

The Seven Senses

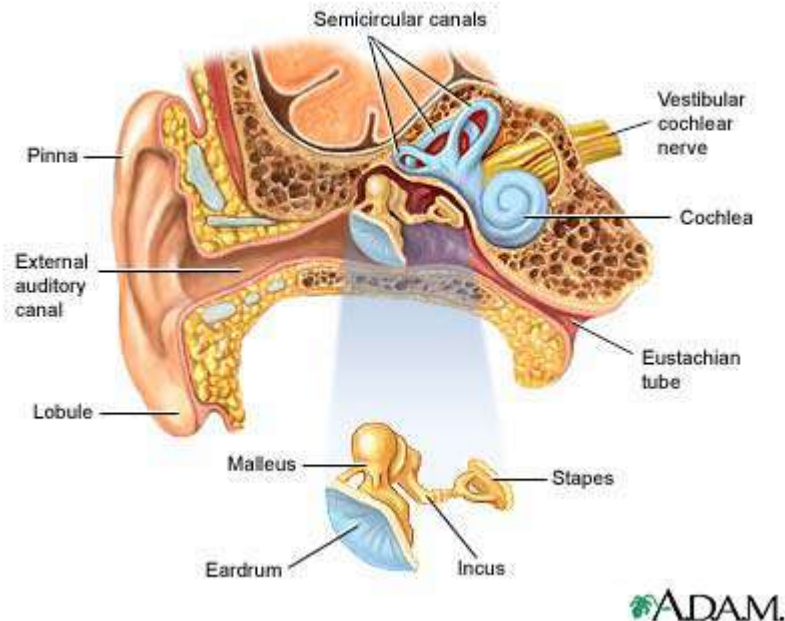
II. Hearing

The sense of hearing is also known as **AUDITION**.

Sound travels in **waves** and aspects of these waves determine the sound we hear.

- 1) **FREQUENCY** -- (number of waves per second) determines the **PITCH**.
- 2) Amplitude or **STRENGTH** -- (height of the wave) determines the **LOUDNESS**.

There are three parts to the ear: **OUTER**, **MIDDLE**, and the **INNER**.



The **outer ear** is composed of the **PINNA**, the **AUDITORY CANAL**, and the **EARDRUM**. The function of the outer ear is to focus the sound waves to the middle ear.

The **middle ear** is composed of three bones: the **HAMMER**, the **ANVIL**, and the **STIRRUP**. The function of these bones is to amplify the sound waves.

The **inner ear** is composed of the **COCHLEA** and the **SEMICIRCULAR CANALS**. The **COCHLEA** is involved in hearing, whereas the **CANALS & VESTIBULAR SAC** are involved in balance.

Inside the cochlea, there is a membrane (called the **BASILAR membrane**) covered in tiny **HAIR CELLS**.

Amplified sound waves cause these to bend, which opens ion channels and sends a neural message to the thalamus via the auditory nerve. From there, the message is passed to the auditory cortex in the **BRAIN**.

How does our brain distinguish pitches? Two complementary theories:

1. **FREQUENCY theory** – the basilar membrane **VIBRATES** at the same frequency as the sound waves; sound waves of higher frequency cause more **NEURON** action potentials which the brain interprets as a **HIGHER** pitch. Problem – we can hear pitches of frequencies higher than the membrane can move.
2. **PLACE theory** – **high-frequency** sounds vibrate most near **THE BASE OF THE COCHLEA CLOSEST TO THE MIDDLE EAR** of the cochlea, whereas **lower-frequency** sounds vibrate more at the **TOP TURN OF THE COCHLEA** end. The brain interprets the pitch based on which nerves are firing.

It is thought that **BOTH** frequency and place are involved, rather than one over the other.

Two types of hearing loss:

1. **CONDUCTION** hearing loss – problems with the **mechanical system** that conducts sound waves to the cochlea; example, a punctured eardrum, stiffening of the middle ear bones
2. **SENSORINEURAL** hearing loss – damage to the hair cell receptors or associated nerves; caused by aging or prolonged exposure to loud noises

III. Smell (also known as OLFACTION)

When we smell something, it is because CHEMICAL MOLECULES in the air have entered our nasal passages and bind to RECEPTOR CELLS IN NASAL CAVITY. When bound, these cells send ACTION POTENTIALS to the brain via olfactory nerves. Different odors bind to different RECEPTORS, which is how the brain can distinguish the different smells.

Unlike other senses, messages from the olfactory nerves go directly to the TEMPORAL LOBES = LIMBIC SYSTEM (without entering the THALAMUS first).

IV. Taste (also known as GUSTATION)

Taste occurs when molecules are MIXED in saliva and drip down to the TONGUE between the little bumps on your tongue where the taste buds are located. When molecules bind to the receptors, ACTION POTENTIALS are sent to the THALAMUS and then passed on regions of your cortex. It was once thought that there were four basic taste categories: SWEET, SOUR, BITTER, AND SALTY. Recently, however, a fifth basic taste was found called UMAMI (IT SENSES THE TAST OF MEAT)

V. Touch

The sense of touch is composed of several different types of receptors in the skin that detect PRESSURE, WARM/COLD, and PAIN. Sensory receptors are distributed UNEVENLY around your body, which is why your sensitivity to pressure, temperature, and pain VARIES from one area of the body to another.

Pain

Pain begins when an INTENSE stimulus WHICH activates special sensory neurons called FREE NERVE ENDING in the skin, muscles, or internal organs. The free nerve endings send their message to the BRAIN, which releases a chemical called SUBSTANCE (SUBP). Substance P stimulates other neurons in the spinal cord, which send the message of pain via the thalamus to the cortex.

How do some people seem to “ignore” extreme pain (think Keri Strugg)?

<https://www.youtube.com/watch?v=p2m6fEPyb4M>

THE GATE-CONTROL THEORY describes the fact that psychological factors can affect our experience of pain. It is believed that there are “gates” in the spinal cord that can BLOCK the message of pain from being sent to the brain. DISTRACTION and RELAXATION are two things that have been found to reduce the perception of pain. In extreme emotional states, the body also releases ENDORPHINS, which act as natural painkillers. This is independent of the “gates” in the gate control theory.

VI. KINESTHESIS – the sense of location and position of body parts in relation to one another.

The kinesthetic sense involves special sensory neurons, called PROPRIOCEPTION, which are located in muscles, joints, and the inner ear. They constantly communicate information to the brain about changes in body POSITION and muscle MOVEMENT.

VII. VESTIBULAR – the sense of balance and equilibrium; controlled by the VESTIBULAR SACS in the inner ear.

Movement of fluid along hair cells located in the VESTIBULAR SACS lets us know which way our head is tilted and whether or not we are moving. The spinning sensation you have immediately after spinning is caused by the fact that the fluid in the semicircular canals has not stops moving yet.

All of the senses are subject to sensory adaptation! Try to name an experience in which each sense has become adapted (kinesthetic? Vestibular?)