11 BIOLOGY
U1: REVIEW

Key

UNIT ONE REVIEW

1. What does the vacuole do?

Storage

2. What is mitochondrion?

power

3. What is the flagella?

skinny thread-like (enables movement)

4. What is the outer shell of a cell?

cell membrane

5. What analogy could you use to describe the roles of organelles? Make sure to include at least three roles.

school
house
factory
etc...

6. What are two main roles of the cell membrane?

- selectively permeable
- holds shape.

7. A phospholipid molecule contains two distinct regions. The POLAR region is attracted to water and the NON-POLAR region is repelled from water.

POLAR → hydrophilic
NON-POLAR → hydrophobic

8. Define homeostasis.

balance of body systems

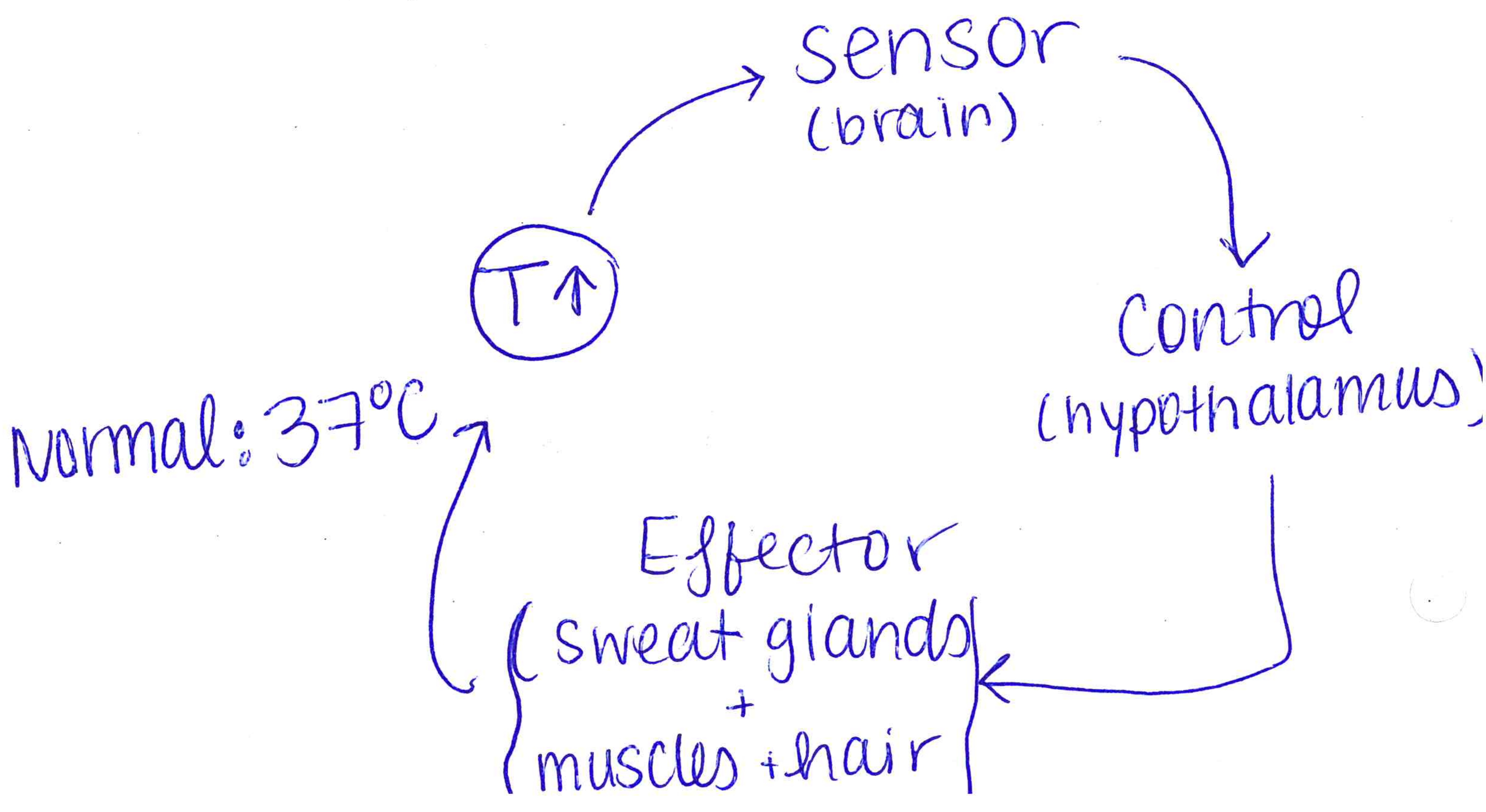
9. Give three examples of homeostatic mechanisms at work in our bodies.

- osmoregulation (H_2O)
- thermoregulation
- waste management.

10. What is a negative feedback mechanism?

cycle of maintaining Homeostasis

11. Draw a negative feedback cycle to illustrate the body's response to an increase in body temperature.



11 BIOLOGY
U1: REVIEW

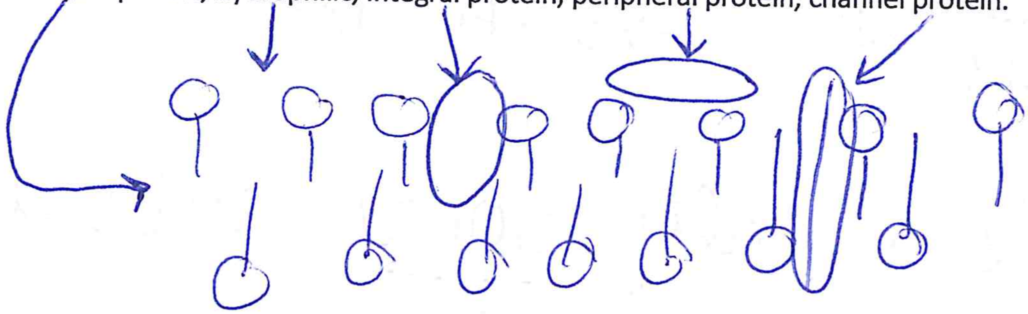
12. Explain the role of each of the following components of a negative feedback mechanism:

a. receptor senses imbalance

b. control center sends message to body

c. effector makes change to balance

13. Draw a labeled diagram of the cell membrane. Include the following components: **hydrophobic, hydrophilic, integral protein, peripheral protein, channel protein.**



14. Explain the difference between active and passive transport.

requires energy

no energy

15. Define the terms hydrophobic and hydrophilic.

water repulsión

attracted to H_2O

16. Compare the following terms:
    a. integral and peripheral proteins

inside vs outside

    b. channel and carrier proteins

↓ hallway /door → helps move

    c. endocytosis and exocytosis

↓ enter ↳ exit

    d. diffusion and osmosis

spread or mix ↲ ↳ diffusion w/ H_2O

17. What does it mean to say that the cell membrane is selectively permeable?

lets only some substances pass.

18. List and briefly describe the three types of passive transport

Diffusion
Facilitated Diffusion
Osmosis

19. What is ATP? What reaction produces ATP and in what part of the cell does this occur?

↳ Energy! Adenosine triphosphate
Cellular Respiration
mitochondria

20. How does the size of a cell affect the rate at which a substance can diffuse through its membrane?

Surface Area + Volume Ratio ↑
Speed ↓

21. What does the term concentration gradient mean? How does the concentration gradient of a substance affect how quickly it will diffuse across a membrane?

particles /solute in a solution
↑CG = ↑ speed of diffusion

22. What are the main components of the cell membrane?

lipids
proteins (phospholipid bilayer)

23. What does the term "lipid bilayer" mean? Use a diagram to help you explain.

fat ↙ ↳ 2 layers

24. What are the two types of proteins found in the cell membrane called?

peripheral
+
integral

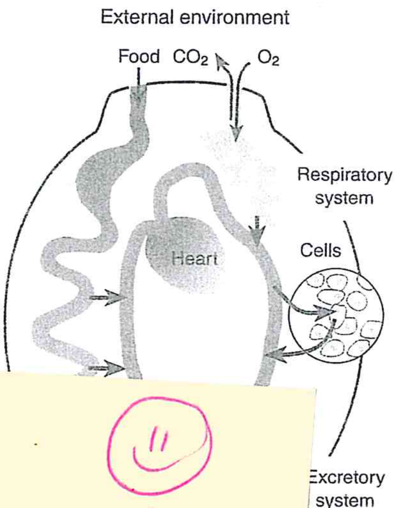
25. How is facilitated diffusion different from diffusion?

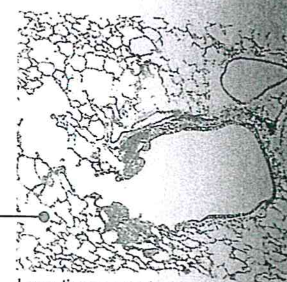
↳ integral proteins help out.

Principles of Homeostasis

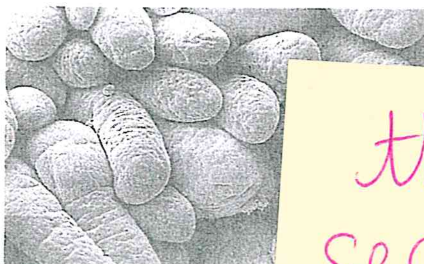
Homeostasis is the condition where the body's internal environment remains relatively constant, despite external fluctuations. Homeostasis of the internal environment is an essential feature of complex animals and it is the job of the body's **organ systems** to maintain it, even as they make necessary exchanges with the environment. Homeostatic control systems have three functional components: a receptor to detect change, a control centre, and an effector to direct an appropriate response. In negative feedback systems, movement away from an ideal state triggers a mechanism to counteract further change in that direction. Using feedback systems, the body counteracts disturbances and restores the steady state.

Organ systems maintain a constant internal environment that provides for the needs of all the body's cells, making it possible for animals to move through different and often highly variable external environments.This representation of a mammal shows how organ systems permit exchanges with the environment. The exchange surfaces of organ systems are usually internal, but may be connected to the environment via openings on the body surface.

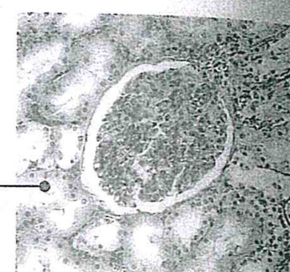




Lung tissue provides an expansive, moist surface for gas exchange.



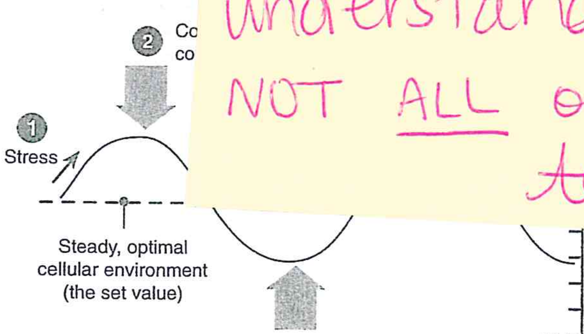
The finger-like villi of the smal
expand the surface area for nutr

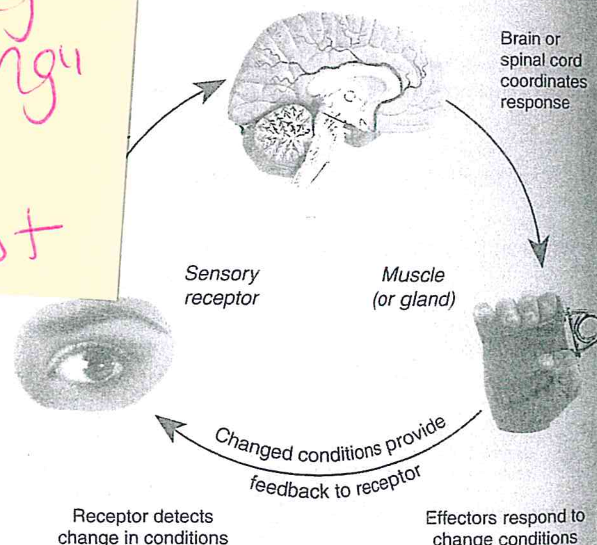


Kidney tubules exchange chemicals with the blood through capillaries.

this ☺ section is "furthering understanding" NOT ALL on test

Negative Fe





1. A stress or disturbance takes the internal environment away from optimum
2. Stress is detected by receptors and corrective mechanisms are activated
3. The corrective mechanisms act to restore conditions back to the set value

Negative feedback acts to eliminate any deviation from preferred conditions. It is part of almost all the control systems in living things. The diagram (above left) shows how a stress or disturbance is counteracted by corrective mechanisms that act to restore conditions back to an optimum value. The diagram (above right) illustrates this principle for a biological system.

1. Identify the three main components of a regulatory control system in the human body:

receptor (sensor) + control + effector.

2. Explain how animals use feedback mechanisms to maintain a steady state despite their constant exchanges with a variable environment:

receptor detects change
control sends signal
muscle/gland effects change

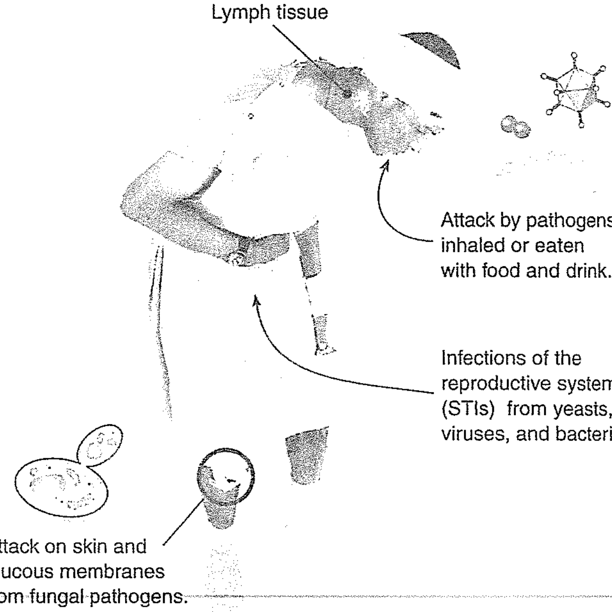
Maintaining Homeostasis

The various organ systems of the body act to maintain homeostasis through a combination of hormonal and nervous mechanisms. In everyday life, the body must regulate respiratory gases, protect itself against agents of disease (pathogens), maintain fluid and salt balance, regulate energy and nutrient supply, and maintain a constant body temperature. All these must be coordinated and appropriate responses made to incoming stimuli. In addition, the body must be able to repair itself when injured and be capable of reproducing (leaving offspring).

Regulating Respiratory Gases

Oxygen must be delivered to all cells and carbon dioxide (a waste product of cellular respiration) must be removed. Breathing (inhalation and exhalation) brings in oxygen and expels CO_2. The rate of breathing is varied according to the oxygen requirement. Both gases are transported around the body in the blood; the oxygen mostly bound to hemoglobin.

Coping with Pathogens

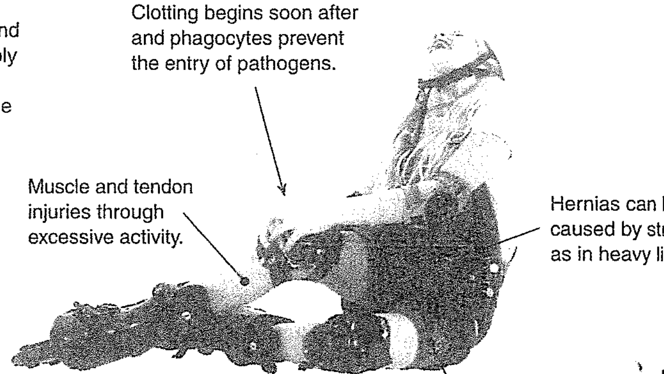


All of us are under constant attack from pathogens (disease causing organisms). The body has a number of mechanisms that help to prevent the entry of pathogens and limit the damage they cause if they do enter the body. The skin, the digestive system and the immune system are all involved in limiting damage.

Maintaining Nutrient Supply

Food and drink must be taken in to maintain the body's energy supplies. Steady levels of energy (as glucose) is available to cells through hormonal regulation of blood sugar levels. Insulin, released by the endocrine cells of the pancreas, causes cells to take up glucose after a meal. Glucagon causes the release of glucose from the liver.

Repairing Injuries



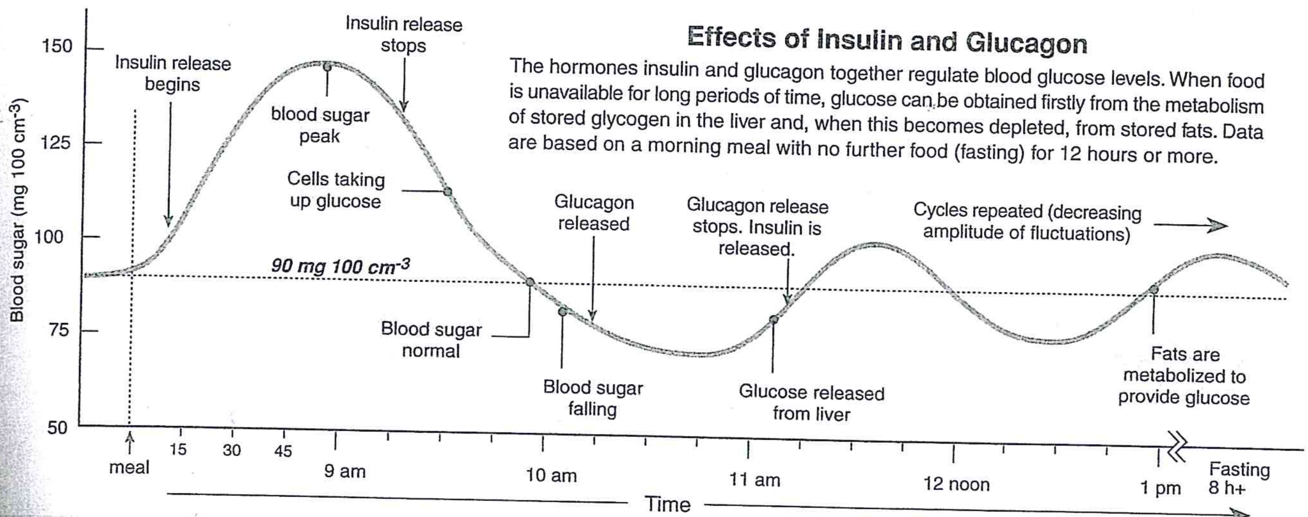
Damage to body tissues triggers the inflammatory response. There is pain, swelling, redness, and heat. Phagocytes and other white blood cells move to the injury site. The inflammatory response is started (and ended) by chemical signals (e.g. from histamine and prostaglandins) released when tissue is damaged.

Control of Blood Glucose

The endocrine portion of the **pancreas** produces the hormones that regulate blood glucose. Two hormones, insulin and glucagon, maintain blood glucose at a steady state through **negative fe[illegible]ack**. Insulin promotes a decrease in blood glucose s[illegible]sizing glycogen and promoting cellular uptake of glucose. Glucagon promotes an increase in blood glucose through the breakdown of glycogen and the synthesis of glucose from amino acids. When normal blood glucose levels are restored, negative feedback stops hormone secretion. Regulating blood glucose to within narrow limits allows energy to be available to cells as needed. Extra energy is stored, as glycogen or fat, and is mobilized to meet energy needs as required. The liver is pivotal in these carbohydrate conversions. One of the consequences of a disruption to this system is the disease **diabetes mellitus**. In type 1 diabetes, the insulin producing β cells of the pancreatic tissue are destroyed as a result of autoimmune activity and insulin is not produced. In type 2 diabetes, the pancreatic cells produce insulin, but the body's cells cease responding its message.

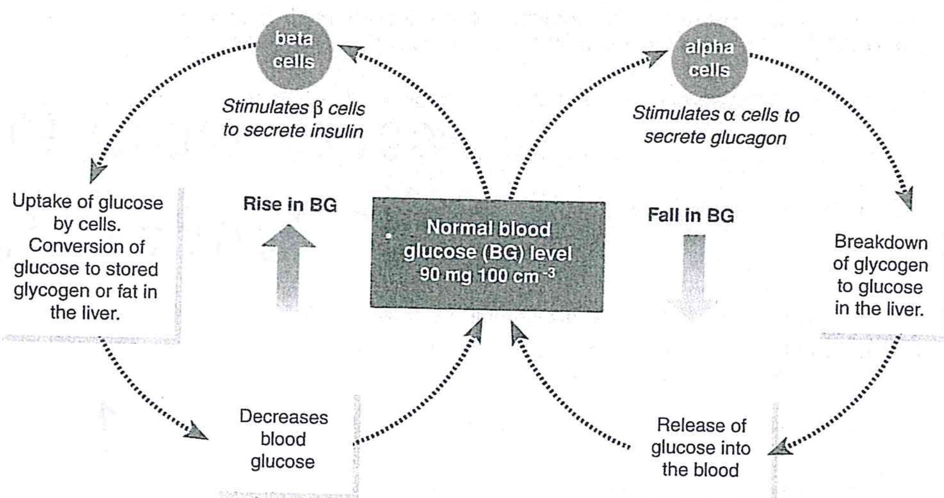
Effects of Insulin and Glucagon

The hormones insulin and glucagon together regulate blood glucose levels. When food is unavailable for long periods of time, glucose can be obtained firstly from the metabolism of stored glycogen in the liver and, when this becomes depleted, from stored fats. Data are based on a morning meal with no further food (fasting) for 12 hours or more.



In type 1 diabetes mellitus, the β cells of the pancreas are destroyed and insulin must be delivered to the bloodstream by injection. Type 2 diabetics produce insulin, but their cells do not respond to it.

Negative Feedback in Blood Glucose Regulation



1. (a) Identify the stimulus for the release of insulin: eating a meal

(b) Identify the stimulus for the release of glucagon: blood sugar falls

(c) Explain how glucagon brings about an increase in blood glucose level:
from breakdown of glycogen

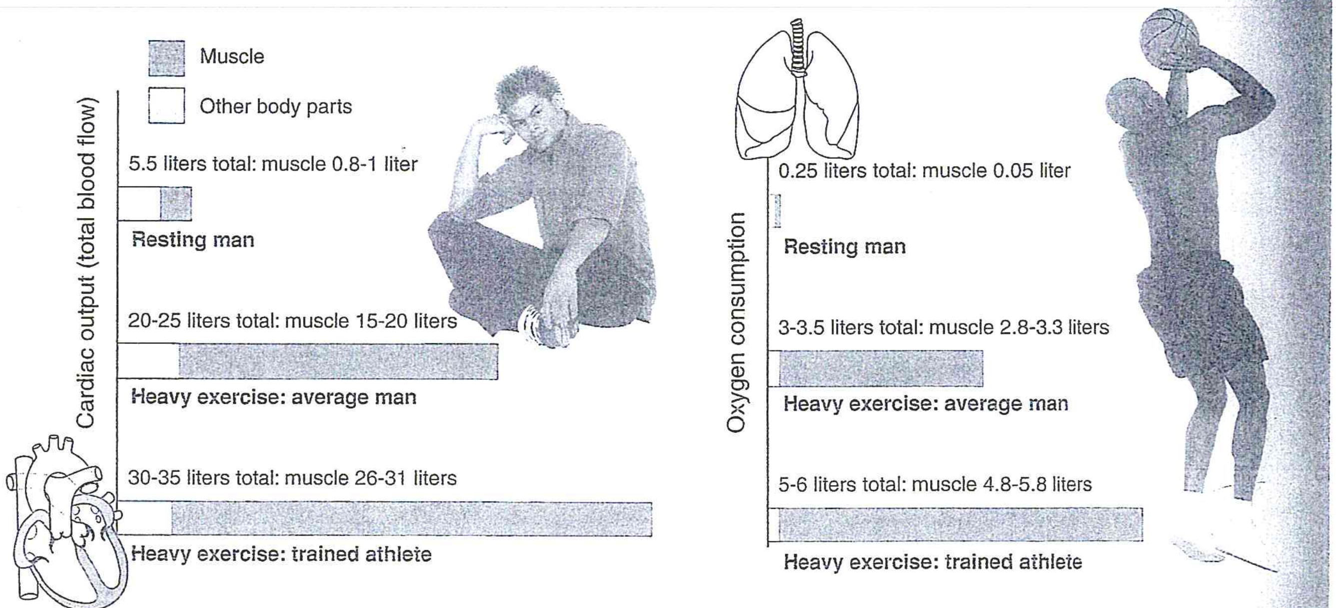
(d) Explain how insulin brings about a decrease in blood glucose level:
synthesize glycogen

2. [illegible]ine the role of negative feedback in the control of blood glucose:
Stimulates cells to effect glycogen in liver.

3. Explain why fats are metabolized after a long period without food:
glycogen stored in liver.

Homeostasis During Exercise

Physical exercise places greater demands on the abilities of the body to maintain a steady state. Extra heat generated during exercise must be dissipated, oxygen demands increase, and there are more waste products produced. The body has an immediate response to exercise but also, over time, responds to the stress of repeated exercise (**training**) by adapting and improving its capacity for exercise and the efficiency with which it performs. This concept is illustrated below. Training causes tissue damage and depletes energy stores, but the body responds by repairing the damage, replenishing energy stores, and adjusting its responses in order to minimise the impact of exercise in the future. The maintenance of homeostasis during exercise is principally the job of the circulatory and respiratory systems, although the skin, kidneys, and liver are also important.



1. The graph above shows the change in blood flow (a measure of the output of the heart) and oxygen consumption between resting and exercise in an athlete and an average man. The different shading on the bars indicates the proportion of oxygen or blood flow in skeletal muscle compared to other body parts.

   a) Describe what happens to the output of the heart (total blood flow) during heavy exercise:
   more blood flow

   (b) Explain why this is the case:
   ↑ O_2 = ↑ heart rate = ↑ output

   (c) List the organ(s) and tissues responsible for adjusting blood flow during exercise:
   muscles, heart, lungs

2. (a) Describe what happens to oxygen consumption during heavy exercise: ↑

   (b) Explain why this is the case: replenishing energy.

   (c) Explain the change in the proportion of oxygen consumed by the muscles during exercise:
   muscle damage needs repairs
   ↑ energy = ↑ O_2 needed

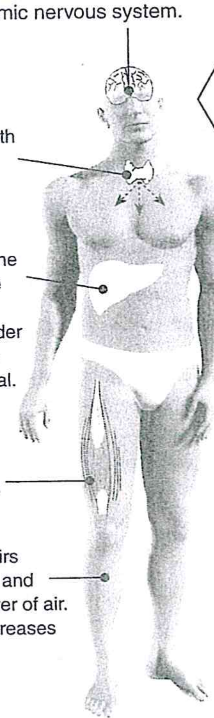
3. Explain the difference in oxygen consumption and blood flow between a trained athlete and an average man:
   Training helps body adapt + improve capacity + efficiency of the homeostasis of O_2 + circulatory system.

Thermoregulation in Humans

In humans and other placental mammals, the temperature regulation centre of the body is in the **hypothalamus**. In humans, it has a 'set point' temperature of 36.7°C. The hypothalamus responds directly to changes in core temperature and to nerve impulses from receptors in the skin. It then coordinates appropriate nervous and hormonal responses to counteract the changes and restore normal body temperature. Like a thermostat, the hypothalamus detects a return to normal temperature and the corrective mechanisms are switched off (negative feedback). Toxins produced by pathogens, or substances released from some white blood cells, cause the set point to be set to a higher temperature. This results in fever and is an important defense mechanism in the case of infection.

Counteracting Heat Loss

Heat promoting center* in the hypothalamus monitors fall in skin or core temperature below 35.8°C and coordinates responses that generate and conserve heat. These responses are mediated primarily through the **sympathetic nerves** of the autonomic nervous system.



Thyroxine (together with adrenaline) **increases metabolic rate.**

Under conditions of *extreme* cold, adrenaline and thyroxine increase the energy releasing activity of the liver. Under normal conditions, the liver is thermally neutral.

Muscular activity (including *shivering*) produces internal heat.

Erector muscles of hairs contract to raise hairs and increase insulating layer of air. Blood flow to skin decreases (**vasoconstriction**).

Factors causing heat loss

- Wind chill factor accelerates heat loss through conduction.
- Heat loss due to temperature difference between the body and the environment.
- The rate of heat loss from the body is increased by being wet, by inactivity, dehydration, inadequate clothing, or shock.

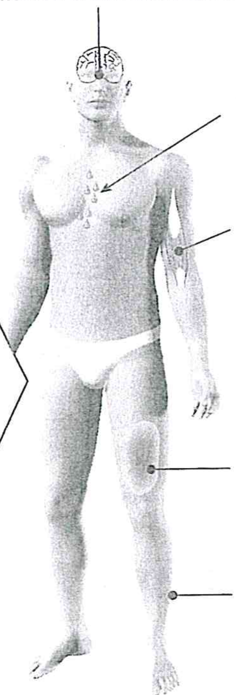
Factors causing heat gain

- Gain of heat directly from the environment through radiation and conduction.
- Excessive fat deposits make it harder to lose the heat that is generated through activity.
- Heavy exercise, especially with excessive clothing.

NOTE: The heat promoting center is also called the "cold centre" and the heat losing center is also called the "hot centre". We have used the terminology descriptive of the activities promoted by the center in each case.

Counteracting Heat Gain

Heat losing center* in the hypothalamus monitors any rise in skin or core temperature above 37.5°C and coordinates responses that increase heat loss. These responses are mediated primarily through the **parasympathetic nerves** of the autonomic nervous system.



Sweating increases. Sweat cools by evaporation.

Muscle tone and **metabolic rate** are decreased. These mechanisms reduce the body's heat output.

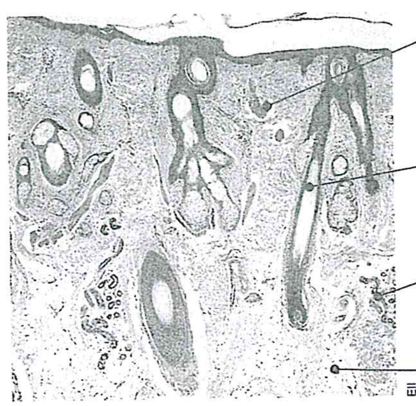
Blood flow to skin (**vasodilation**) increases. This increases heat loss.

Erector muscles of hairs relax to flatten hairs and decrease insulating air layer.

The Skin and Thermoregulation

Thermoreceptors in the dermis (probably free nerve endings) detect changes in skin temperature outside the normal range and send nerve impulses to the hypothalamus, which mediates a response. Thermoreceptors are of two types: **hot thermoreceptors** detect a rise in skin temperature above 37.5°C while the **cold thermoreceptors** detect a fall below 35.8°C. Temperature regulation by the skin involves **negative feedback** because the output is fed back to the skin receptors and becomes part of a new stimulus-response cycle.

Note that the thermoreceptors detect the temperature change, but the hair erector muscles and blood vessels are the **effectors** for mediating a response.



Cross section through the skin of the scalp.

Blood vessels in the dermis dilate (vasodilation) or constrict (vasoconstriction) to respectively promote or restrict heat loss.

Hairs raised or lowered to increase or decrease the thickness of the insulating air layer between the skin and the environment.

Sweat glands produce sweat in response to parasympathetic stimulation from the hypothalamus. Sweat cools through evaporation.

Fat in the subdermal layers insulates the organs against heat loss.

1. State two mechanisms by which body temperature could be reduced after intensive activity (e.g. hard exercise):

   (a) sweating (b) vasodilation

2. Briefly state the role of the following in regulating internal body temperature:

   (a) The hypothalamus: responds + coordinates hormonal + nervous responses.

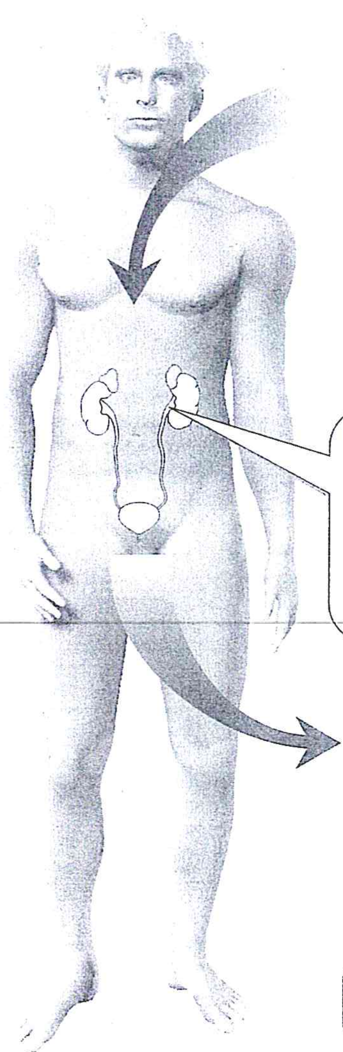
   (b) The skin: detect change

   (c) Nervous input to effectors: hair erectors + blood vessels dilate / constrict

Water Budget in Mammals

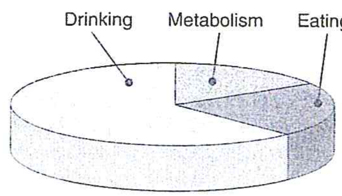
Water loss is a major problem for most mammals. The degree to which urine can be concentrated (and water conserved) depends on the number of nephrons present in the kidney and the length of the loop of Henle. The highest urine concentrations are found in mammals from desert environments, such as kangaroo rats (below). Under normal conditions these animals will not drink water, obtaining most of their water from the metabolic breakdown of food instead.

Regulation of Water Balance in Humans



Water gains

A typical 70 kg male human requires 2.4 liters of water daily. Of this, 63% is obtained through drinking fluids, 21% from food, and the remaining 16% as a result of metabolism.

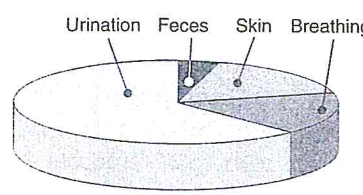


The water content and solute concentration of the body fluids is maintained at a relatively constant level by **osmoregulation**. Osmoregulation is achieved primarily by regulating the volume and composition of the urine.

Water losses

The same adult male will lose 63% of body water through urination, 16.5% as a result of breathing, 16.5% through the skin, and 4% in feces.

Urine/plasma concentration ratio = 4



Adaptations of Arid Adapted Rodents

Most desert-dwelling mammals are adapted to tolerate a low water intake. Arid adapted rodents, such as jerboas and kangaroo rats, conserve water by reducing losses to the environment and obtain the balance of their water needs from the oxidation of dry foods (respiratory metabolism). The table below shows the water balance in a kangaroo rat after eating 100 g of dry pearl barley. Note the high urine to plasma concentration ratio relative to that of humans.

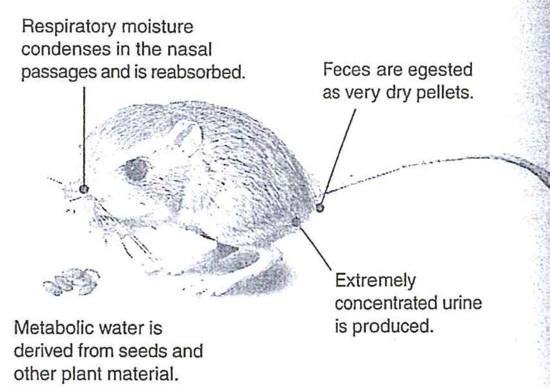
Water balance in a kangaroo rat
(*Dipodomys spectabilis*)

Water gains		Water losses	
Absorbed from food	6.0 cm^3	Breathing	43.9 cm^3
From metabolism	54.0 cm^3	Urination	13.5 cm^3
		Defecation	2.6 cm^3

Urine/plasma concentration ratio = 17

Adaptations of kangaroo rats

Kangaroo rats, and other arid-adapted rodents, tolerate long periods without drinking, meeting their water requirements from the metabolism of dry foods. They dispose of nitrogenous wastes with very little output of water and they neither sweat nor pant to keep cool.



1. Explain why most mammals need to drink regularly: 63% is lost by urinating, 16.5% breathing, etc...

2. Using the tabulated data for the kangaroo rat (above), graph the water gains and losses in the space provided below.

3. Describe three physiological adaptations of desert adapted rodents to low water availability:

(a) respiratory metabolism

(b) metabolise dry foods

(c) no sweating/panting