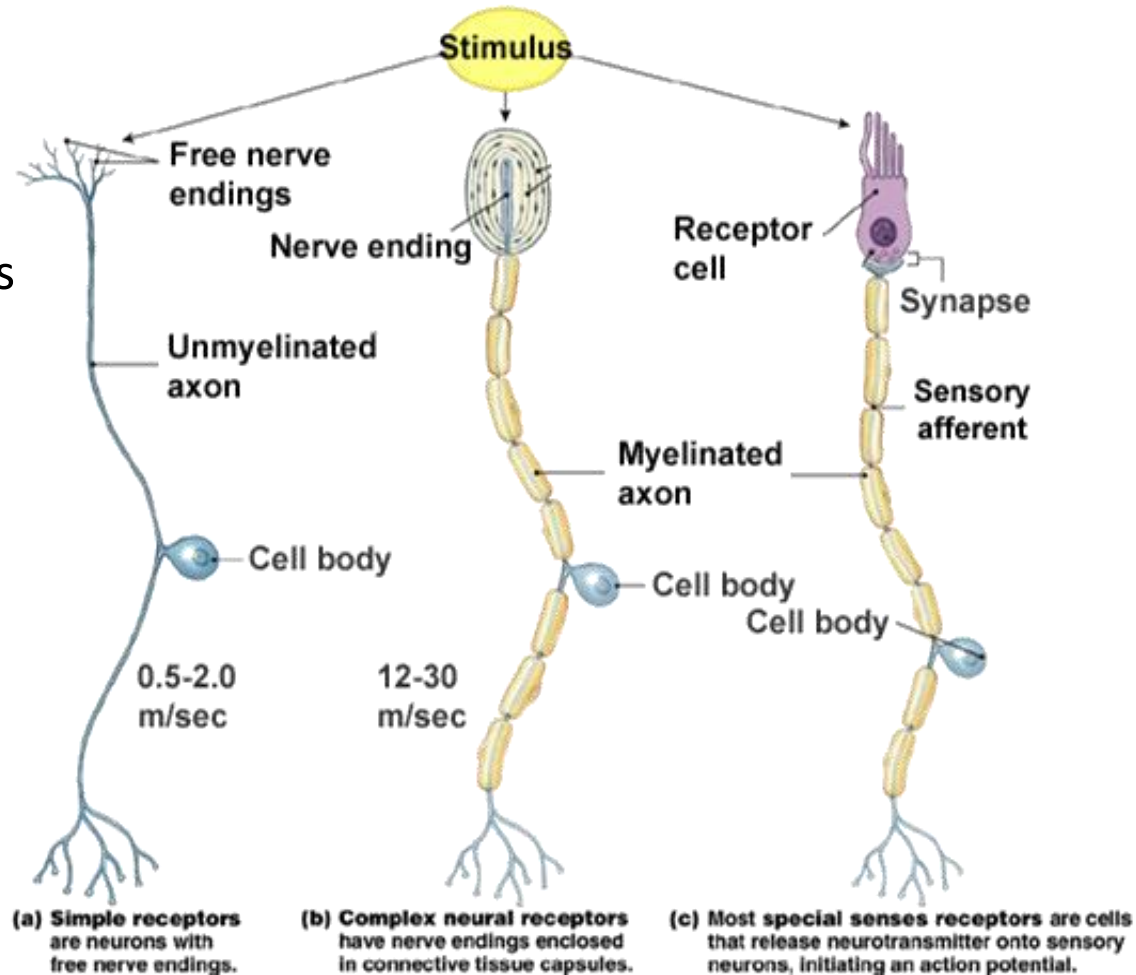


**6**

**Somatosensitivity,  
viscerosensitivity, proprioception  
and pain II**

# Receptors

- Simple
- Complex
- General
  - Superficial – somatosensors
  - Deep – viscerosensors
  - Muscles, tendons, joints – proprioceptors
- Special
  - Part of sensory organs
- Mechanoreceptors
- Thermoreceptors
- Chemoreceptors
- Fotoreceptors

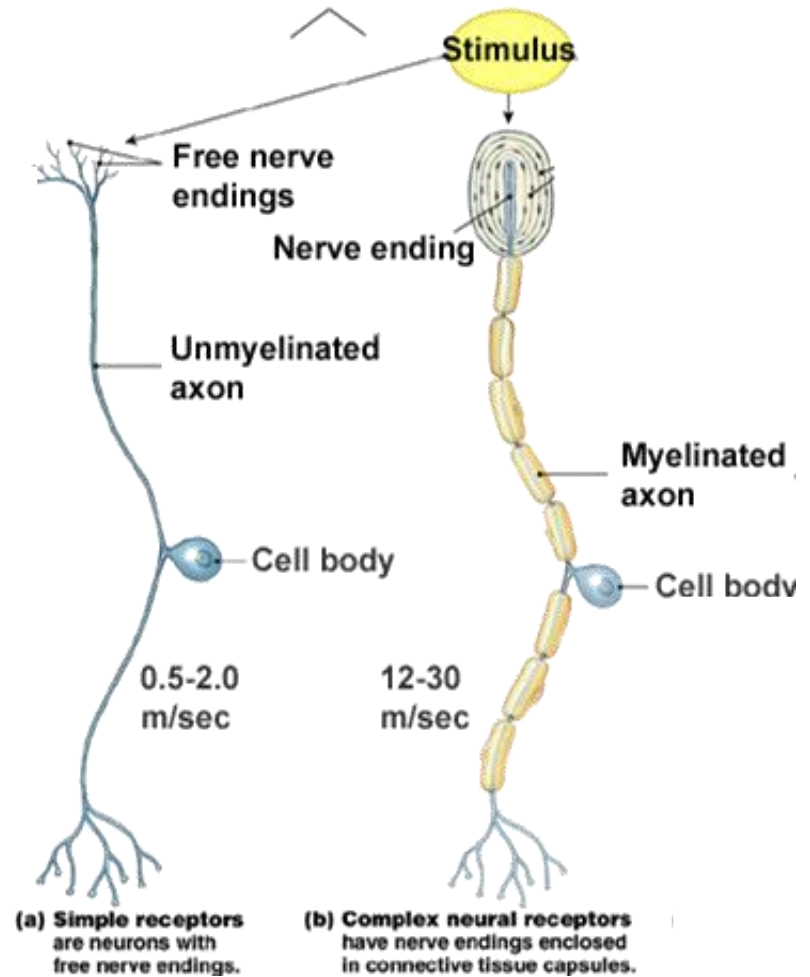


# Somato/viscero/ proprio sensitivity

- Somatosensitivity
  - Pain
  - Temperature
  - Touch
- Viscerosensitivity
  - Pain
- Proprioception
  - Position
  - Movement

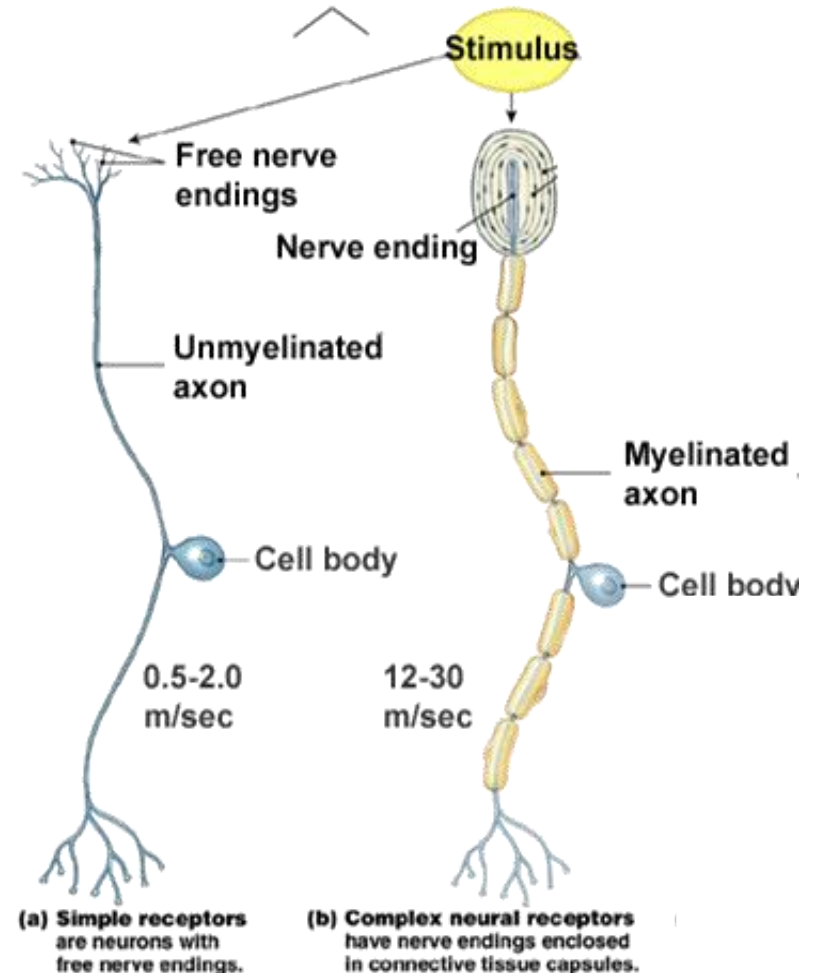
**Evolutionary  
point of view**

**The majority of  
information does not reach  
consciousness**



# Evolutionary point of view

- The signals indicating potential damage are the most important and the corresponding systems evolved early
  - Pain
  - Temperature
- The touch signals have adaptive value and evolved later



# Evolutionary point of view

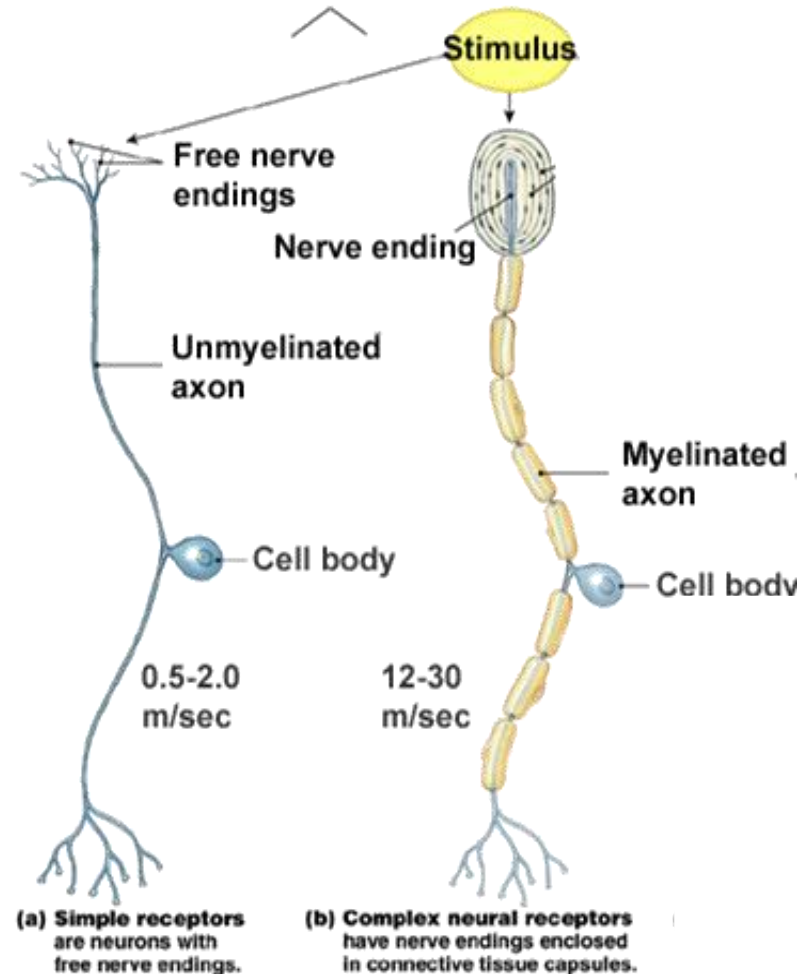
- The signals indicating potential damage are the most important and the correct response evolved

**Immediate survival**

- Temperature

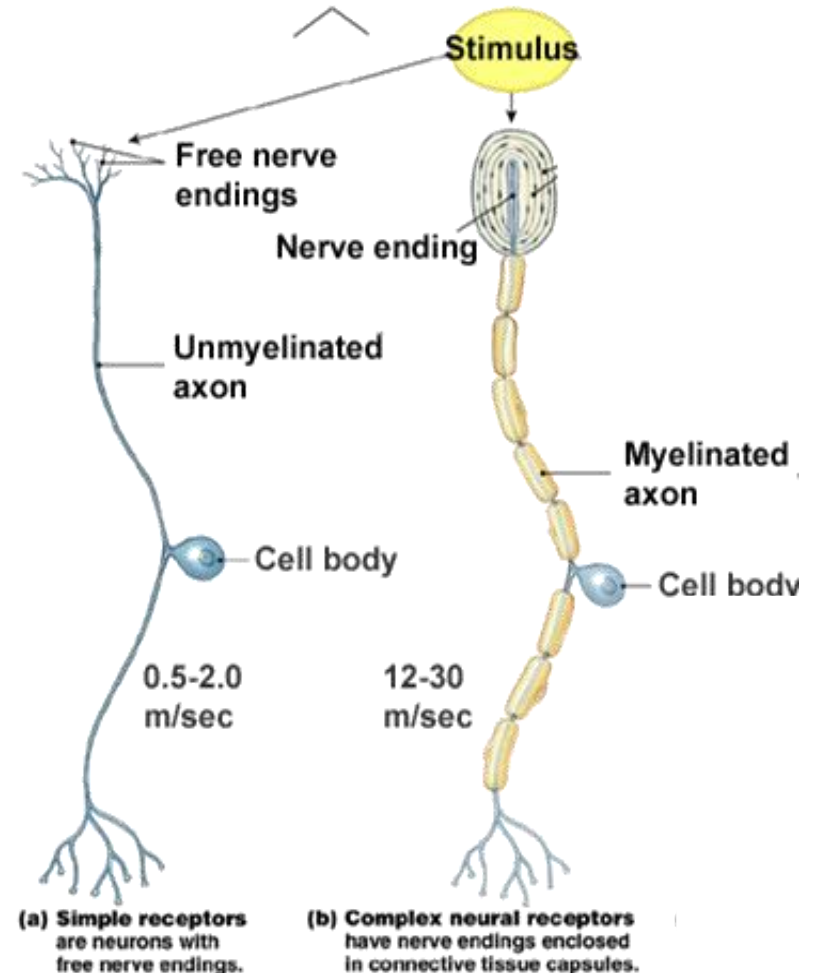
- The evolution of more complex neural receptors have adaptive value

**Long-term survival**



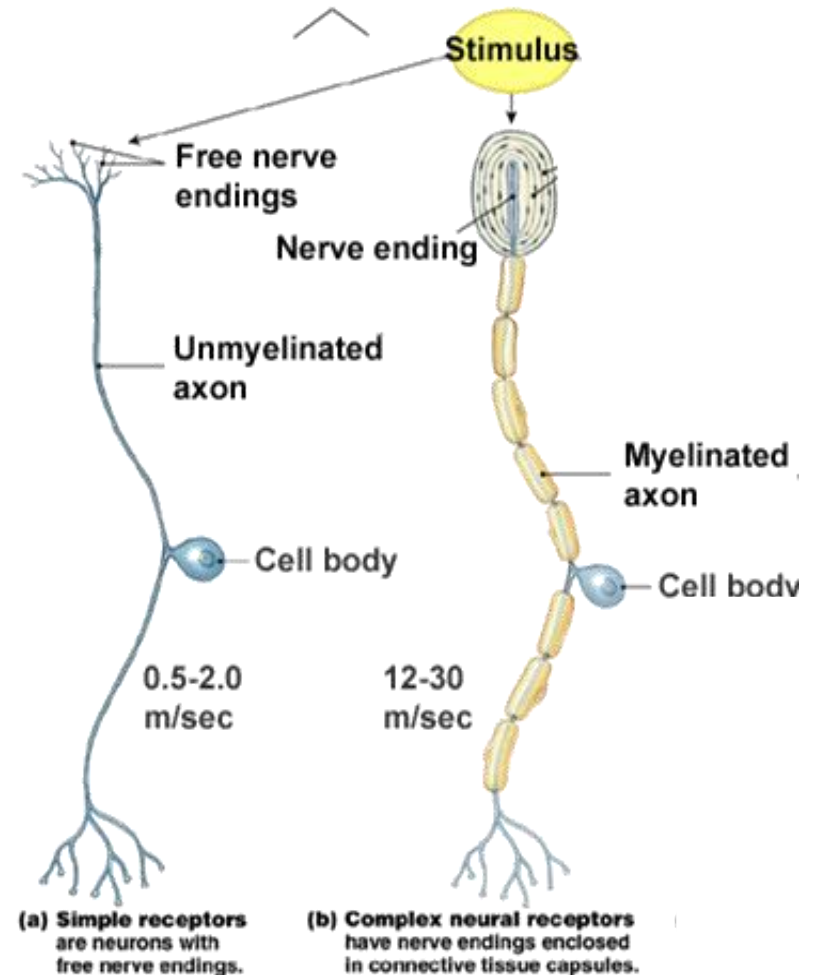
# Evolutionary point of view

- The signals indicating potential damage are the most important and the corresponding systems evolved early
  - Pain
  - Temperature
- The touch signals have adaptive value and evolved later
- The structure of the receptor, nerve fibers and pathways reflects the evolution

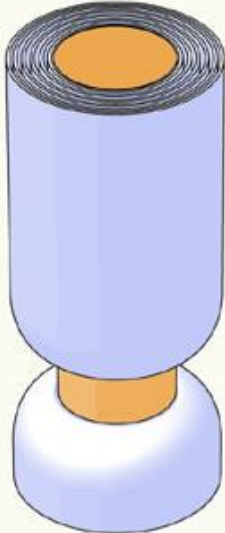





# Free nerve endings

- Non-specialized nerve endings
- Polymodal
  - Nociception
  - Thermoreception
  - Mechanoreception
- A delta fibres
- C fibres



# Nerve fibres

Axons from skin	$A\alpha$	$A\beta$	$A\delta$	C
Axons from muscles	Group I	II	III	IV
				
Diameter ( $\mu\text{m}$ )	13–20	6–12	1–5	0.2–1.5
Speed (m/sec)	80–120	35–75	5–30	0.5–2
Sensory receptors	Proprioceptors of skeletal muscle	Mechanoreceptors of skin	Pain, temperature	Temperature, pain, itch



# Nociceptors

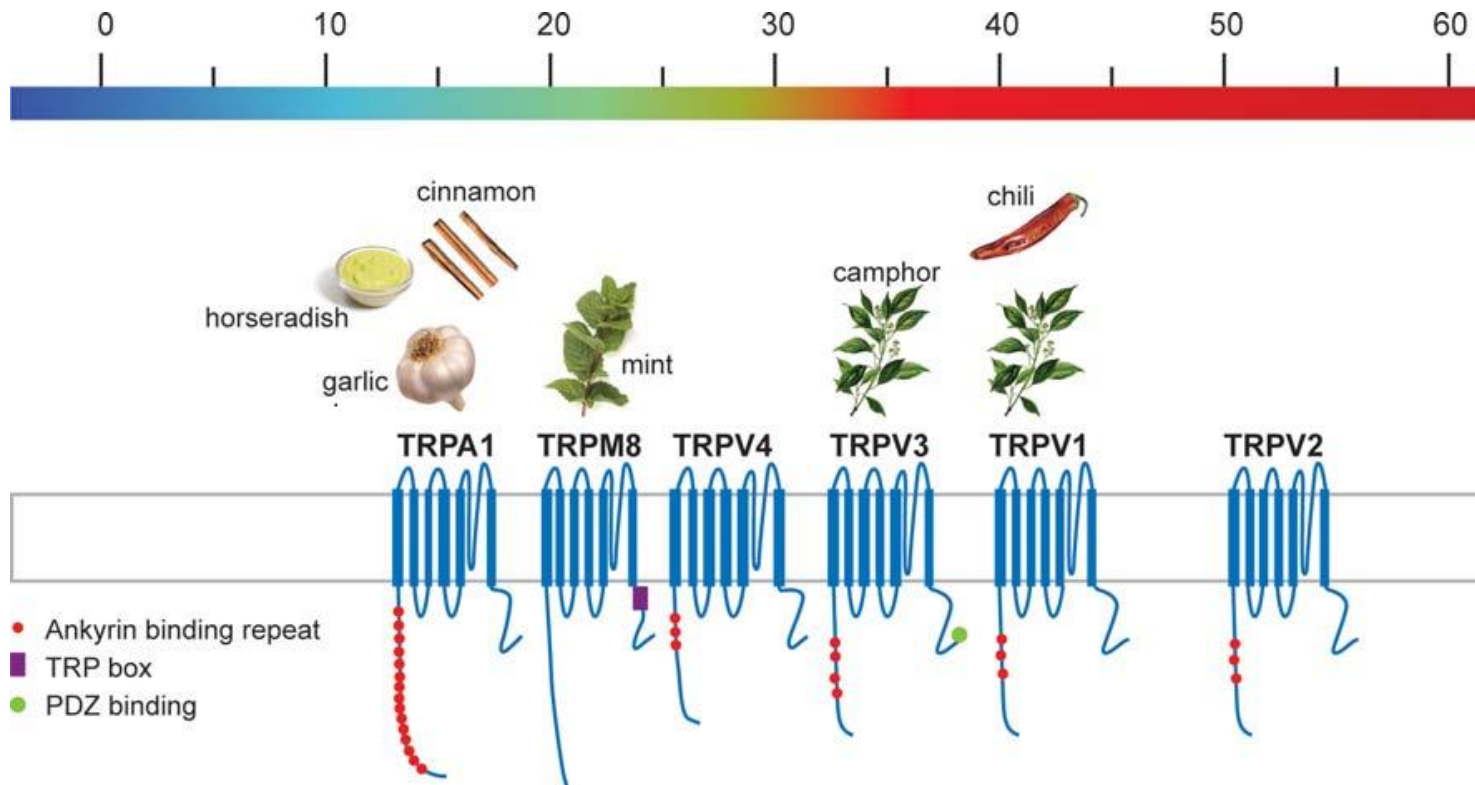
- Free nerve endings responding to high-intensity stimuli
- Stimulus
  - Mechanical
    - ✓ High pressure
    - ✓ Sharp object
  - Thermal
    - ✓ Above aprox. 45°C
    - ✓ Low treshold – variable
  - Chemical
    - ✓ pH
    - ✓ Mediators of inflammation and so on

**A delta fibers**  
– sharp, localized pain

**C fibers**  
– dull, diffuse pain

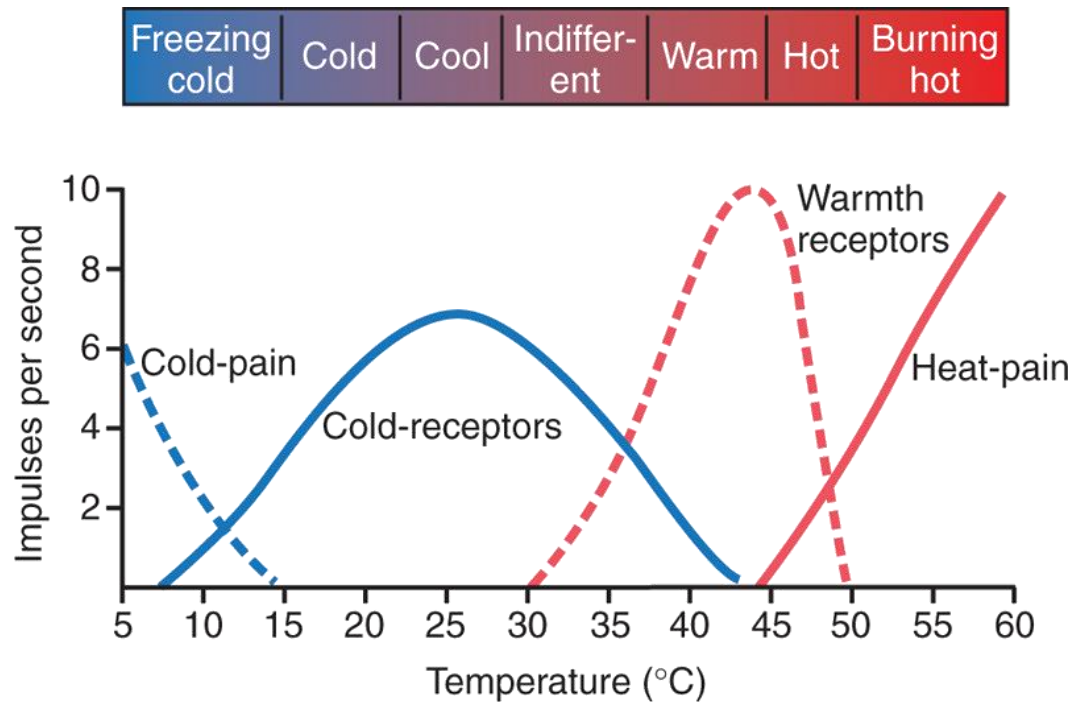
# Thermoreceptors

- Free nerve endings receptive to thermal stimuli
- TRP (transient receptor potential) channels
- Each subtype of TRP channel is sensitive to a certain temperature and chemical substance



# Thermoreceptors

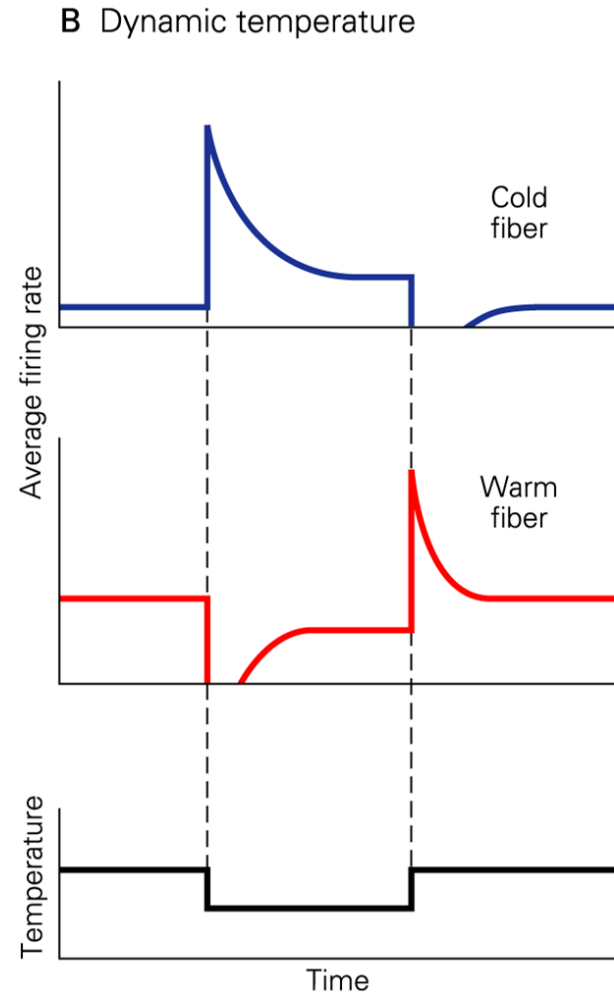
- Perceived temperature is determined by relative activity of cold and warm receptors



Hall: Guyton and Hall Textbook of Medical Physiology, 12th Edition  
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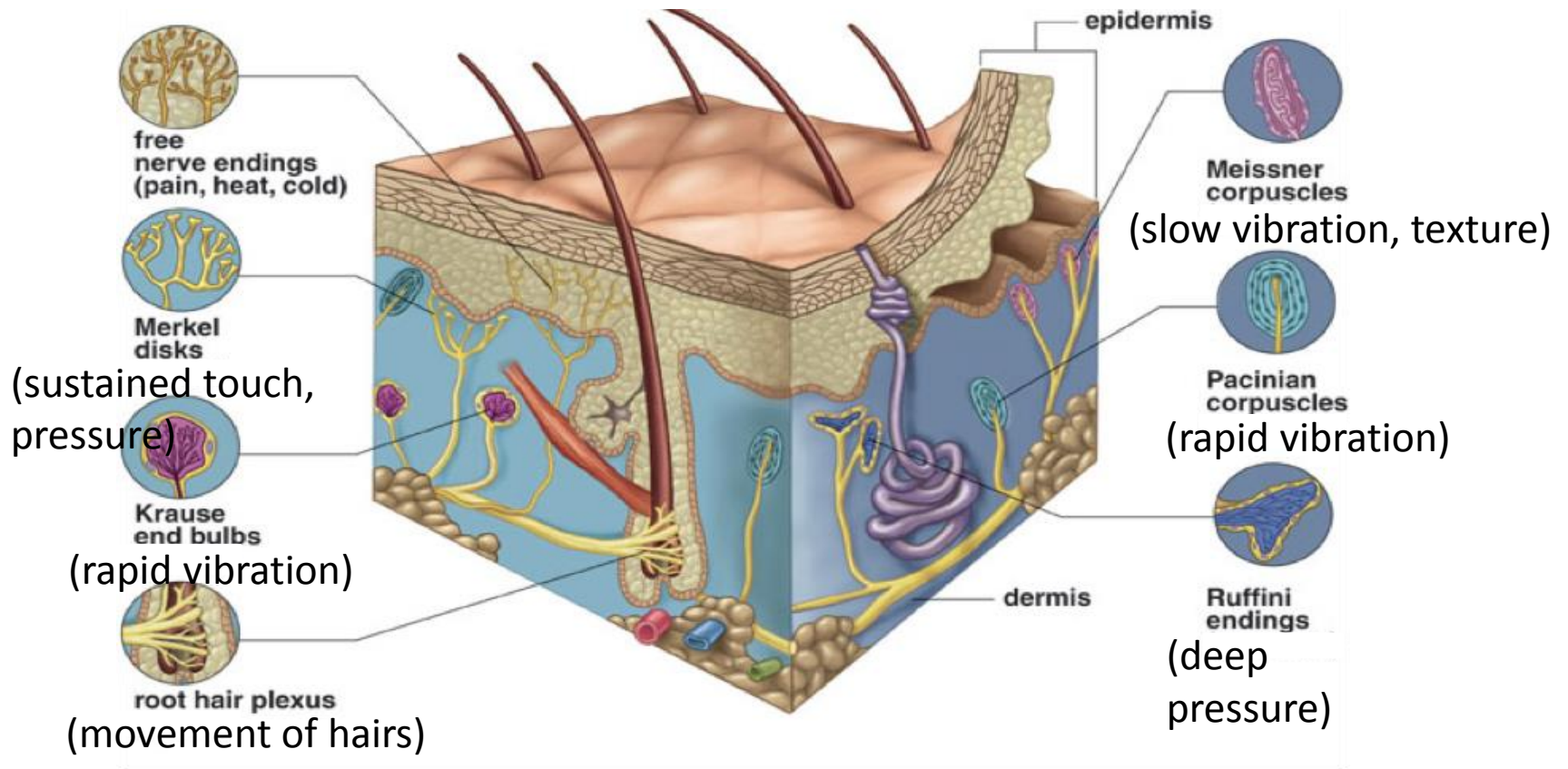
# Thermoreceptors

- Mostly phasic response



# Skin receptors

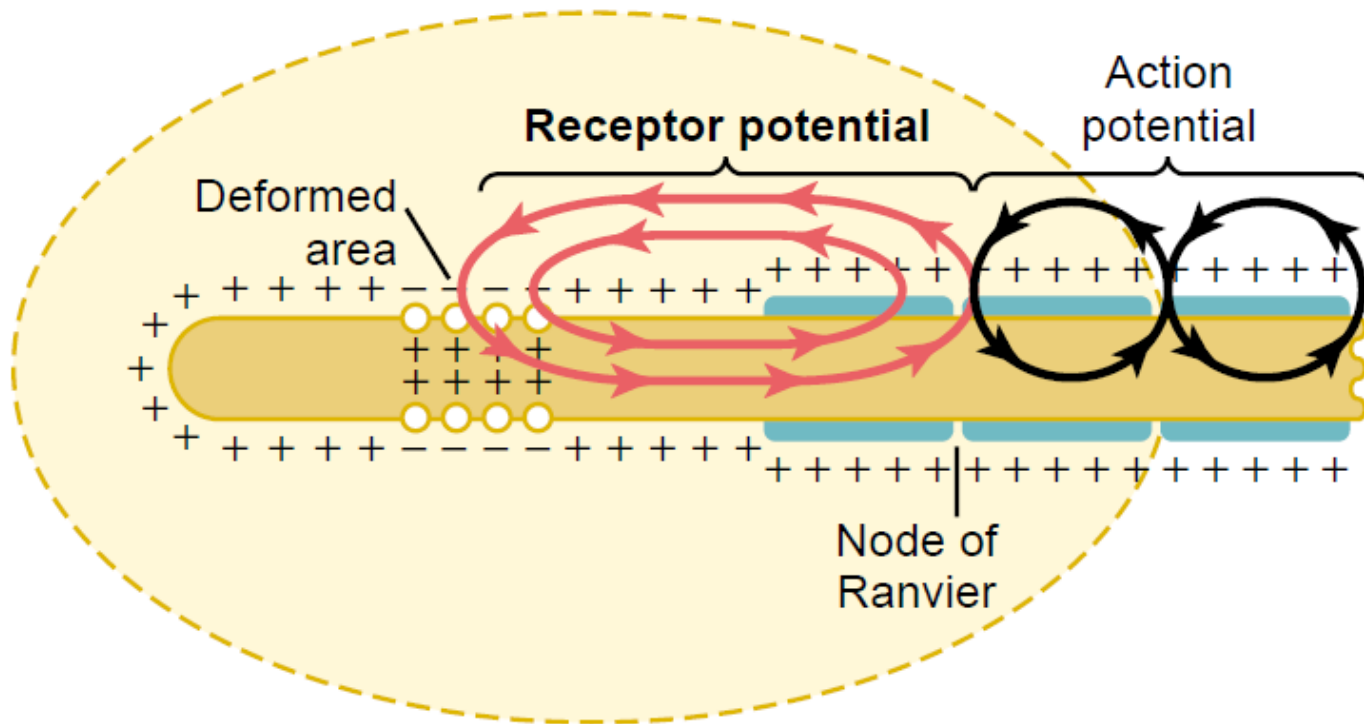
Simple *versus* complex



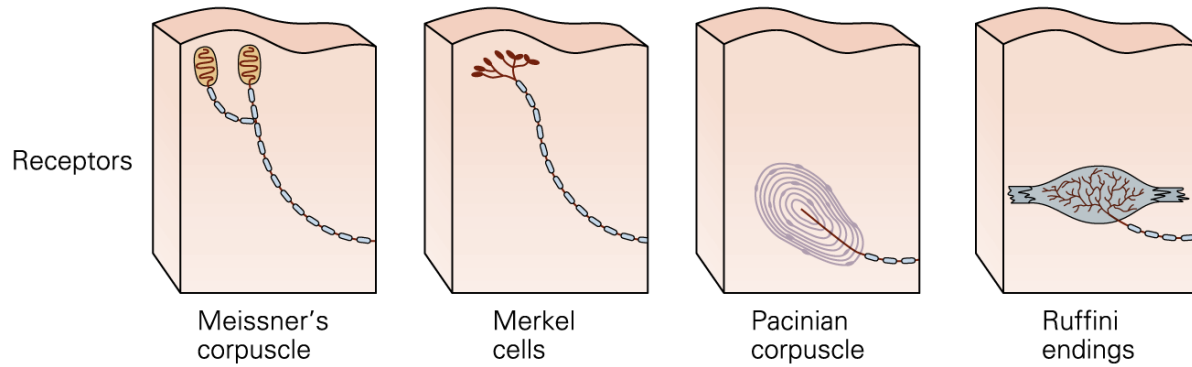
# Skin receptors

Receptor	Type	Sensation	Signals	Adaptation
<b>Meissner corpuscle</b>	Encapsulated & layered	Touch: Flutter & Movement	Frequency/Velocity & Direction	Rapid
<b>Pacinian corpuscle</b>	Encapsulated & layered	Touch: Vibration	Frequency: 100-300 Hz	Rapid
<b>Ruffini corpuscle</b>	Encapsulated collagen	Touch: Skin Stretch	Direction & Force	Slow
<b>Hair follicle</b>	Unencapsulated	Touch: Movement	Direction & Velocity	Rapid
<b>Merkel complex</b>	Specialized epithelial cell	Touch, Pressure, Form	Location & Magnitude	Slow
<b>Free Nerve Ending</b>	Unencapsulated	Pain, Touch, or Temperature	Tissue damage, Contact, or Temperature change	Depends on information carried

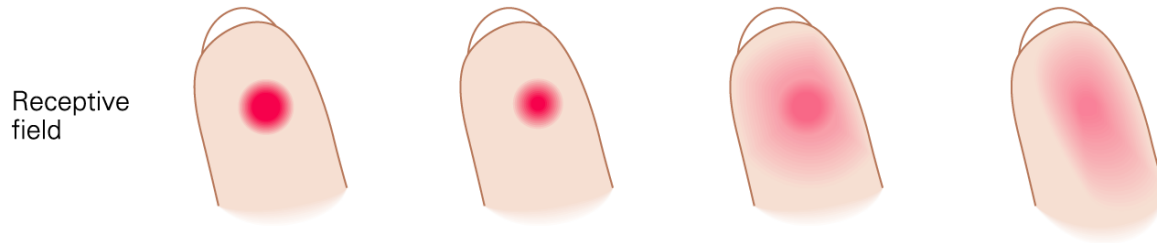
# Receptor potential *versus* action potential



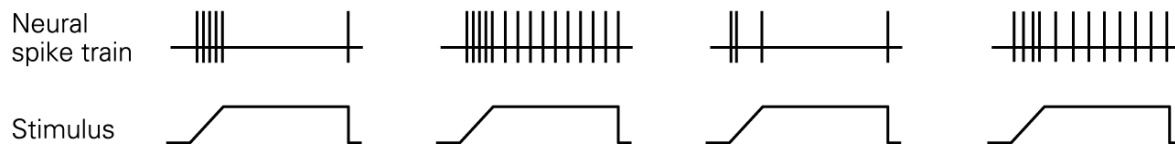
# Skin receptors



## B Location

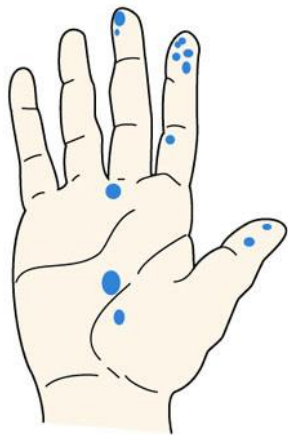
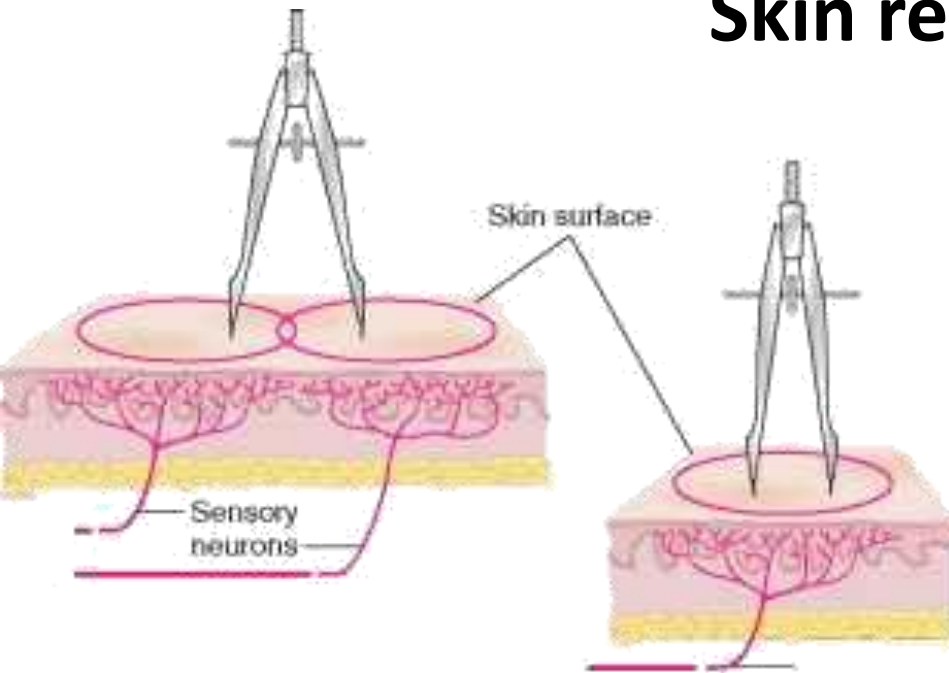


## C Intensity and time course

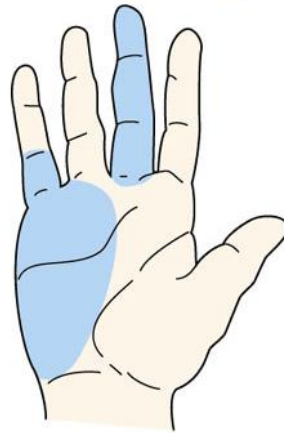




# Skin receptors

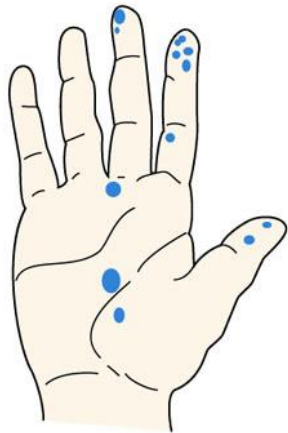
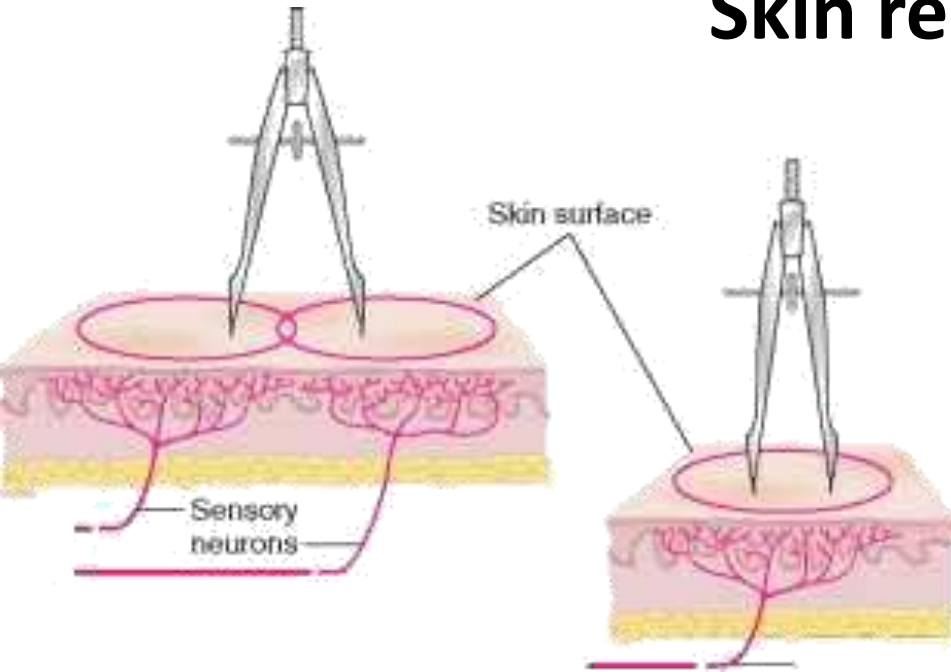


Meissner's corpuscles

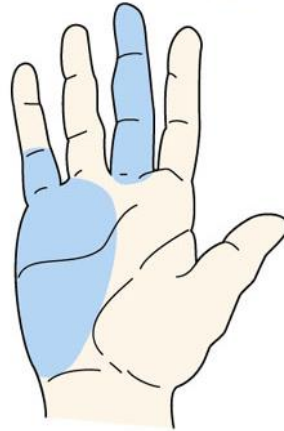


Pacinian corpuscles

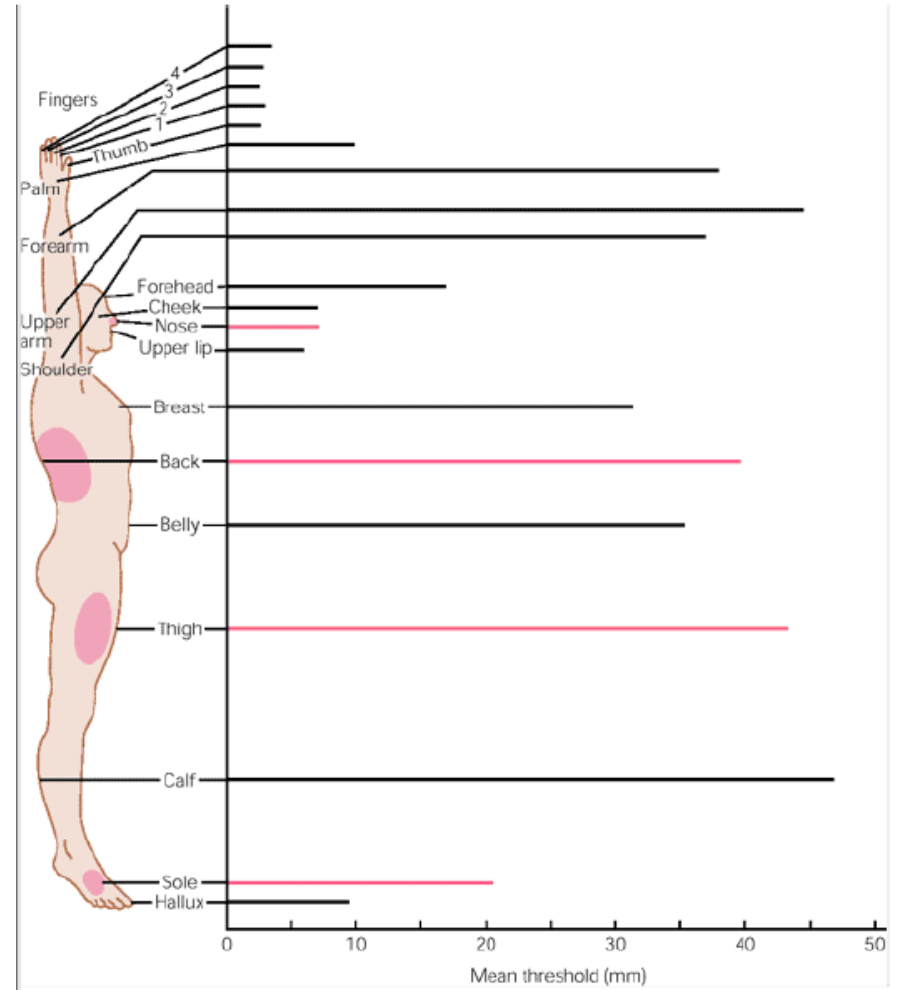
# Skin receptors



Meissner's corpuscles



Pacinian corpuscles



# Viscerosensitivity

- An information from visceral and cardiovascular system
- Linked to the autonomic nervous system
- The most of information does not reach higher structures than hypothalamus
- The most of information does not reach consciousness
- Parasympathetic nervous system (IX., X.)
  - „Operational information“ (blood pressure, pO<sub>2</sub>, pCO<sub>2</sub>)
- Sympathetic nervous system
  - „Potential danger“ (pressure, pain, cold)
- More will be discussed in lecture about the autonomic nervous system

# Proprioception

- Information from muscles, tendons, and joints
- Important for precise coordination of movements
- Overload protection
- More will be discussed in lecture about the motor system