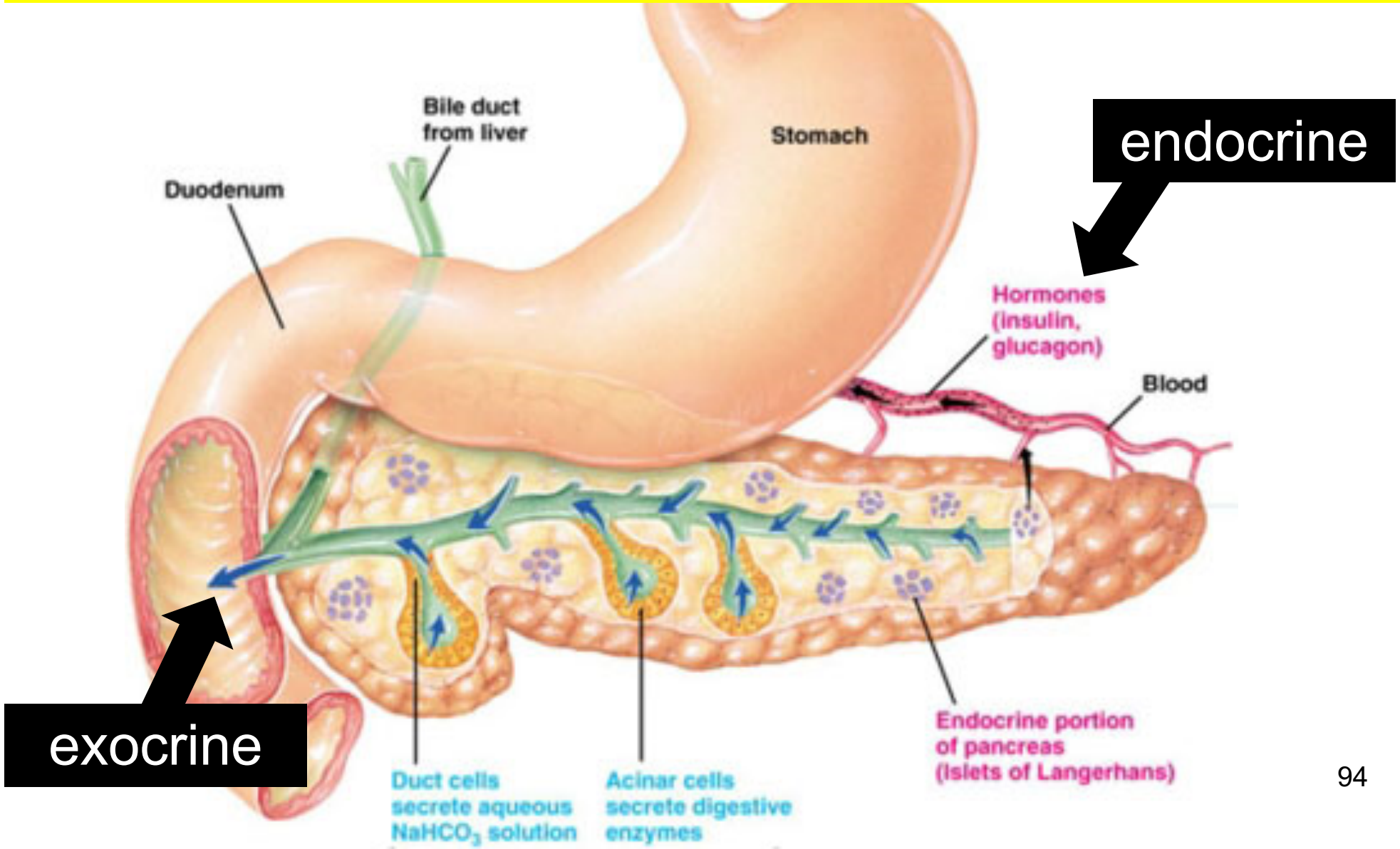
Terms you need to know

Endocrine
Exocrine
Islets of Langerhan
Insulin
Glucagon
Permeability
Glycogen
Alpha Cells

Terms you need to know

Beta Cells
Diabetes Mellitus Type I
Diabetes Mellitus Type II
Prostaglandin
Estrogen
Progesterone
Testosterone

THE PANCREAS
Islets of Langerhans



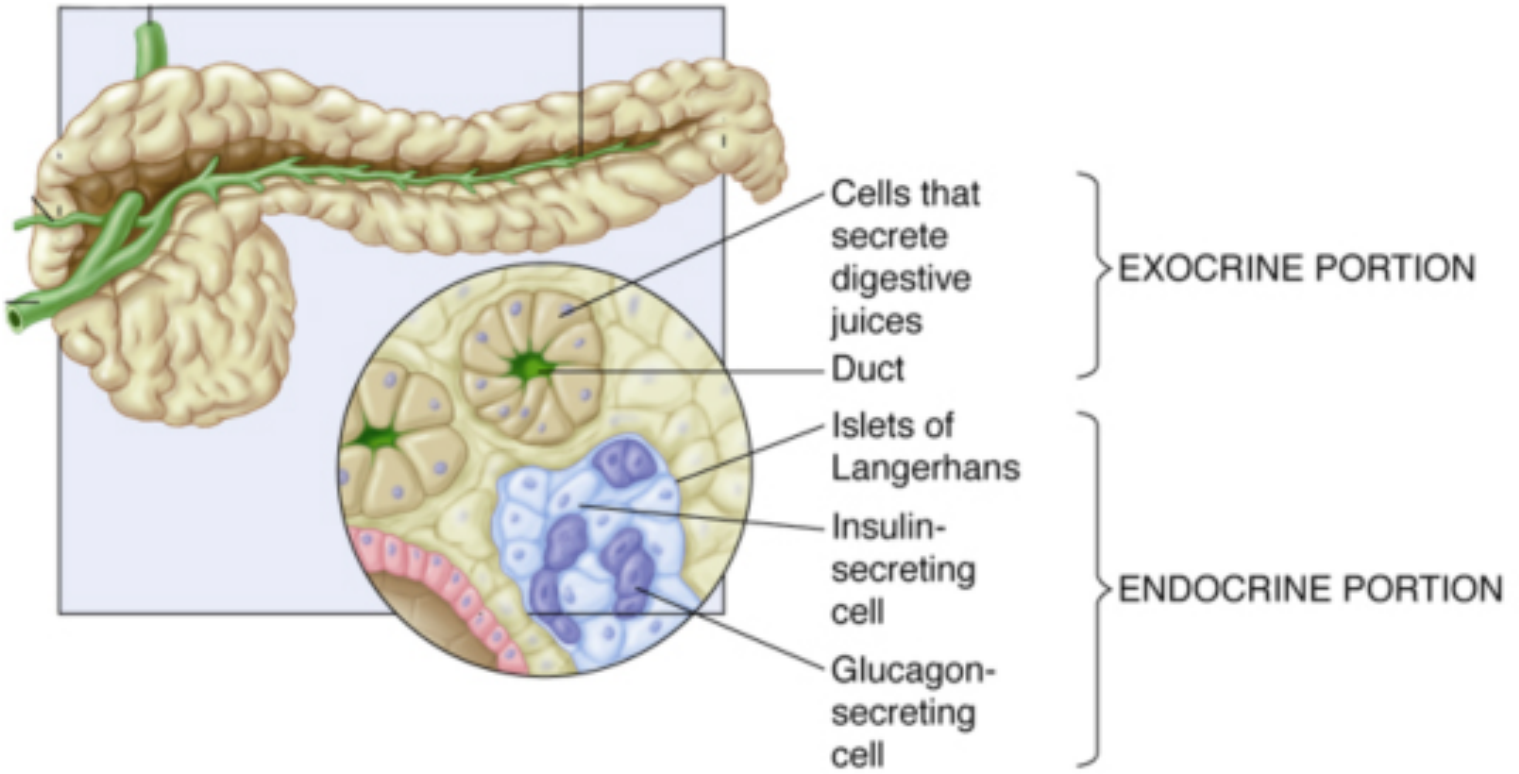
Pancreas

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.

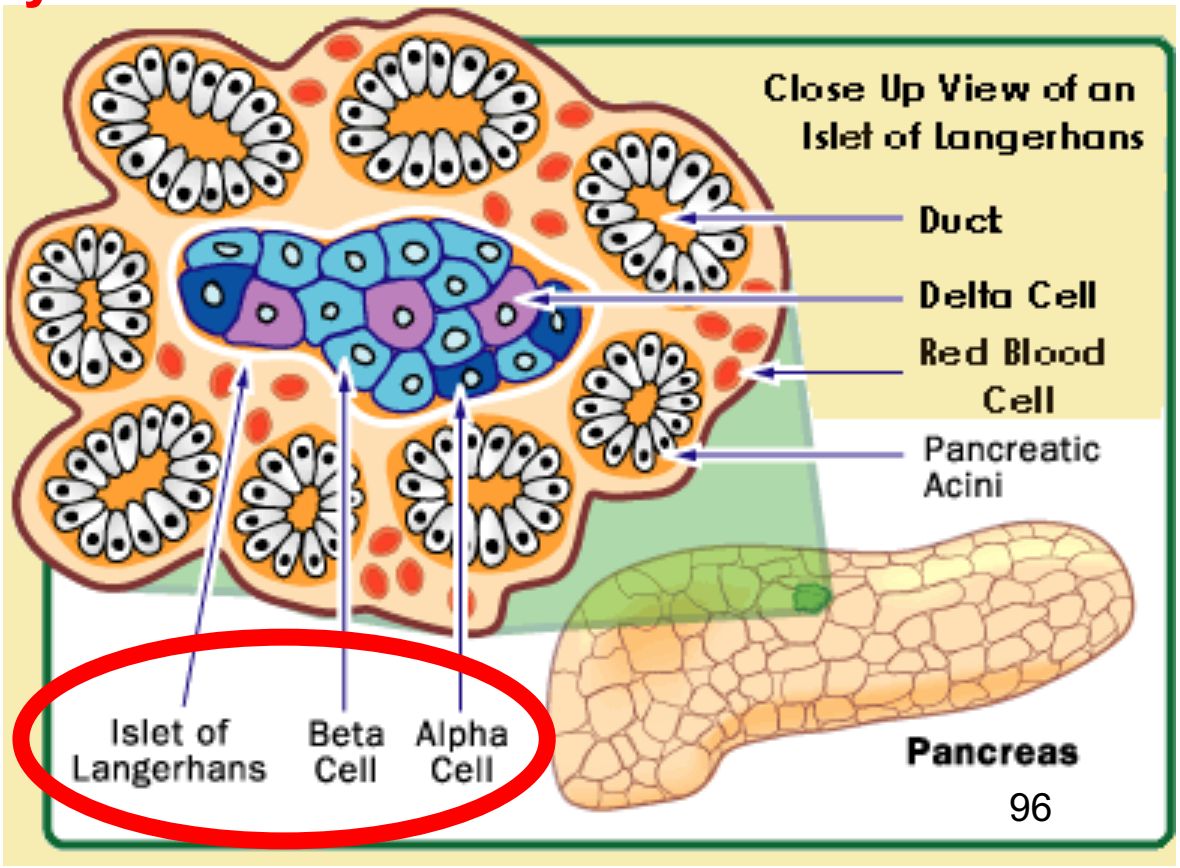


Islets of Langerhans

Produced inside the **Islets of Langerhans**

1) **insulin- produced by BETA cells**

2) **glucagon- produced by ALPHA cells**



Insulin and Glucagon

Glucose is gone!

Insulin

- **Production site: BETA cells** of the **islets of Langerhans**
- **Target: liver, muscles and all other cells**
- **Function:** released after a meal to

A. lower glucose levels in the blood

B. Increase all cells **permeability** to glucose

(makes it easier for glucose to be absorbed by cells)

Excess Glucose converted to **glycogen in liver and muscle cells**

Glucagon

- **Production site: ALPHA cells** of the **islets of Langerhans**
- **Target**: liver and muscles and all other cells
- **Function:** released after long periods of fasting to

A. raise glucose levels in the blood

B. Decrease cell **permeability to glucose**

(makes it more difficult for glucose to be absorbed by cells)

– Glycogen converted to **glucose**

These two are antagonistic

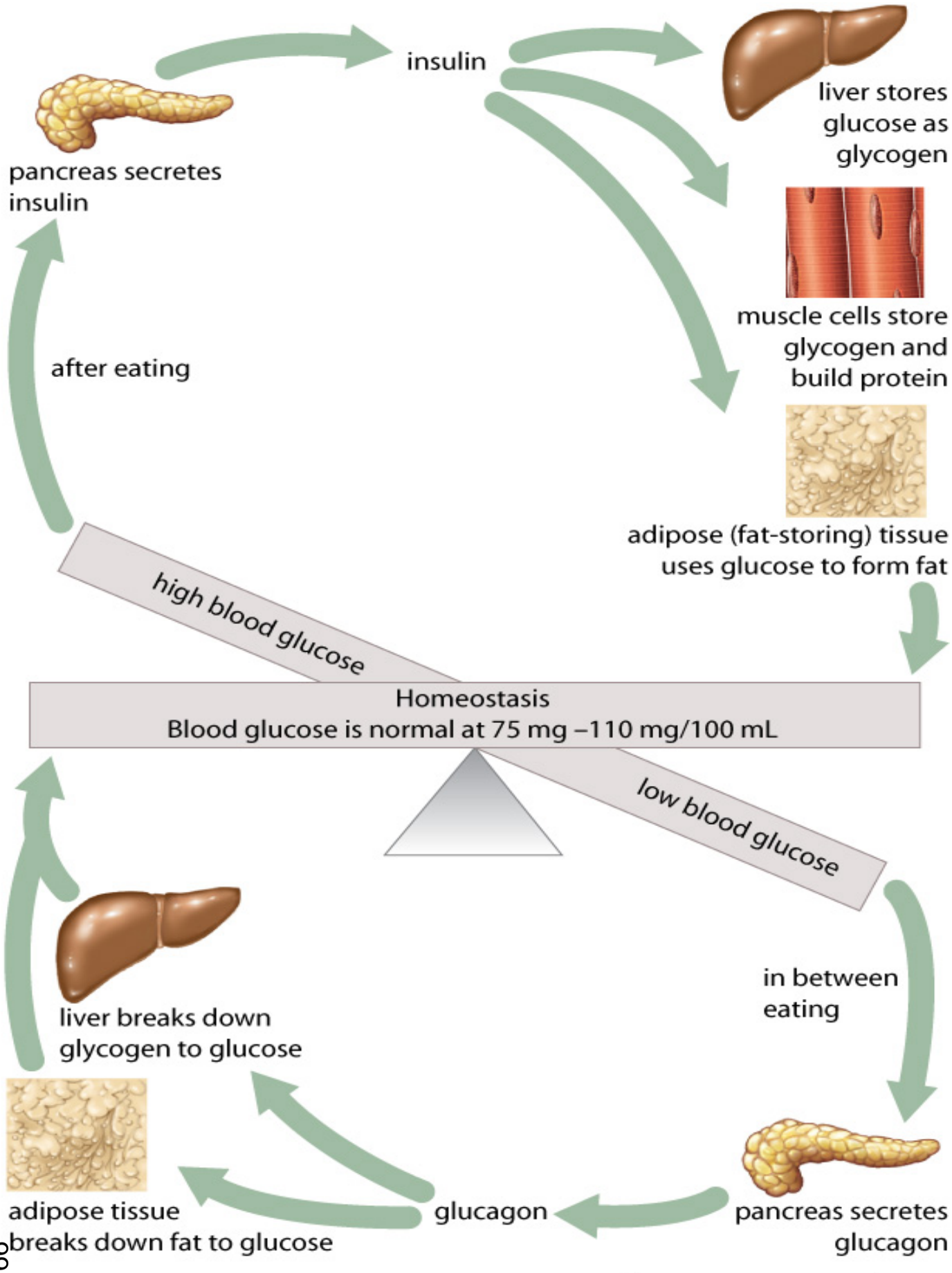
How can I remember these terms?

Glucose – sugar

Glucagon – "glucose is GONE" from blood so glucagon gets glucose back into the blood

Glycogen – storage form of glucose

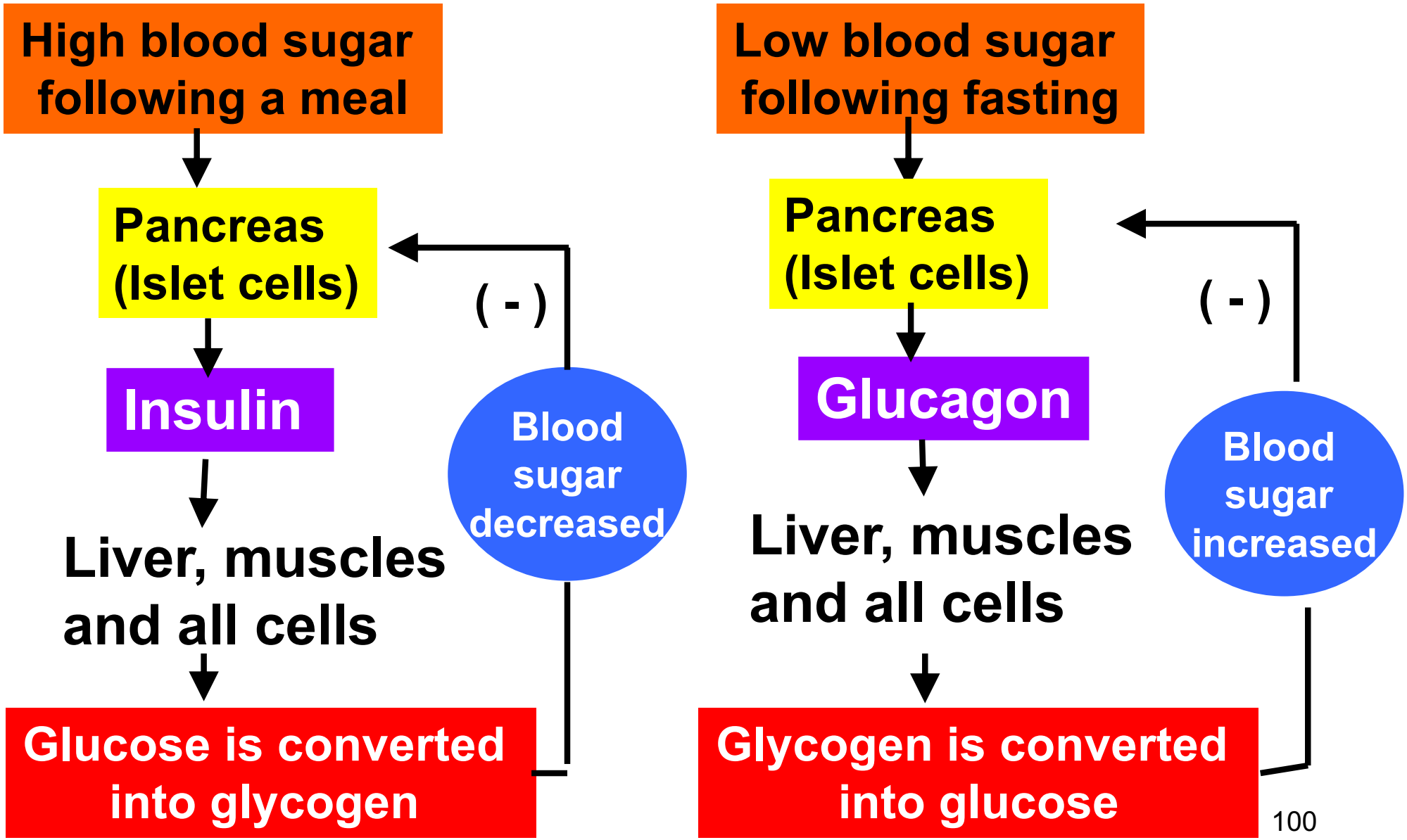
Insulin – lowers blood sugar


insulin
liver stores glucose as glycogen
pancreas secretes insulin
muscle cells store glycogen and build protein
after eating
adipose (fat-storing) tissue uses glucose to form fat
high blood glucose
Homeostasis
Blood glucose is normal at 75 mg –110 mg/100 mL
low blood glucose
liver breaks down glycogen to glucose
in between eating
adipose tissue breaks down fat to glucose
glucagon
pancreas secretes glucagon

Negative feedback loops

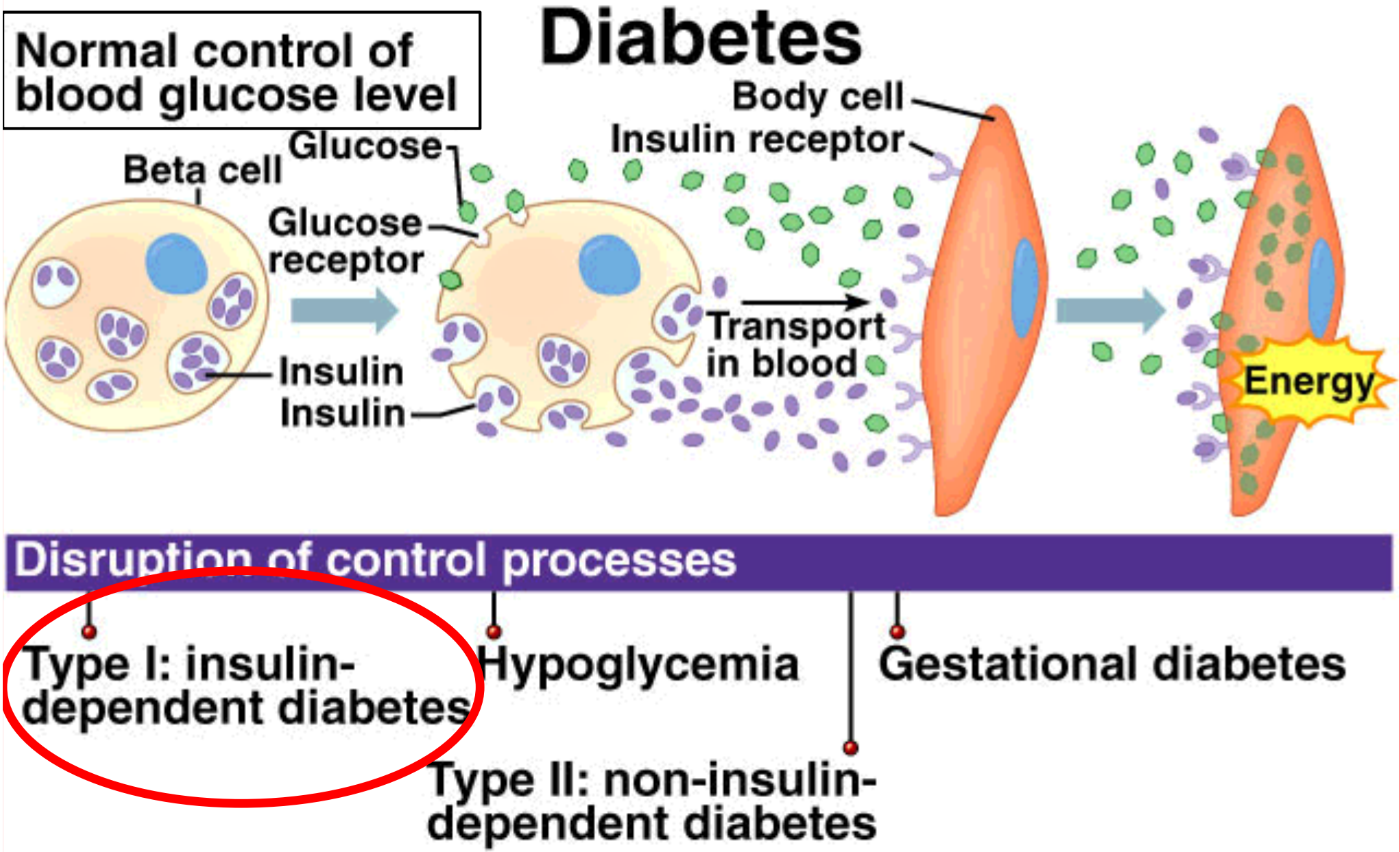
Insulin vs. Glucagon

https://www.youtube.com/watch?v=eDm9hEOn8zc



Diabetes mellitus “mell-e-tus”

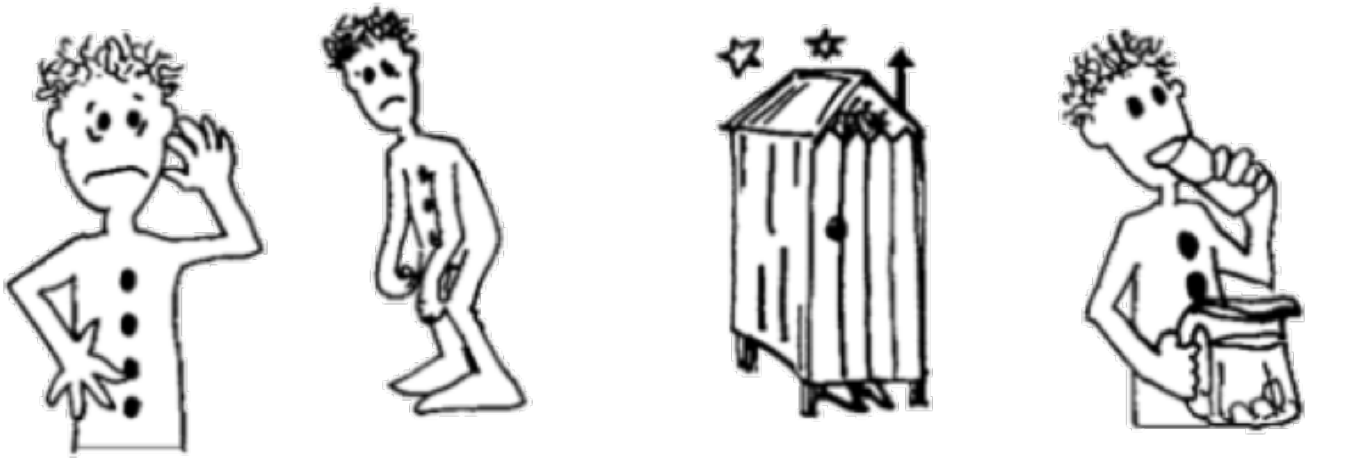
- Genetic disorder
- Not enough **insulin** production due to deterioration of **beta cells** within the islets of Langerhans
- **Result** = **high blood sugar levels after eating** **(hyperglycemia)**
- **Glucose** can appear in the **urine**
- **Normal urine contains NO glucose.**
- Glucose also draws water from the body = **large volumes of urine**



PLAY ME!! Pancreas and Insulin Animation

Symptoms of Diabetes Mellitus

- Frequent urination & constant thirst
- Diabetics experience **low energy levels**
- Lots of sugar in the blood, but little move into cells
- Break down fat and proteins for energy
- **"acetone breath"** due to fat metabolism



Boy before and after Insulin Treatment

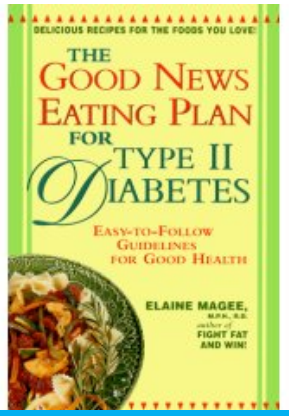
Diabetes Mellitus 2 types

Juvenile (early-onset) (TYPE 1)

- Due to early **degeneration** of **beta cells**
- Treatment: **insulin injections**

Adult (maturity-onset) (TYPE 2)

- Due to **decreased effectiveness of insulin**
- Less effective beta cells
- Treatment: oral drugs such as can be controlled with diet and exercise and medications (**sulfonamides**)



PLAY ME! What is Diabetes?

CAUSES - Diabetes Mellitus

(TYPE 1)

Juvenile (early-onset)

-exact cause unknown

but…

Your immune system attacks and destroys your insulin producing cells

(TYPE 2)

Adult (maturity-onset)

-obesity

-lack of physical activity

-genetic factors

-high fat and carbohydrate (sugar) diet

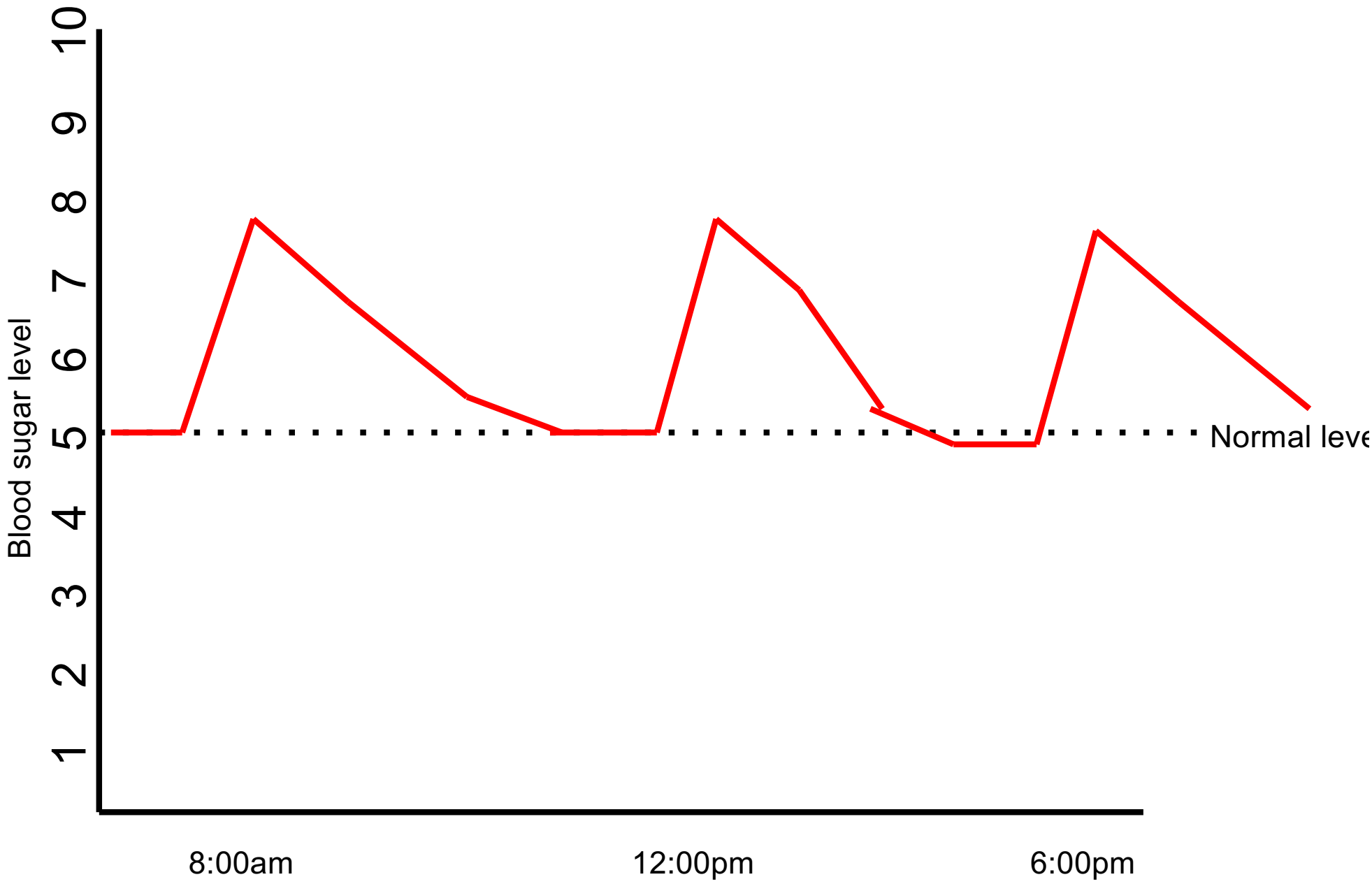
-high alcohol intake

-age

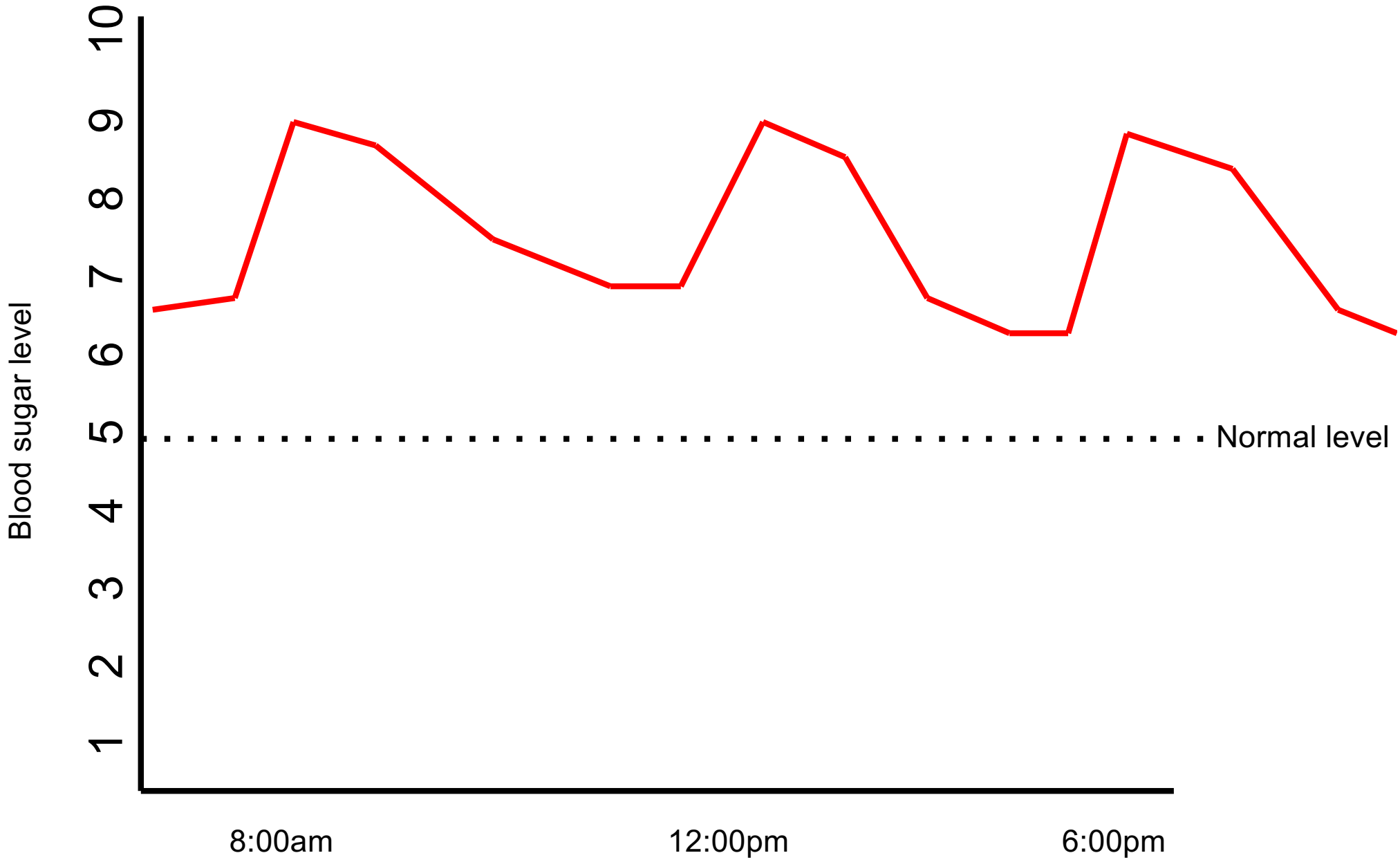
What would the blood sugar level on a graph look like if?

a) A normal person ate a meal at 8:00, 12:00 and 6:00.

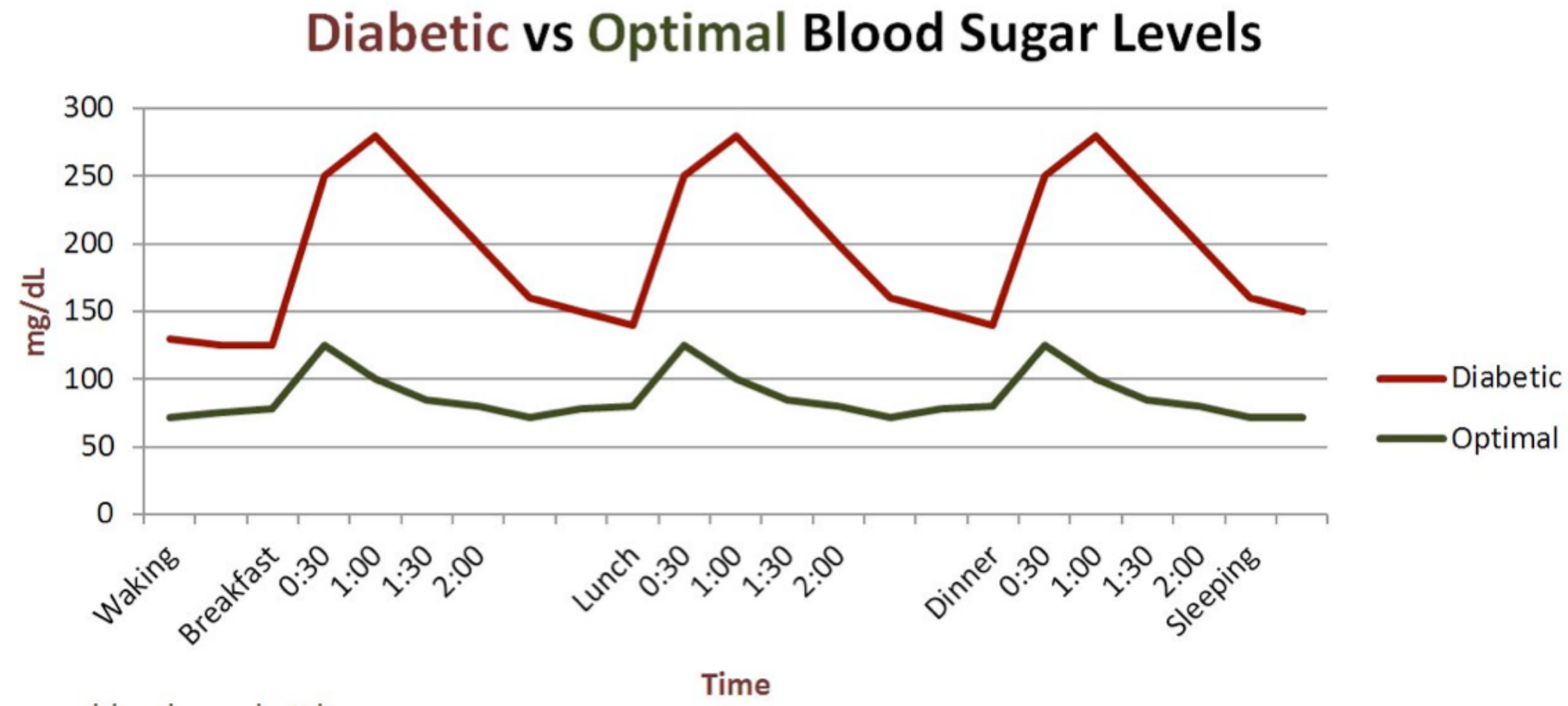
b) A diabetic TYPE 2 person ate meals at the same time.



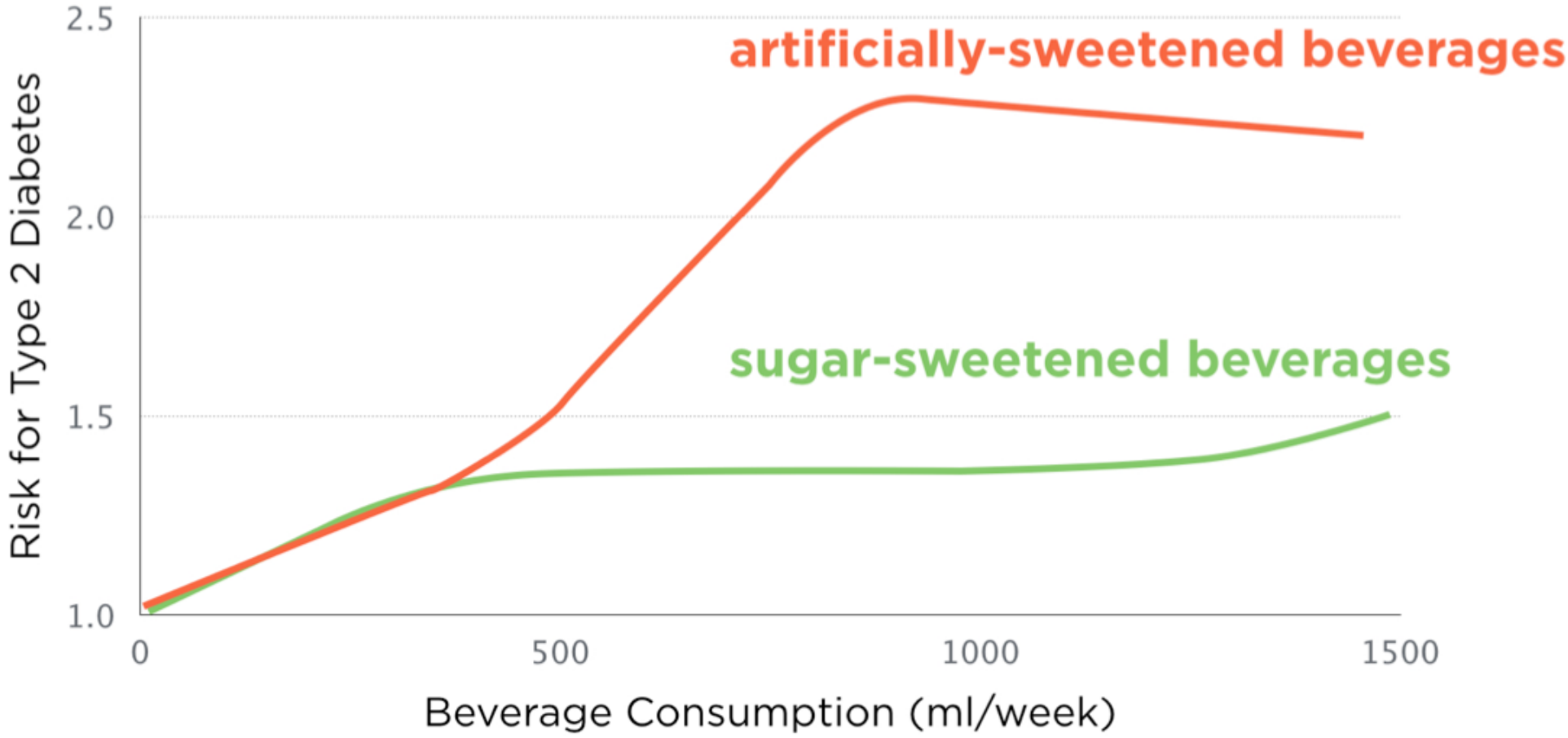
Normal Blood Sugar Regulation



Diabetic Type II


Diabetic vs Optimal Blood Sugar Levels
300
250
200
150
100
50
0
mg/dL
Waking
Breakfast
0:30
1:00
1:30
2:00
Lunch
0:30
1:00
1:30
2:00
Dinner
0:30
1:00
1:30
2:00
Sleeping
Time
Diabetic
Optimal
www.bloodsugarbattles.com

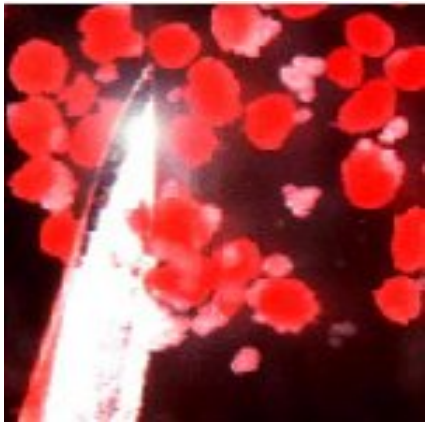
FYI- some studies find…



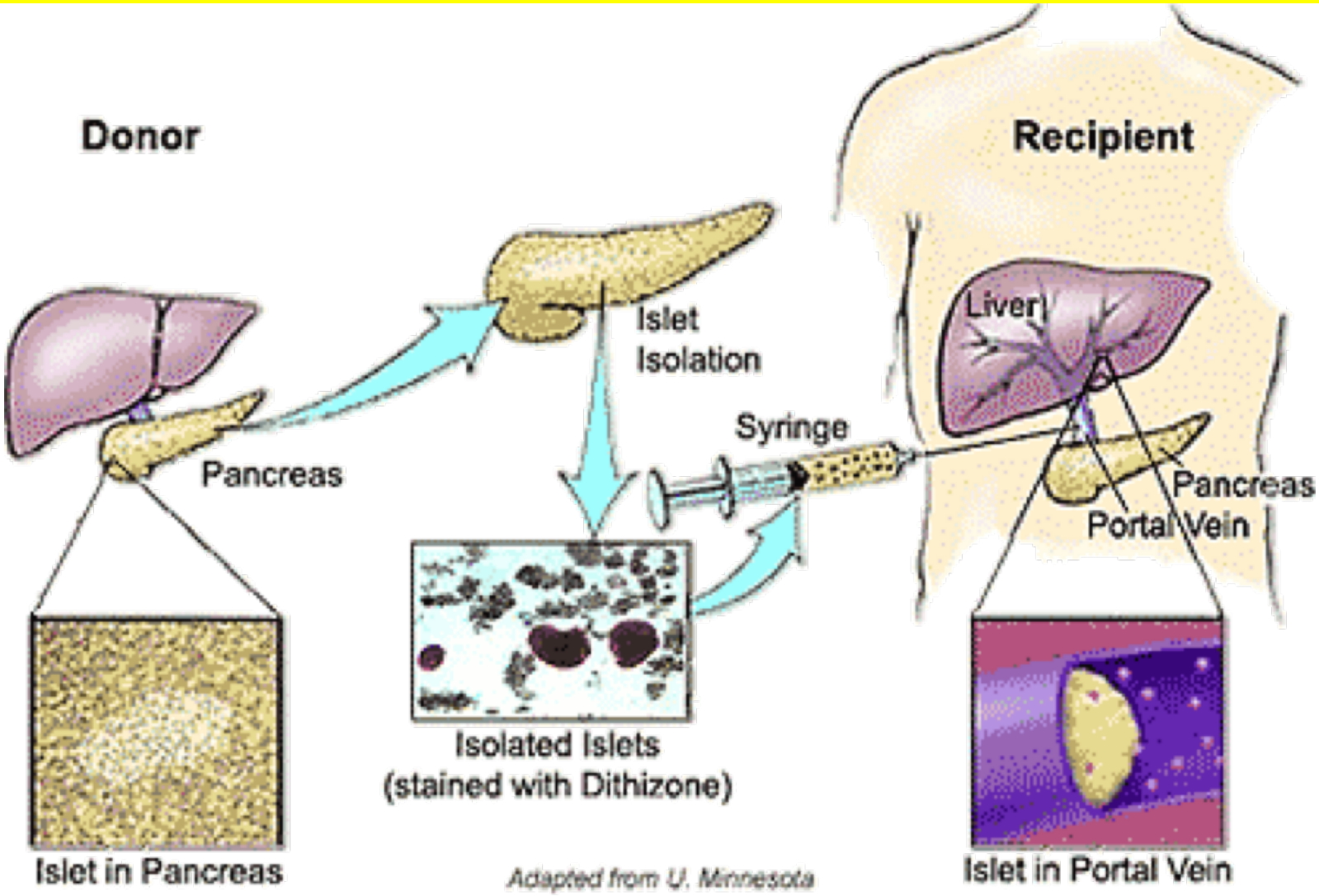
NO!! This does not give you permission to drink as much sugar as you want!

Islet transplants

- Islet transplants can reverse the effects of diabetes
- The **U of A** is a leader in islet transplants
- U of A hospital was the **first to successfully transplant** islets of Langerhans cells into a patient
- **Islet cells are taken from two cadavers and transplanted by injection into the patient.**
  - Patients are required to take immunosuppressant drugs.
- Need to have **2 pancreas** donations **per operation!** **(From 2 separate people)**



Islet transplants

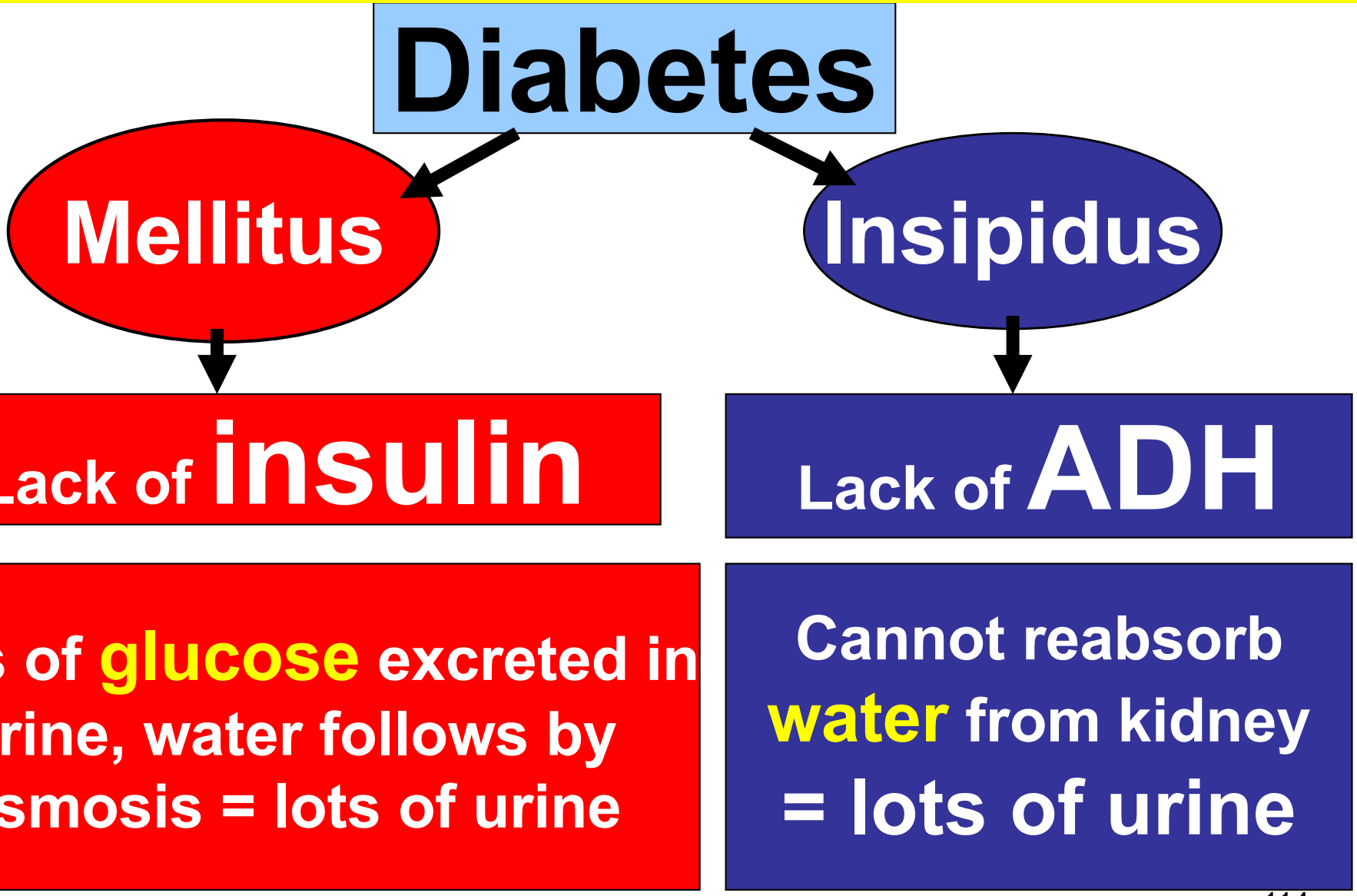


Islet transplants

Challenges and Controversies:

- Who receives islet cell transplants?
- Where do we get adequate donor tissues?
  - Xenogenic (neonatal pigs)
  - Stem Cells
  - Engineered beta cells
- Can we improve the survival rate of transplanted cells?
- How do we reduce/eliminate the need for immunosuppressants and related side effects?

Don’t confuse Diabetes Mellitus and Diabetes Insipidus!



KEY to Control of Blood Glucose

1	Pancreas	Insulin glucose → glycogen	⇩BG
		Glucagon glycogen→glucose	⇧BG
2	Adrenal Cortex	Cortisol ⇧aa in blood →liver → glucose	⇧BG
3	Thyroid	Thyroxin cellular respiration	⇩BG
		$Glucose + O_2 \rightarrow CO_2 + H_2O + ATP$	
4	Adrenal Medulla	Epinephrine glycogen→ glucose	⇧BG

Control of Metabolism

1 . Thyroid Gland

Thyroxine - increases metabolism

2. hGh

-Promotes protein synthesis (growth)
-used to change the “fuel” muscles use (fat used in times of fasting)

Control of Blood pressure / water balance

ADH released in response to

dehydration (lack of water)

Aldosterone is released in response to low **blood pressure or low volume**

(due to loss of fluid like diarrhea or hemorrhage).

Prostaglandins

- Group of hormones that do not travel to sites in the body
- Have a pronounced effect in a small localized area

(eg) when tissue is damaged(stressed), the cells of the area release prostaglandins

- They stimulate inflammation, increase blood flow, and stimulate blood clotting in the area

Aspirin blocks prostaglandin from being released and this prevents blood from clotting which is why it is given to patients with heart disease

Estrogen and Progesterone

Estrogen

- **Production Site: follicles** within the ovary, and **corpus luteum** **(part of ovary)**
- **Targets: various cells**
- **Functions:**

-promotes development of **secondary sexual characteristics** (breasts, body hair);

-Initiates **thickening of uterine lining** in preparation for pregnancy each month

Progesterone

- **Production Site:** corpus luteum (part of ovary)
- **Target:** mammary glands for development
- **Target:** Endometrium (uterine lining)
- **Functions:** growth and maintenance of endometrium; inhibits ovulation and prevents **uterine contractions**

Testosterone

- **Produced in: testes**
- Production is regulated by **LH** from the anterior pituitary

- **Targets:** various cells

- **Function:**

-development of **primary** sexual characteristics
(penis, prostate, seminal vesicle development),

-development of **secondary** sexual characteristics
(facial hair, deepening voice, broadening shoulders);

-increases **sperm production**

Check your Understanding…

How does insulin affect the bodies cells?

Increases permeability to glucose

How does glucagon increase blood glucose levels? 2 ways

Decreases cell permeability to glucose, converts glycogen to glucose

How is glycogen different from glucose?

Glycogen is storage form of glucose in liver and muscles

How much glucose should normal urine posess?

NONE

How does insulin do its job?

Hooks up with receptors which then allows glucose to enter cell

Which type of Diabetes Mellitus requires life dependent injections of insulin?

Type 1

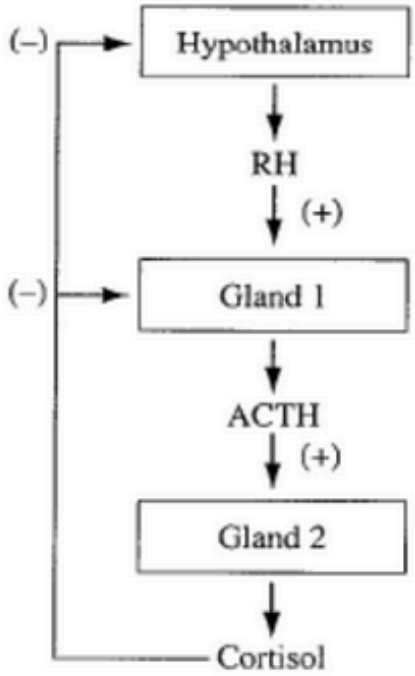
Why is Diabetes Type II not immediately life threatening?

They still produce insulin but in lower amounts and/or insulin is not as effective to allowing glucose into cells

Researchers suggest that the brain has a daily "internal clock" that is controlled by the endocrine and nervous systems. The hormone ACTH helps to regulate the nervous system and gives the body the ability to respond to changes in sleep patterns. The release of ACTH is suppressed during sleep but increases before a person awakes.

The feedback loop below illustrates part of the regulatory hormonal control of the internal clock.

Regulatory Hormone Feedback Loop



The secretion of ACTH is suppressed during sleep as a result of

A. increased activity of the pituitary gland
B. decreased secretion of RH by the hypothalamus
C. decreased secretion of cortisol by the adrenal cortex
D. increased nervous system input to the medulla oblongata

ANSWER B: If the hypothalamus does not release a "RH" (releasing hormone), then GLAND 1 will not release ACTH.

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

Parathormone and calitonin are hormones that work antagonistically. Two other hormones that work antagonistically are

A. TSH and thyroxine
B. insulin and glucagon
C. ADH and aldosterone
D. prolactin and oxytocin

Low levels of calcium ions in the blood cause

A. decreased secretion of PTH and increased depo
B. decreased secretion of calcitonin and increased 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

ANSWER C: PTH (parathyroid hormone) RAISES blood calcium by taking it out of bones(storage).

Which of the following hormones plays a role in returning the salt concentration in the blood to homeostatic levels following heavy exercise?

A. Cortisol
B. Thyroxine
C. Aldosterone
D. Epinephrine

As you sweat, water and salt(sodium) is lost from blood. Aldosterone retains sodium in kidneys and with it, water. So this sodium and water has been saved from being released out of bladder.

Chemicals found in alcohol and tea have a diuretic effect. Diuretics cause the body to produce greater-than-normal volumes of urine.

Diuretic chemicals counteract the effect of the hormone

A. ADH
B. insulin
C. cortisol
D. prolactin

ADH = anti-diuretic hormone which means it prevents water loss

Homework

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