

SUMMING-UP

1 The transport of substances in the body

- Nutrients and oxygen must be distributed to all the cells in the body.
- In simple animals like sponges, the transport takes place between a cell and its neighbour, through simple diffusion.

- In more complex animals such as invertebrates, there is an open circulatory system in which the vital fluids flow through the body directly between cells.
- In the vertebrates there is a closed circulatory system, also called the cardiovascular apparatus, in which the blood circulates within a system

- of vessels.
- There are three types of vessels:
 - arteries that carry blood from the heart to the organs;
 - capillaries, which enter into the organs and allow the exchange of substances;
 - veins, that carry blood to the heart.

2 How circulation functions in vertebrates

- Vertebrates have a closed circulatory apparatus. Fish possess a so-called **simple circulation**, in which blood passes only once from the heart for each full cycle inside the body.
- Terrestrial vertebrates have double circulation, in which blood passes

twice from the heart for each full cycle. **Pulmonary circulation**, which carries blood to the lungs for oxygenation, is distinguished from the **systemic circulation**, which carries blood to the organs of the body.

- In reptiles, the heart is divided into three cavities and therefore has a

- mixture of oxygenated blood coming from the lungs and oxygen-poor blood from the organs.
- In birds and mammals, the heart is divided into four cavities and therefore the two circuits remain separate.

3 The human cardiovascular system

- The cardiovascular system consists of the **blood vessels**, more or less thin channels in which blood flows. The vessels that carry blood can be of three types.
- **Arteries** are blood vessels with thick walls, also consisting of a muscular

layer, which allows them to withstand relatively high internal pressure.

- **Capillaries** have very thin walls as they are the sections where gas and nutrient exchange between the blood and cells occurs.
- **Veins** have thin walls and large lumen, since the blood flows through

- them at low pressure. There are valves that prevent blood from flowing backwards.
- At the level of the capillaries some of the plasma escapes from the vascular apparatus and moves into the interstitial fluid. This fraction of liquid is returned to the blood by the **lymphatic system**.

4 The human heart

- The heart is the organ that gives blood the necessary boost it needs to reach all the organs of the human body. It consists mainly of cardiac muscle tissue.
- The heart is composed of three

layers: the **pericardium**, **myocardium** and **endocardium**. The different cardiac chambers communicate through valves.

- The activity of the heart, called the **heartbeat**, alternates between a phase of contraction, the systole, in

- which the heart pushes the blood outwards, and a relaxation called the diastole, when blood enters the cavities within the heart.
- The force exerted by blood on the walls of the arteries in leaving the heart is called **blood pressure**.

5 How blood is made

- Blood is made of a liquid component, called **plasma**, which contains the nutrients, inorganic ions and proteins, and a solid component composed of red blood cells, white cells and platelets.

- **Red blood cells** contain haemoglobin and carry out the function of transporting oxygen and carbon dioxide.
- **White blood cells** are cells that perform the function of protecting the body against attacks by viruses,

- bacteria, cancer cells etc.
- **Platelets** are cell fragments that enable blood to coagulate.

6 The lymphatic system and the body's defences

- The **lymphatic system** carries out the function of returning the fluid, that passes from the blood to the interstitial tissues via the capillaries, to the circulatory system. The

lymphatic system is also hosts the body's defence system.

- The lymphatic system, in which the fluid called lymph circulates, is composed of **lymph vessels**, **lymph nodes** and a series of lymphoid organs. The function of the lymph

- nodes is to filter and clean harmful microorganisms from the lymph.
- **Non-specific defences** are mechanisms put in place by the body to defend against viruses and bacteria. These include the inflammatory response and fever.

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7 The immune system and specific defences

- If the non-specific defences do not provide the necessary protection, the body can fall back on specific defences put into action by the immune system.
- The immune system is able to detect any virus or bacteria that invades the

body and produce special proteins, called **antibodies**, which favour the destruction of the invading cell by the **white blood cells**. The production of antibodies is triggered by the presence of a substance recognised as foreign to the body, termed an **antigen**.

- The immune system is equipped with

a kind of memory: once it is put in contact with certain antigens it is able to render the body immune from subsequent infections.

- The immune system's memory is used in medicine to immunise against some diseases through vaccination.

8 Transport in plants

- Plants have a need to transport water and nutrients from their roots, where they are absorbed, to the leaves where they are used for photosynthesis.

- **Xylem** transports sap upwards: it is formed by tracheids in conifers, whilst hardwoods have vessels.
- **Phloem** distributes the products of photosynthesis and is made up of sieve tubes.

- In a mature tree these tissues form bark and wood. Growth is assured by vascular cambium, a thin layer of cells placed between the wood and bark.