

Sensory Systems

Senses

Most important for neural engineering:

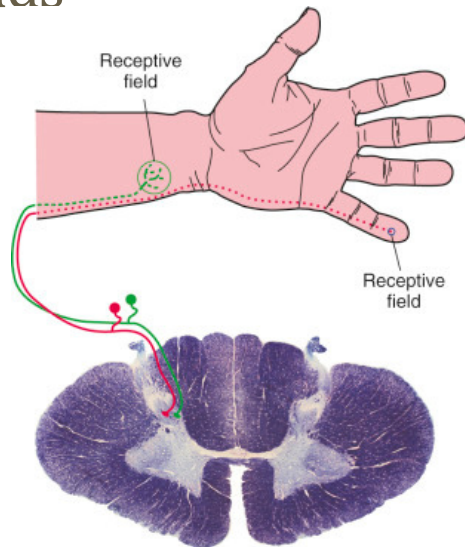
- Vision
- Hearing
- Vestibular (balance/rotation)
- Somatosensation
- Proprioception
- Pain

Additional senses include:

- Smell
- Taste
- Itch
- Temperature
- Hunger
- Thirst
- Circadian rhythm
- And so on...

[2]

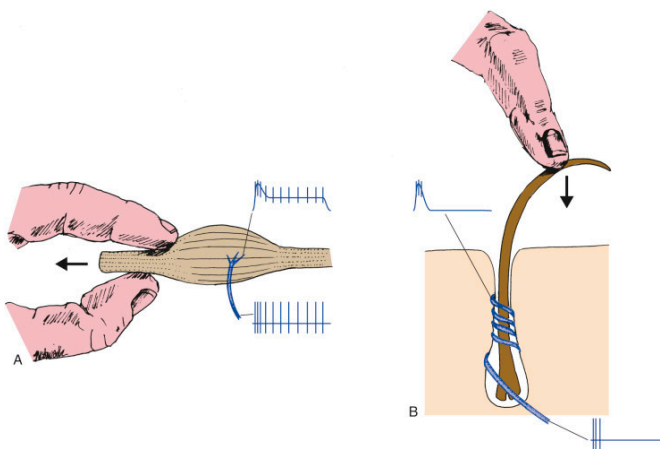
General principles - receptive fields



Vanderah

[3]

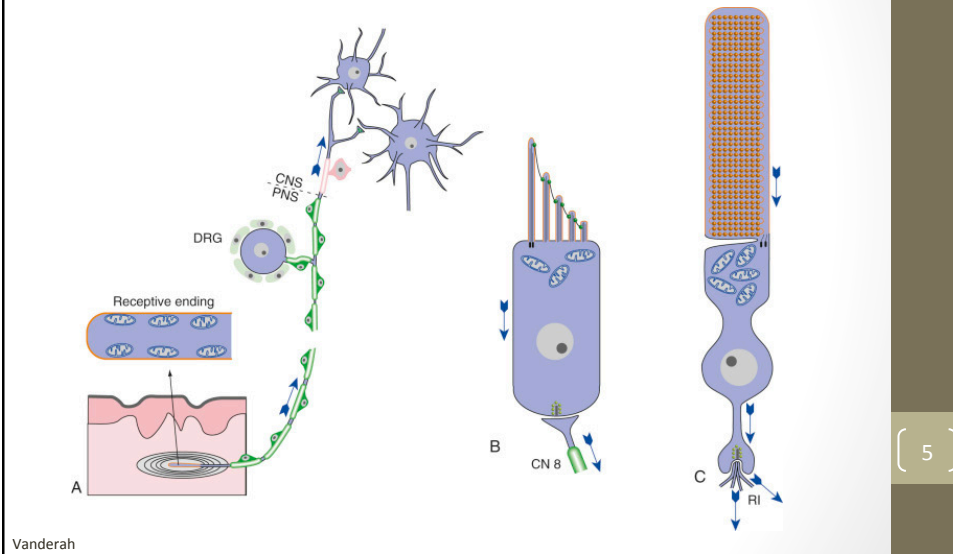
General principles - slow and rapid adaptation



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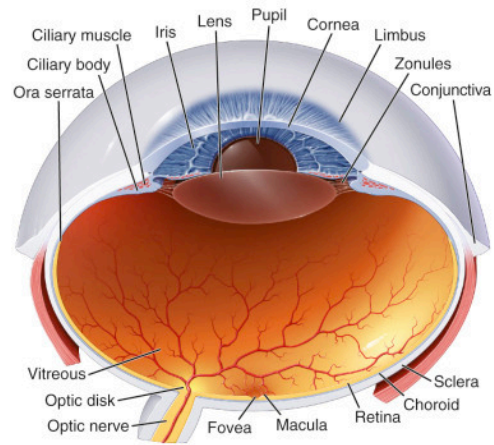
[4]

General principles - features of sensory organs



VISION

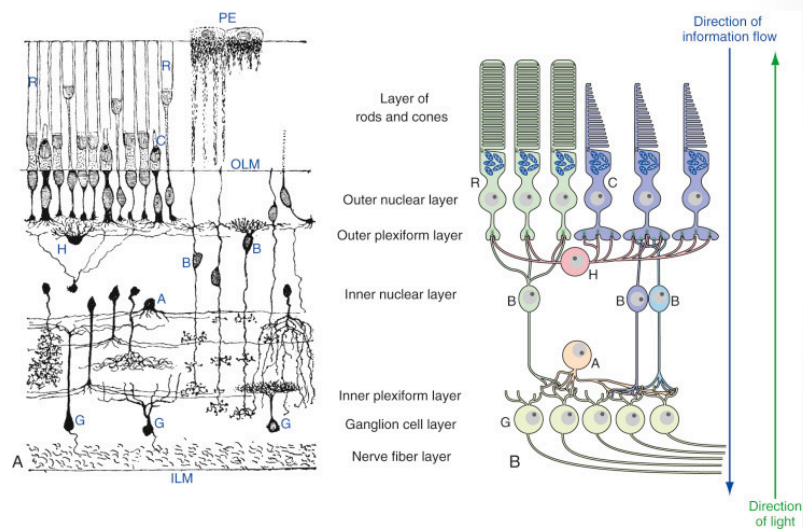
The eye



[7]

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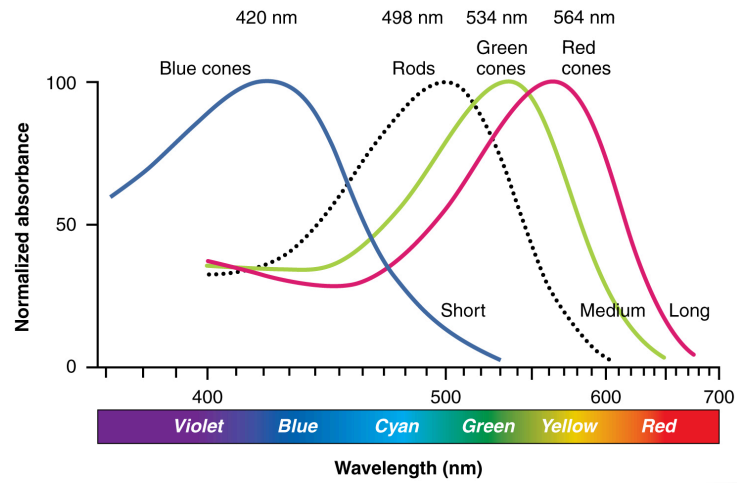
The retina



[8]

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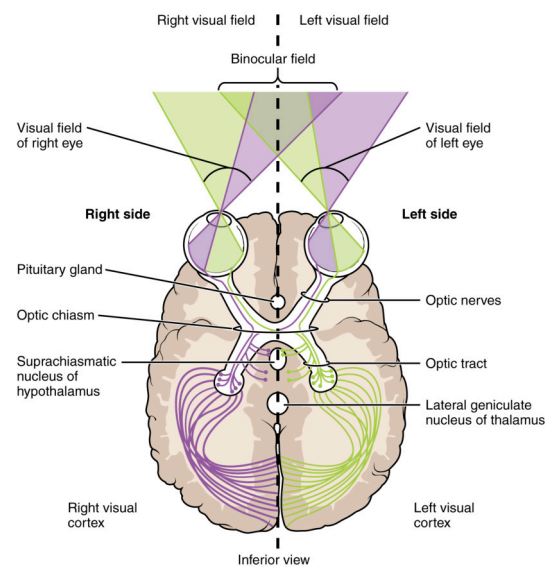
Color



OpenStax

[9]

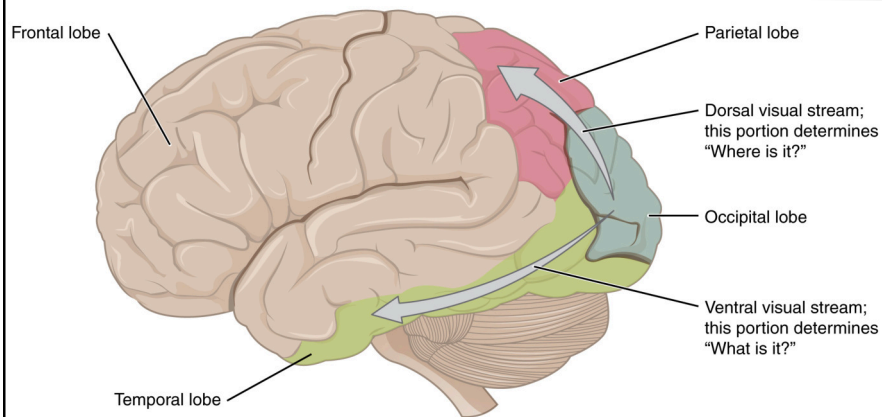
Pathway to brain



OpenStax

[10]

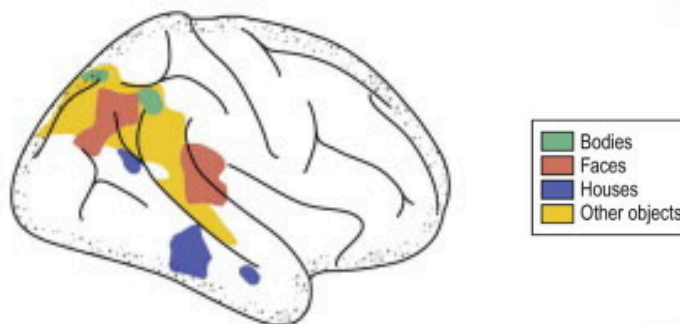
Occipital cortex and beyond



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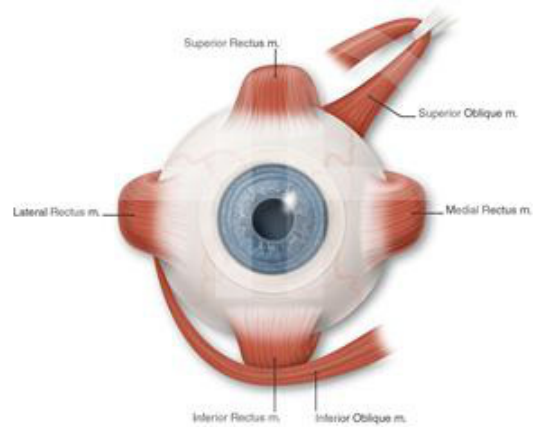
Special processing - faces

**B**

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Forrester

Eye movements



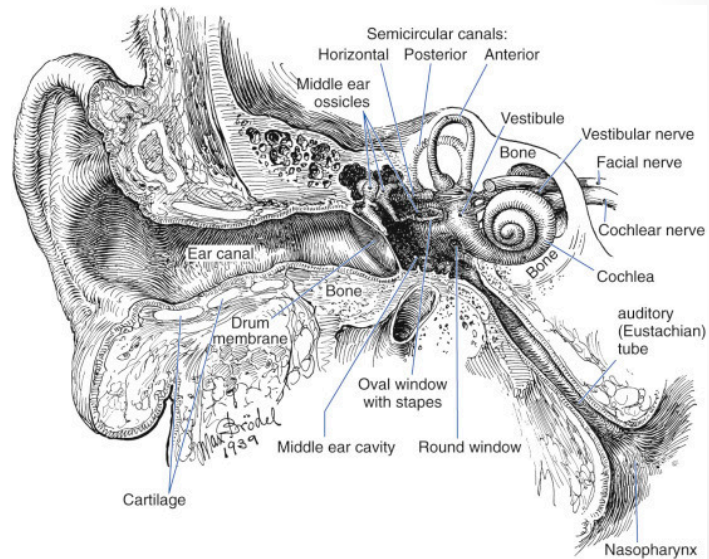
[13]

AAO

HEARING

[14]

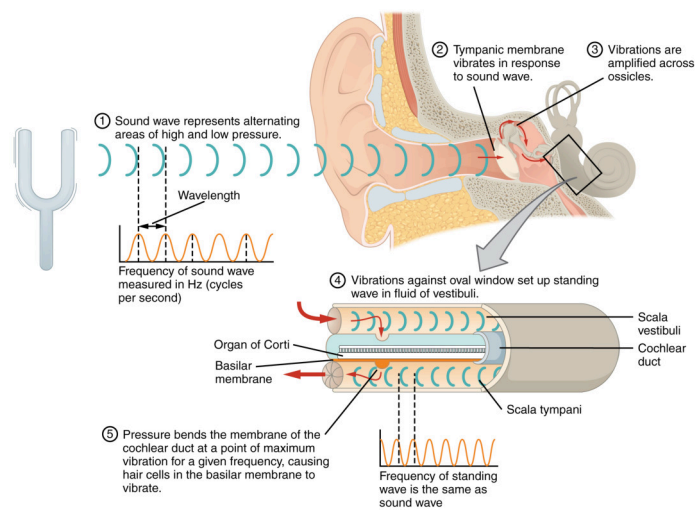
Ear anatomy



Brödel in Vanderah

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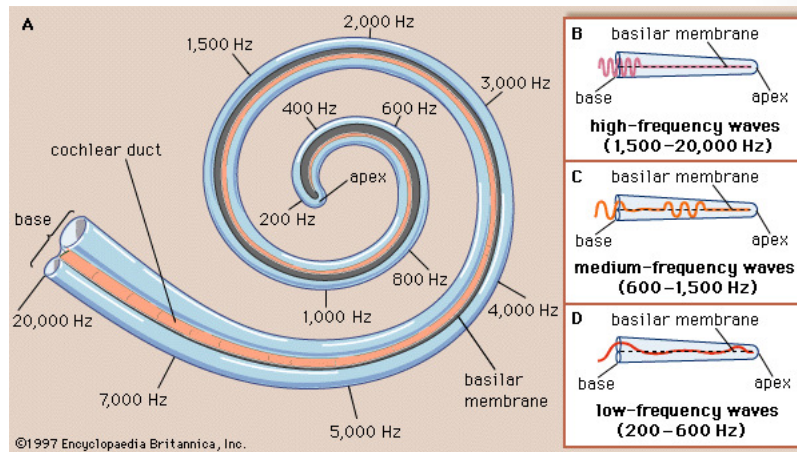
Ear sound transduction



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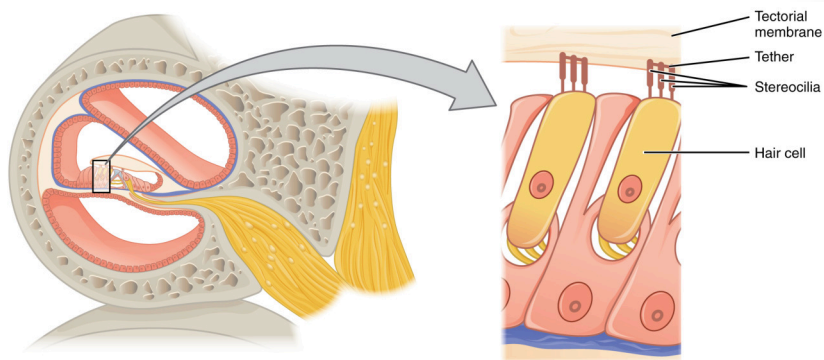
16

Cochlea



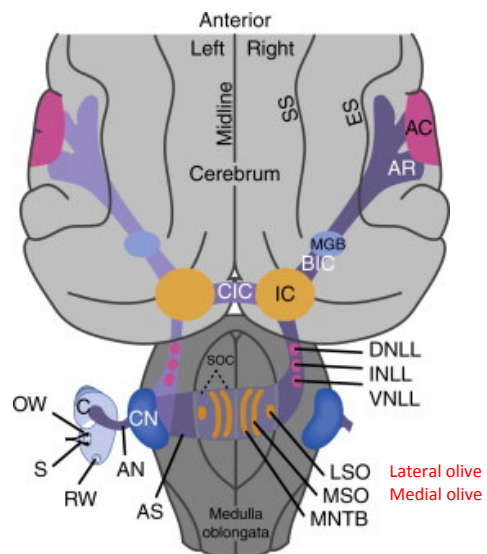
[17]

Inside the cochlea



[18]

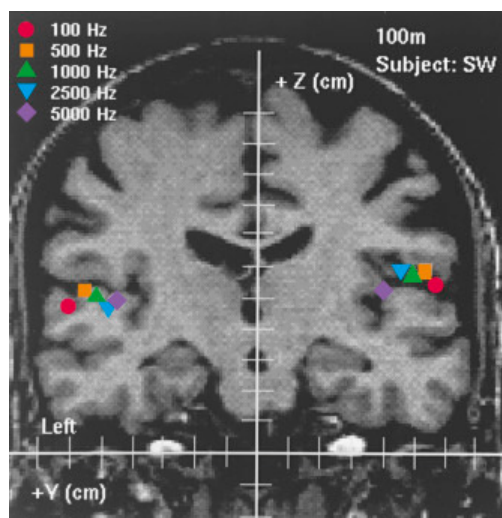
Destinations in brain



Squire

(19)

Hearing and the brain



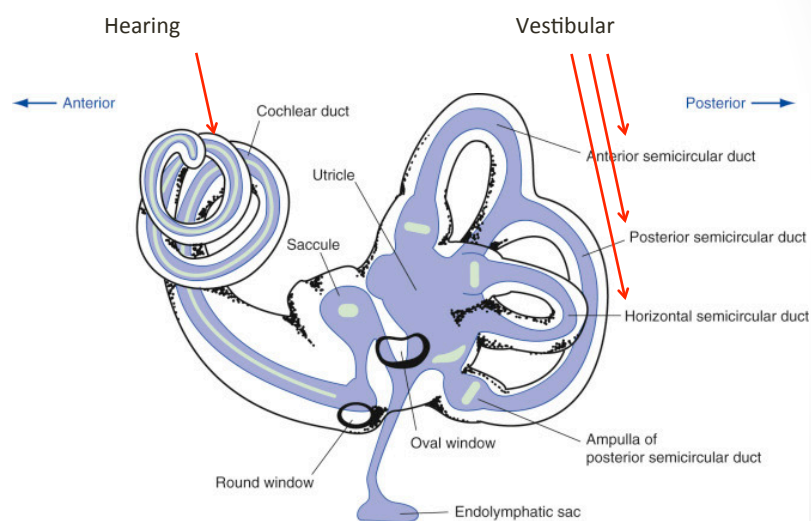
Vanderah

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VESTIBULAR

[21]

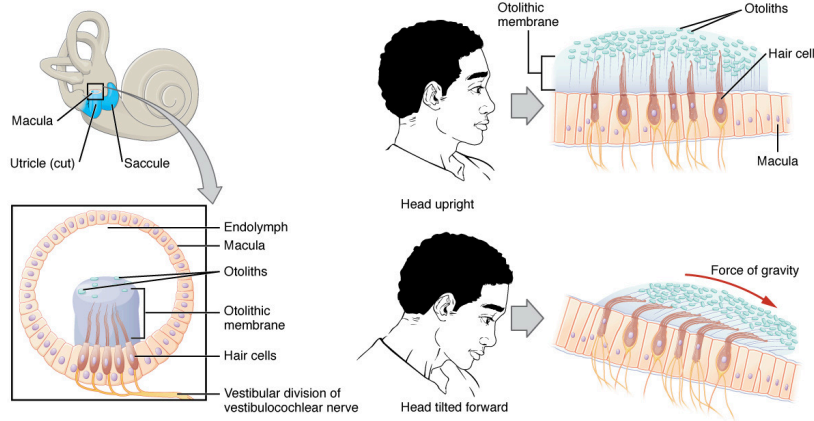
The inner ear – double duty



[22]

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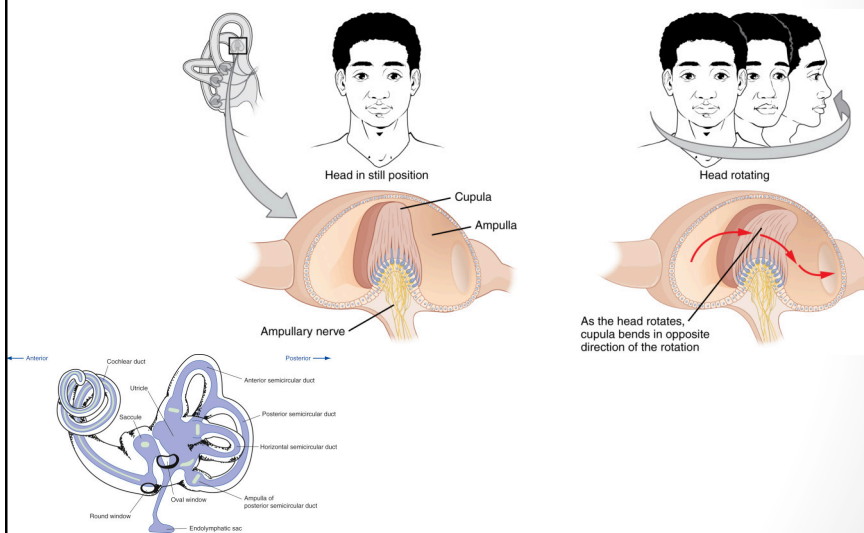
Position



[23]

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Rotation

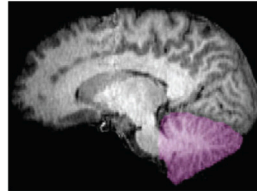


[24]

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Vestibular destinations

- Cerebellum
- Thalamus
- Reticular formation (brainstem)
- Spinal cord

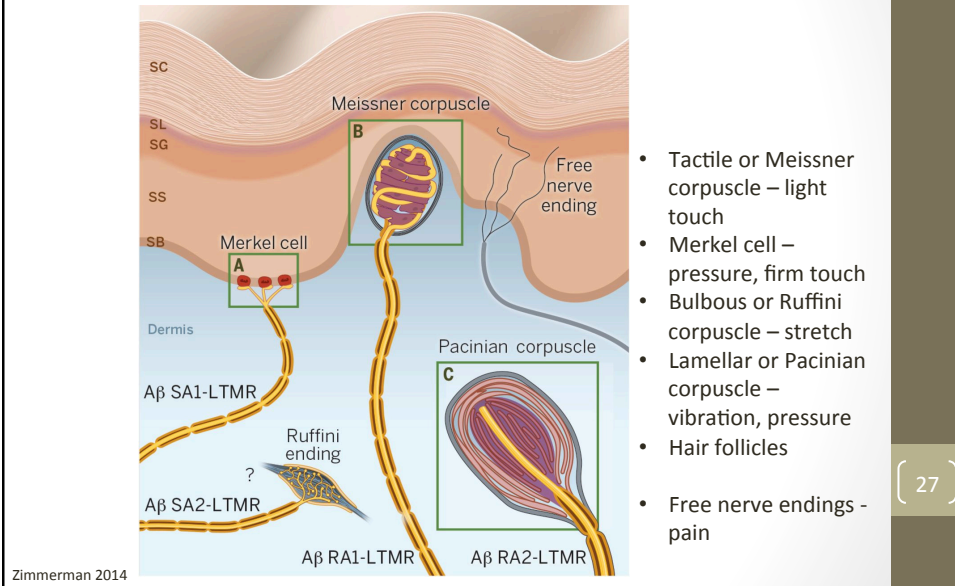


[25]

PERIPHERAL RECEPTORS

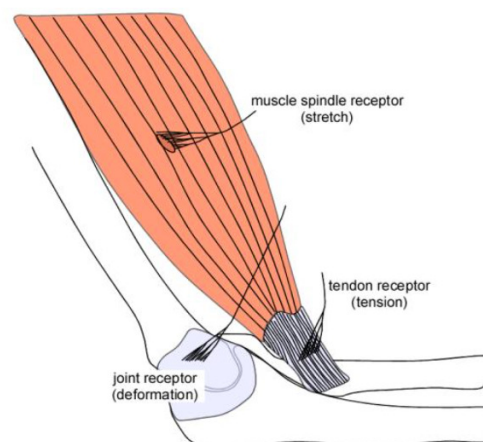
[26]

Touch receptors



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Proprioceptors



Muscle spindles

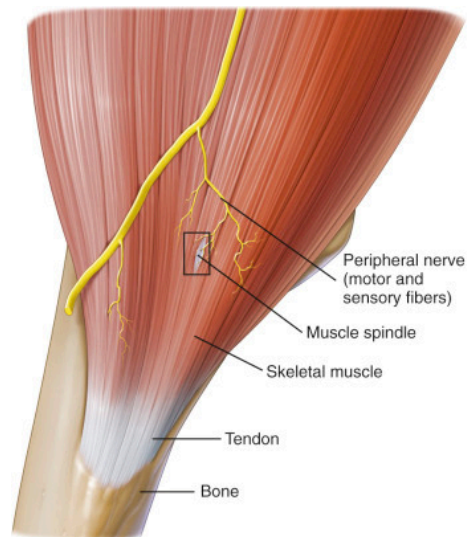
Golgi tendon organs

Fibrous joint capsules

[28]

Ric Robinson

Proprioceptors

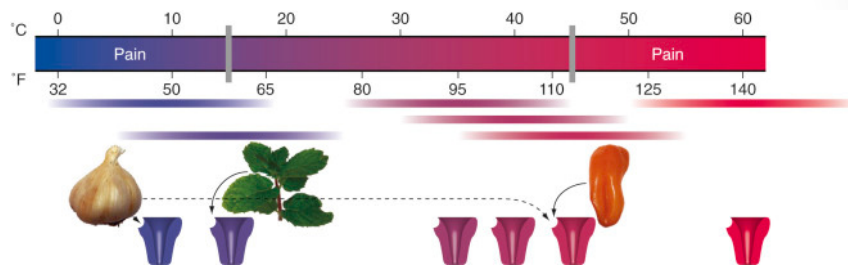


Vanderah

A

[29]

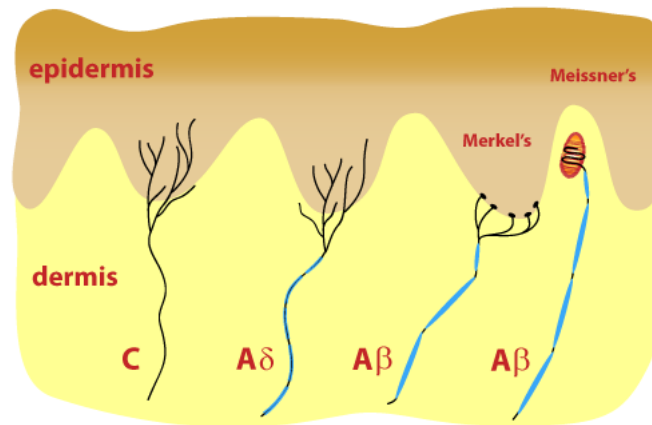
Temperature



Vanderah

[30]

Pain - nociceptors



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Linder

Axon diameter

from what receptors?	proprioceptors in striated muscle	skin mechanoreceptors (previous figure)	skin pain & temp receptors (previous figure)	skin pain & temp receptors, itch (previous figure)
conduction speed	80 - 120 m/sec	35 - 75 m/sec	35 - 75 m/sec	0.5 - 2 m/sec
axon diameter	10-20 μm	6-9 μm	1-5 μm	0.2-1.5 μm
relative size of cross section				

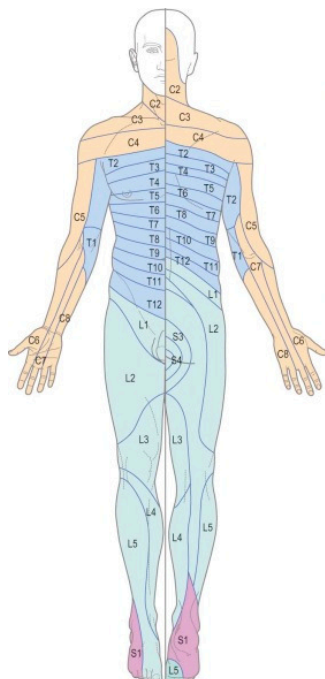
(32)

Ric Robinson

BODY TO BRAIN

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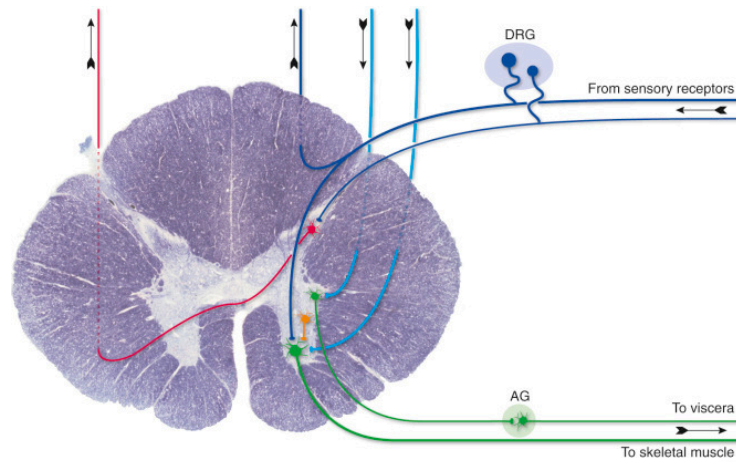
Dermatome



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Mancall

Spinal cord



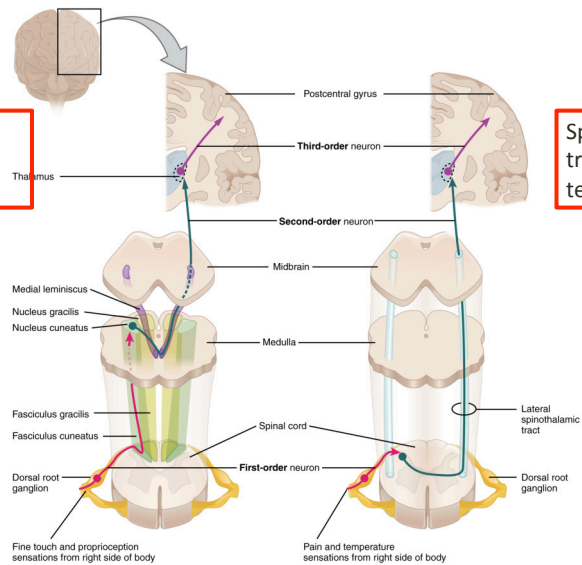
Vanderah

[35]

Spinal cord

Dorsal column:
touch,
proprioception

Spinothalamic
tract: pain,
temperature



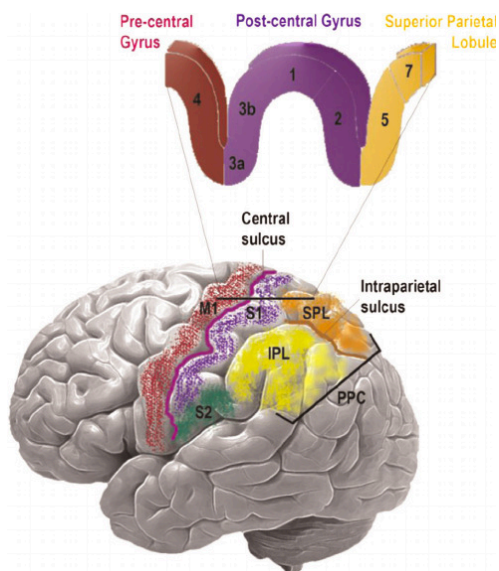
OpenStax

Dorsal column system

Spinothalamic tract

[36]

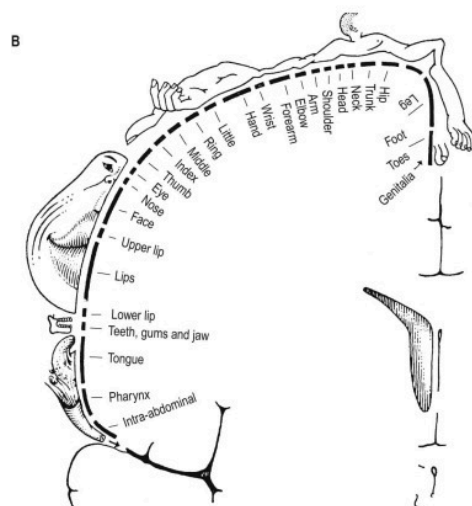
Principal somatosensory areas



Ackerley 2015

[37]

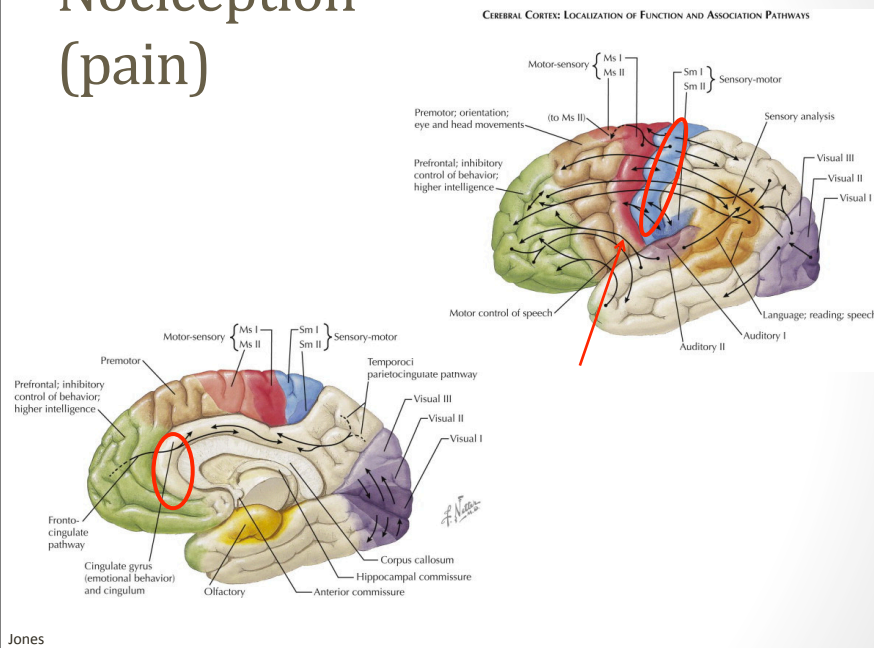
Somatosensory cortex



Mancall

[38]

Nociception (pain)

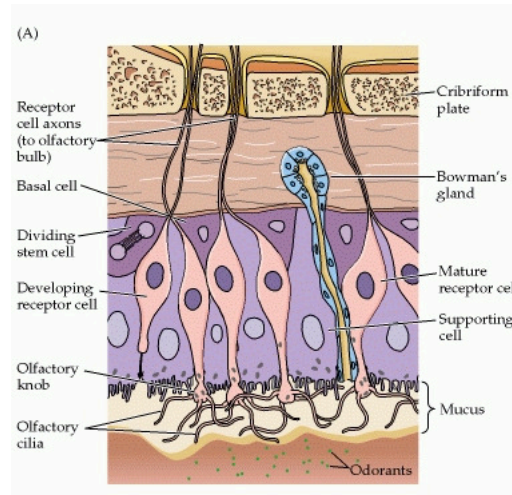


[39]

OTHER SENSES (NOT IN NEURAL
ENGINEERING MUCH)

[40]

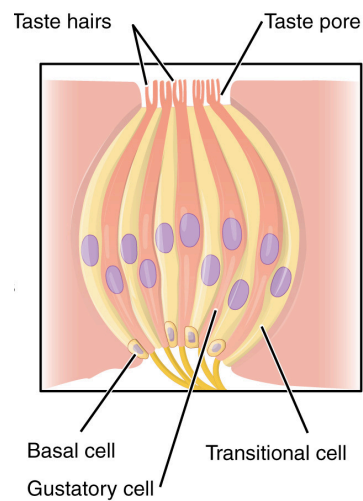
Smell



Purves

[41]

Taste



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[42]

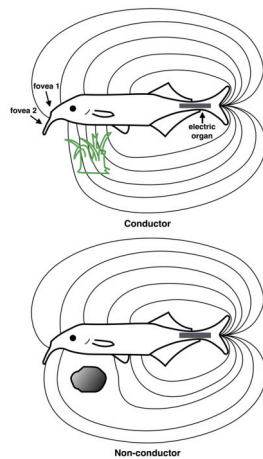
Vomeronasal



Wikimedia

[43]

Electro- and magnetoreception



[44]