**Name:**

|  |  |
| --- | --- |
| **3.4 Breathing System and Excretion** | **Objectives**At the end of this sub section students should be able to: |
| **3.4.6 Skin** | * 1. Explain how and why temperature influences the rate of the chemical reactions that sustain life
	2. Explain the different methods of temperature regulation in animals.
	3. Compare Ectotherms and Endotherms
	4. Give an account of temperature regulation in humans
	5. Say what happens us in cold conditions
	6. Recognise and label a T.S of human skin
	7. Refer to piloerection, vasoconstriction and brain initiated increased metabolic rate as responses to cold conditions
	8. Say what happens us in warm conditions
	9. Refer to perspiration and the evaporation of sweat
	10. Show the position of sweat glands in the skin,
	11. List the components of sweat
 |

**Structure of skin - diagram**

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The skin is composed of 2 main layers, outer epidermis and inner dermis, that overlay the adipose tissue which stores lipids and insulates against heat loss.

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**Epidermis** - is made up of a cornified layer, a granular and a malphigian layer.

**Cornified layer:**

A thick layer of flattened dead cells. This waterproof covering is pierced by pores which are openings of sweat gland and hair follicles.

**Granular layer:**

Composed of living cells. The nearer the epidermis these cells become filled with keratin, a tough protein, which forms hair and nails.

**Malphigian layer:**

A meristematic layer which gives rise to all the cells of the epidermis. These cells also contain melanin which gives skin its colour. Freckles and moles = conc. melanin.

**Dermis:**

A dense matrix composed of connective tissue (with a strengthening protein - collagen), muscle fibres, sensory cells and nerve fibres, sweat glands, hair follicles, blood vessels and **sebaceous glands** (produce **sebum,** an oily-secretion, which forms a waterproof layer over the skin).

**Functions of skin**

* **Protection:**

Cornified layer prevents damage by friction and the dermis prevents mechanical damage.

Melanin protects body from harmful U.V. light.

Cornified layer and sebum prevent water loss.

Prevents entry of pathogens.

* **Excretion:**

Sweat glands (palm of hand, armpits) secrete sweat i.e. water, salts, urea.

* **Sense organs**

Receptors for pain, pressure, touch, hot and cold.

* **Vitamin production:**

Vitamin D is produced in skin following exposure to UV radiation. Vitamin D helps to absorb calcium in intestine.

* **Food store**

Fat in adipose tissue.

* **Temperature regulation**

**Warm conditions:**

* Blood vessels dilate (expand), so blood flows to the surface, where heat is lost from the surface of the skin.
* Sweating cools the skin.
* The hair is flattened by the relaxation of the erector muscles. This allows free movement of air over the hairs and this in turn has a cooling effect.
* Decrease in metabolism.

Sweating may cause a lack of water in the blood if the body overheats. This is why athletes drink large quantities of water before, during and after exercise, to replace lost water. Salts e.g. potassium may also be lost. ‘Sports’ drinks contain added salts.

**Cold conditions**

* Blood vessels constrict (narrow) so that blood is diverted away from the surface to the deeper layers.
* No sweating - very little evaporation occurs and hence there is no cooling effect.
* The hair is raised by contraction of the erector muscles (‘goose pimples’). Therefore air gets trapped in the spaces between the hairs. The air is warmed by the body and acts like an insulator.
* Increase in metabolic rate and shivering muscles produce more heat.

Fat under skin insulates body from heat loss

Warm-blooded animals (**endotherms**) - generate heat from metabolic reactions e.g. man, birds.

Cold-blooded animals (**ectotherms**) gain heat from the environment e.g. lizard, frogs, fish and most invertebrates

**Examination Questions**

1. **[2006 OL] [15(a)]**

(a) The diagram shows a vertical section through human skin.



(i) Identify parts A, B, C and D on the diagram.

(ii) The human being is an endotherm. What does this mean?

(iii) What is the main source of body heat in endotherms?

(iv) Describe the role of D in relation to body temperature.

(v) What happens to the small arteries (arterioles) in the skin when the external temperature drops?

1. **[2008 OL] [6]**

The diagram shows a section through human skin.



(a)Name parts **A** and **B**.

 (b)Place **X** on the diagram to show where sweat

reaches the skin surface.

(c)Apart from water, name **one** other substance

which is found in sweat **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(d)Describe briefly **one** way by which the skin helps

to retain heat in cold conditions.

1. [2012 OL] [15(a)]

The diagram shows a section through human skin.



(i)  Name the parts labelled A, B, and C.

(ii)  The skin is one of the excretory organs in humans.

Name **one** substance excreted by the skin.

(iii)  List **two** other functions of the skin.

(iv)  Name another organ of excretion **and** state **one** substance it excretes.

(v) What is meant by the term *homeostasis?*(vi) The human being is an endotherm. What does this mean?

1. **[2004 HL] [12(c)]**

Answer the following questions in relation to human body temperature.

(i) What is the source of the heat that allows the body to maintain a constant internal temperature?

(ii) State two ways in which the body is insulated against loss of heat.

(iii) Describe the ways in which the body responds when its internal temperature rises above the normal level.

 (iv) Describe briefly the hormonal and nervous responses that occur when internal body temperature drops.

1. [2010 HL] [15(c)(v)]

Suggest a biological explanation for **each** of the following observations:

 A person’s fingers may turn white when exposed to low temperature for a period of time.

1. 2012 HL Q15(c)(iv)

Describe the role of the skin in controlling body temperature.

**Marking scheme**

1. **[2006 OL] [15(a)]**

 (i) A = (erector) muscle B = hair C = capillaries [allow blood vessels or arterioles or arteries or venules or veins] D = sweat gland

(ii) Has constant body temp. or warm blooded or can regulate temp.

(iii) Carbohydrate (or named) or lipid or respiration or liver or muscle or food or metabolism

(iv) Sweat / evaporates/ heat lost

(v) Contract

1. **[2008 OL] [6]**
2. [2012 OL] [15(a)]

(i) A = Hair B = Sweat gland C = Blood vessels

(ii) e.g. Sweat

 (iii) e.g. Protection / Melanin production

(iv) e.g. Kidney / Urine

(v) Maintaining constant internal conditions

(vi) Produces heat (internally) or warm blooded

1. **[2004 HL] [12(c)]**

(i) Source: respiration or named site e.g. muscle, liver, kidney,

brain or named food e.g. carbohydrate or named

(ii)  Two methods of insulation: fat (adipose tissue) / (trapped) air or hair

 (iii)  When temp high: vasodilation (or explained) / (secretion of) sweat /

hairs lie flat or less air trapped any two

(iv)  Response when temp drops: receptor (or detection) / receptor in skin /

receptor in medulla or brain / shiver / generates heat / hairs stand up
or goose bumps / air trapped / vasoconstriction (or explained) / increased metabolic rate or increased respiration / any relevant comment on named hormone e.g. thyroxine increases metabolic rate or increases respiration

1. [2010 HL] [15(c)(v)]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | (v)  | Arterioles / constrict / less blood (in fingers) / heat loss minimised  |  |

1. [2012 HL] [15(c)(iv)]

Too hot: Sweat / dilation of blood vessels / hair flat

Too cold: Constriction of blood vessels / hair stands up/ insulation by (subcutaneous) fat Any three