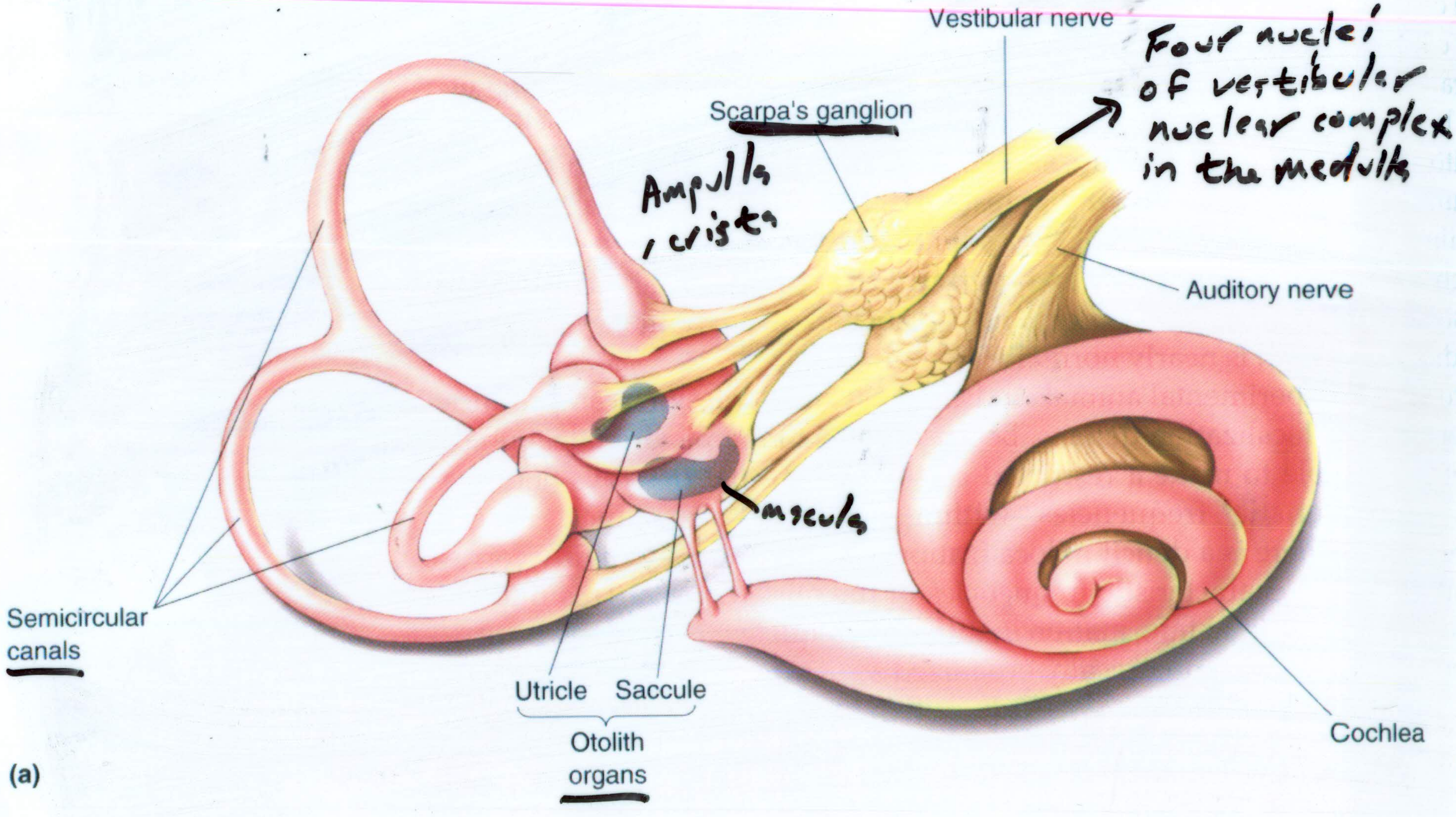


Vestibular nerve
Four nuclei of vestibular nuclear complex in the medulla
Scarpa's ganglion
Ampulla / crista
Auditory nerve
macula
Semicircular canals
Utricle
Saccule
Otolith organs
Cochlea

(a)

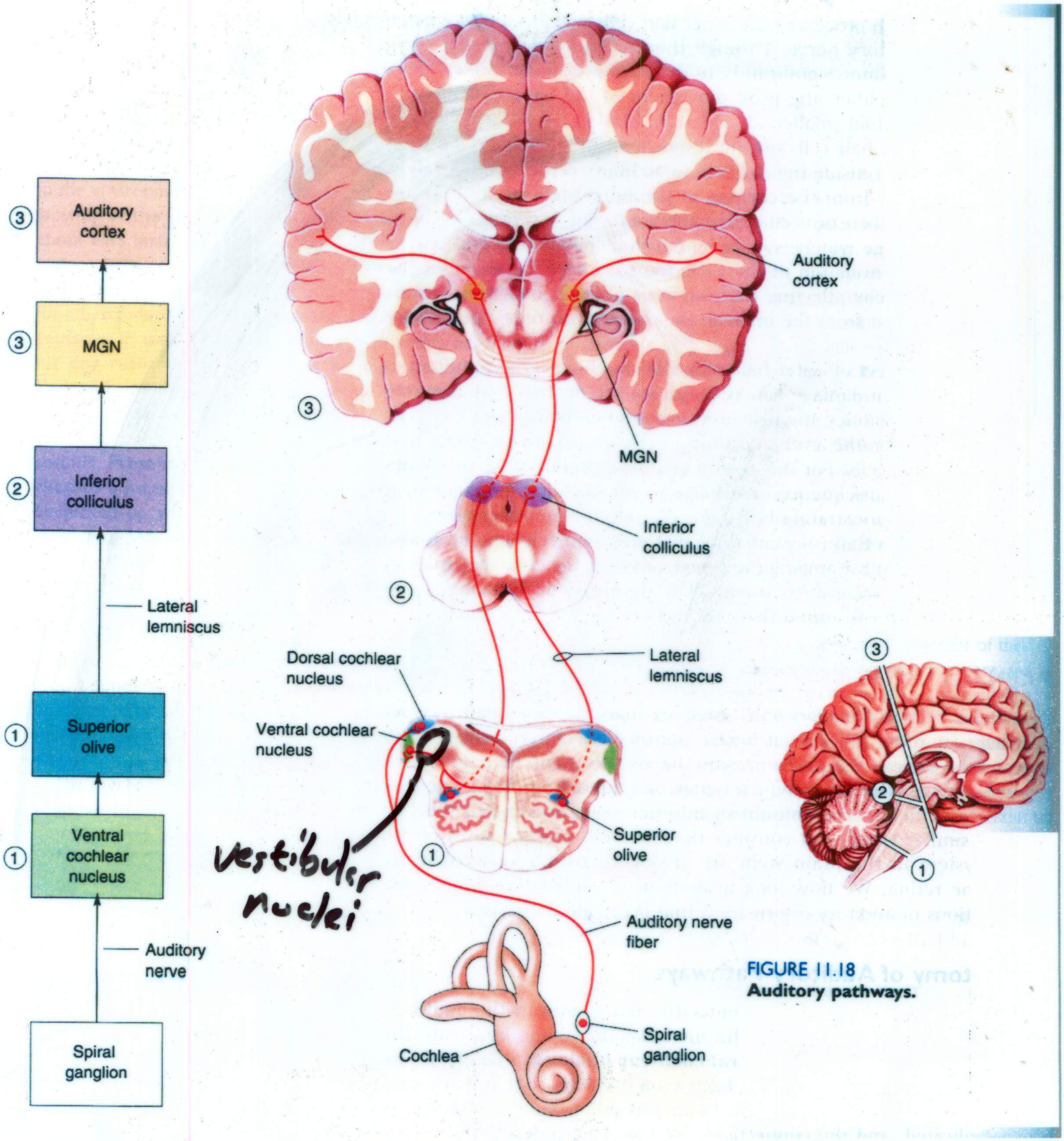
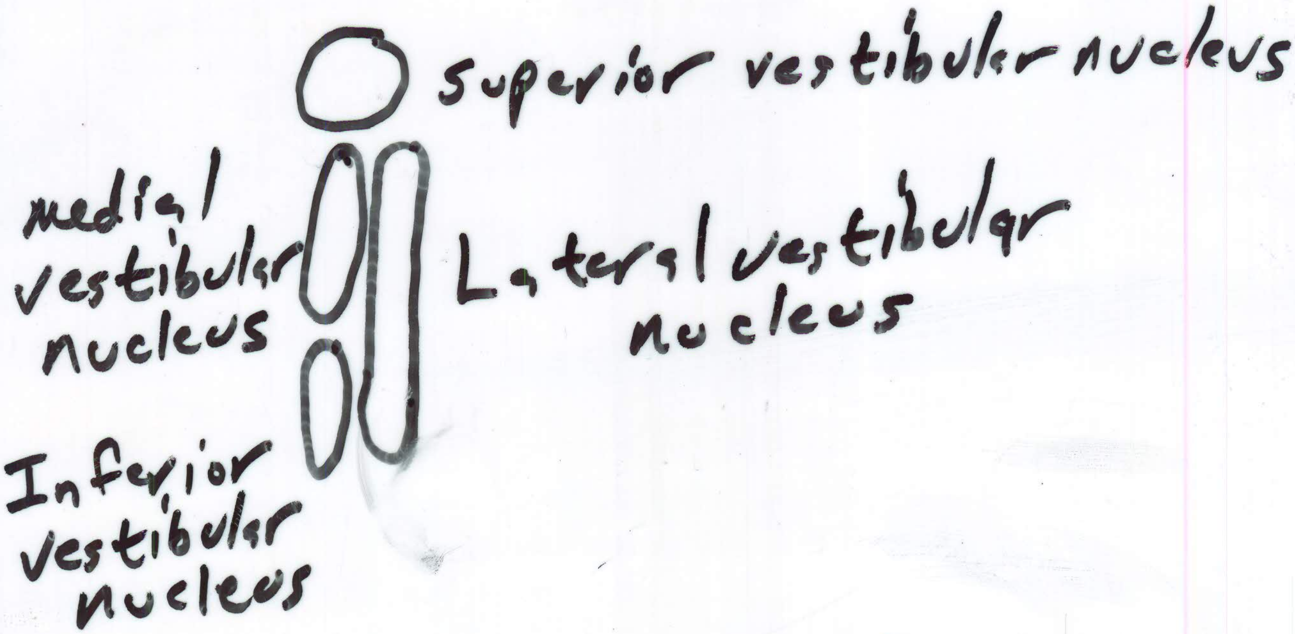


FIGURE 11.18
Auditory pathways.

4 vestibular nuclei



Neurons of the vestibular nuclei make 4 sets of connections:

- With motor neurons that innervate the extrinsic eye muscles (oculomotor nucleus, trochlear nucleus, abducens nucleus)

These connections mediate the vestibulo ocular reflex

- somatic motor neurons in the spinal cord.

Two tracts:

- medial vestibulospinal tract
- lateral vestibulospinal tract

These connections mediate postural adjustments in response to vestibular inputs.

- Connections with the cerebellum, which uses the vestibular inputs to coordinate vestibular reflexes.

- Connections with the ventral posterior nucleus of the thalamus, which relays the inputs to somatosensory + somatomotor cortex provides concious sense of head position relative to the body.

General Sensory Systems

a.k.a. Somatic Sensory Systems

Include:

sense of touch, temperature, pain, and proprioception (sense of relative position of your arms and legs to the rest of the body)

4 groups of somatic sensory receptors based on stimulus sensitivity:

Nocicceptors – respond to stimuli that are painful or have the potential to do tissue damage (ex. pinch)

Thermoreceptors - Respond best to changes in temperature

Chemoreceptors - Respond to changes in the chemical composition of body fluids

Mechanoreceptors - respond to mechanical Stimuli (ex. touch applied to the skin)

Nociceptors

Free nerve endings in the tissues, thinly myelinated or unmyelinated, found in most tissues with exception of the brain and spinal cord.

4 types:

- Mechanical nociceptors – respond to strong pressure from a sharp object (ex. a tack)
- Thermal nociceptors – respond to burning heat (temps > 45°C)
- Chemically sensitive – mechanically insensitive nociceptors –

respond to extremes in
pH or neuroactive substances
released by damaged tissue.

— Polymodal nociceptors —
respond to a combination
of mechanical, chemical,
and thermal stimuli.

Thermoreceptors

Free nerve endings that are
thinly myelinated or unmyelinated

Found in:

— In the CNS (hypothalamus +
spinal cord)

sense body temp and
initiate autonomic reflexes
when body temp varies
from 37°C.

Autonomic reflexes causing vasodilation
or vasoconstriction of blood vessels
supplying blood to body surface.

- In skin
  Two types:
  - Cold thermoreceptors
    Respond best to changes
    in temperature below
    35°C down to 10°C,
    below which they stop
    responding.

Some cold receptors will also respond
to temps > 45°C

But brain interprets the activation of these receptors by this hot temp. as a cold stimulus.

"paradoxic cold"

Warm thermoreceptors –

Respond to changing temps > 30°C up to 45°C at which point they stop responding.

These thermoreceptors respond to changes in temperature not an absolute temperature

If they are exposed to a fixed temp for more than a few minutes they stop responding.

This phenomenon, in which a receptor stops responding to a constant of fixed stimulus is called "sensory adaptation."

Mechanoreceptors

most numerous and most structurally diverse of somatic sensory receptors.

Respond to stimuli that stretch or distort the tissue they are located in.

3 general types:

- Baroreceptors – sense the stretch in the walls of blood vessels, the urinary bladder, or rectum

initiate autonomic reflexes,
ex. cardiovascular reflexes that regulate blood pressure and heart rate.

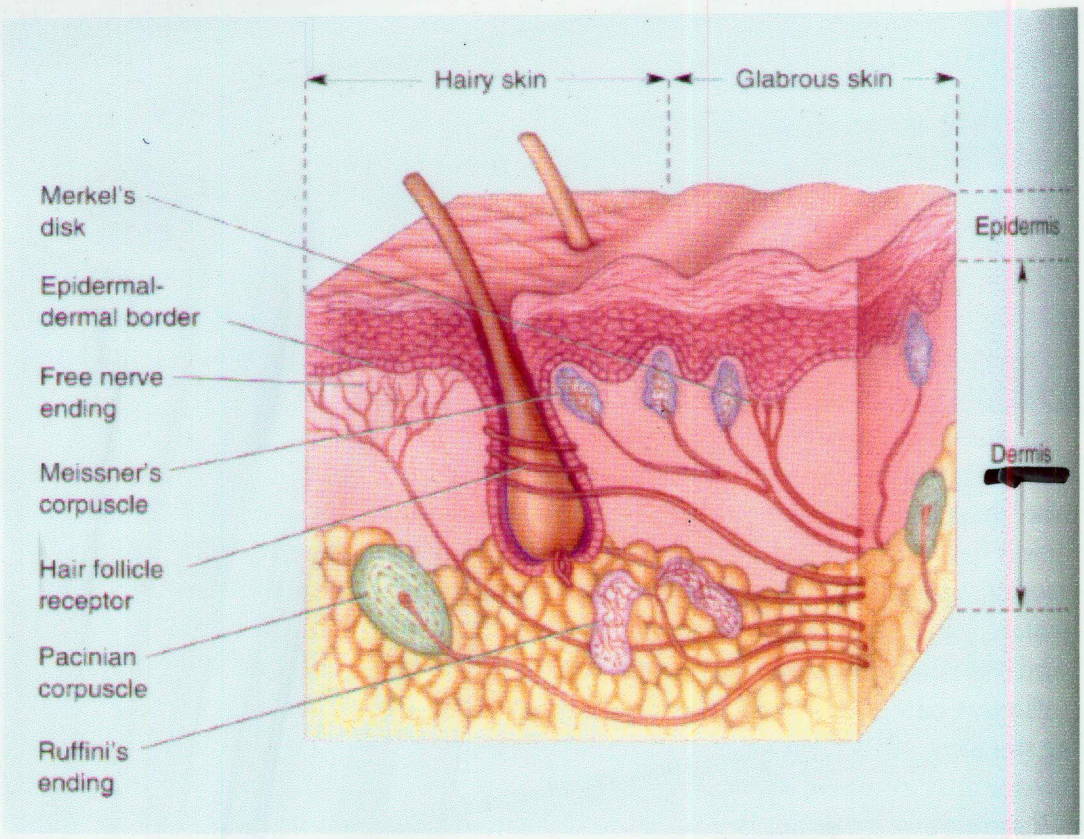
urinary bladder → urination reflex
rectum → defecation reflex

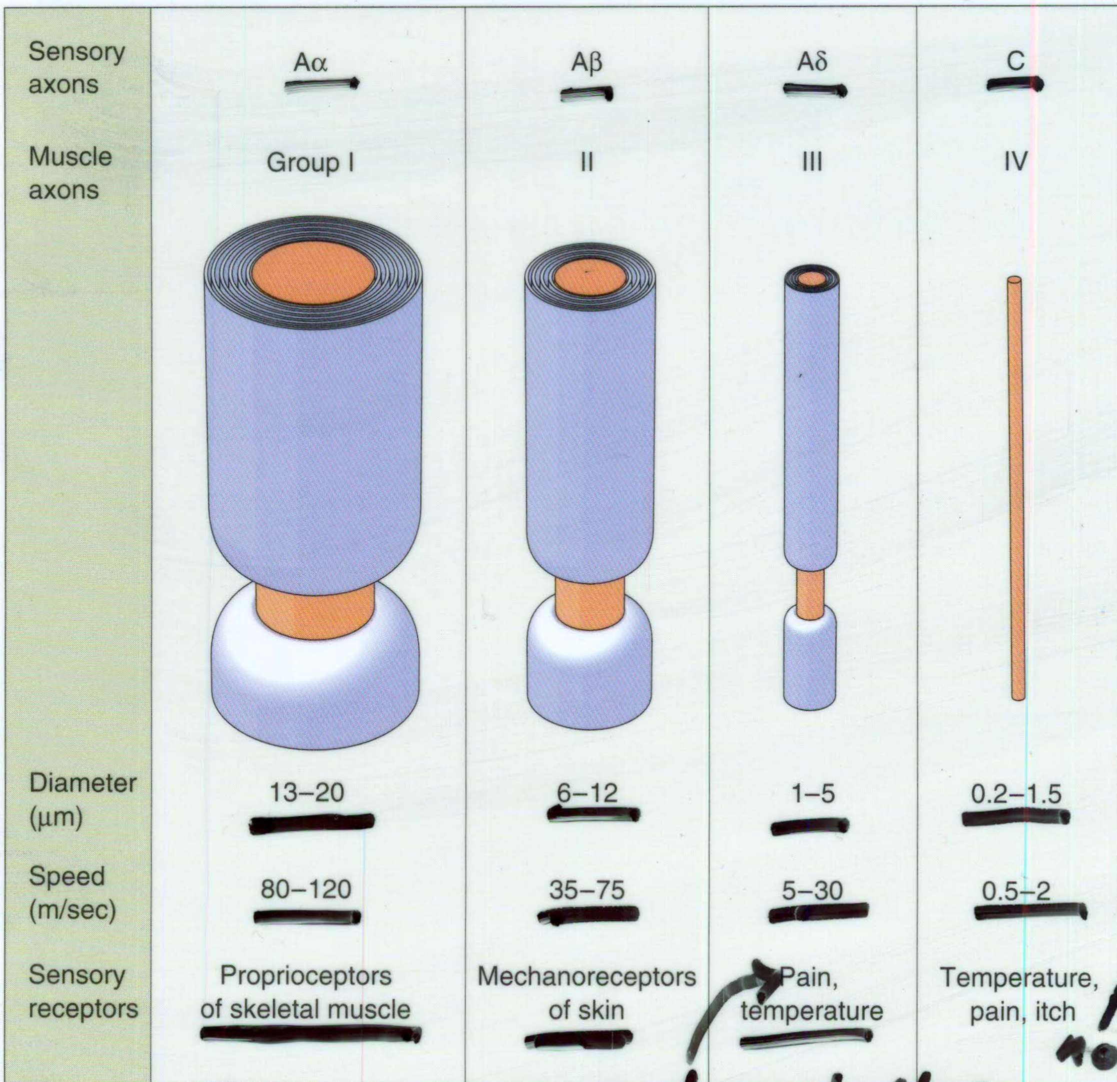
- Proprioceptors – found in connective tissues of joints + in somatic muscles

sense stretch in these
tissues and CNS uses
this info to sense limb
position relative to the
rest of the body.

- Tactile receptors - sense touch
and vibration
stimuli applied
to the skin

12.1


Hairy skin
Glabrous skin
Merkel's disk
Epidermal-dermal border
Free nerve ending
Meissner's corpuscle
Hair follicle receptor
Pacinian corpuscle
Ruffini's ending
Epidermis
Dermis



mech. nociceptors

polymodal nociceptors & thermal nociceptors

Figure ~~12.10~~ 12.9

Various sizes of primary afferent axons. The axons are drawn to scale but are shown 2000 times life size. The diameter of an axon is correlated with its conduction velocity, and with the type of sensory receptor to which it is connected.

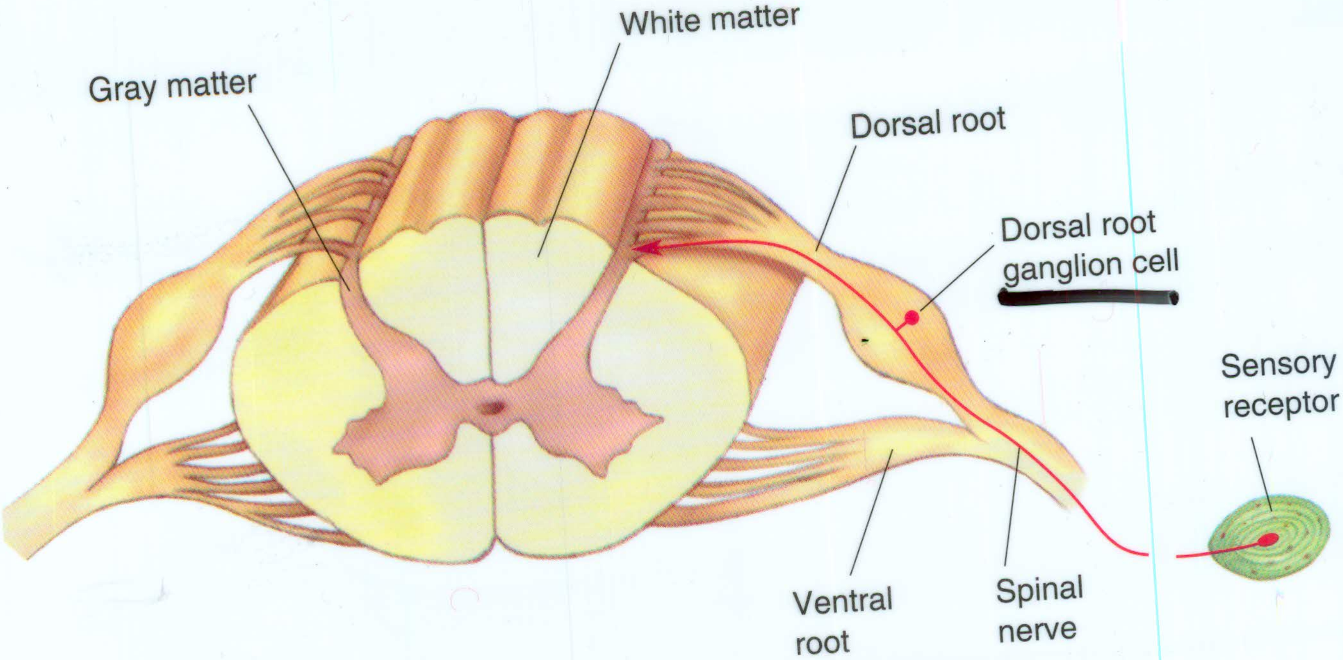
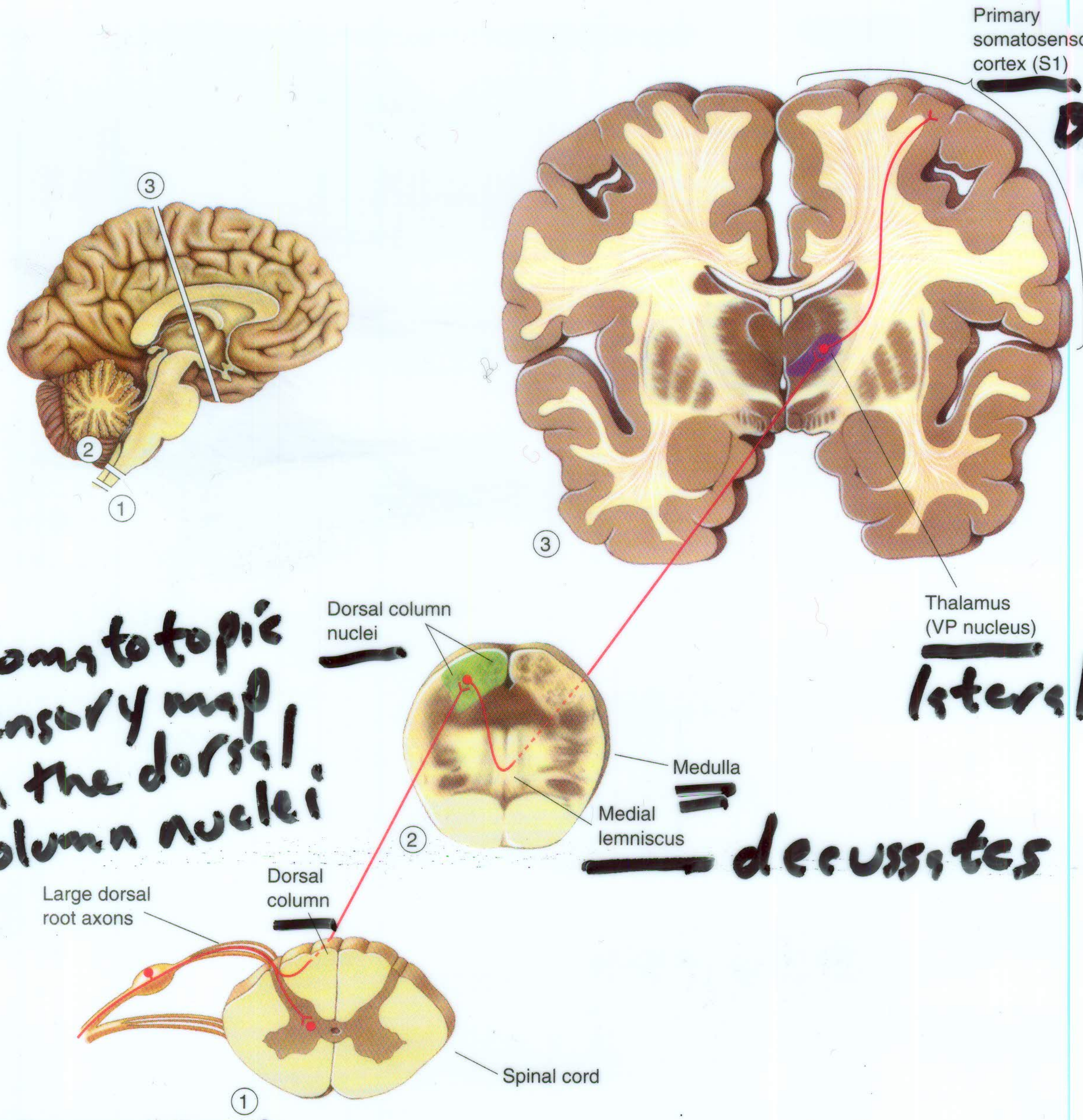


Figure ~~12.9~~ 12.8
Structure of the spinal cord and its roots.

Two pathways by which somatic sensory sensations reach the cerebral cortex.



Broadmann areas 1, 2, +3

lateral part

Somatotopic sensory map on the dorsal column nuclei

decussates

Figure ~~12.15~~ 12.14
The dorsal column-medial lemniscal pathway. This is the major route by which touch and proprioceptive information ascend to the cerebral cortex.

Carries information on sense of touch, vibration, and proprioception.

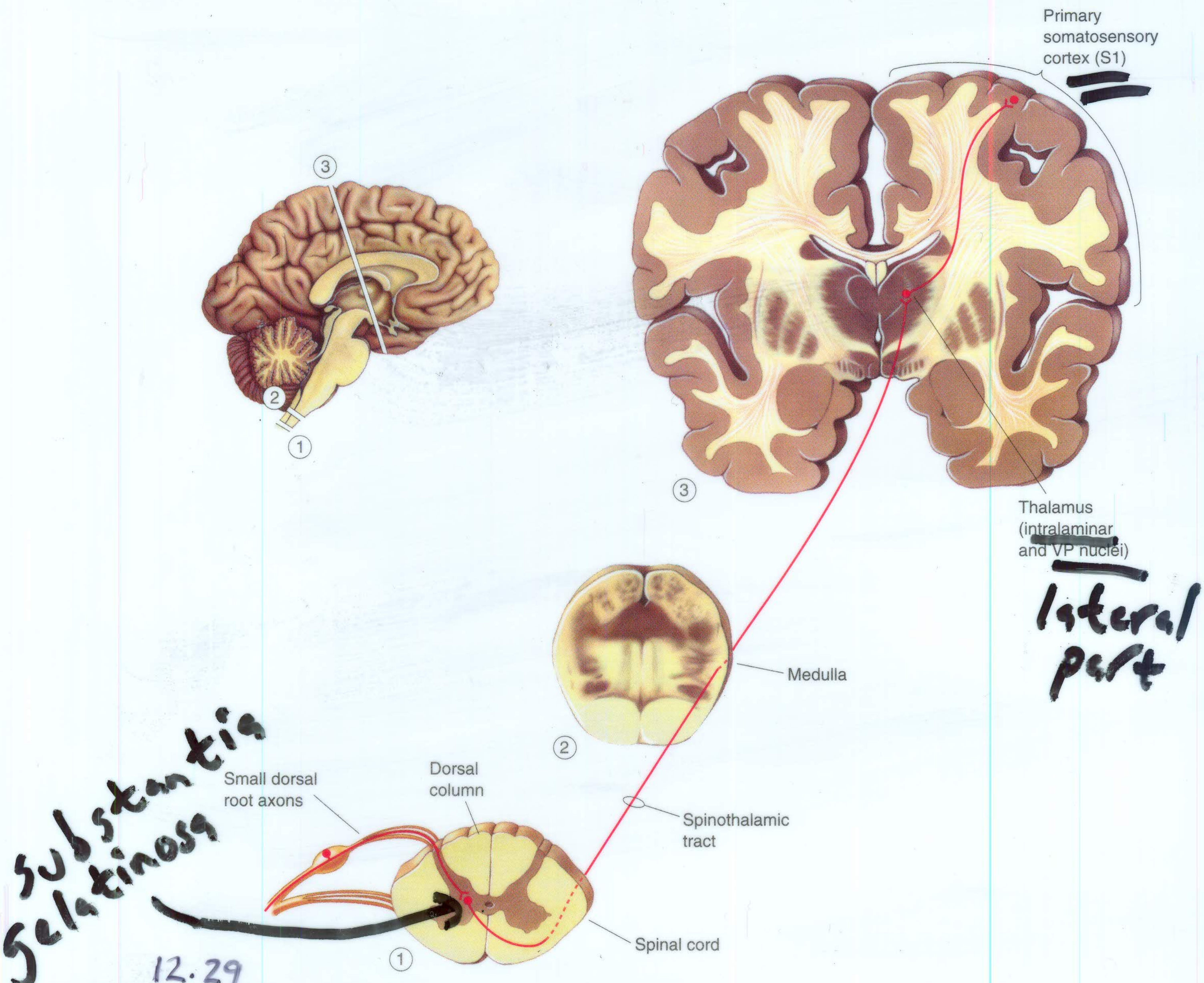


Figure ~~12.16~~ 12.29
The spinothalamic pathway. This is the major route by which pain and temperature information ascend to the cerebral cortex.

Carries information on pain + temperature from the body up to the brain.

Figure 12.16

Sensory information from the face, oral cavity, nasal cavity, + pharynx are conveyed to the brain by sensory afferents primarily in The trigeminal nerve.

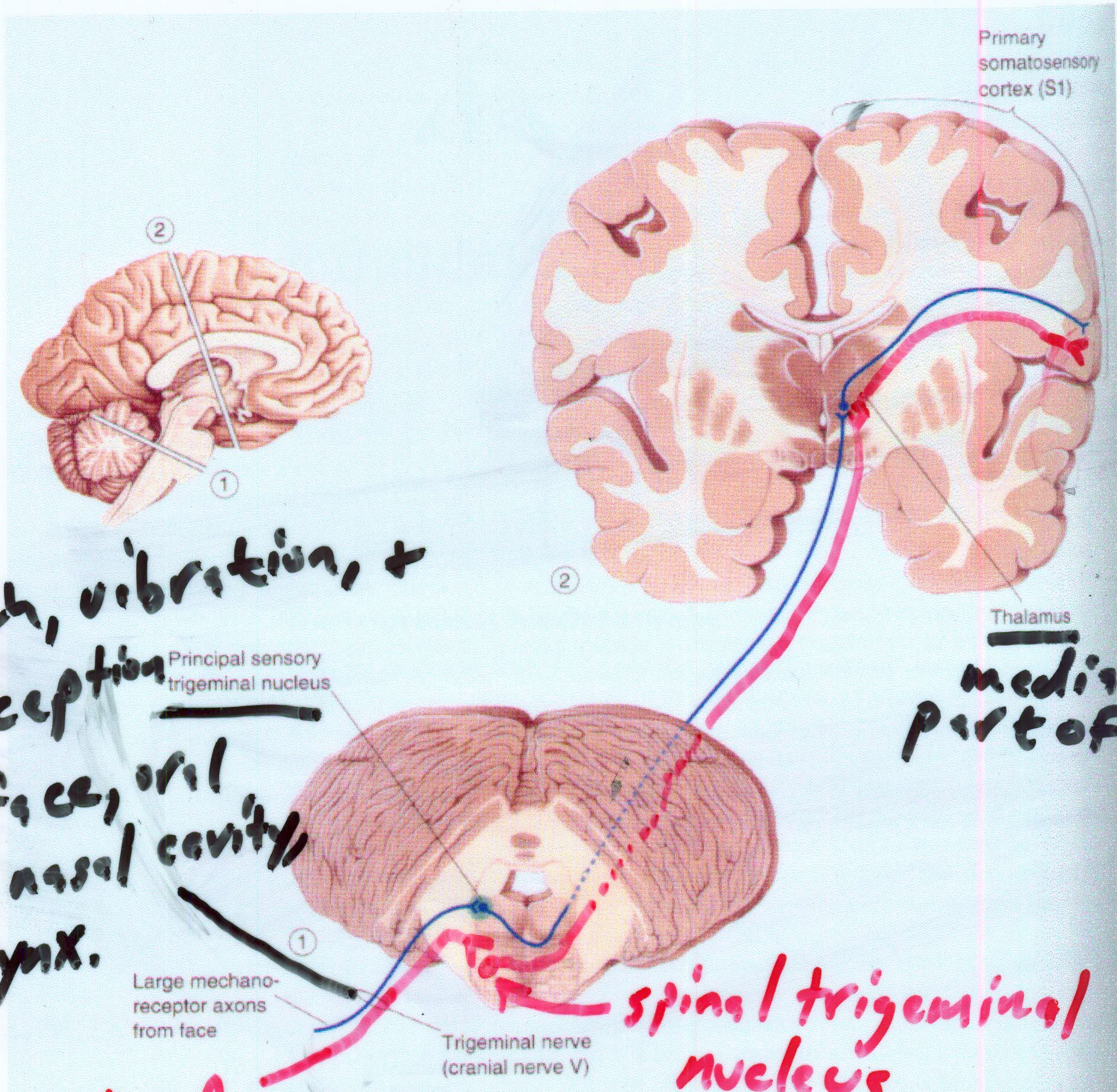


Figure 12.15
The trigeminal nerve pathway.

inferior part

medial part of VP

touch, vibration, + propioception from face, oral cavity, nasal cavity, + pharynx.

spinal trigeminal nucleus

pain + temp information from face, oral cavity, nasal cavity, + pharynx

Neurons in area 3b send their axons to synapse on neurons in areas 1 & 2

Neurons in area 1 - sense object texture

Neurons in area 2 - sense object size + shape

Nociceptive inputs to primary sensory cortex are diffuse.

Inputs to each area of primary sensory cortex are somatotopically organized, so their are 4 somatotopic maps on primary sensory cortex, one on each area

Somatotopic maps on primary sensory cortex depict the density of sensory receptors rather than surface area

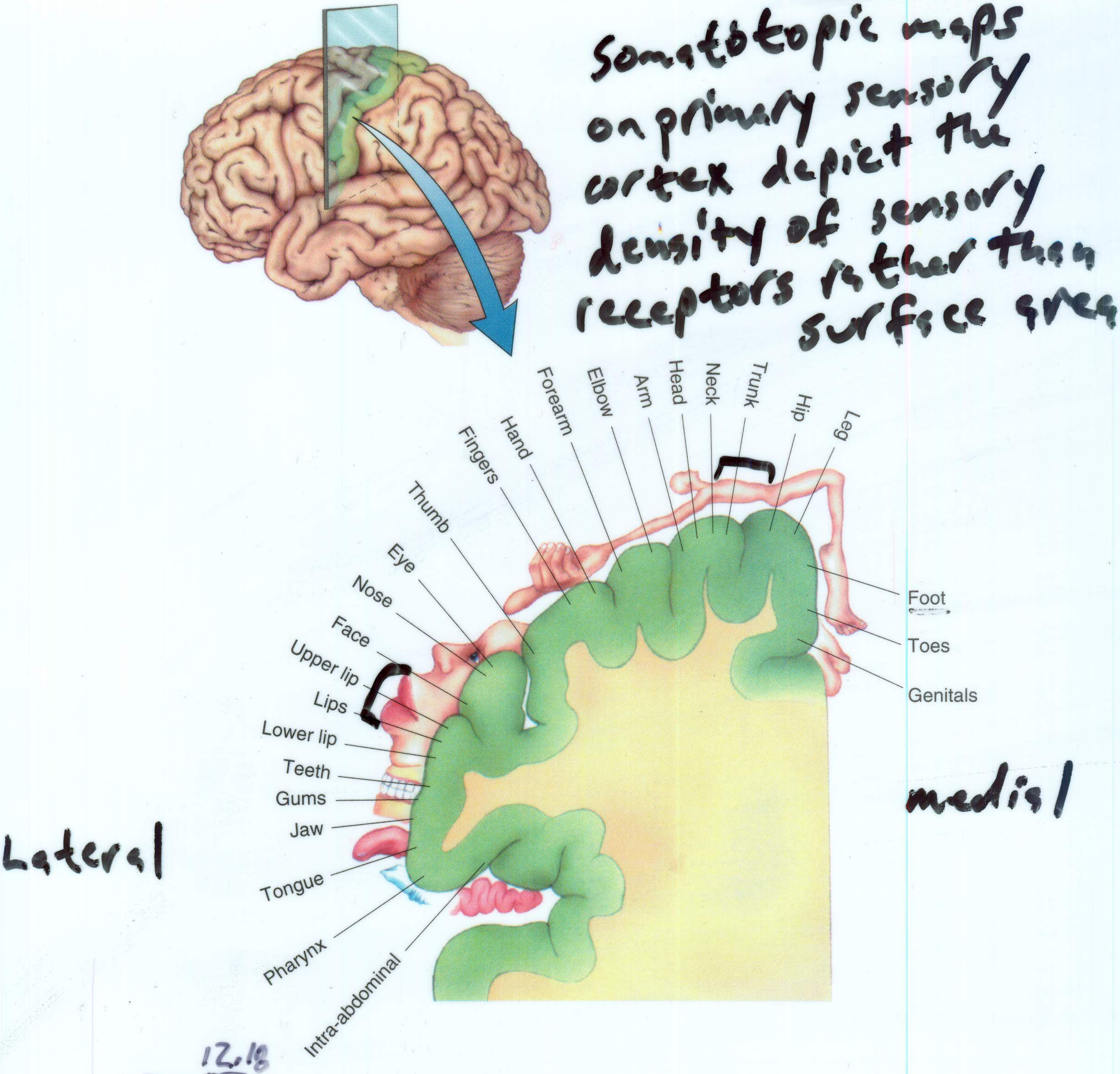
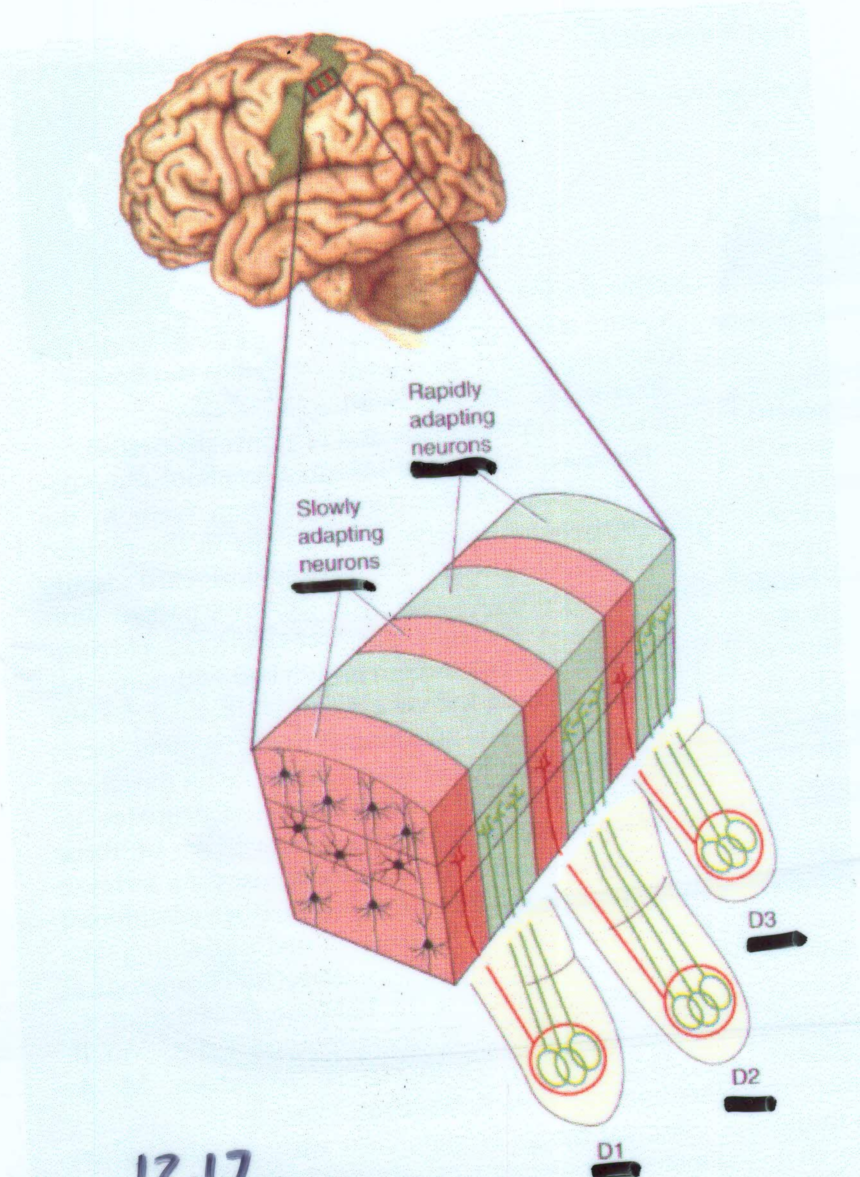


Figure ~~12.20~~ 12.18
Somatotopic map of the body surface onto primary somatosensory cortex. This map is a cross section through the postcentral gyrus (shown at top). Neurons in each area are most responsive to the parts of the body illustrated above them. (Source: Adapted from Penfield and Rasmussen, 1952.)

Figure 12.20



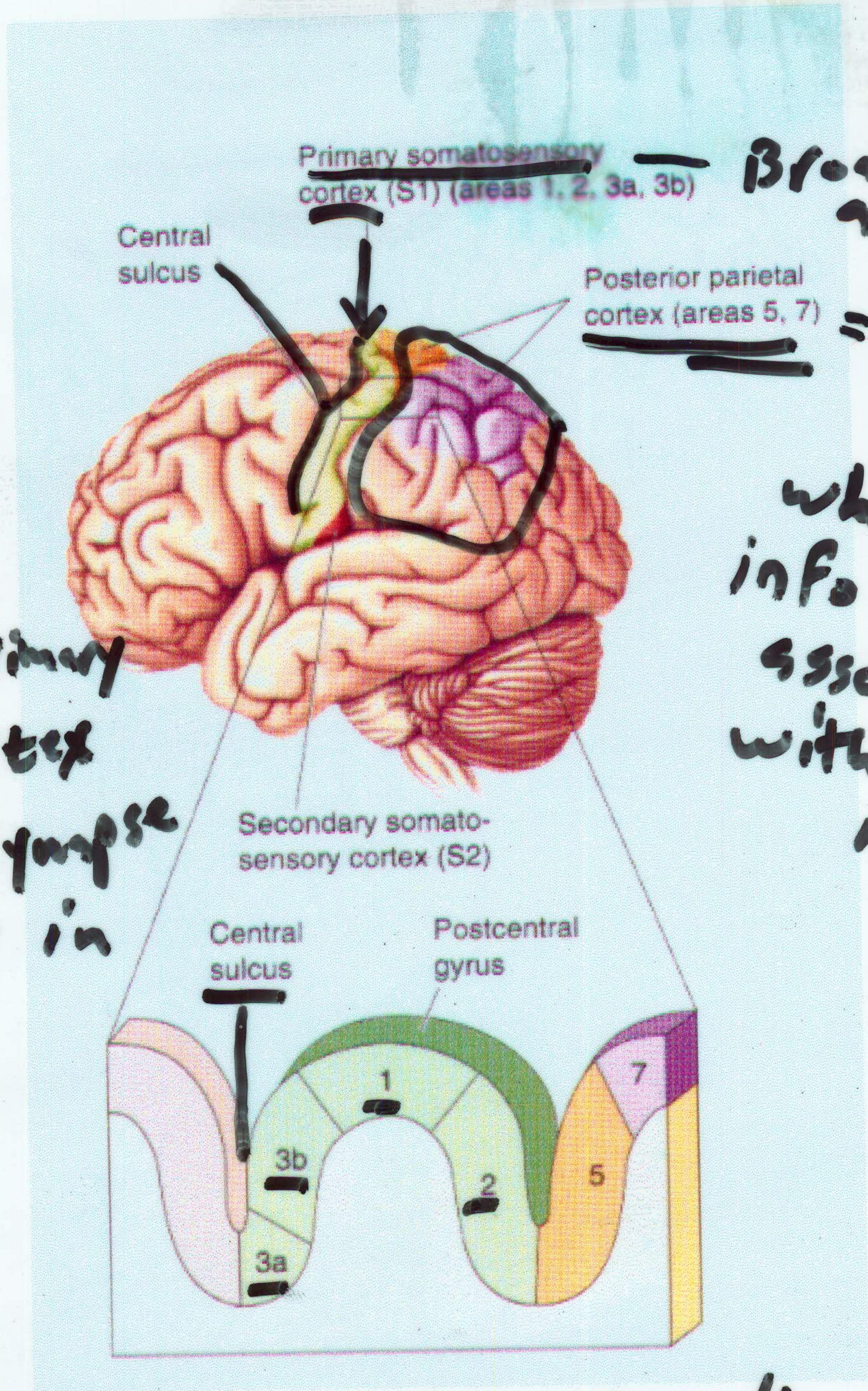
12.17

Figure [redacted]
Columnar organization of S1's area 3b. Each finger (D1–D3) is represe

=

Within each area of the primary sensory cortex there are several sensory specific maps of the body, each processing information from a different type of receptor.

Broadmann areas 1, 2, & 3



= "Association cortex" where sensory info is associated with a meaning

inputs to primary sensory cortex from VP synapse on neurons in layer IV

Neurons in 3a — receive primarily proprioceptive inputs

Neurons in 3b — concerned with sensing the texture, size, & shape of objects

Agnosia - inability to recognize common objects.

Damage to the anterior part of the right posterior parietal cortex causes difficulty in identifying common objects by touch, without allowing the person to look at the object. This type of deficit is called Astereognosia -

Visual agnosia - results from bilateral damage to the posterior parts of the posterior parietal cortex causes inability to identify common objects by site.

Gertsmann's Syndrome – results from damage to the inferior part of the posterior parietal cortex on the left side.

causes inability to count or do simple math calculations.

Based on studies of individuals with damage to the posterior parietal cortex, it is clear that different skills are processed in the right post. parietal cortex -vs- the left post. parietal cortex.

Language skills – grammer, writing, speaking, and math skills

reside primarily in the left posterior parietal cortex

Spatial skills – understanding the spatial relationships between objects, and analysis of objects by touch

reside primarily in the right posterior parietal cortex.