Education Services Ltd

EB Education Revision Guide

How to work with Homeostasis: Part 1 Thermoregulation

...helping everybody achieve Even Better

Education Services Ltd

What you need to know about Homeostasis: Part 1

- Basics of homeostasis
- Thermoregulation

a) Why your body regulates temperature

b) How your body detects temperature changes

c) How it regulates temperature

Education Services Ltd

Homeostasis

What does it mean?

Homeostasis means:

" the maintenance of the same state inside the body/keeping a constant internal environment"

Homo = Same
Stasis = State

Homeostasis makes sure our bodies have the correct levels of:

WATER **IONS** **GLUCOSE**

and stays at the same TEMPERATURE

Examples:

Crowded places can be too hot.

Too cold.

If your body cannot maintain the same conditions, this can lead to illness or death.

Running a marathon could make you too hot, or have low sodium levels in the blood caused by drinking too much water. This can lead to collapse.

Homeostasis

Type of homeostasis	What does this mean?
• Blood glucose regulation	• You need to make sure the amount of glucose in your body does not get too high or too low
• Thermoregulation	• You need to regulate your body temperature. If it gets too hot, you need to reduce your body temperature, and if it gets too cold you need to increase your body temperature
• Osmoregulation	• You need to regulate the water content in your body. You need to maintain a balance between the water you take in (in food, drink and from respiration), and the water you lose (from urine, sweat and breathing out)

Thermoregulation

Why?

If your body temperature becomes too high (40˚C +), enzymes in the body can become DENATURED.

This means that the shape of the enzyme's active site is changed and substrates can no longer fit in. The enzyme no longer works.

If your body temperature is too low, enzyme activity is reduced, and this means the rate of metabolic reactions is also reduced.

Enzymes in the human body work best at 37°C

Beyond GCSE

The enzyme's molecules vibrate more, as more energy is provided to them in the form of heat energy.

They vibrate too much and this will break the hydrogen bonds that hold them into a specific 3D shape.

Education Services Ltd

Thermoregulation

How?

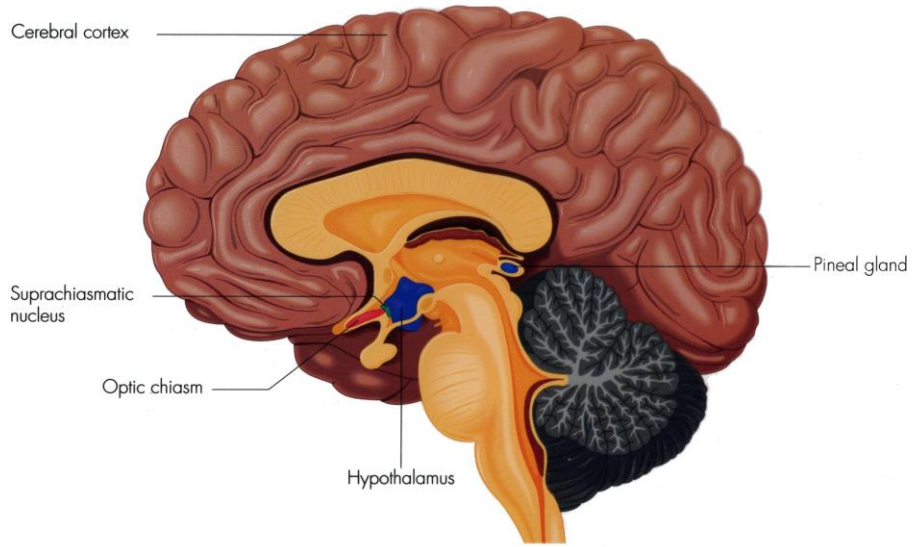
If there is a change in the temperature of your body, a response will be triggered which will either raise or lower your body temperature.

The thermoregulatory centre is found in the hypothalamus, a structure in your brain.

Receptors in the thermoregulatory centre are sensitive to the temperature of the blood that travels through your brain.

The external temperature of your body is provided by receptors in your skin (in the epidermis and dermis) which send this information to the hypothalamus.

Once the hypothalamus detects changes in the temperature it will trigger responses.

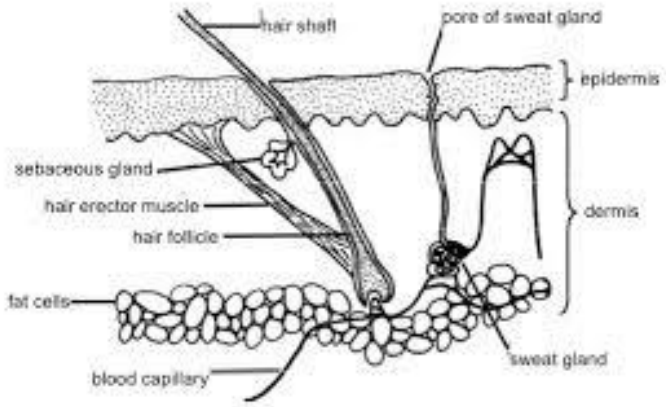


Thermoregulation

How does the body respond? Too hot

Hair erector muscles in your skin will relax.

This means the hairs will lie flat against your skin



How does the body respond? Too cold

Hair erector muscles in your skin will contract.

This means the hairs will stand on end. This causes a layer of air to be trapped near the surface of the skin which provides insulation to help keep you warm

Thermoregulation

How does the body respond? Too hot

Your sweat glands, which are in the dermis (a deeper layer of skin just below the epidermis) will produce lots of sweat. The sweat contains water and salts.

This sweat is released through pores in the epidermis onto the surface of the skin.

The sweat then evaporates, cooling you down by transferring the heat energy from your skin to the environment.

How does the body respond? Too cold

Your sweat glands produce very little sweat.

Thermoregulation

How does the body respond? Too hot

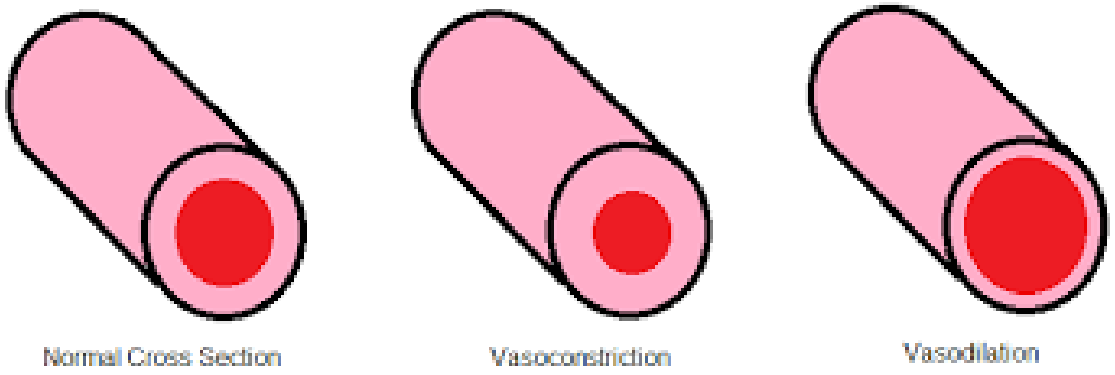
Blood vessels which are close to the surface of the skin widen or dilate. This is called VASODILATION.

This means more blood can flow near the surface of your skin, so that more energy can be transferred from your blood into the surroundings, cooling you down.

How does the body respond? Too cold

Blood vessels near the surface of your skin narrow or constrict. This is called VASOCONSTRICTION.

This means less blood can flow near the surface of your skin, so less energy is transferred to the surroundings, helping to keep you warm.



Thermoregulation

How does the body respond? Too hot

You do not shiver.

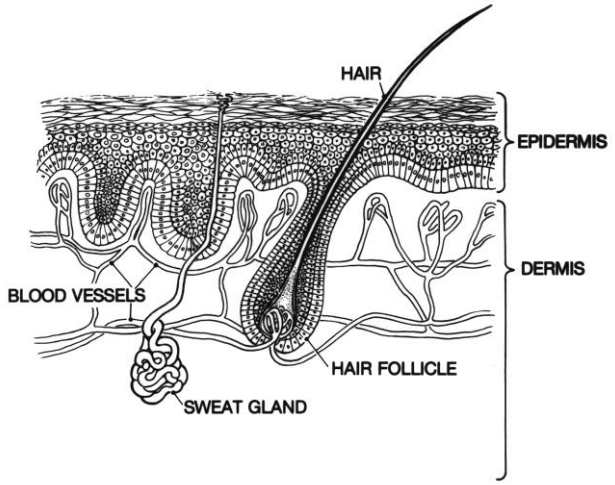
How does the body respond? Too cold

You will start to shiver.
This is when your muscles contract automatically. This increases the rate of respiration, resulting in heat energy being transferred to nearby tissues, warming up the body.

Education Services Ltd

Your turn:

1. A cross section of human skin is shown in the diagram below.



a) What is the function of the sweat gland during thermoregulation?

……
……
……

b) What is the function of the erector muscles, which are attached to the hair follicles?

……
……

c) Define what homeostasis is.

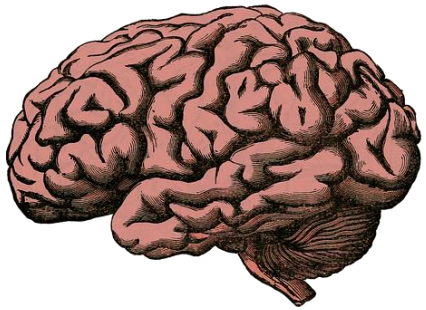
……
……
……
……

d) Why does the temperature of the human body need to be maintained at around 37°C?

……
……
……
……

Your turn:

2. The thermoregulatory centre is found in the brain.



a) Which part of the brain is the thermoregulatory centre found in?

A Medulla
B Cerebellum
C Cerebrum
D Hypothalamus

b) The thermoregulatory centre is responsible for controlling the internal temperature of your body.

Describe and explain how blood vessels help in controlling your internal body temperature.

……
……
……
……
……
……
……

Education Services Ltd

Your turn:

3. After a brisk walk to work, Imogen had a body temperature of 37.9°C. She sat down for an hour, and her body temperature decreased to 37.5 °C.

a) Explain how thermoregulation causes this reduction in body temperature

……
……
……
……
……
……
……
……

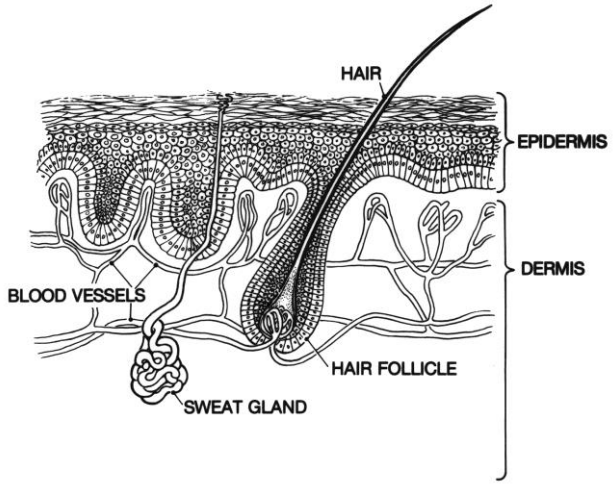
b) Explain how exercise can cause body temperature to increase.

……
……
……
……

Education Services Ltd

Answers:

1. A cross section of human skin is shown in the diagram below.



a) What is the function of the sweat gland during thermoregulation?

The gland releases sweat onto the skin surface. The water will evaporate, removing heat from the surface of the skin/transferring heat away

b) What is the function of the erector muscles, which are attached to the hair follicles?

The erector muscles will contract, causing the hairs to stand on end. This will trap an insulating layer of air, reducing heat loss from the body.

c) Define what homeostasis is.

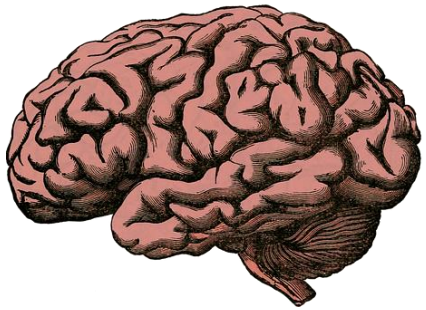
The maintenance of a constant internal environment.

d) Why does the temperature of the human body need to be maintained at around 37°C?

It is the optimum temperature for enzymes to work during metabolic reactions in the body. If the temperature is too high, enzymes will denature. If the temperature is too low, then reactions are much slower.

Answers:

2. The thermoregulatory centre is found in the brain.



a) Which part of the brain is the thermoregulatory centre found in?

A Medulla
B Cerebellum
C Cerebrum
D Hypothalamus X

b) The thermoregulatory centre is responsible for controlling the internal temperature of your body.

Describe and explain how blood vessels help in controlling your internal body temperature.

When body temperature is too low, blood vessels narrow or constrict. This causes less blood to flow near the surface of the skin, retaining body heat. This is called vasoconstriction.
When body temperature is too high, blood vessels widen or dilate. This enables more blood to flow near the surface of the skin, and therefore more heat can be transferred from the body to the surroundings, reducing body temperature. This is called vasodilation.

Education Services Ltd

Answers:

3. After a brisk walk to work, Imogen had a body temperature of 37.9°C. She sat down for an hour, and her body temperature decreased to 37.5 °C.

a) Explain how thermoregulation causes this reduction in body temperature

The hypothalamus detects and controls the body temperature. When it is too high, it will trigger the following responses to reduce temperature

a) Sweat glands will release sweat which evaporates off the surface of the skin transferring heat energy from the body to the surroundings

b) Blood vessels will dilate, causing more blood to flow near the surface of the skin, so more heat can be transferred to the surroundings. This is called vasodilation

c) Hair erector muscle relax, causing hairs to lie flat against the skin, so there is no insulation

This is an example of negative feedback.

b) Explain how exercise can cause body temperature to increase.

Increased respiration (from muscles contracting more) will cause more heat energy to be released, raising the body temperature.

Education Services Ltd

For more help and resources, or to work with us as a tutor, please contact us

www.ebeducationservices.co.uk

contact@ebeducationservices.co.uk

0161 442 5270

...helping everybody achieve Even Better