Somatosensory

Cutaneous Senses (touch)
Kinesthesia, proprioception: joint and muscle stretch formation
Organic Senses: receptors on organs such as stomach and gallbladder

Physical stimulus
- Vibration: tested with tuning fork (texture perception)
- Temperature: tested with water bath (body temp regulation)
- Pain: tested chemically or mechanically (protect from damage)
- Pressure: tested mechanically (sensation and protection)

Sensory Apparatus: the skin and receptors

Skin:
- Epidermis: upper layer. Peals off, 27 day cycle, damaged by skin cancer
- Dermis: affected by deep burns, contains hair follicles
- Subcutaneous tissue: Fat

Function of Skin:
- Protection: mechanical and chemical (prevent fluid loss)
- Tempregualtion
- Communication: blushing (emotions), state of health, camouflage, excretion (water & urea)
- Respiratio: oxygen absorption

Cutaneous
Mechanoreceptors

Different receptors are specialized

- Ruffini Corpuscles: free nerve ending. Deep in dermis, respond to skin stretch and static force (poke)
- Pacinian Corp: encapsulated nerve ending, large onion-like structure, deep in dermis, respond to high frequency stimulus (tickle)
- Meissner Corp: low frequency, tap vibration, detection of texture Glabrous Skin Only (finger tips)
- Merkel Disk: light mechanical pressure, finger tips, lips, genitalia. Mostly glabrous skin
Sensory Receptors

Touch
- Sensation: mechanoreceptors, pressure and vibration
- Sensation: emotion
- Sensation of touch can be modified by learning/experience
  - Musicians
  - Blind people
- Sensitivity positively correlates with the number of responsive neurons present in the area. (homunculus)
- Pathway: Receptor - Spinal Cord - Somatosensory Cortex

Dermatomes
- Different levels of spinal cord (C, T, L, S)
- Cervical: shoulder & arms
- Thoracic: torso
- Lumbar: hips & legs
- Sacral:

Damage/Illness
- Tactile Agnosia: neural deficiency

Temperature

Temp:
- Receptors: free nerve endings
- Cold - superficial dermis
- Warmth - deep dermis
- Transduction involves a family of dedicated receptors
- Pathways similar to pain
- Hypothalamus: in charge of temp regulation (Sweating)

Physiology:
- Able to adapt quickly to constant of slow temp changes
- 8°C = 47°F - 52°C=122°F (thresholds for pain)
- Temp, especially in body, is naturally variable

Mechanoreceptor: intense pressure

Intense heat & acids

Irritant receptors: chemicals that produce inflammation

Components of Sensation:
- Sensory = receptors - spinal cord - thalamus (VPN) - primary sensory cortex
- Emotional: primary cortex - anterior cingulate cortex "how much is it disruptive?"
- Long-Term (chronic pain): Prefrontal cortex (pain memory)
• Every pain has a memory attached to it.

**Percpetion**

• Can be controlled by hypnosis
• Pain can be imagined (empathy or sympathy)
• Pain can be managed with learning and experience
  - Phantom Limb and the mirror box

2 Pathways:
Spino-Thalamic: pain, temp
Dorsal Column: precise touch and movement

**Chemical sense**
Taste = gustation, flavor = olfaction
6 taste dimensions:
• Bitter
• Sweet
• Sour
• Saltiness (NaCl)
• Umami (MSG)
• Fat

Taste apparatus = tongue, palate, pharynx, larynx
Receptors: tastebubs
10,000 receptors: renewed every 10 days approx.

**Sense of taste:**
• Supertasters: bitter sensitivity, more prevalent in women and Euros
• Non-tasters

**Tongue**

Dissolve saliva - bind to receptors - ion flow - receptor potentials

Sour: acidity (Potassium channel)
Saltiness: NaCl (sodium channel)
Bitter: Many receptors (protective, nothing that is bitter is good for you, detect "bad foods")
Sweetness: specific (absent in felines)
Umami: Glutamic Acid, MSG, metabotropic channels

**Pathway:**

Lateral Hypothalamus: perception of hunger, metabolism
Amygdala: perception of like/dislike
Primary gustatory cortex: perception of taste

**Maps for taste vary from subject**
Smell = Olfaction

Chemical Sense
Stimulus: Volatile molecules
Receptors: 6 mill receptors
Transduction: Slow sodium channel
Strong genetic bases

Pathway:
Olfactory Bulb- thalamus - orbitofrontal cortex
(cognitive)
Amygdala -

Humans can perceive 10,000 odors but have only 3,000 receptor types:
- This is achieved by pattern matching
- Basic odors are unknown
- Olfaction is an ART:
  - cooking
  - perfume
  - wine tasting

Sensation

Molecules:
- Odorants dissolve in mucus
- Bind to olfactory cells (cilia)
- Each cell sends one axon to olfactory bulbs mitral cells approx 35 per bundle
- Synapses on mitral cells from glomeruli (10,000) glomeruli are molecule specific (chemical map)
- Axons of mitral cells go to association areas in the brain (olfactory nerve)

Practice

4 types of taste receptors?
- False, there are 6 (bitter, sweet, etc)

Mitral cells are in the olfactory bulb? True

The perception of pain cannot be controlled by any means? False
Pacinian corpuscles respond to:
  • High frequency stimulus (tickles)