

## A & P - The Senses

### I. Receptors and Sensations

#### A. Traits of Receptors:

1. Low threshold
2. Only sensitive to one type of stimulus

#### B. Types of receptors

1. Chemoreceptor's - (taste) and (smell)
2. Pain receptors - sense eminent tissue damage
3. Thermoreceptors - sense hot (25° - 45° C) and cold (10° -25° C)
4. Mechanoreceptors - sense light touch, and pressure
5. Photoreceptors - sense light

#### C. Sensations - conscious or unconscious awareness of internal or external stimuli.

Perception - conscious awareness and interpretation of the meaning of sensations.

So, sensations are only felt when impulses are interpreted by the brain

1. The type of sensation depends on the brain region that interprets the impulse
2. Projection - brain “projects” sensation back to its apparent source ... this helps to locate the stimulus

#### D. Sensory Adaptation - with continuous stimulation, the number of impulses leaving the receptor decreases; may be rapid or slow (i.e. You don't smell smoke, flowers, etc. after being in the room for awhile, the shower doesn't feel so hot after the 1st minute, etc.)

### II. Somatic Senses in the skin, muscles, joints, and organs include:

#### A. Tactile – touch, pressure, vibrations. Itch, & tickle

#### B. Thermal – temperature (note – temperatures below 10° C & above 48° C stimulate nociceptors, not thermal receptors)

#### C. Proprioception – imbedded in muscles and hair of inner ear (we know where our head and limbs are even when we aren't looking. Important for equilibrium and kinesthesia (perception of body & estimating the weight/force needed to lift an object))

#### D. Pain - (nociceptors)

1. [Referred Pain](#) - due to common nerve pathways, pain may feel like its coming from another body area
2. [Acute Pain](#) - sharp pain that stops when the stimulus stops; felt from the skin
3. [Chronic Pain](#) - dull, aching pain that may continue after the stimulus stops; felt from deeper tissues
4. Regulation of pain impulses
  - a. [Thalamus](#) - senses pain
  - b. [Cerebral Cortex](#) - judges intensity, locates source, decides on response
  - c. [Brain Stem](#) - blocks pain by sending inhibiting neurotransmitters (i.e. serotonin or [endorphins](#))

### III. Smell - Olfactory

- A. Olfactory organs
  1. Olfactory cells are located in the upper part of [nasal cavity](#). The total area of olfactory epithelium is 5 cm<sup>2</sup> (less than 1 in<sup>2</sup> )
  2. Extensions from the olfactory cells go through the holes (olfactory foramina) in the [ethmoid](#) bone
  3. [Olfactory bulbs](#) - impulses from the olfactory cells are analyzed here (We can recognize around 10,000 different odors)
  4. [Limbic system](#) - smell is interpreted here ( this is also the site of emotional memory)

### IV. Taste - Gustation

- A. Works similarly to [smell](#) - interconnected (when you have a cold and can't taste food, it's a blockage of smell, not taste)
- B. Types of taste sensations
  1. [Sweet](#)
  2. [Sour](#)
  3. [Salty](#)
  4. [Bitter](#)
  5. [Umami](#) (musty, savory)
- C. We have roughly 10,000 taste buds on the tongue, soft palate, pharynx, & epiglottis - BUT, most bumps ([papillae](#)) on the tongue are NOT taste buds

## V. Hearing

### A. Anatomy of the ear

#### 1. External ear - Auricle and External Auditory Meatus

**note** - near the opening, hair and specialized sebaceous glands that secrete cerumen (ear wax) work to keep out foreign objects

#### 2. Middle ear

- a. Tympanic Membrane (ear drum)
- b. Ossicles: ( Malleus (hammer), Incus (avil), and Stapes (stirrup)
- c. Eustacian Tube - connects with the pharynx to equalize pressure in the ear
- d. Oval Window - opens to the inner ear

#### 3. Inner ear - Labyrinth

- a. 3 Semicircular Canals - to sense dynamic equilibrium (detects motion of the head) *level*
- b. Vestibule - to sense static equilibrium (senses the position of the head)
- c. Cochlea - hearing receptors

### B. Hearing

1. Tympanic membrane reproduces the vibrations of sound waves
2. Malleus and Incus amplify sound and send vibrations to the Stapes
3. Stapes vibrates directly on the Oval Window and sends vibrations to a liquid in the cochlea
4. Different frequencies of sound stimulate different receptors in the Cochlea
5. The audible range of sound waves is from 20–20,000 Hertz (Hz); we clearly hear sounds in the 500–5000 Hz range (the easily recognizable high C of a soprano is 1048 Hz)

Sound is measured using 3 variables:

- a. Frequency – pitch (high or low vibrations)
- b. Intensity – how loud; measured in decibels (dB)
  - i. Rustling leaves 15 dB; normal conversation 30 dB; nearby motorcycles 90 dB; inexpensive headphones 110 + dB
  - ii. Uncomfortably loud @ 120 dB; painful @ 140 dB
  - iii. In US, protection is required for workers exposed to any sounds over 90 dB, but those with sensitive ears may need earplugs for any sound above 30 dB

- iv. Prolonged exposure to loud noise causes hearing loss - If a bystander can hear your music outside your headphones, it is in the damaging range
- c. Duration – how long

## VI. Equilibrium – balance

- A. Static Equilibrium – maintaining posture and body position (especially of the head) relative to the force of gravity
- B. Dynamic Equilibrium - maintaining posture and body position (especially of the head) in response to sudden movement

## VII. Sight

- A. More than half of all sensory receptors in the body are located in the eyes. Humans have binocular vision, meaning both eyes focus on 1 thing enabling us to have depth perception and see things in 3-D
- B. Visual accessory organs
  - 1. Eyebrows and eyelashes help protect the eye from foreign objects, sweat and sun. If the sebaceous glands at the base of the lashes become infected - a sty
  - 2. Eyelid has 4 layers:
    - a. Skin
    - b. Muscle
    - c. CT
    - d. Conjunctiva (mucus membrane)
  - 3. Lacrimal gland - secrete tears to keep eyes moist, lubricated, and infection free (lysozyme is a protective bactericidal enzyme)
  - 4. Extrinsic muscles - six muscles move each eye
- C. Structure of the eye – 3 layers
  - 1. Outer layer is tough, fibrous, CT – Fibrous Tunic
    - a. Cornea - transparent bulge in the front of the eye, curved to help focus light
    - b. Sclera - white part of eye; provides protection and muscle attachment

2. Middle layer is very vascular – Vascular Tunic
    - a. Choroid coat - blood vessels that bring nourishment to the tissues
    - b. Ciliary body - contains muscles that attach to the lens and change its shape to focus
    - c. Lens – transparent protein layers focus an image onto the retina
    - d. Iris - colored part of the eye that lies in front of the lens and divides the eye into two chambers; the iris regulates light entry and secretes a watery fluid that fills both chambers
      1. Aqueous humor - fluid that fills the anterior chamber
      2. Vitreous humor - fluid that fills the posterior chamber
    - e. Pupil - opening in the middle of the iris; the size of the pupil is controlled by two sets of muscles in the iris
  3. The inner layer is nervous tissue and is called the Retina
    - a. Transparent layer
    - b. Contains photoreceptors
    - c. Central Fovea - part of retina that produces sharpest image
    - d. Optical Disk - blind spot; where the optic nerve leaves the eye
    - e. Contains melanin (dark pigment) to absorb stray light and thus keep the image clear and focused (Albinos lack melanin and need sunglasses minimize glare)
- D. Photoreceptors are modified neurons; there are two types
1. Cones:
    - a. For color vision
    - b. Need bright light in order to fire
    - c. Produce a sharp image
    - d. Central fovea contains many cones
  2. Rods:
    - a. For black & white images
    - b. Will fire in dim light
    - c. Produce a fuzzy image
- E. Eye Health & Vision
1. We need vitamin A found in carrots, spinach, broccoli, & yellow squash
  2. Common vision issues:
    - a. Myopia - nearsighted
    - b. Hypermetropia/Hyperopia - farsighted
    - c. Presbyopia - with aging, the lens loses elasticity and the ability to accommodate, so the elderly can't read print up close
    - d. Astigmatism - cornea or lens has irregular curvature, so part of an image is in focus and part is blurry

