

SUMMING-UP

1 Perception of stimuli and their transmission

- Animals possess receptor cells, which are located in the sensory organs and are able to receive messages from the outside.
- There are 5 types of receptors, sensitive to different signals:
 - **thermoreceptors**, sensitive to *temperature*;
 - **nociceptors**, sensitive to *pain*;
 - **mechanoreceptors**, sensitive to different types of *pressure*;
 - **chemoreceptors**, sensitive to the presence of certain chemical substances;
- **electromagnetic receptors**, sensitive to *electricity*, *light*, etc.
- The nervous system performs a role that is divided into three phases:
 - **sensory acquisition**, achieved by *sensory neurons* that carry the impulses from receptor cells to the central nervous system;
 - the **integration** of information acquired via *interneurons* (also called *relay neurons*) of the central nervous system;

- **motor stimulation**, the impulse response to stimulus that is carried out through the intervention of *motor neurons* that transmit responses processed by the central nervous system to the muscle cells.
- Receptors convert a signal into an electrical impulse that is sent to the central nervous system, where it is processed. This processing enables the passage of a *sensation* into a *perception*.

2 The eye and light reception

- Animals that live on the Earth's surface are equipped with organs for the reception of light.
- Very simple animals possess an **eyespot**; arthropods have a **compound eye** that permits the formation of an image.
- The compound eye is made up of thousands of functional units called **ommatidia**. Every ommatidium consists of a transparent membrane, the *cornea*, and a lens, the *crystalline cone*. Each ommatidium has its own field of vision. The brain reprocesses the information and composes a single image.
- Human beings, like other vertebrates, possess a single-lens eye, called the crystalline lens. Light enters the eye through the *cornea*, the transparent front part of the eye. The *iris*, which gives colour to the eye, is located behind the cornea. The *pupil*, the hole through which light enters, is located at the centre of the iris.

The light rays then pass through the *crystalline lens* that focuses the image on the *retina*, a network of photoreceptors.

- In the human eye, images are brought into focus by means of the changing shape of the crystalline lens, enabling light rays to be focused on the retina. Some defects of vision, such as **myopia** and **hypermetropia** (more commonly known as **hyperopia**), prevent correct focusing in the eye.

3 The ear: sound reception and maintenance of positional equilibrium

- In most vertebrates the ear is the organ for the reception of sound and the maintenance of positional equilibrium, known as balance.
- The human ear is divided into three main parts: the outer ear, middle ear and inner ear.
- The **outer ear** collects sounds and conveys them to the middle ear. It consists of the pinna (also called *auricle* or *auricula*) and the *external acoustic meatus*. The *tympanic membrane* is located at the end of the
- acoustic meatus. This membrane, stimulated by sound waves, vibrates and converts the sound into a mechanical impulse.
- The **middle ear** is a small cavity which contains three tiny bones (the *anvil*, *hammer* and *stirrup*) that amplify the vibrations generated by the eardrum and transmit them to another membrane, the *oval window*.
- The **inner ear**, located within the skull, contains the *cochlea*, the real and actual organ of hearing. The cochlea is a spiral-shaped cavity that receives vibrations from the oval window. The *organ of Corti*

containing the receptor cells is located within the cochlea.

- Also located within the inner ear is the **bony labyrinth**, consisting of the vestibule, which enables the maintenance of static equilibrium, and the semicircular canals, which maintain dynamic equilibrium. The combined action of the vestibule and semicircular canals enables us to always be aware of the position of our body relative to the Earth's surface, both when in motion and when stationary.

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4 The reception of other stimuli

- The senses of smell (called olfaction) and taste depend on the presence of **chemoreceptors** able to detect the presence of certain chemicals.
- **Olfactory receptors** line the ceiling of the nasal cavity. Their number depends on the species to which the organism belongs.
- Inhaled air flows along the nasal cavity and odorous molecules contained in it are caught by the hair (cilia) cell receptors. The receptors react to stimuli and give rise to a nerve impulse that is reprocessed in the brain.
- Olfactory receptors are very sensitive and can also be activated by low concentrations of odorous molecules.
- Taste depends on receptors in the mouth called **taste buds**. These are clustered together, mainly on the tongue and to a lesser extent on the palate. Taste buds are composed of cilia cells that capture chemical substances dissolved in saliva.
- The sense of touch is achieved by a large number of **mechanoreceptors** distributed on the skin. They provide information regarding the surface of the objects we touch.
- There are also receptors in the muscles, bones and viscera called **proprioceptors**, which tell us about the state of our body.