the senses

general principles

- sensation -> sensory information that reaches the brain; action potential frequency, more neurons stimulated
- perception -> how we interpret the sensation
- adaptation -> decrease in sensitivity, decreased aciton potential frequency with the same stimulus, some systems are more sensitive to adaptation

PNS sensory input

- sitting on ganglia, outside the central nervous system
- dorsal side of the spinal cord
- pseudo unipolar neuron, one long axon with the body in the middle

somatosensation

- touch and pressure -> mechanoreceptor in encapsulated and free nerve endings
- propioception -> muscle stretch receptors, mechanoreceptors in skin, joints, tendons, ligamente, vision, vestibular system
- temperature -> different types of thermoreceptors (ion channels activated at certain temps), also respond to menthol, capsaicin, ethanol
- pain -> free nerve ending expressing nociceptor, sense mechanical deformation, chemicals released by damaged cells or immune cells

visual system

1. light enter the eye and is focused by a lens on to the retina
2. retinal photoreceptor transduce light energy into electrical signal
3. processing of the electrical signal through neural pathways

the eye

- cornea
  - most of the focusing of the light
- pupil
  - light travels through
- lens
  - fine focus near/far
  - changes shape
  - contracts/relaxes <- ciliary muscles connected by zonular fibers
  - contracted = less tension, more rounded lens (focus on near object)
  - relaxed = more tension, more flattened lens (focus on distant object)
- phototransduction
  - light hit photoreceptors

    - g protein coupled receptor <- binded to retinal (vitamin A)
    - retinal changes conformation when hit by photon
    - start signal transduction cascade
        * decrease in cyclic GMP
            · GMP-gated cation channel closes
            · at rest photoreceptor cell is depolarized
    - action potential <- graded potential <- ganglion
    - 3 color sensing cones RGB + rhodopsin
- retina
    - contains the photoreceptors cells

Hearing and the vestibular system

auditory system

- detects sound waves compression and expansion of air molecules in the form of pressure waves
- amplitude of the wave determines volume
- frequency determines de pitch
- anatomy of the ear
- malleus, incus, stape <- transduce to liquid in the cochlea
    - amplification of air vibrations
- cause vibrations on the oval windows of the cochlea
- fluid paths
    - oval windows
        * scala vestibuli
        * scala timpani
    - round window
    - organ of corti
        * scala vestibuli: fluid right behind oval window
        * scala tympani, above basilar membrane
            · hair cells <- tectorial membrane
            · bending of hair cause hyper or depolarization

vestibular system

- angular accelarion
- linear acceleration
- semicircular canals: changes in head rotation
- otolith organs
    - involve hair cells

    - linear or position of the head
- semicircular canal <- 3 channels at 90° angles
    - cupula <- hair cells that have extensions
- utricle
    - detect movement on the horizontal
- saccule
    - detect vertical movement

chemical senses

- taste
    - taste pore
    - taste receptor cell
    - afferent nerve
    - modalities <- increase in intracellular Ca++
        * sweet <- gprotein
        * sour <- ion channels (H+)
        * salt <- ion channels (Na+)
        * bitter <- gprotein
        * umami <- gprotein
- smell
    - primary afferent neurons themselves, express olfactory receptors
    - neurons send out cillia
    - have receptor that bind odorant
    - gprotein coupled receptor
    - 400~ olfactory receptor types
    - can discriminate 10.000 odors
    - creates graded potentials -> leads to action potentials
    - combinatorial perception