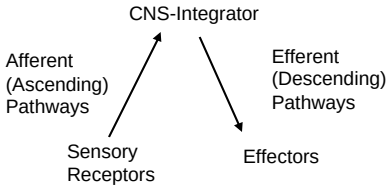
Lecture 17- Sensory Physiology, etc.

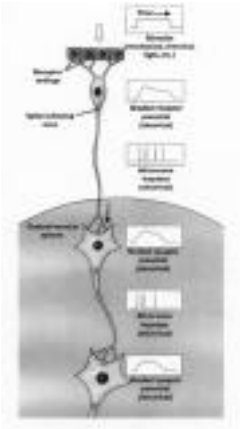
- Chapter 15- Sensory, motor and integrative functions (2 lecture)
- Chapter 16 - Special senses (3-4 lectures)
- Chapter 17 - Autonomic Nervous System (2 lectures)
- Exam III- Monday Oct 28

How do sensory receptors work to relay information?



Nervous system overview

- Receptors respond to stimulus
- Graded and all-or-none electrical signals alternate along a neuronal circuit



Sensory receptors

- can be very simple (naked nerve endings)
- Can be exquisitely elaborate and sensitive (visual and auditory receptors)
- See Fig 15.1

Sensory receptors transduce (and usually amplify) energy

- Result in change in membrane potential
- depolarize (~ EPSP) or hyperpolarize (~IPSP)
- Generator potentials or receptor potentials are types of graded potentials

Types of transduction- used to classify receptor types

- Chemoreceptor
  - Taste, olfaction, carotid bodies (oxygen, pH) glucose, pain receptors (= nociceptors)
- Electromagnetic Receptors
  - Photoreception, thermoreception (hot and cold), electric organs (fish) and magnetic receptors
- Mechanoreceptors
  - Touch, haircells in ear, proprioreceptors, osmo-receptors, blood pressure receptors

Mechanoreceptors in skin- (Fig 15.2)

- Dermis - often encapsulated with connective tissue to sense strong pressure and touch
- Epidermis and those at base of hair are naked dendrites

Muscle spindle and stretch receptors (Fig 15.4)

- Monitors length of skeletal muscle fibers
- Involved in negative feedback to keep muscle fiber length constant
- Must adjust their length in order to contract muscle
- Example-stretch reflex and Jendrassik Maneuver

Sensory receptor classification

- Exteroceptors (e.g. cutaneous) for monitoring external environment
- Interoceptors (e.g. visceral) for monitoring internal environment
- Proprioceptors (e.g. in muscle, tendons and ear) for monitoring body position

General characteristics

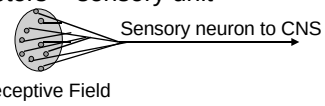
- 1. Modality and perception
  - Nervous system is like a “labeled line”
- 2. Sensitivity
  - One photon in retina
  - Movement of 10^{-11} cm in basilar membrane of ear
- Sensitivity achieved at expense of selectivity

3. Intensity coding

- Amplitude/frequency proportional to stimulus strength
- Recruitment (sensory units)
- Weber-Fechner Principle
  - Logarithmic coding to judge stimulus strength over large dynamic range
  - (Vision, hearing, cutaneous)

4. Sensory unit and receptive field

- One sensory neuron/ often many receptors = sensory unit



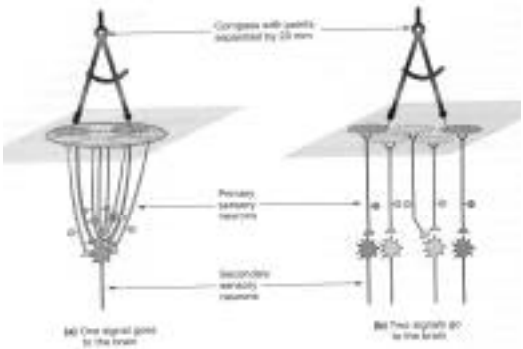
- Receptive fields can overlap
- Acuity decreases as size of receptive field increases

Acuity/sensitivity in retina

- Rod cell convergence for sensitivity
  - Spatial summation
- Cone cell
  - No summation,high acuity, but not sensitivity

Two point threshold test:
With your neighbor, use two pencil tips to measure the minimum distance the points have to be apart to be felt as two inputs on index finger and calf or forehead

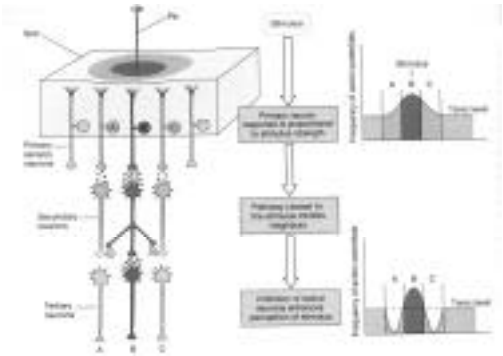
Two point discrimination



5. Lateral inhibition

- For stimulus localization (edges)
- Cutaneous, vision, pitch discrimination
- Collateral connections inhibit neighboring neurons
- Weak signals get weaker
- Strong signals get relatively stronger

Lateral inhibition



6. Adaptation

- Respond to changing signal input, not a constant signal
- Example: Pacinian corpuscle
- Phasic receptors adapt quickly (touch, odor, temperature)
- Tonic receptors adapt slowly (proprioreceptors, blood pressure receptors)