



Etege Menen Girls' Boarding Secondary School

Biology Department

Grade 10



Prepared by: Genene Teshome (2012)

Lesson Contents

3.5. HOMEOSTASIS

3.5.1 Controlling temperature

3.5.2 Homeostasis in the kidney

3.5.3 Liver and homeostasis

3.5 HOMEOSTASIS

- ❑ Come from two Greek words.

 - homoios** ; like

 - Stasis**; states

- ❑ Keeping internal environment the same state.

- ❑ The body ability to maintain a constant internal environment

- ❑ The ability of an organism maintaining a constant internal environment both in tissue fluids and cells.

Controlling temperature

- ❖ **Temperature** is a way of measuring hotness and coldness of something.
- ❖ **Living organism continually gained and lost heat by;**
 - **Conduction** the transfer of heat through direct contact
 - **Conviction** the transfer of heat through the current of air and water
 - **Radiation** the diffusion of heat from through the air
- ❖ **In addition to this living organism**
 - Gain heat by **cellular respiration**
 - Lost heat by **evaporation**

With regard to temperature regulation organism can be divided into two major groups

1. Poikiltherms

2. Homoiotherms

1. Poikilotherms

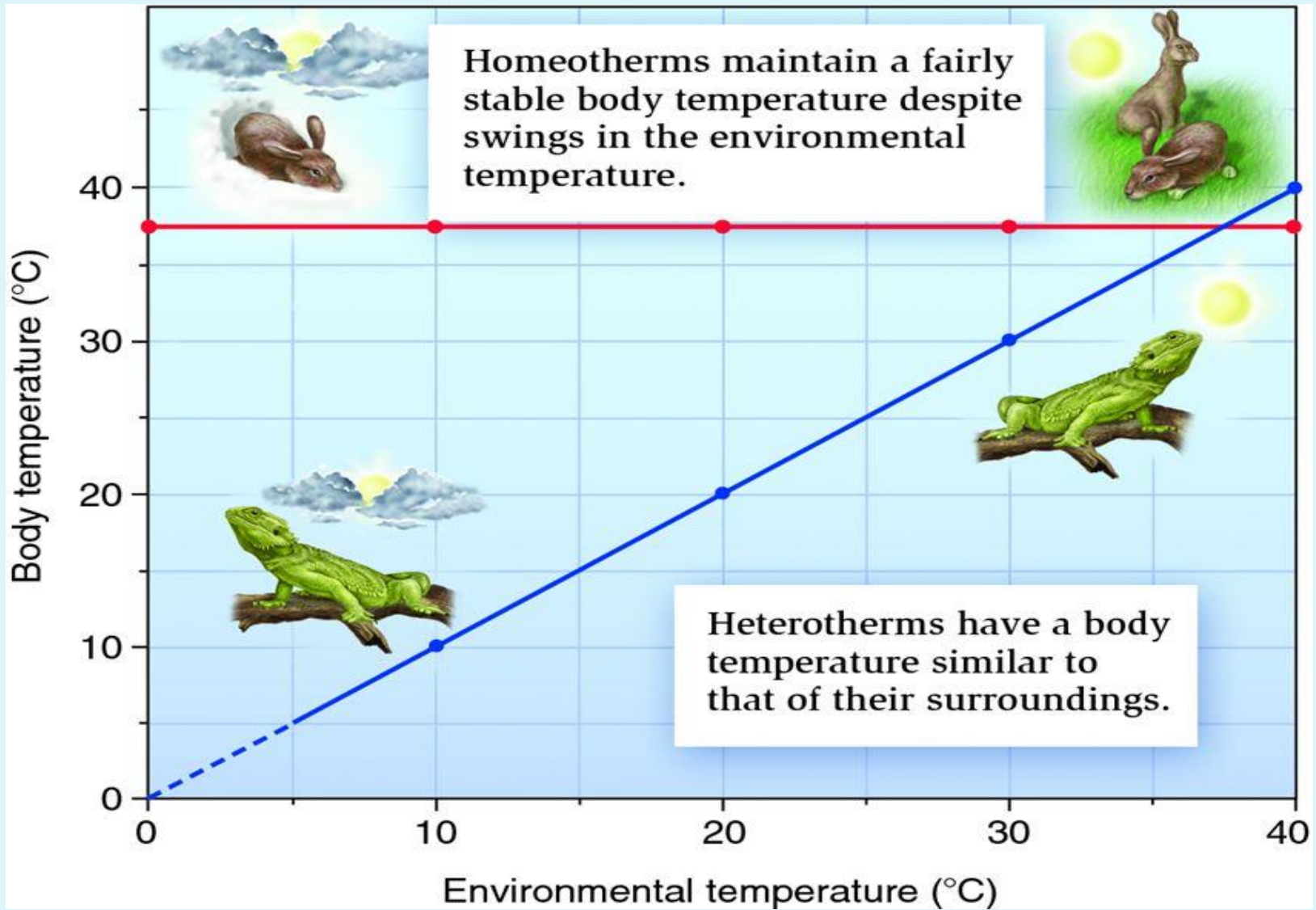
- ❖ Body temperature governed by external temperature.
- ❖ Body temperature vary over a wide range
- ❖ E.g.; **Invertebrates , Fish, Amphibians and Reptiles**

Organism	Environmental temperature	Body Temp
Fish	25 ⁰ C	25 ⁰ C
	30 ⁰ C	30 ⁰ C
	40 ⁰ C	40 ⁰ C

2. Homoiotherms

- ❖ Constant internal body temperature
- ❖ Independent of environmental temperature
- ❖ **E.g. Birds and Mammals**

Organism	Environmental temperature	Body Temp.
Human	25°C	37°C
	30°C	37°C
	40°C	37°C



Temperature controls in Poikilotherms

When hot

- ❖ Move into water
- ❖ Move into shade

When cold

- ❖ Press their body to warm temperature
- ❖ Bask in the sun

Temperature controls in Homoiotherms

1. Physiological method

- ❖ **Heat losing mechanism** in response to **hot condition** in order to **cool the body**

A. Sweating

- ❖ As sweat evaporates from the skin surface it has a cooling effect because the evaporating liquid carries away body heat.

B. Vasodilatations

- ❖ Is the widening (dilates) of blood vessels
- ❖ More blood flows through the capillaries
- ❖ More heat is lost through the surface

C. Panting and licking



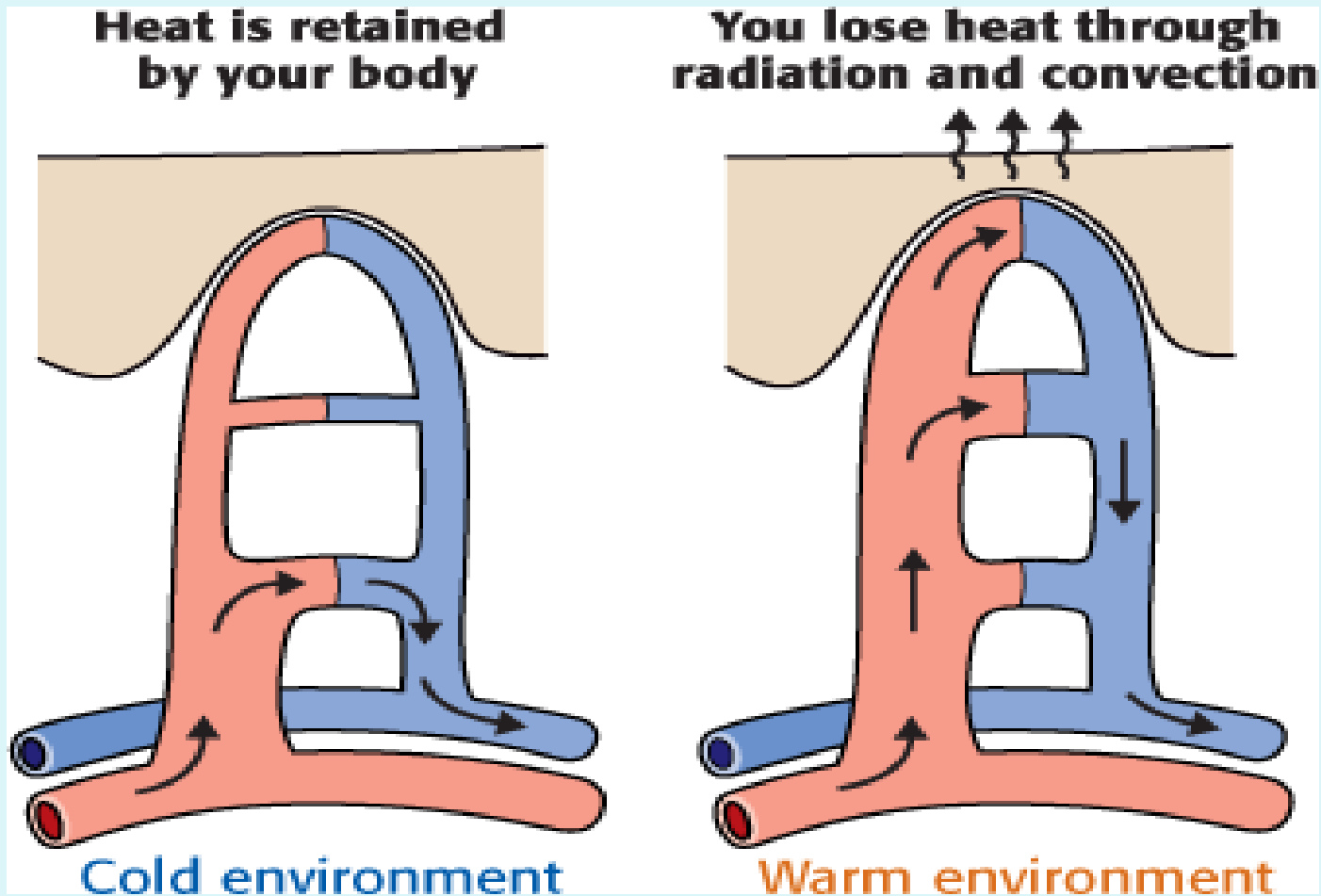
Heat gain mechanism

Heat gain mechanism operates **in response to cold condition** in order **to warm the body**

A. Vasoconstriction

- ❖ Narrowing (constricts) of blood vessels
- ❖ Reduce the flow of blood through capillaries
- ❖ Reduce heat lost through the surface of skin

Vasoconstriction and Vasodilation



B. Piloerection → pulling the hair upright

When body temperature falls (drops)

- ❖ **Pulling the hair upright:** trapping an insulating layer of air to conserve heat.

When body temperature rises

- ❖ **Hair lie flat:** reduce an insulating layer which makes easier to loss heat by convection.

C. Shivering and metabolic response

When body temperature fails (drops, cools)

- ❖ The muscle starts shiver and contract rapidly
- ❖ Increase the rate of respiration to generate more heat.
- ❖ The body temperature starts to go up.

When body temperature rises (warms up)

- ❖ Shivering stops
- ❖ Metabolic rate drops and less heat produce.

D. Fat layer under skin → Subcutaneous fat

- ❖ Serve as an insulator and reduce heat loss from the body in cold climates.
- ❖ Animal that **lives in cold climate** like **polar bear** and **seal** have thick layer of fat which aid in heat conservation

2. Behavioral method of temperature regulation

- ❖ Clothing
- ❖ Bathing
- ❖ Seeking shade and shelter
- ❖ Taking high calorie food
- ❖ **Hibernation**; animal response to **cold environment** undergo period of dormancy (deep sleep)
- ❖ **Aestivation** ; animals response to **hot environments** undergo a period of dormancy (deep sleep)

3. Morphological method of temperature regulation

- ❖ Surface area to volume ratio is the amount of surface area to per unit volume

Larger organism

- ❖ Smaller surface area to volume ratio
- ❖ Do not loss heat faster
- ❖ Adapted to live cold condition

Smaller organism

- ❖ Larger surface area to volume ratio
- ❖ Loss heat faster
- ❖ Adapted to live hot condition



Size and SA:V

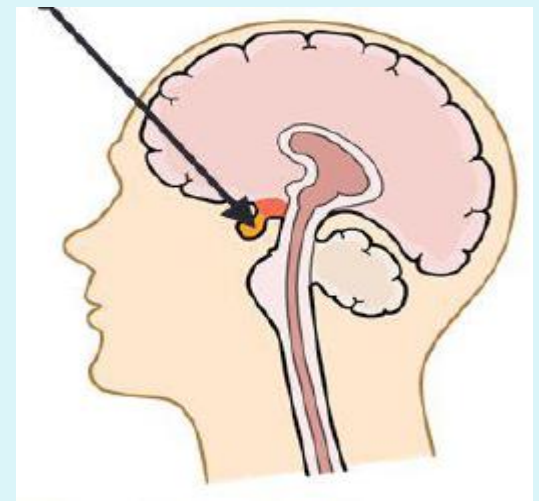
- ❖ Polar bears are the largest bears in the world
- ❖ This means that they have a smaller SA:V
- ❖ This means that they lose less heat
- ❖ This is important to its survival in polar regions



How is temperature controlled?

- ❑ Body temperature is monitored and controlled by **temperature receptor** in **skin** and **brain**
- ❑ Those **receptors detect change in temperature** of blood flowing through these area
- ❑ **Thermoregulatory center** of the brain is Called **hypothalamus**
- ❑ If the body temperature **deviates from 37°C** hypothalamus and skin receptor detects these and regulate body temperature

Hypothalamus



Controlling core body temperature

As the core body temperature rises; heat **lost** from the body using:

- ❖ **Dilation of blood vessels**
- ❖ **Lot of sweat** produced
- ❖ **Hair lie flat**

As the core body temperature falls; heat gain to the body using

- ❖ **Contraction of blood vessels** /Vasoconstriction/
- ❖ **No sweat produce**
- ❖ **Hairs pulled erect** to trap insulating air

3.5.2 Homeostasis in the kidney

- ❖ **Kidney, lung** and **skin** are the main excretory organ of the body
- ❖ Human kidney has vitally **important in two aspect of homeostasis:**

i. **Excretion**

ii . **Osmoregulation**

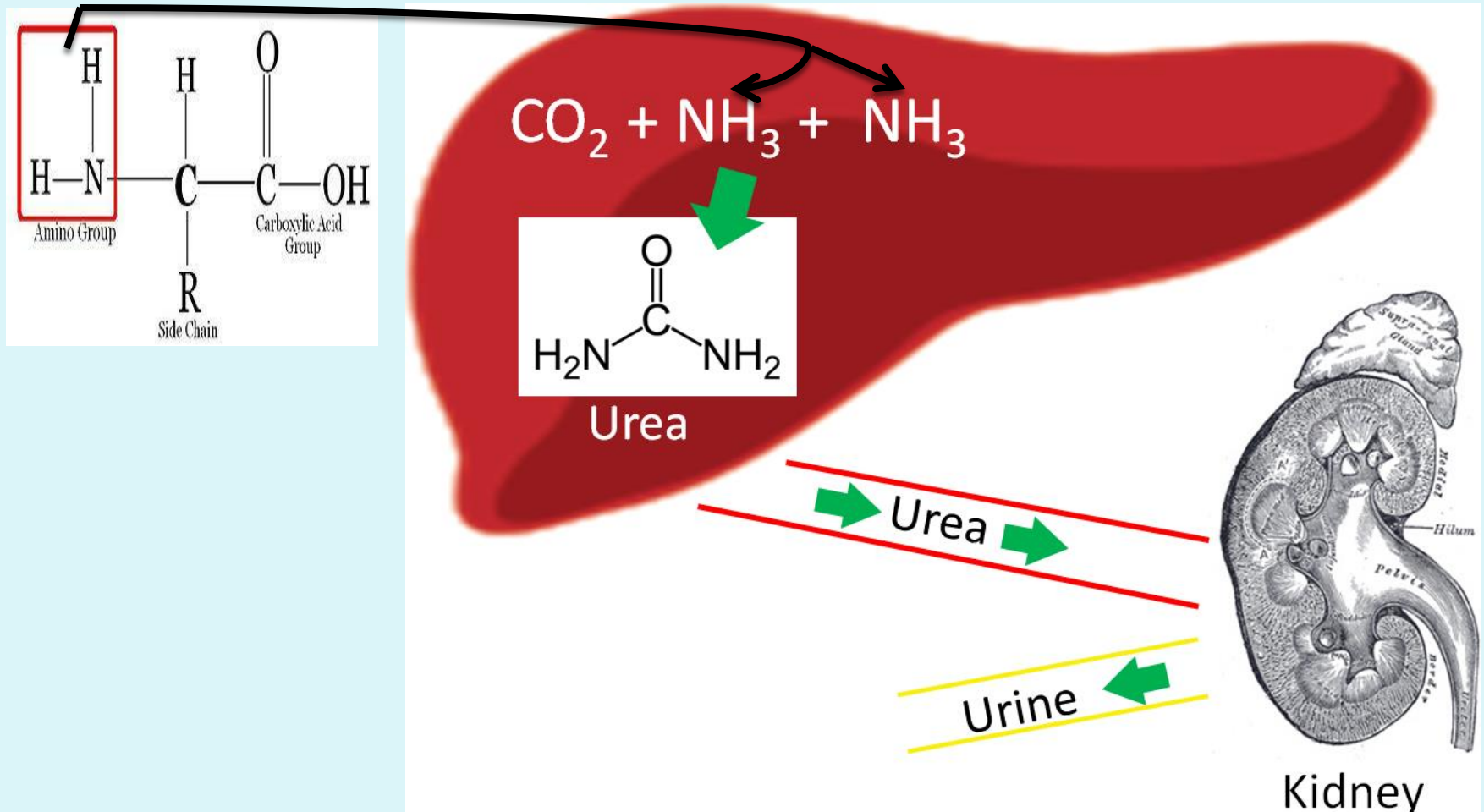
1. Excretion. The removal of metabolic waste from the body

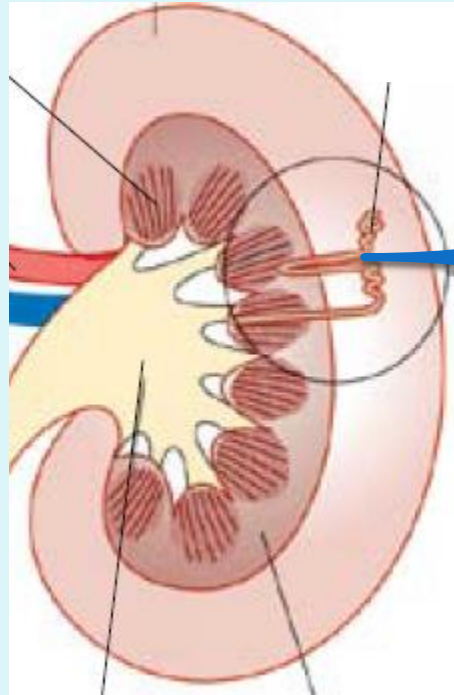
- ❖ Kidney removes nitrogenous waste such as urea.
- ❖ Urea is produced in the liver.

How urea produce in the liver?

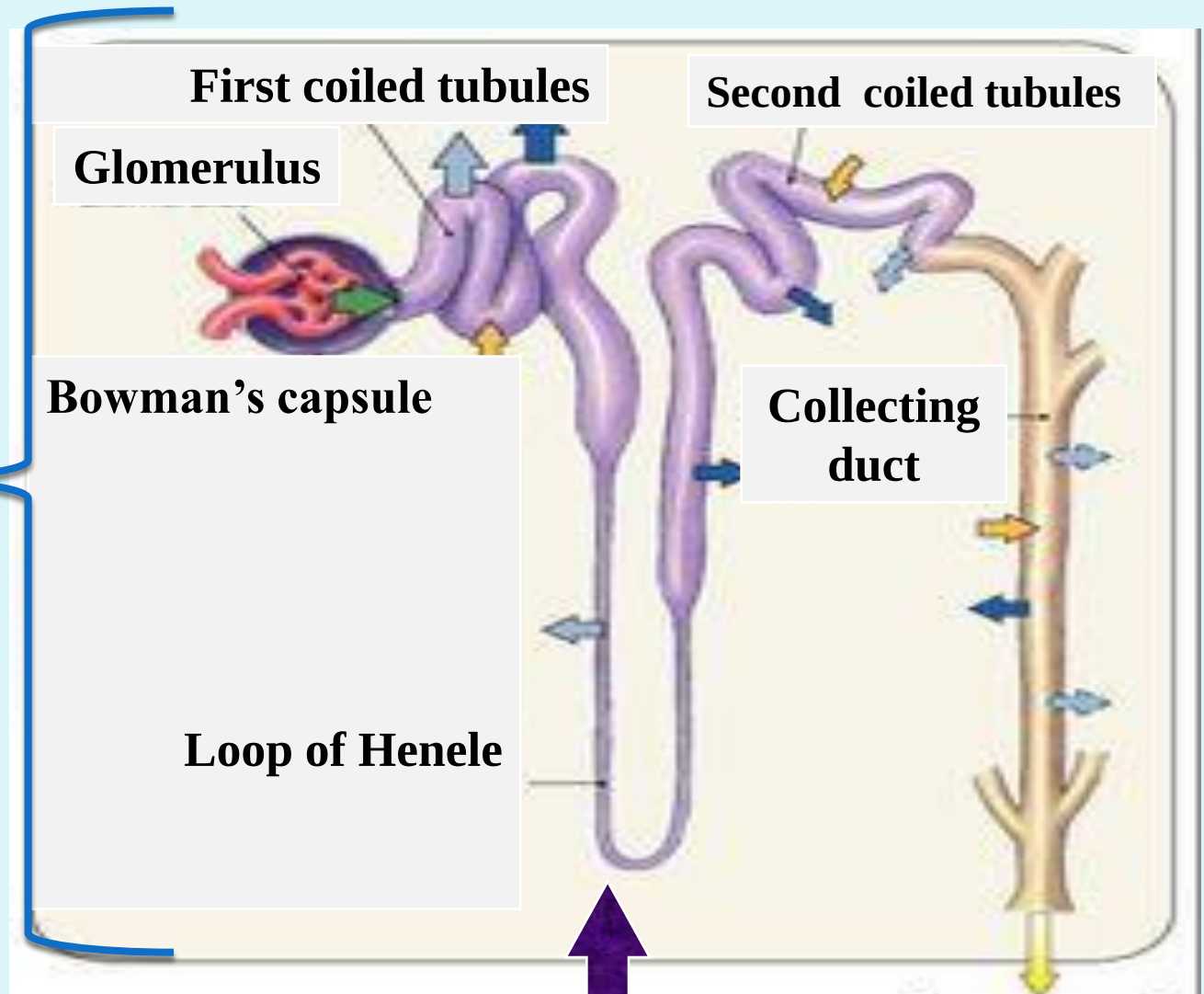
- ❖ Amino acid contain amino group and carboxylic group.
 - ❖ In excess amino acid liver converts;
 - amino group into ammonia
 - carboxylic acid into carbohydrate
 - ammonia and carbon dioxide forms urea
 - ❖ Urea filtered out of blood by kidney and removed as urine
- 2. Osmoregulation.** control of water and ion balance in the body

Urea production





kidney



Nephron (microscopic unit of kidney, blood is filtered and urine is formed)

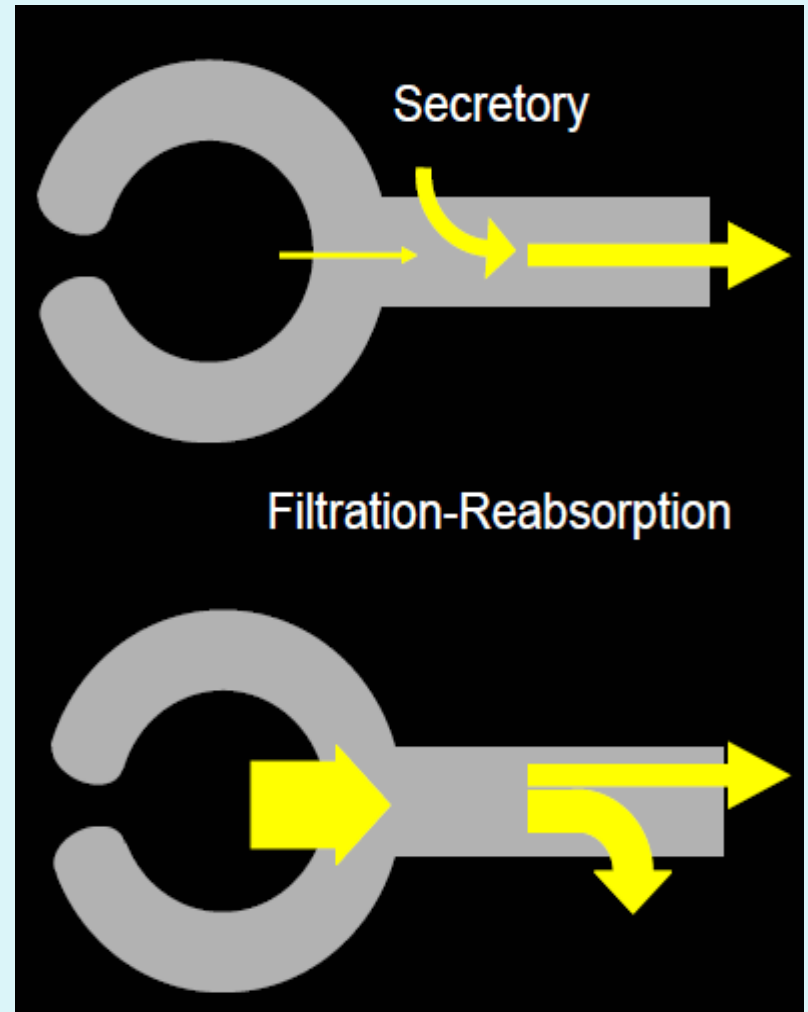
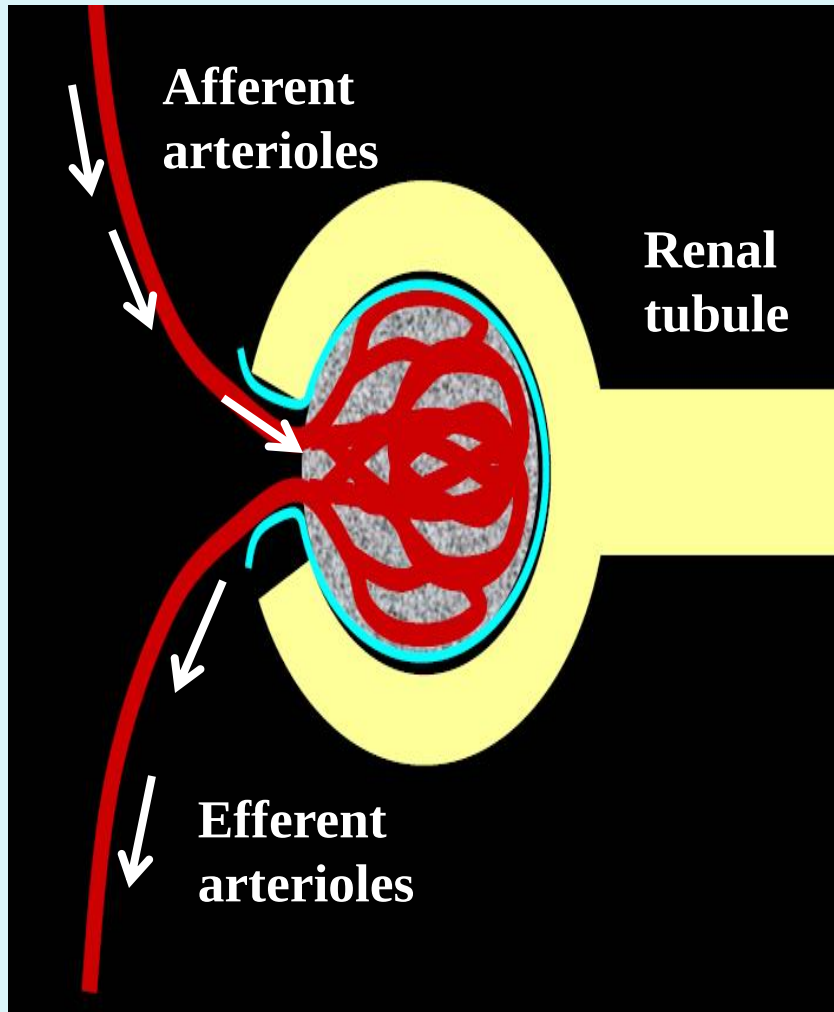
Urine storage and elimination

Section of nephrones

1. Bowman's capsules site of ultra filtration

- ❖ **Ultrafiltration:** the filtration salt, glucose, urea and other substance from the blood into bowman's capsules.
- ❖ **Glomerulus**—the knot of blood vessels in bowman capsules
 - **Afferent arterioles;** arterioles takes blood into the glomerulus
 - **Efferent arterioles;** arterioles carry blood away from the glomerulus
 - **Glomerular filtrate**—the liquid resulting from filtration in the bowman capsules

Bowman's capsules



Parts of nephrones...

2. First coiled (proximal convoluted) tubules –

- ❖ Reabsorptions of useful substance

3. Loop of Henley urine is concentrated and more water is conserved.

4. Second coiled (Distal convoluted) tubules /the main water balance is done under the influence of ADH

5. Collecting Duct: reabsorbs water and solute from filtrates

The role of ADH in second convoluted tube

If the water contents of the blood is too low-

- ❖ **More ADH is released** into the blood
- ❖ Kidney tubules **reabsorb more water**
- ❖ Little dark colored **concentrated urine** is produced

If the water content in the blood is too high

- ❖ **Less ADH is released** into the blood
- ❖ Kidney tubules **reabsorbs less water**
- ❖ Much pale colored large volume of **dilute urine** is produced

3.5.3 Liver and homeostasis

Liver plays the following role:

- ❖ **Regulation of blood glucose level-**
- ❖ **Protein metabolism;** the process of removing amino group from amino acid is called **deamination**
- ❖ **Control toxins** -change harmful substance to harmless **detoxification**
- ❖ **Temperature control**
- ❖ Control fat and cholesterol in the blood
- ❖ Production of plasma protein

Summery of the lesson

Homeostasis

1) Temperature regulation

- Classification of organism based on temperature regulation
- How Poikilotherms regulate there body temperature?
- How Homoiotherms regulate there body temperature using; Physiological, behavioral and morphological method?

2) Kidney as homeostasis

- What is role of kidney such as excretion and osmoregulation
- What is the part of nephron
- What is role of ADH in water balance

3) Role of liver as homeostasis

Lesson quizzes

Choose the correct answer from the given alternatives

1. Some reptiles living in temperate go into very deep sleep for a longer time during cold season. This kind of adaptation is called
 - A. Vasoconstriction
 - B. Aestivation
 - C. Hibernation
 - D. Vasodilation
2. Which of the following is a principal organ of for maintaining body water balance?
 - A. Skin
 - B. kidney
 - C. Liver
 - D. Anus
3. Which of the following physiological method has a cooling effect on the body?
 - A. Shivering
 - B. Sweating
 - C. Vasoconstriction
 - D. Fat layer

4. Negative feedback mechanism is best described as the process that helps?

- A. Keep body conditions near a normal steady state
- B. Directly control muscle contraction in the leg
- C. Destroy hormones in the blood
- D. Reduce hormone level below normal

5. Which of the following animal has a greater surface area in proportion to its weight?

- A. Whale B. Cat C. Elephants D. mouse

6. Which part of the nephrons reabsorption of water take place use ADH?

A. Bowman's capsule

C. first coiled tubules

B. Second coiled tubules

D. loop of henele

7. One of the following is not the function of liver?

A. Regulation of blood glucose level

B. Maintain water balance in the blood

C. protein metabolism

D. Control core body temperature

8. What does high level of ADH hormone in the blood indicates?

- A. Blood water level greater than salt level
- B. Water should removed from blood via urine
- C. Blood salt level greater than blood water level
- D. Water and salt level is balanced

9. Which process increase when the human body temperature decreases?

- A. Dilation of blood vessels
- B. Secretion of sweat
- C. Secretion of insulin
- D. Shivering

10. Which of the following is true about homoeothermic animal

- A. Have variable body temperature
- B. Include reptiles and fishes
- C. Have high metabolic activity
- D. Unable to control body temperature

11. Which part of the nephrons are involved in osmoregulation of salt and water

- A. Glomerulus and Bowman's Capsule
- B. Second coiled tube and loop of Henle
- C. Collecting duct and second coiled tube
- D. First coiled tube and loop of Henle

12. It is estimated that the concentration of urea in urine is 60 times more than in the blood. This increase in concentration results because

- A, Some urea could be produced in the kidney nephrons
- B. The volume of water is decreased in urine.
- C. Much of the urea is reabsorbed into the blood.
- D. Much of the mineral ions in the blood are removed.

13. Which of the following is correct about anti-diuretic hormone (ADH)?

- A. It is produced when the water content of the blood is too low.
- B. Its production is initiated by low salt concentration in the blood.
- C. It facilitates reabsorption in the first convoluted tubule.
- D. It works in the direction of producing dilute urine.

14. Which of the following is an adaptive mechanism for animals in cold climates?

- A. Have small surface area to volume ratio.
- B. They have thin layer of fat.
- C. They have thin skin
- D. They are small in size