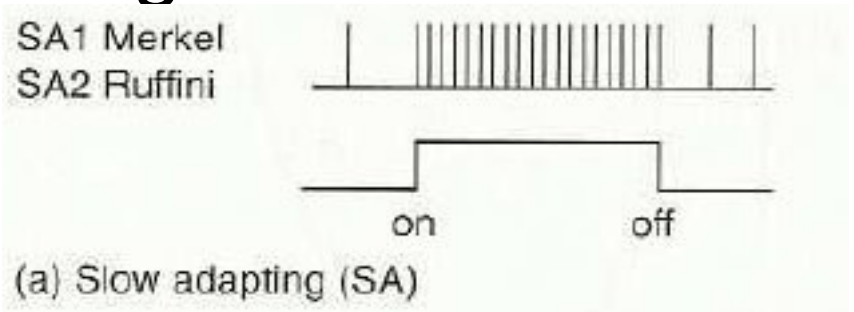
# Skin Senses: Touch, Haptics, Nociception, Vestibular System

# Receptors

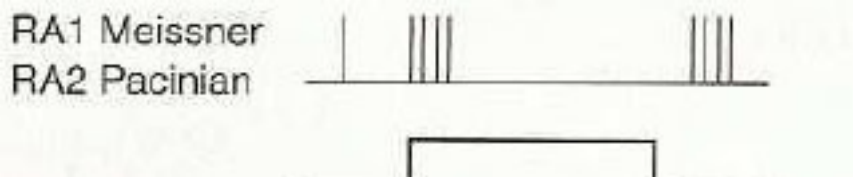
- The receptor cells in the skin are (mostly) called *mechanoreceptors*, and *transduce mechanical force*.
  - Mechanical force is any kind of physical prodding, pushing, stretching, pulling, etc.
  - Most of these cells live a little ways under your skin in the *dermis,* the second layer of skin (unlike the *epidermis*, which consists of dead cells, the dermis is alive.)

- Mechanoreceptors (cont.)
  - There are two main varieties of mechanoreceptor:
  - *Slowly adapting* mechanoreceptors continue to fire for a long time, as long as they are continually being stimulated.



(a) Slow adapting (SA)

  - *Rapidly adapting* mechanoreceptors fire only briefly, right after a stimulus disturbs the skin, and then stop firing.

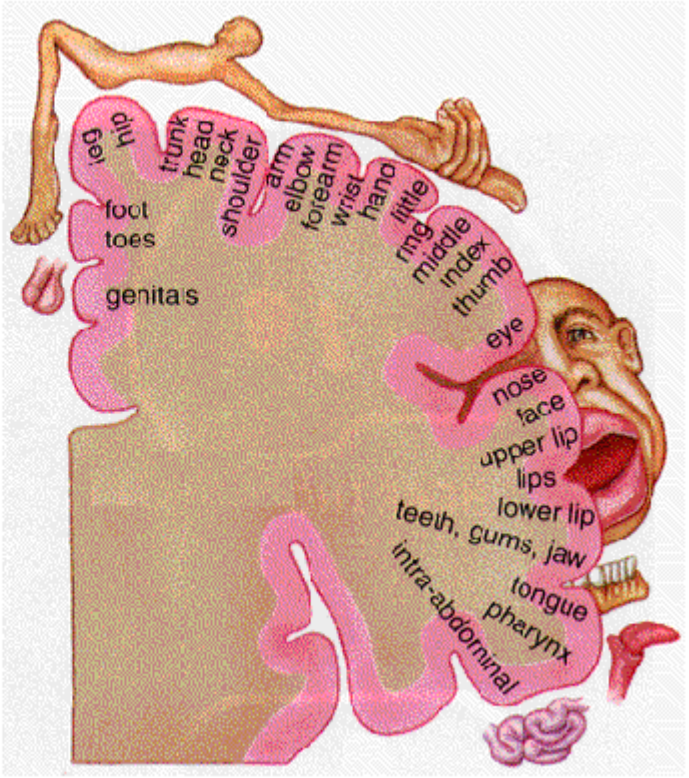


(b) Rapid adapting (RA)

- Mechanoreceptors (cont.)
  - Each mechanoreceptor has a *receptive field*, that region of skin that may activate the receptor if stimulated.
    - With more receptor cells, there are smaller receptive fields, and with few receptor cells, there are larger receptive fields.
    - Receptor cells project into the spine, and up into the brain.
    - The brain has a particular region, the s*omatosensory cortex*, devoted to processing touch input.

- Mechanoreceptors (cont.)
  - Somatosensory cortex (cont.)
    - Regions on your skin are mapped into S.C., so that, if a place on your skin is touched, you'll see activation in the corresponding region of S.C.






The critter drawn on the left around the brain is referred to as a homunculus (“little man”).

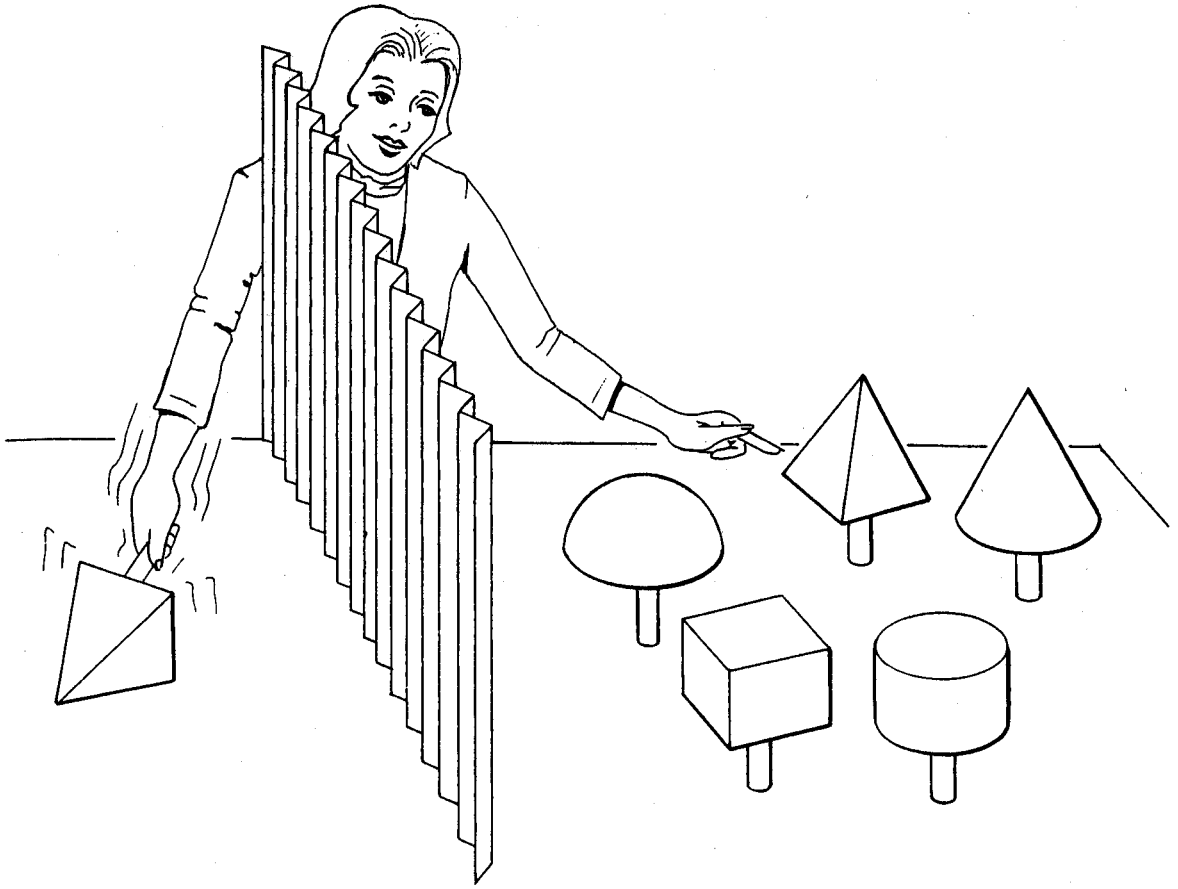
- Mechanoreceptors (cont.)
  - Somatosensory cortex (cont.)
    - S.C. Is *topographically mapped*. This means that (most of the time) points near each other on your skin are near each other in S.C.
  - Regions on your skin that have high receptor density (and hence large amounts of somatosensory cortex devoted to them) will be sensitive to a *two-point acuity test*.
    - Two-point acuity test: using calipers, pins, or toothpicks (or something) stimulate two points on a participant's skin. Can the participant tell it's two points? If not, the two points are below threshold.

- *Kinesthesis, Haptic perception*
  - Kinesthesis is the perception of whether your body is moving or stationary, as well as the perception of how your limbs are arranged when you can't see them.
  - Your sense of kinesthesis (often called proprioception) comes from *muscle spindle* cells located in muscles and joints.
    - These spindle cells are stretched by movement; the stretching causes neural firing.
    - Spindle cells then project into the spine, and then the brain.

- *Kinesthesis, Haptic perception (Cont)*
  - "Pride and a Daily Marathon"
    - Ian Waterman, at age 19, lost his sense of proprioception (and light touch) due to a viral infection.
    - Initially, he collapsed to the floor, unable to move. Although the neurons never recovered, over the course of years he taught himself to use vision as a replacement for proprioception – he can walk unaided.
    - Still, if the lights go out unexpectedly (depriving him of his sense of vision), he collapses to the floor.

- *Kinesthesis, Haptic perception (Cont)*
  - Haptic perception: the combination of touch and kinesthesis that allows us to identify objects.
  - Exploration of three-dimensional objects with the hand (either via touch or *wielding*
  - *Tadoma*: method of speech perception using only hands placed on “articulators:” lips and neck.

- *Kinesthesis, Haptic perception (Cont)*
  - *Wielding*: you can perceive certain object properties simple by holding and moving an object.



- *Nociception and* pain
  - What is pain?
    - It's complicated
    - “Unpleasant sensory and emotional experience associated with actual or potential tissue damage.” (Merskey, 1986)
    - Often useful because it tells you when you're in some kind of danger. (Melzack and Wall, 1988: a woman born without a well-functioning sense of pain dies at age 29 because she had not detected various injuries that then became infected.)

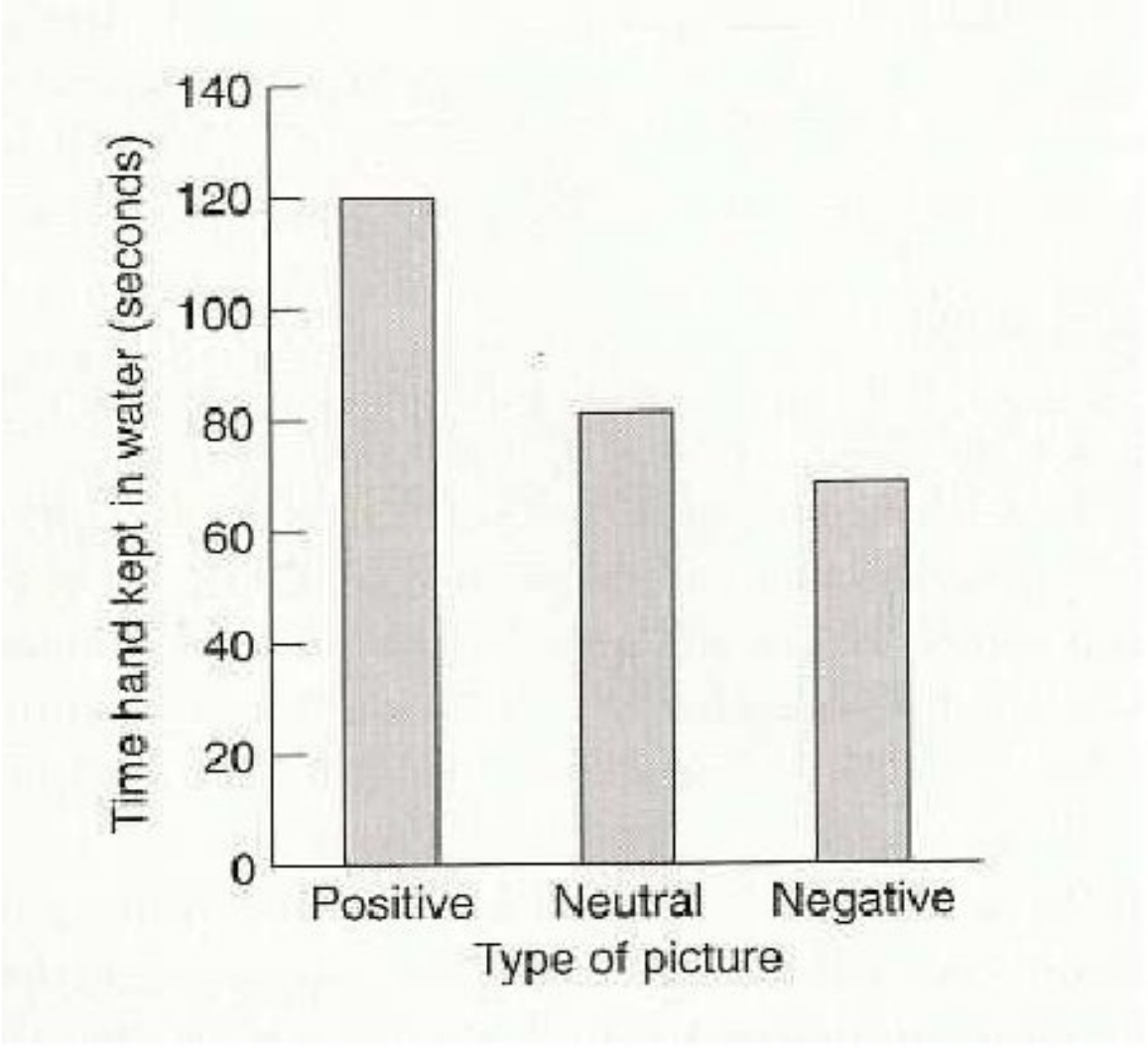
- *Nociception and* pain
  - Pain receptors (nociceptors) are free nerve endings in the skin (in epidermis and subcutaneous fat)
  - Pain can also occur when normal skin receptors fire and the central nervous system pain pathways respond (as a result of injury or disease)
    - For example, *phantom limb pain*: perceived pain in an amputated arm or limb

- *Nociception and* pain
  - *Top-down influences on pain*
    - *Placebo*: people report relief from pain after taking only a sugar pill, if they believe it's morphine – probably works because your body can produce endogenous opiates (Petrovic, et. al. 2002)
    - *Acupuncture*: long needles inserted into different sites on the body. Don't directly interfere with nociceptors. Seems to be effective (Mamtani and Cimino, 2002). Also probably releases opiates

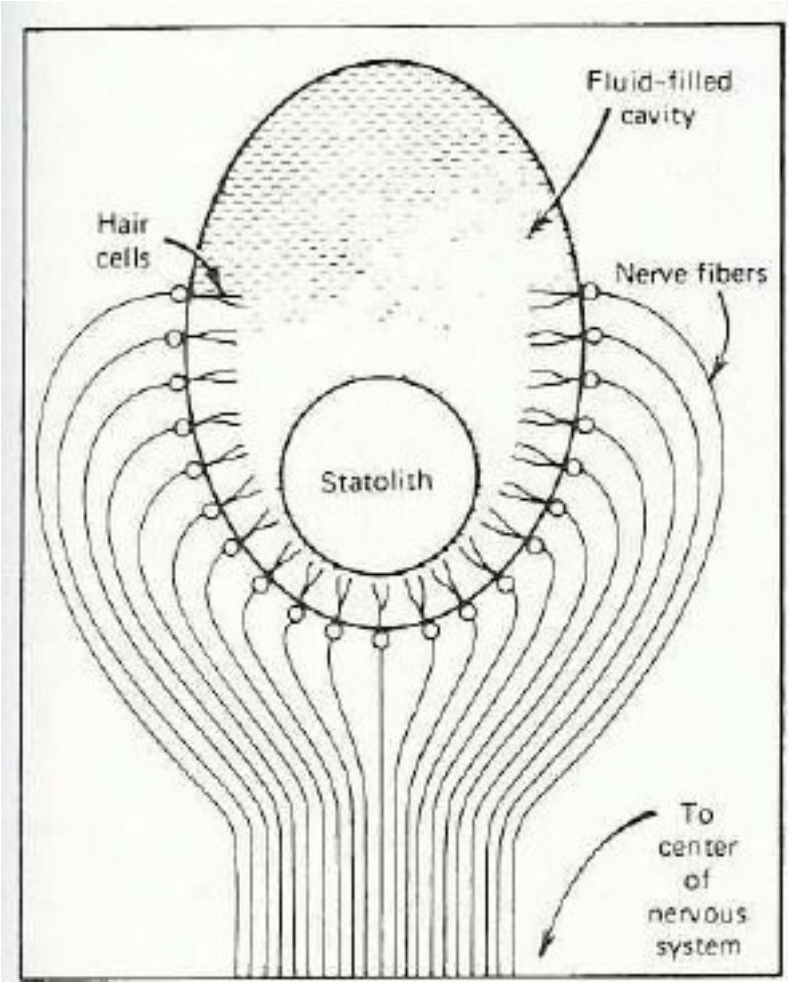
- *Nociception and* pain
  - Top-down influences on pain
    - *expectation*: Weisenberg, 1977. Surgical patients
      - gp 1: told what kind of pain to expect, instructed to relax to alleviate pain.
      - gp 2: no info.
      - result: gp 1 left hospital 2.7 days earlier, and requested fewer painkillers.

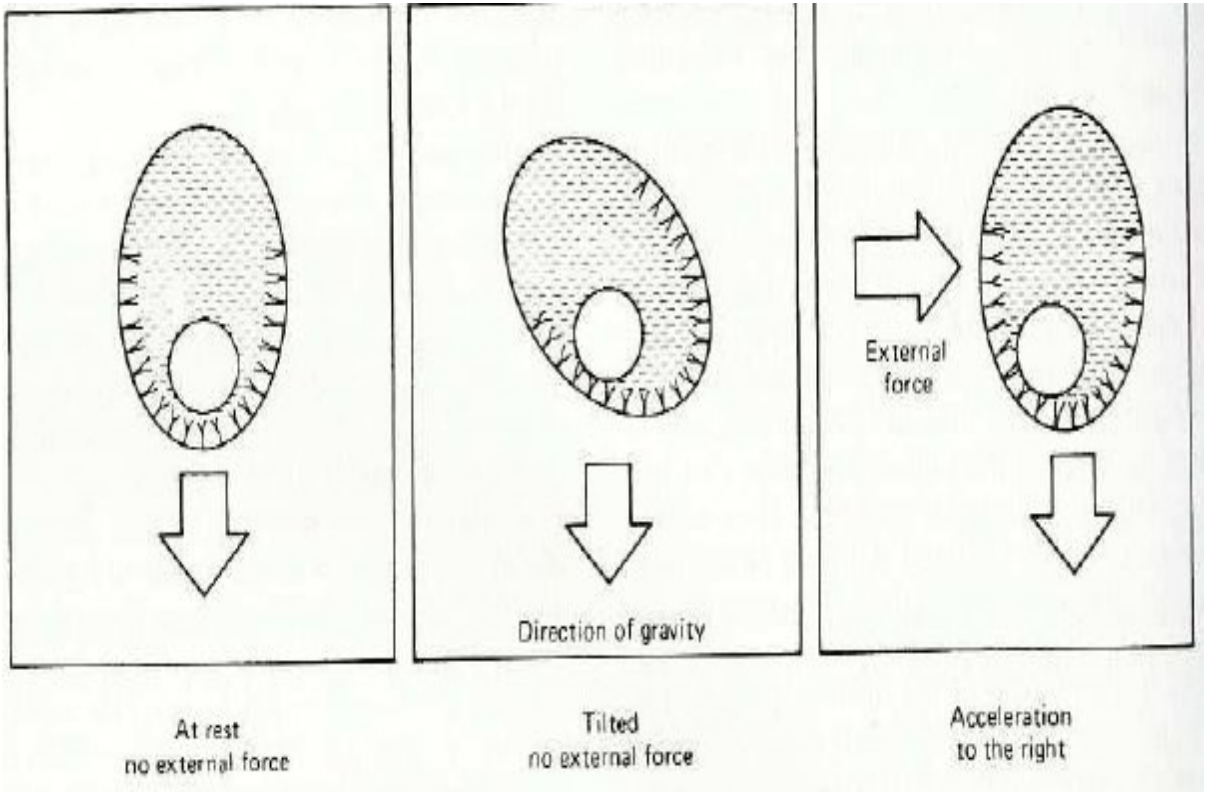
- *Nociception and* pain
  - Top-down influences on pain
    - *emotional distraction*. deWeid & Verbaten (2001). 3 gps (all males)
      - gp 1: view positive pictures – attractive women, sports, etc.
      - gp 2: view neutral pictures – household objects, nature scenes, people.
      - gp 3: view negative pictures – burn victims, accidents

- *Nociception and* pain
  - All three groups immersed hands in 2± C water, told to withdraw hand when it began to hurt.
  - results:

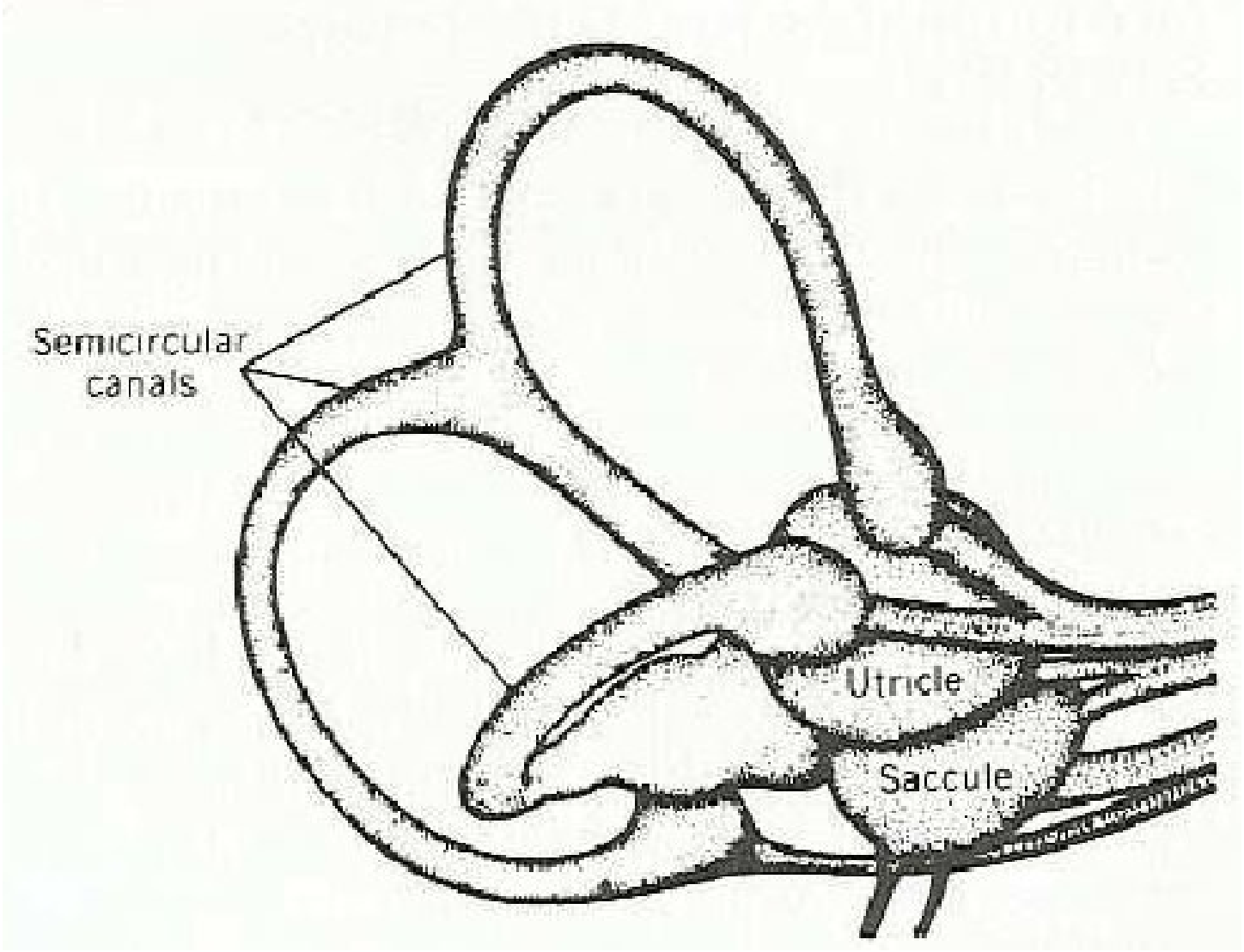


- orientation perception
  - *vestibular system* – for perceiving orientation and acceleration.
    - simple invertebrate system:



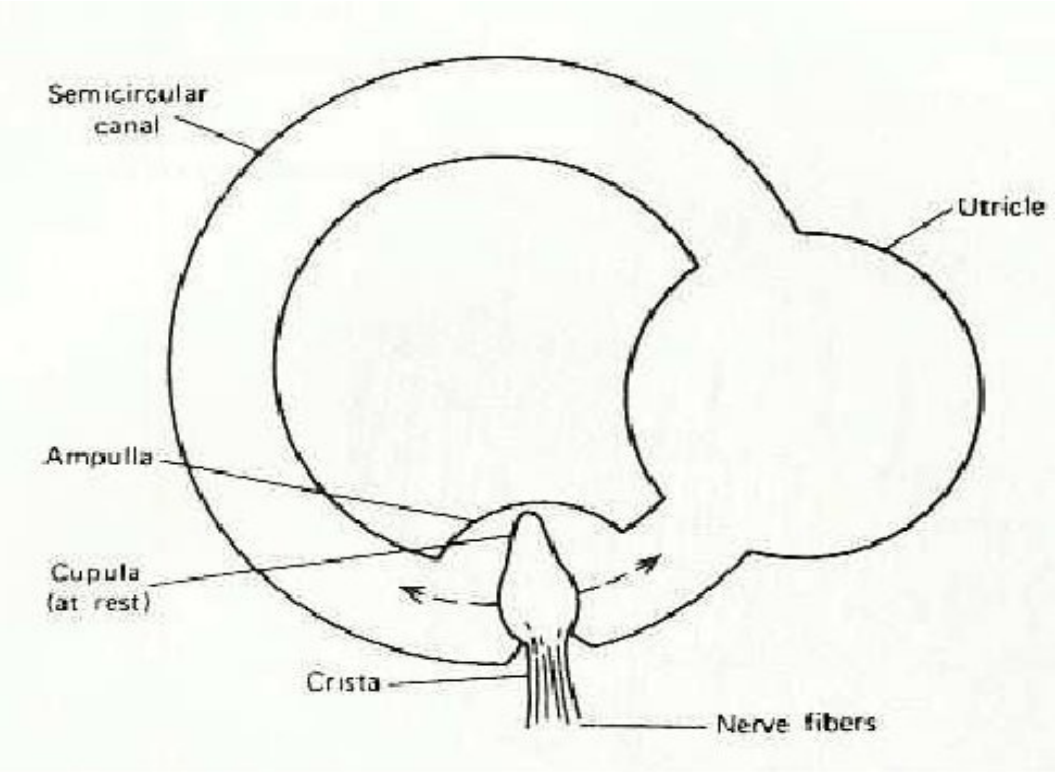



- orientation perception
  - vestibular system
    - Human vestibular system is similar.

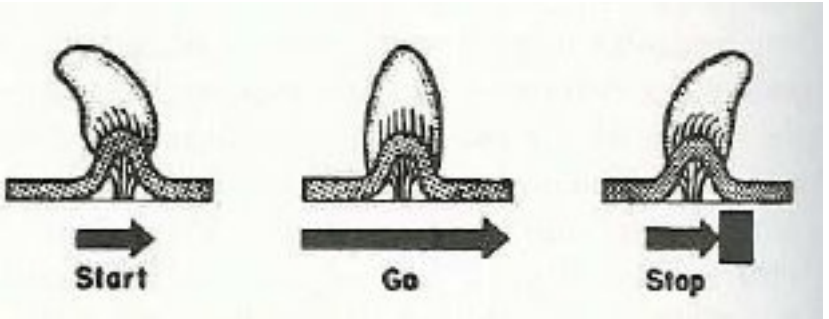


- orientation perception
  - vestibular system
    - Depends on saccule, utricle, semicircular canals, located in inner ears.
    - *saccule* – recognize motion up-down
    - *utricle* – recognize front-back or left-right
    - *Semicircular canals* – three canals are located in different planes (think depth,width, height); allows recognition of rotation in any of three directions.

- orientation perception
  - vestibular system
    - *Semicircular canals*
      - *Cupula*




- Fluid in the canals can push the cupula in different directions.



- orientation perception
  - vestibular system
    - *compensatory eye movements*. nerve fibers go from canals to eye muscles. result in eye movements in opposite direction of rotation – helps keep eyes focused on an object fixed in space while rotating.
    - *dizziness from alcohol*: alcohol gets into cupola, alters density of liquid inside.

- orientation perception
  - vestibular system
    - *Motion sickness*: motion information signaled by vision is not matched with motion information signaled by vestibular sense.
    - Occurs more for up-down movements.
      - shutting your eyes is a fair way of dealing with the problem.
      - Wrist-bands, magnets, etc. seem not to work, except as placebos.
      - Dramamine, meclizine are effective ways to prevent motion sickness

# List of terms, section 2

Transduction

Mechanoreceptors

Dermis

Epidermis

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