SPECIAL SENSES

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- All the content material provided here is only for teaching purpose.

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SPECIAL SENSES

- Vision – Eye
- Hearing – Ear
- Equilibrium – Ear
- Taste – Taste receptors
- Smell – Olfactory system

General Senses

- Skin – Hot, cold, pressure, pain
- Muscles, joints, and tendons – proprioceptors- stretch receptors respond to stretch or compression
- Pain Receptors – somatic or visceral

Eye - Vision

- Light energy is transduced into neural activity
- Neural activity is processed by the brain

Human visual systems permit light reflected off distant objects to be:

- Localized relative to the individual within his or her environment
- Identified based on size, shape, color, and past experience
- Perceived to be moving (or not)
- Detected in a wide variety of lighting conditions

Sequence of events

- Light entering the eye is focused on the retina
- Retina converts light energy into neuronal activity
- Axons of the retinal neurons are bundled to form the optic nerves
- Visual information is distributed to several brain structures that perform different functions

EAR – HEARING

Outer Ear & ear canal – brings sound into eardrum

Eardrum – vibrates to amplify sound & separates inner and middle ear

Middle ear has 3 small bones or **Ossicles =** anvil, stirrup, stapes – amplify sound (small bones) which vibrate sound

Eustachian tube – connects middle ear to throat and equalizes pressure on eardrum

Cochlea – in inner ear – has receptors for sound & sends signals to brain via Auditory Nerve

Ear – Equilibrium

Equilibrium

• Equilibrium is a response to movements of the head - Example: a cat landing on its feet if dropped from upside down

• Vestibular Apparatus: the equilibrium receptors of the inner ear

• Divided into static and dynamic equilibrium

Taste and Smell – Chemical Receptors

Taste buds

• The mouth contains around 10,000 taste buds, most of which are located on and around the tiny bumps on your tongue.

• Every taste bud detects **five primary tastes**:

o Sour

o Sweet

o Bitter

o Salty

o Umami

Smell Receptors or Olfactory receptors

• Humans able to detect thousands of different smells

• Olfactory receptors occupy a stamp-sized area in the roof of the nasal cavity, the hollow space inside the nose

• Tiny hairs, made of nerve fibers, dangle from all your olfactory receptors. They are covered with a layer of mucus.

Touch Receptors – fine touch

- **Meissner's corpuscles** are enclosed in a capsule of connective tissue
- They react to light touch and are located in the skin of your palms, soles, lips, eyelids, external genitals and Nipples these areas of your body are particularly sensitive.
- **Merkel disks** – found deep at junction of epidermis and dermis
- Root hair plexus – at base of hair follicle

Touch receptors – Pressure sensitive

- **Pacinian corpuscles** sense pressure and vibration changes deep in your skin.
- Every square centimeter of your skin contains around 14 pressure receptors
- **Pacinian corpuscles** – deep pressure sensors, onion shaped capsule (layers of Schwann cells enclosed in a connective tissue membrane), respond to *on-off* pressure or *vibration*
- **Ruffini's endings** and **Krause's end bulbs** – encapsulated pressure sensors, dermis (and elsewhere), respond to *continuous* pressure

Pain

- skin receptors register pain
- pain receptors are the most numerous
- each square centimeter of your skin contains around 200 pain receptors

Temperature

• skin receptors register warmth and cold

• each square centimeter of your skin contains 6 receptors for cold and 1 receptor for warmth

• **Cold receptors** start to perceive cold sensations when the surface of the skin drops below 95 º F. They are most stimulated when the surface of the skin is at 77 º F and are no longer stimulated when the surface of the skin drops below 41 º F. This is why your feet or hands start to go numb when they are submerged in icy water for a long period of time.

• **Hot receptors** start to perceive hot sensations when the surface of the skin rises above 86 º F and are most stimulated at 113 º F. Beyond 113 º F, pain receptors take over to avoid damage being done to the skin and underlying tissues.

Proprioceptors - Stretch receptors located in joints, ligaments, and tendons (respond to either stretch or compression)

- Maintain some degree of continuous contraction (partial sustained contraction) or **muscle tone**
- **Muscle spindles** – modified muscle fibers with sensory nerve endings wrapped around the middle (and also found at the ends)
- Detect stretch and stimulate a reflex contraction; think about banging on your patellar ligament (just an extension of a quadriceps tendon) and watching your knee jerk up – the quadriceps contracted in response to the stretch of the patellar ligament, which stretched muscle spindles and) impulses are sent to the hamstring group (the antagonists) to cause them to relax, so they don't oppose the contraction of the quadriceps

Pain Receptors – nociceptors

- **Somatic nociceptors -** from skin and skeletal muscle
- **Visceral nociceptors -** receptors that help maintain internal homeostasis

§ Respond to stretch, lack of O2, chemicals released from damaged cells and inflammatory cells.

§ ***Referred pain*** – visceral pain afferents travel along the same pathways as somatic pain afferents, so sometimes the brain interprets the visceral pain as the more common somatic pain. Example – Often pain from the heart felt during a heart attack is perceived as a pain that originates in the left arm.

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