



*PHGY 210,2,4 - Physiology*

# **SENSORY PHYSIOLOGY**

## **Sensory Neural Pathways**

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## *PHGY 210,2,4 - Physiology*

# **SENSORY PHYSIOLOGY**

## Sensory Neural Pathways

### Reading

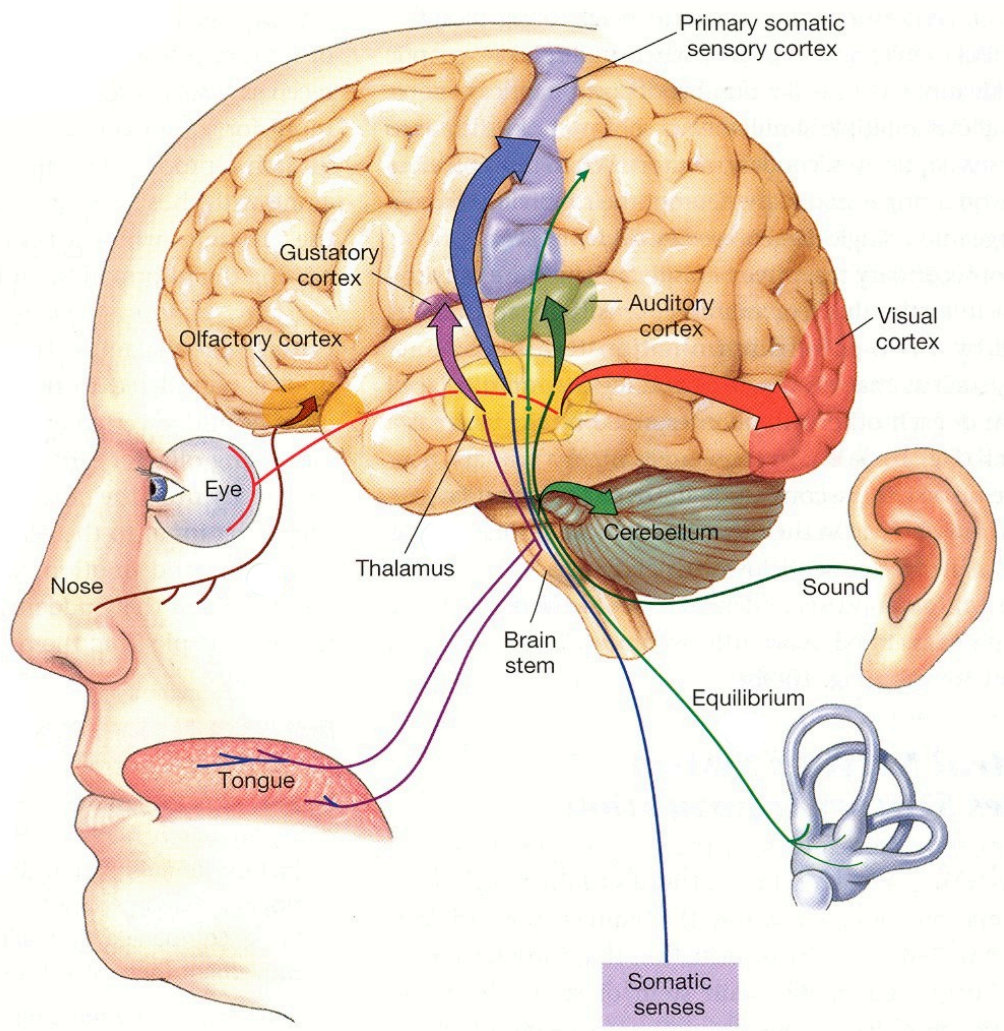
#### **Rhoades & Pflanzner (4<sup>th</sup> edition)**

Chapter 7: *Organization of the Nervous System* (p. 209-215)

Chapter 8: *Somatosensory Pathways* (p. 263-268)

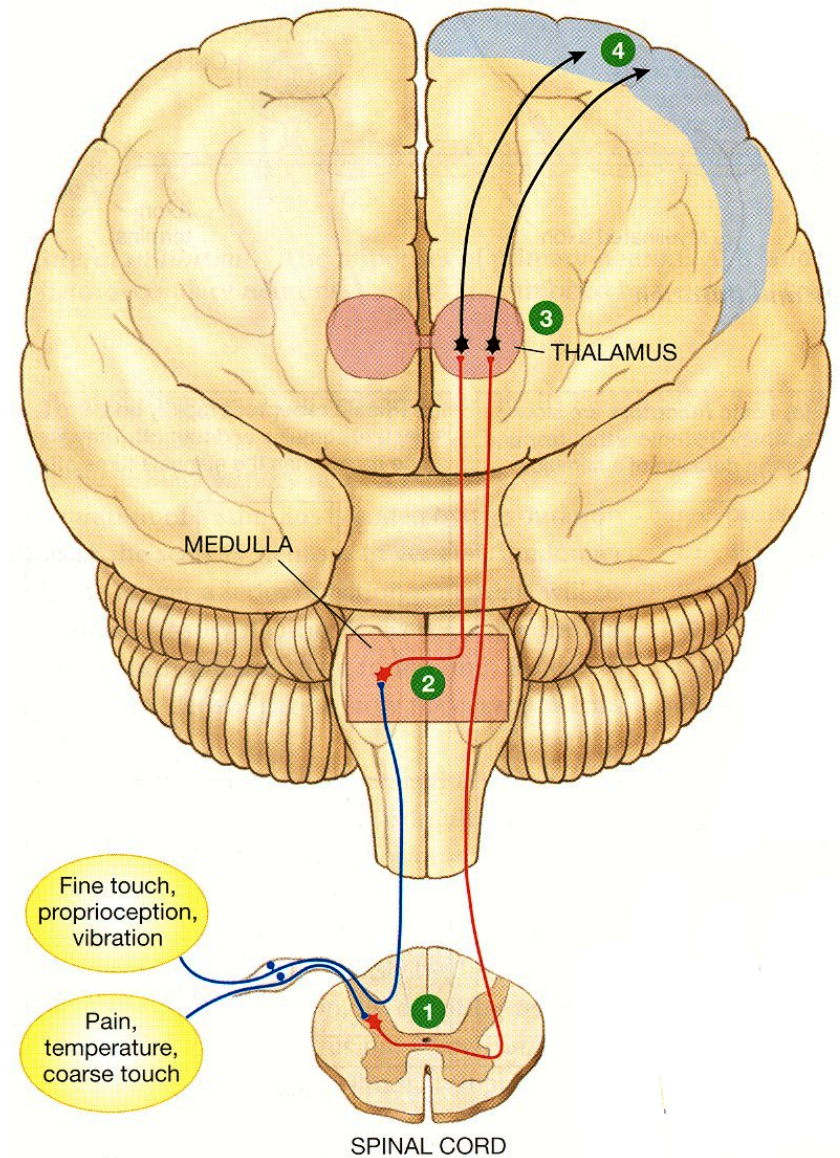
Chapter 11: *Language Systems* (p. 375-379)

# Pathways for Sensory Perception



# Pathways for Sensory Perception

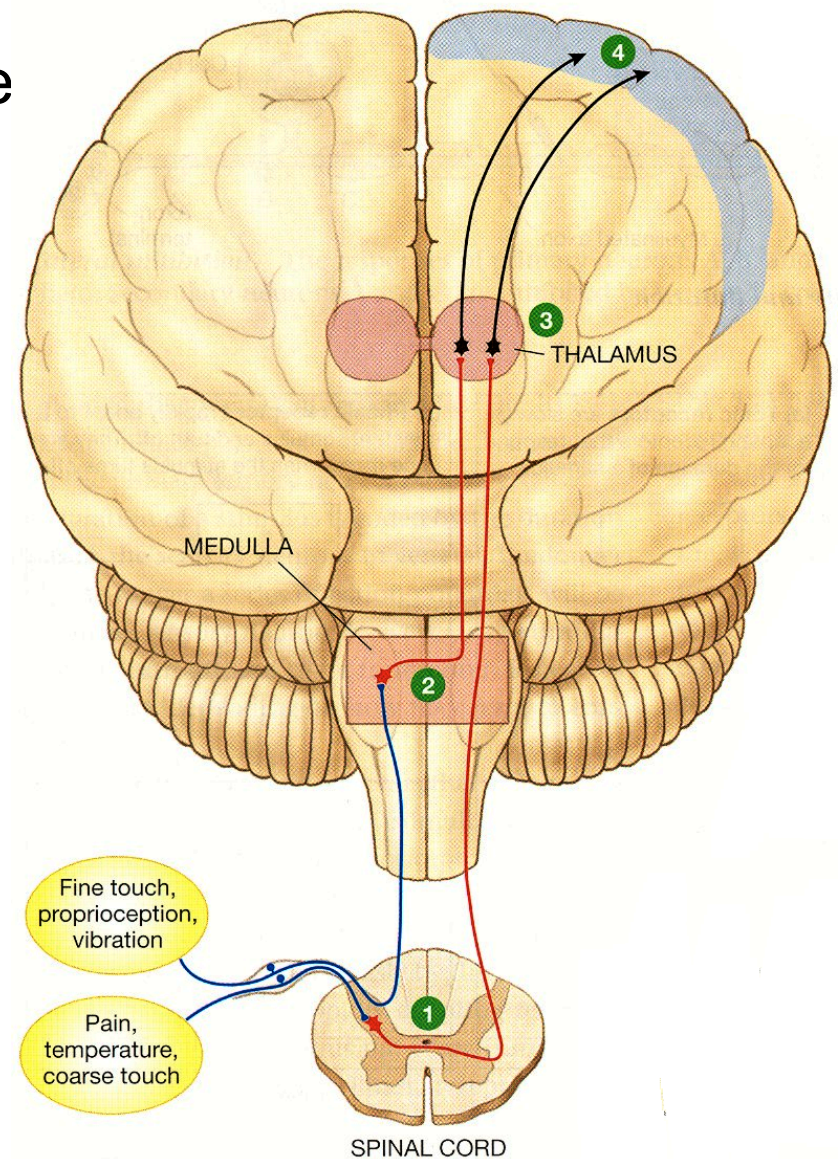
**Primary sensory neurons** bring information from receptors to **secondary sensory neurons** within the CNS.





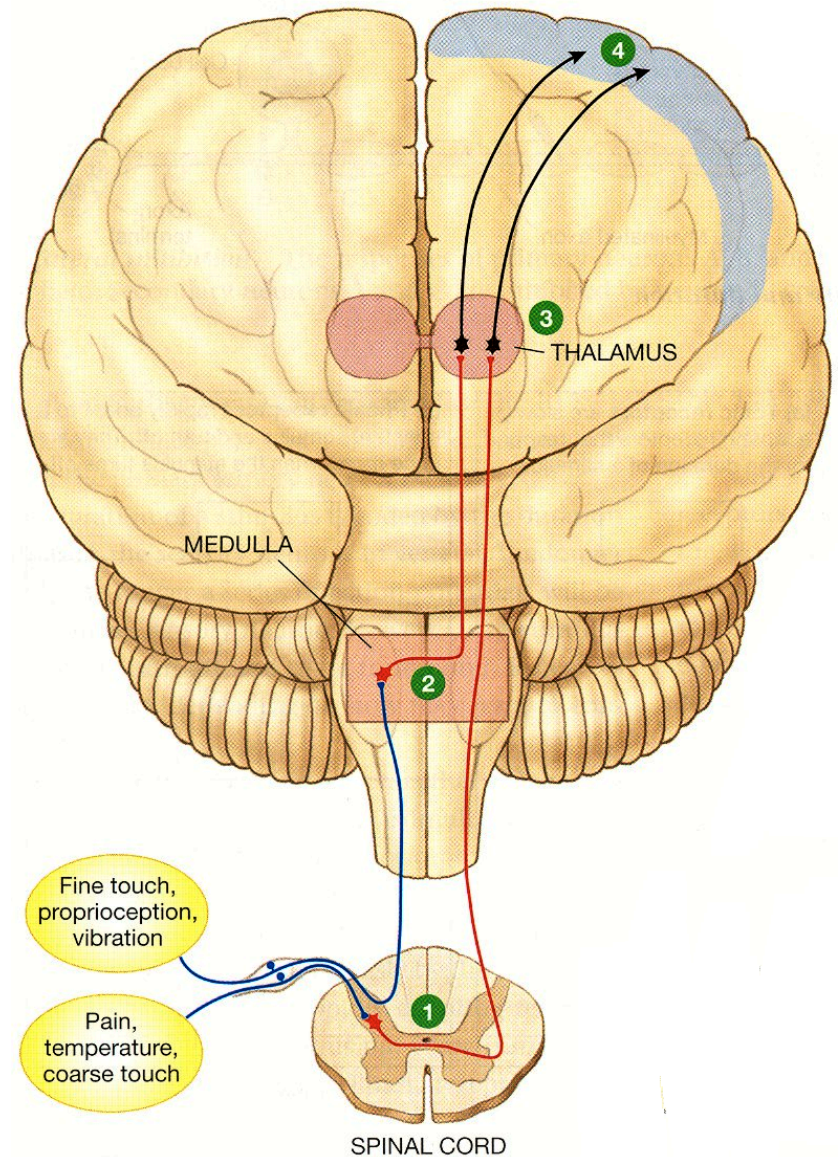
# Pathways for Sensory Perception

The location of the synapse between **primary sensory neurons** and **secondary sensory neurons** varies according to the receptor.



# Pathways for Sensory Perception

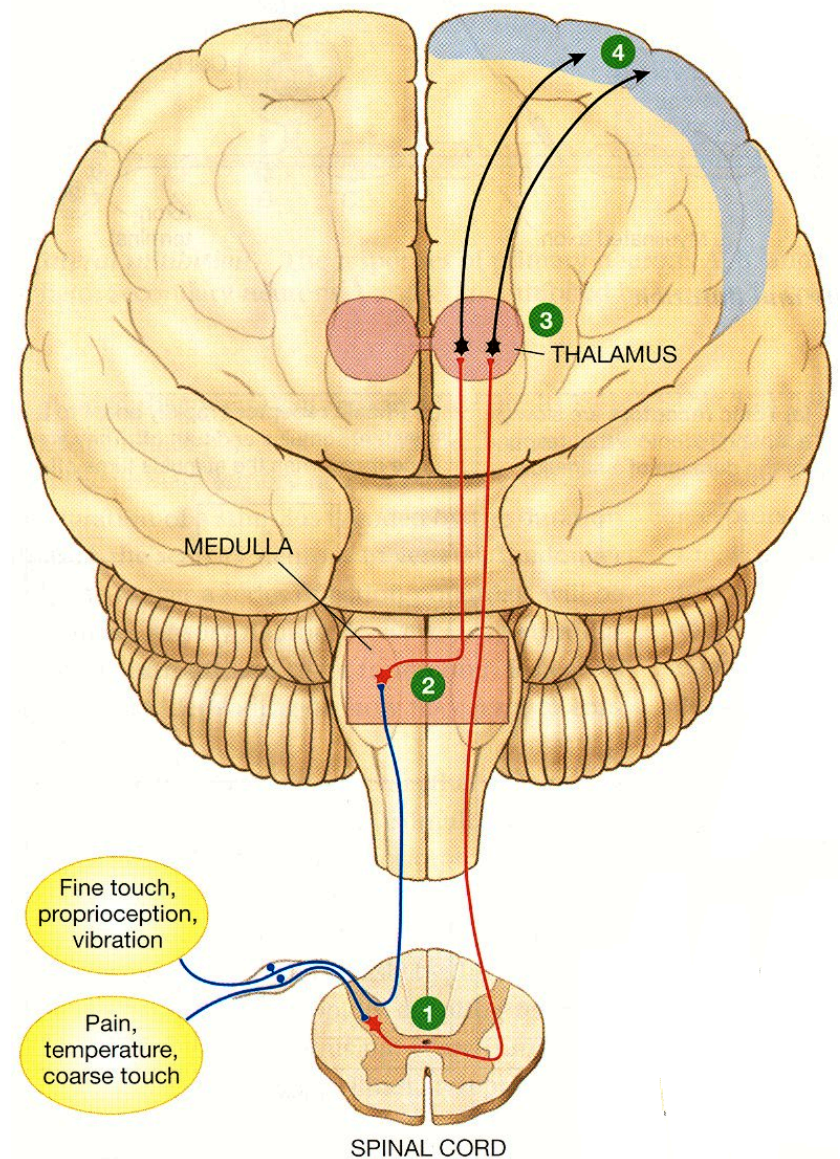
**Secondary sensory neurons** cross the midline of the body, so that sensations from the left side of the body are processed in the right hemisphere.





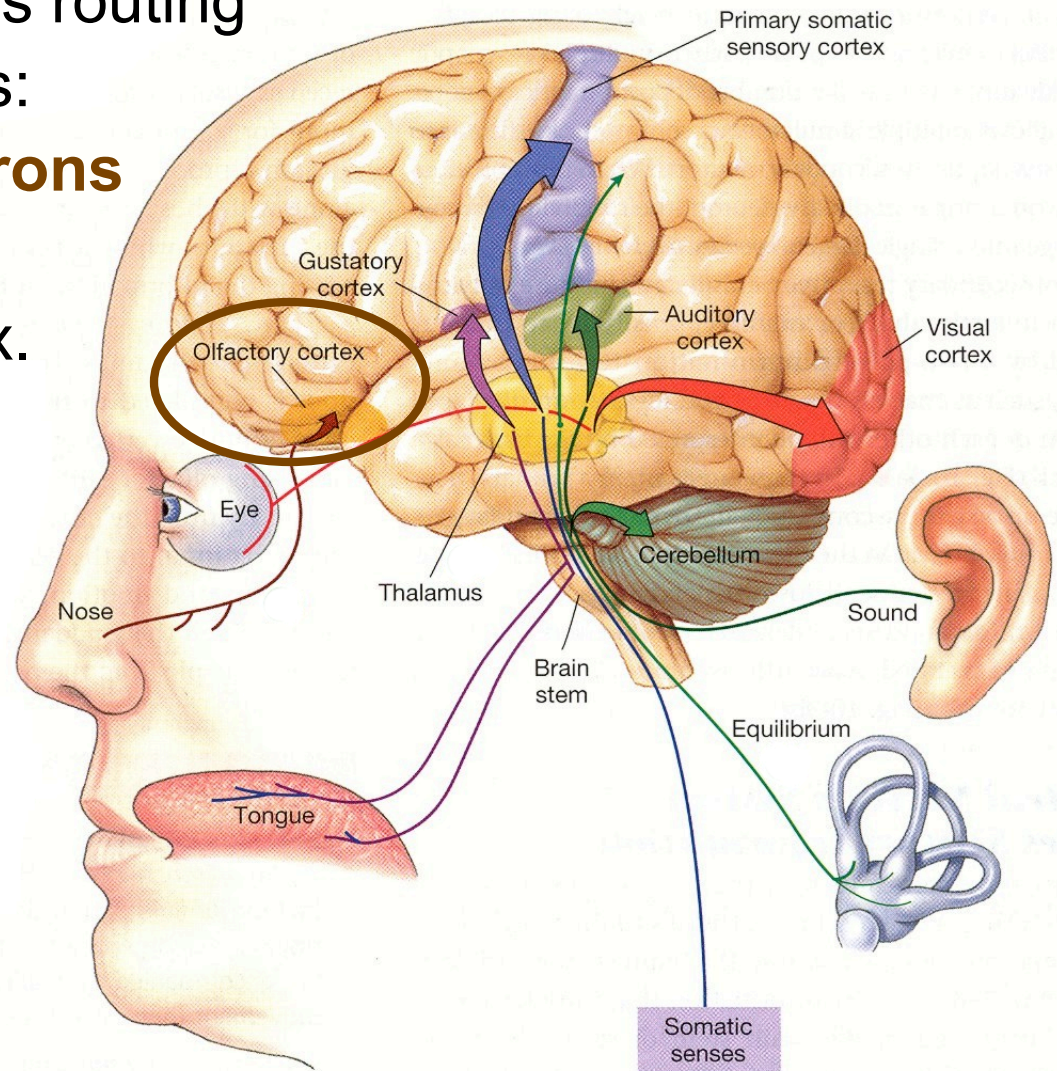
# Pathways for Sensory Perception

In the thalamus,  
**secondary sensory neurons**  
synapse onto  
**tertiary sensory neurons**,  
which in turn project  
to the cerebral cortex.



# Pathways for Sensory Perception

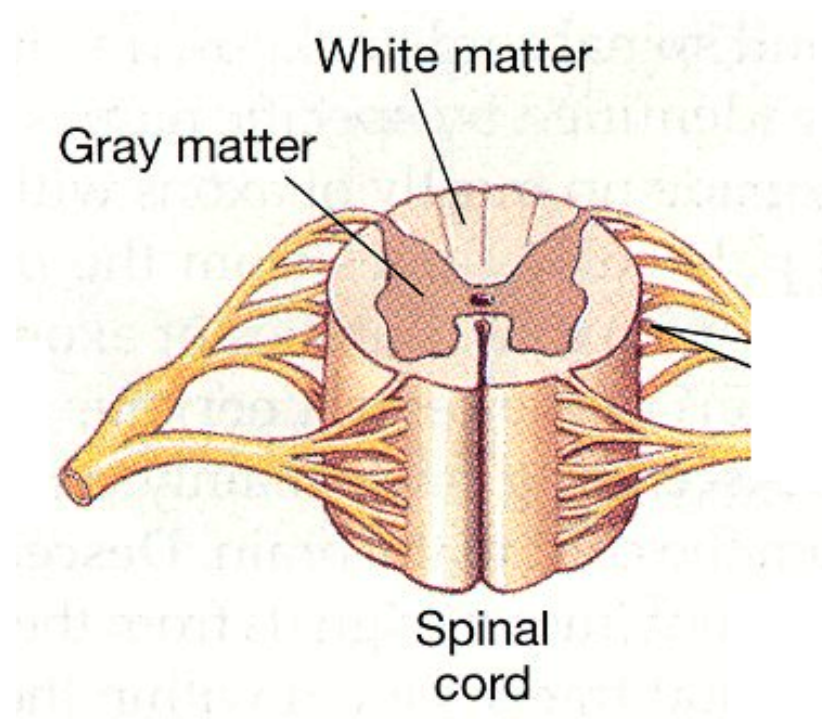
There is one exception to this routing through the thalamus:  
through the thalamus:  
**olfactory sensory neurons**  
project directly  
to the cerebral cortex.





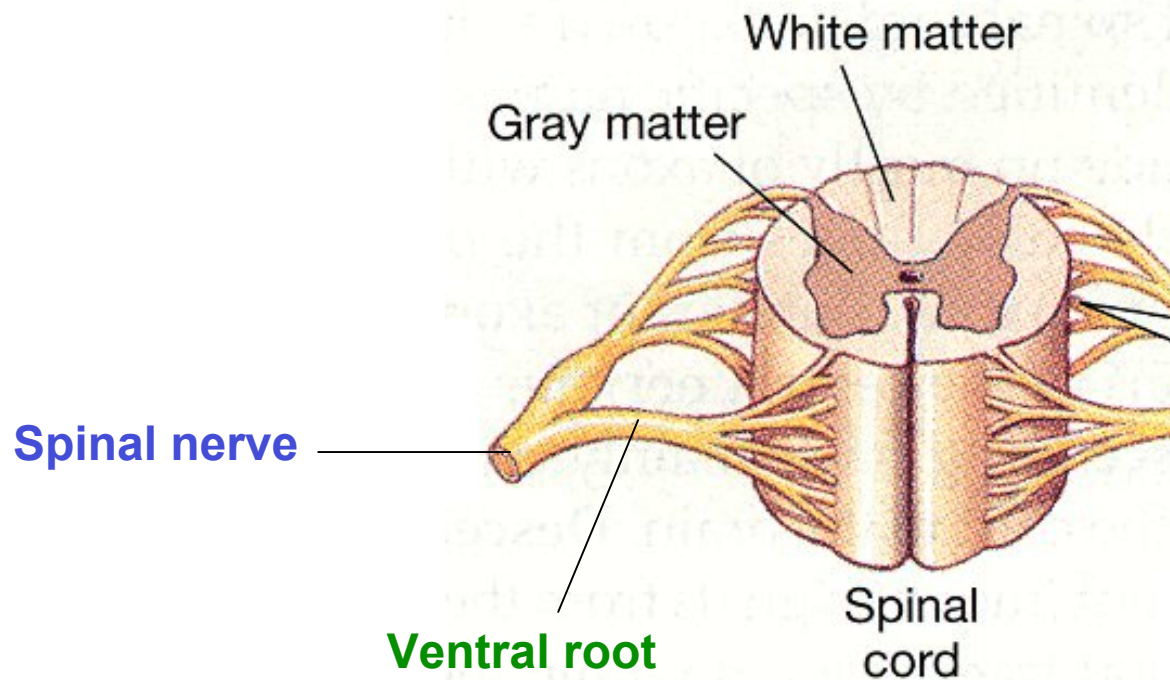
# Spinal Cord

The spinal cord has a core of **gray matter** (neuron cell bodies) and a surrounding rim of **white matter** (nerve fibers).



# Spinal Cord

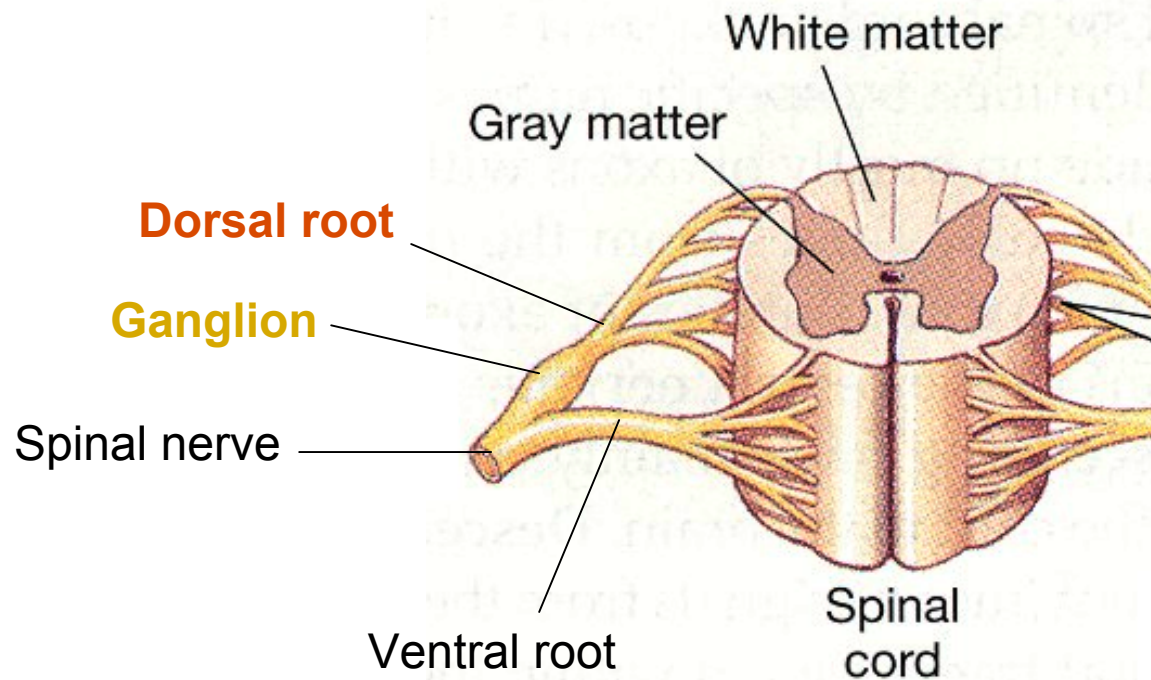
**Spinal nerves** divide into two branches called **roots**. The **ventral root** of each spinal nerve carries information from the CNS to the muscles and organs/glands.



# Spinal Cord

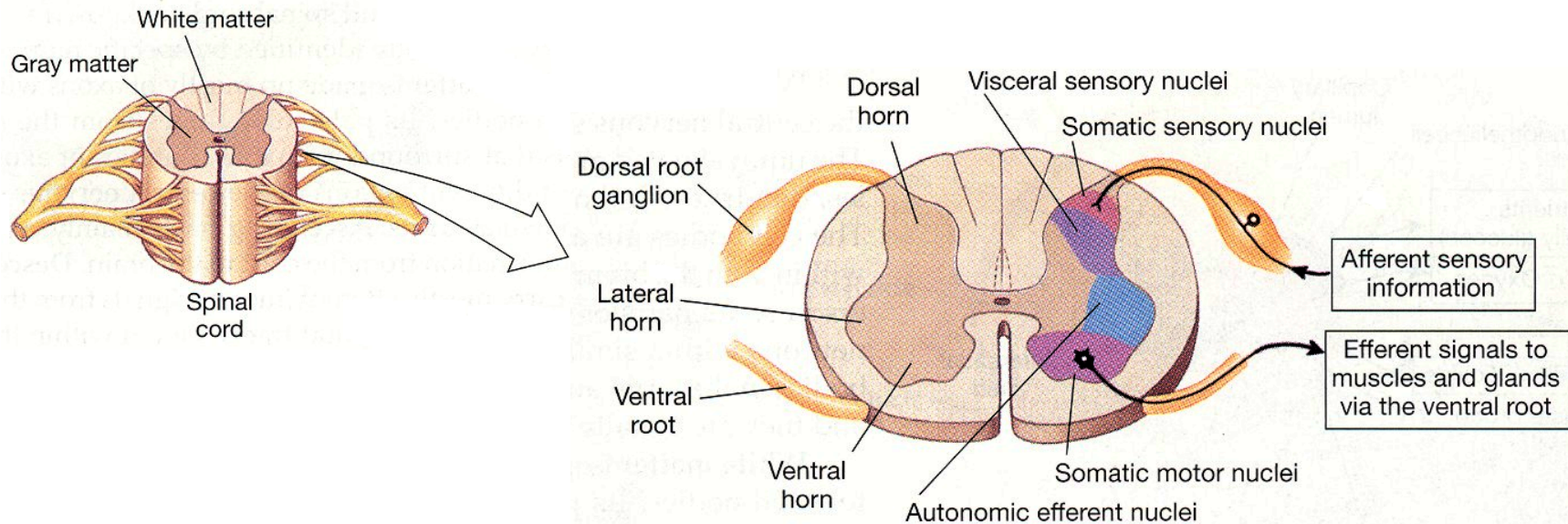
The **dorsal root** of each spinal nerve is specialized to carry incoming sensory information.

The **dorsal root ganglia** contain cell bodies of sensory neurons.



# Spinal Cord

The **gray matter** contains the cell bodies of interneurons. Cell bodies in the **dorsal horn** form two sensory nuclei receiving somatic and visceral information. Cell bodies in the **ventral horn** form two efferent nuclei sending motor and autonomic information.

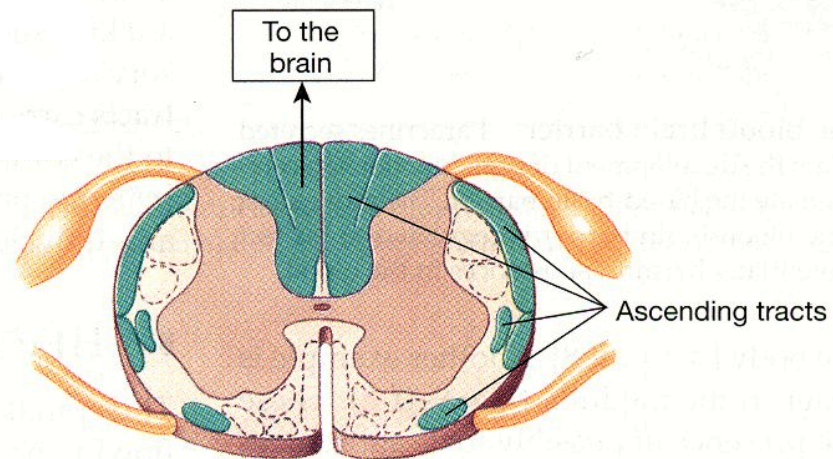
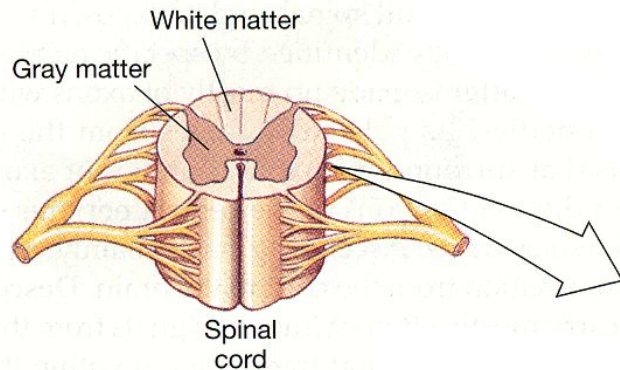




# Spinal Cord

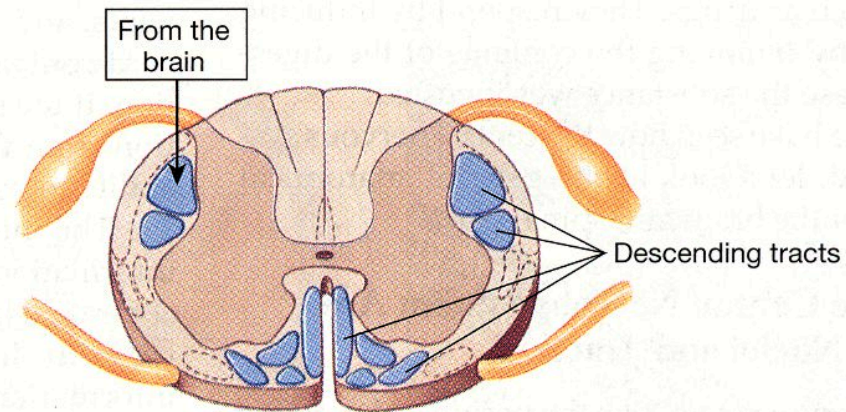
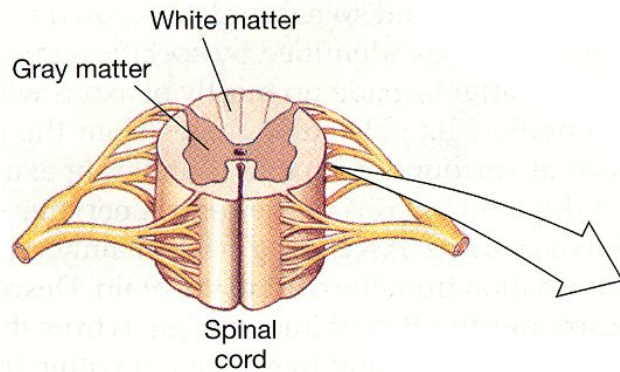
The **white matter** contains axons that transfer information up and down the spinal cord.

**Ascending tracts** that take sensory information to the brain occupy the *dorsal* and *external lateral* portions of the cord: dorsal column & spinothalamic tracts.

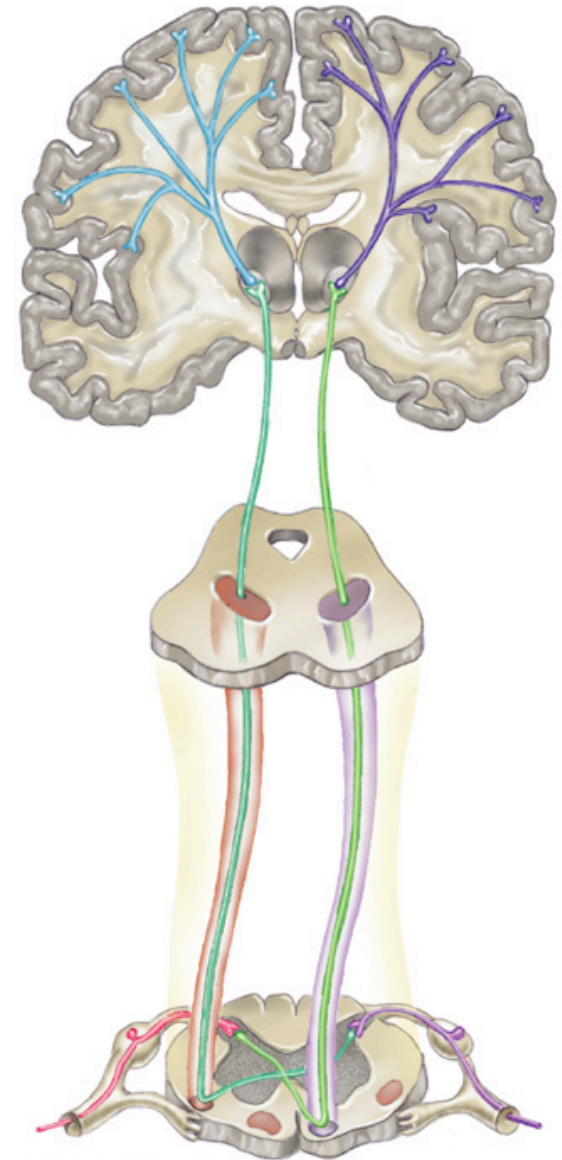
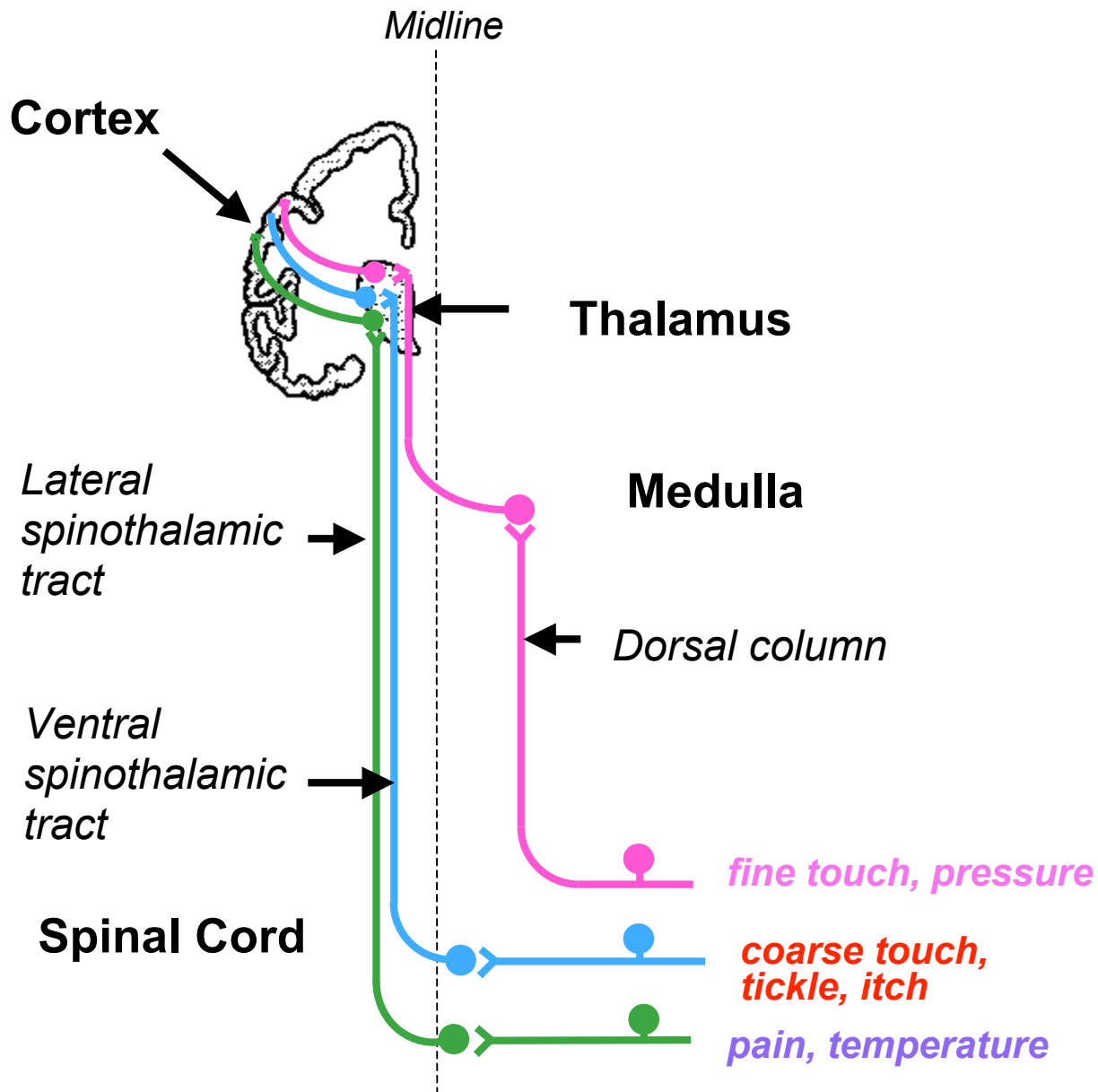


# Spinal Cord

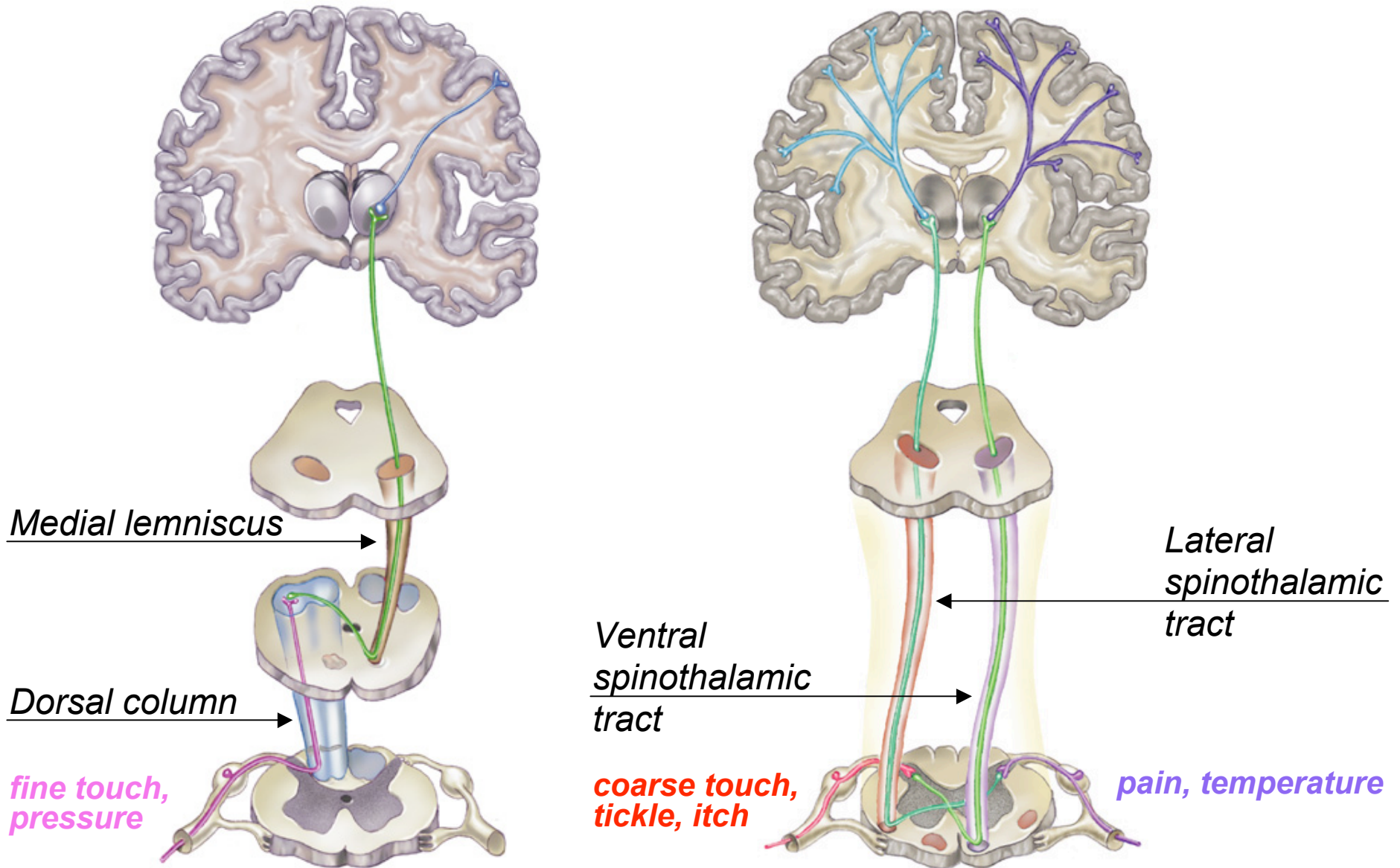
**Descending tracts** that carry commands to effector organs occupy the *ventral* and *internal lateral* portions of the cord, e.g., lateral & ventral corticospinal tracts.



# Somatic Pathways



# Somatic Pathways

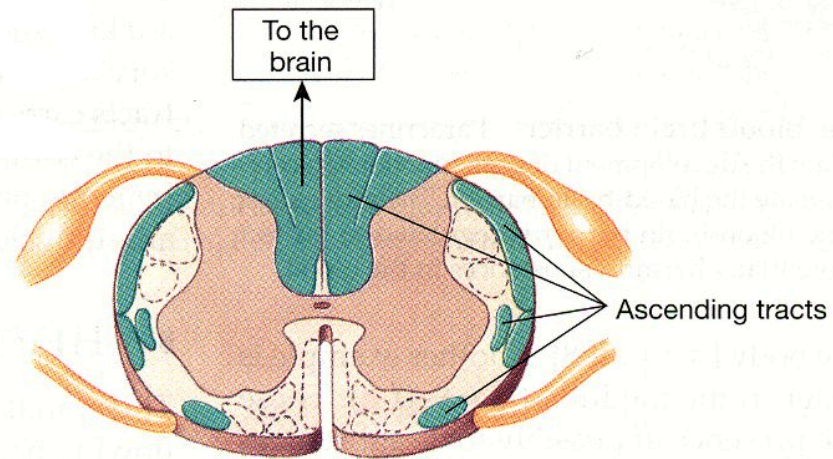
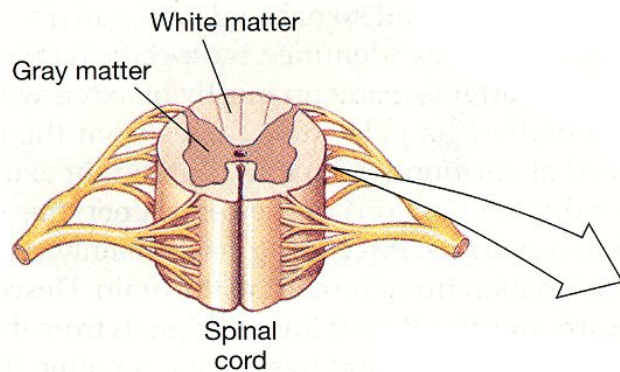




# Somatic Pathways

**Dorsal column** consists of large myelinated axons that carry fine touch information. They cross over at the medulla.

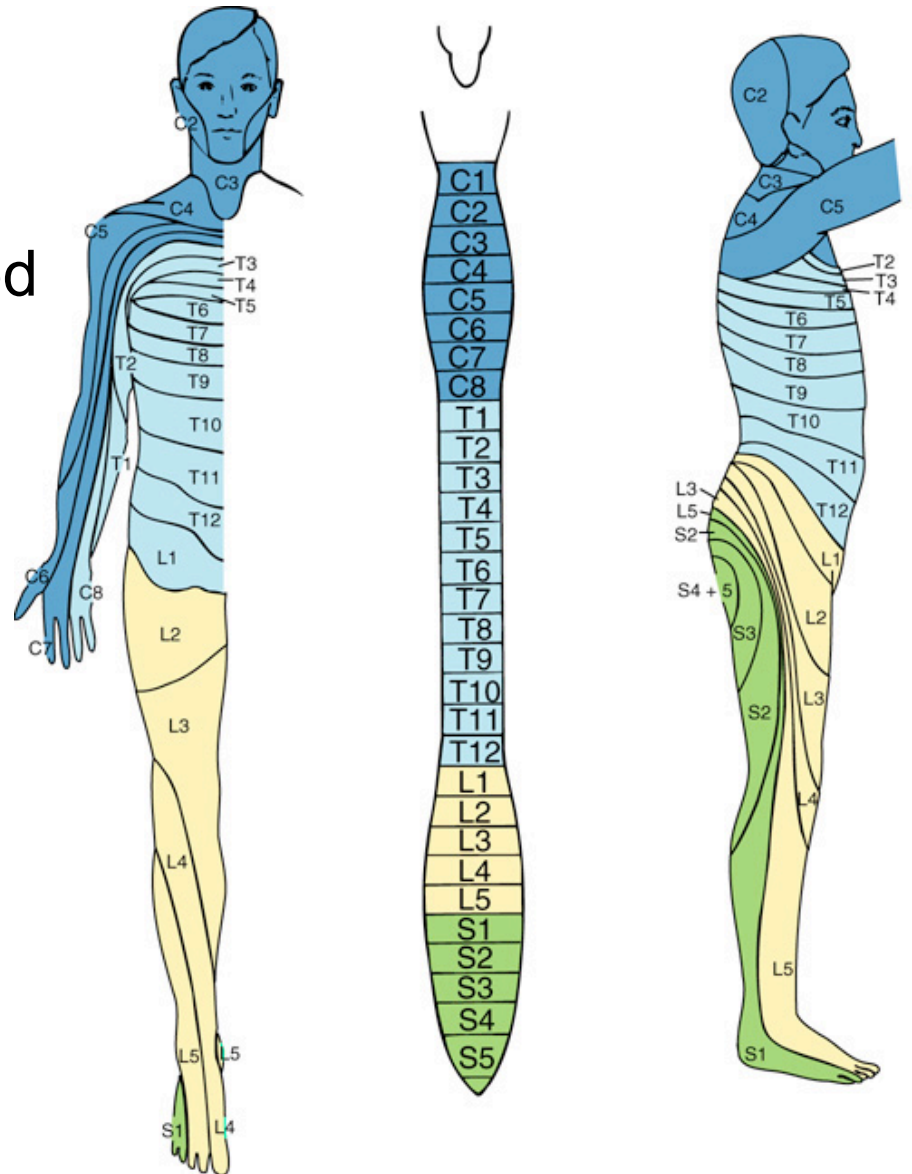
**Spinothalamic tracts** consist of small unmyelinated axons that carry pain, temperature, and coarse touch. They cross over at the level of the spine.



# Somatic Pathways

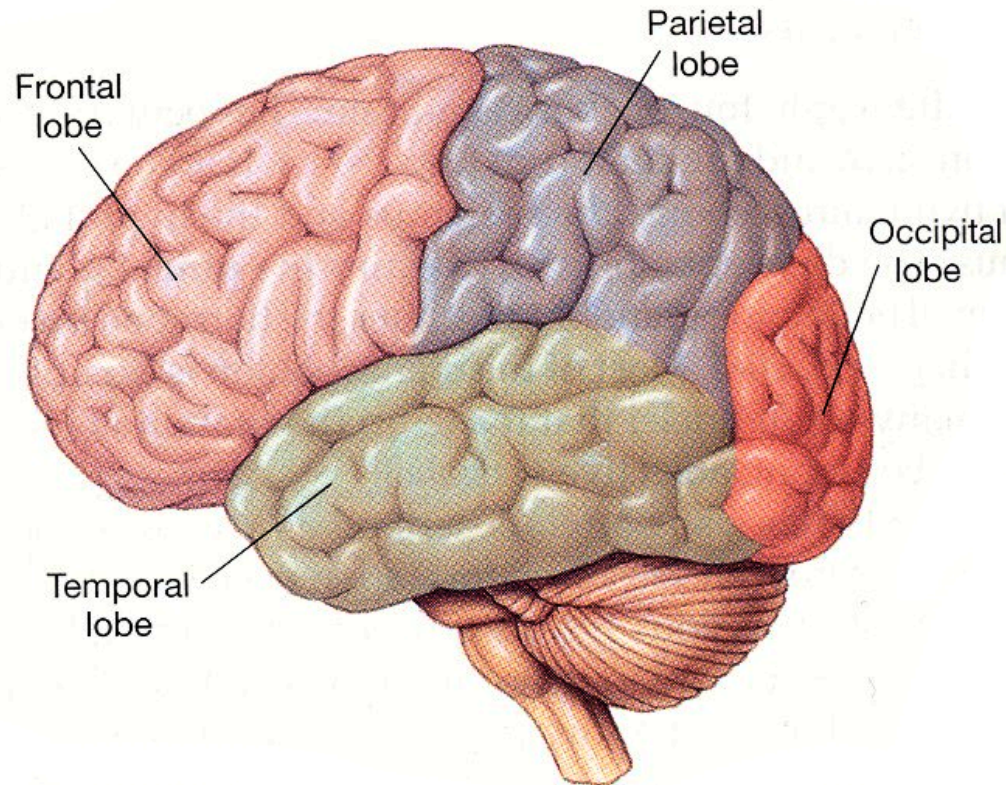
The spinal cord is divided into 31 segments, receiving inputs from receptors localized within delimited areas of the skin (**Dermatomes**).

There are 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 sacro-coccygeal segments.



# Cerebral Cortex

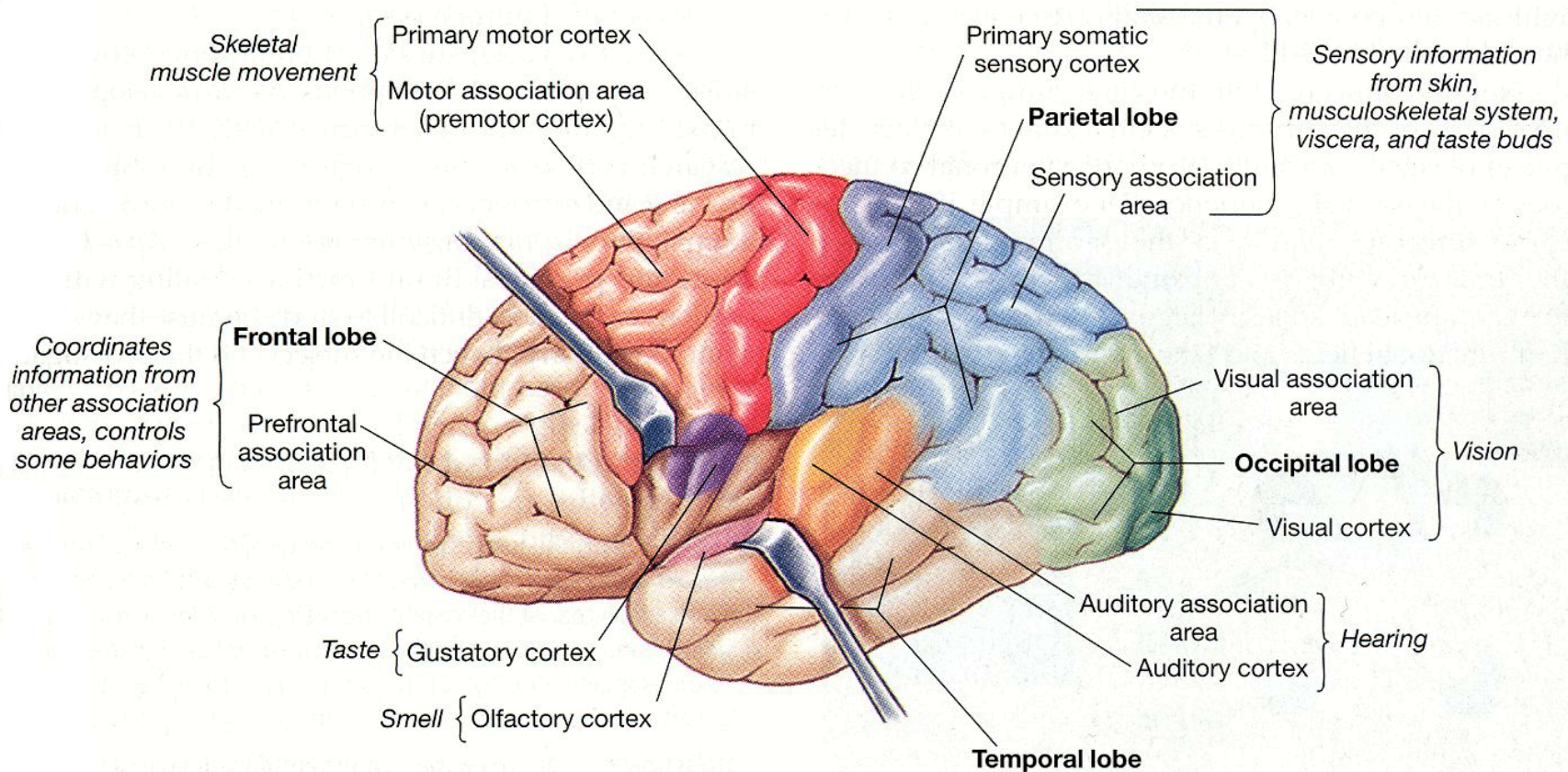
Cerebral cortex contains **four lobes** linked to distinct functions.





# Cerebral Cortex

**Somatic senses** are processed in the primary somatic sensory cortex (**parietal lobe**).



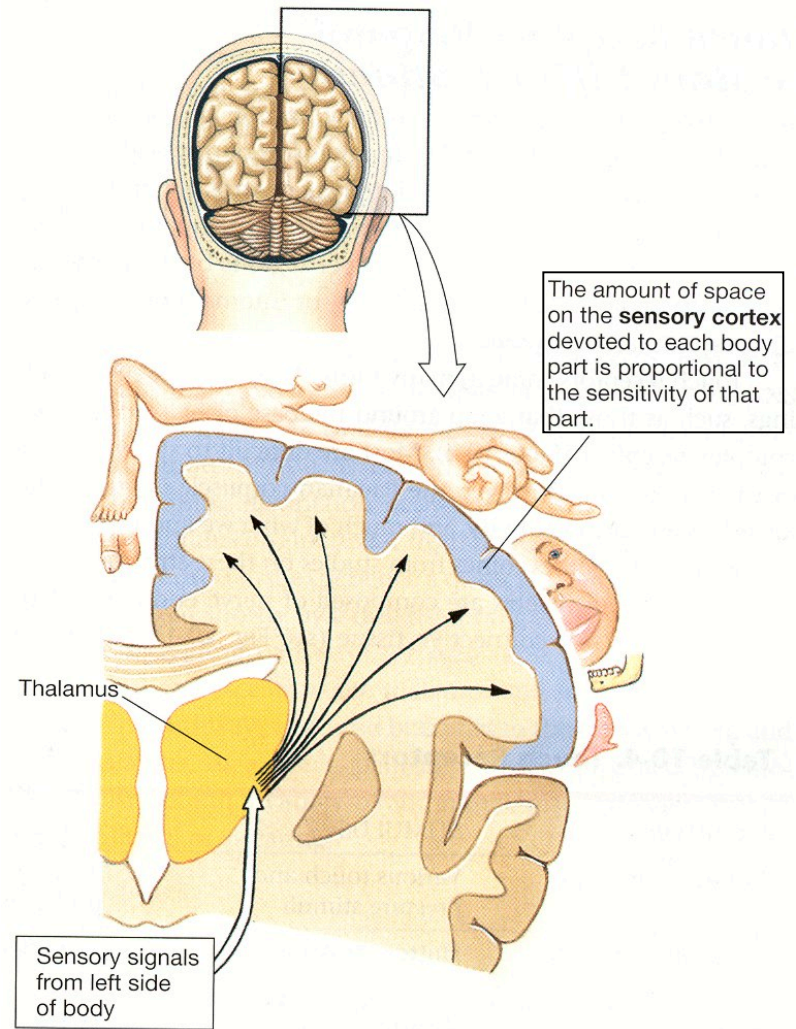


# Somatosensory Cortex

Sensory receptive fields are orderly organized in somatosensory cortex to form a map of the body:  
**the Homunculus**

Density of sensory receptive fields dictates in which proportions the body parts are represented

Boundaries of this map are not fixed; **plastic** changes occur.



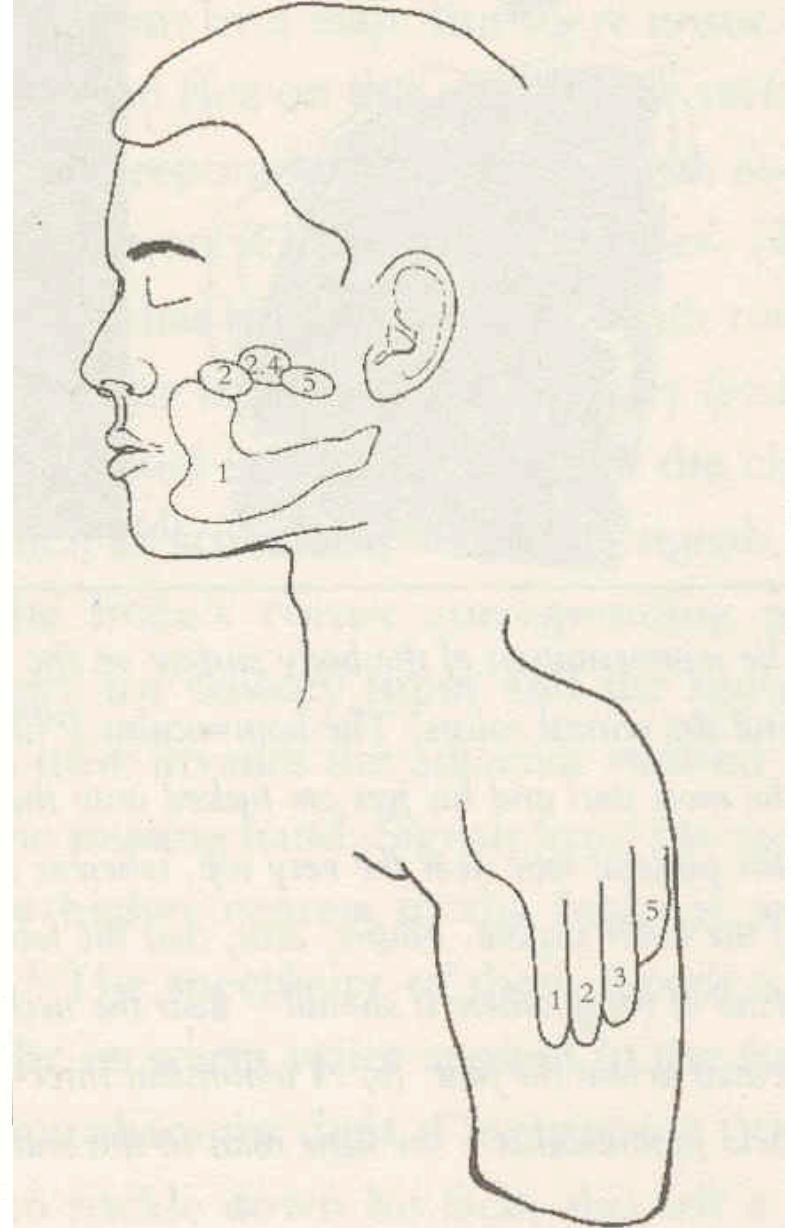
Cross section of the right cerebral hemisphere and sensory areas of the cerebral cortex

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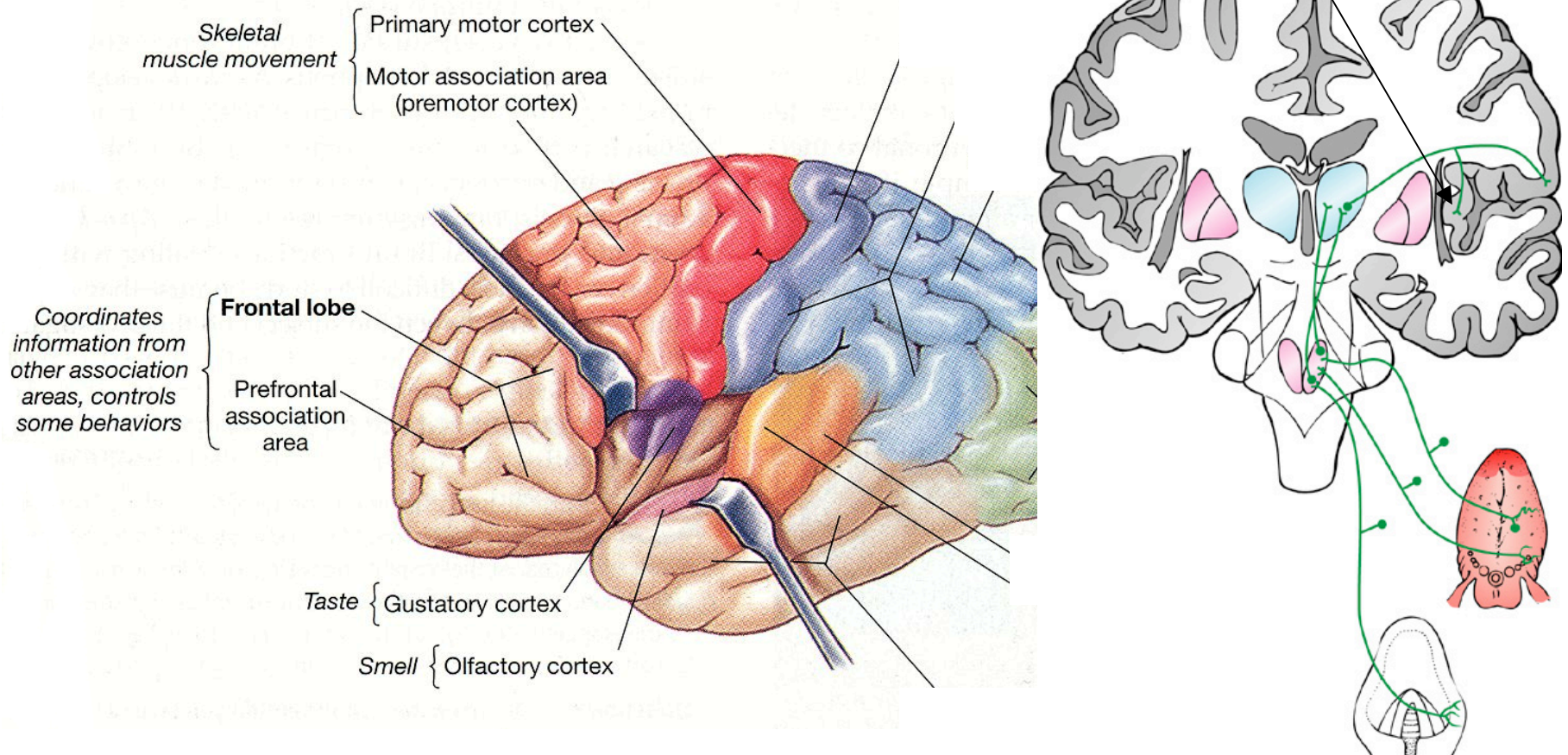
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# Cerebral Cortex

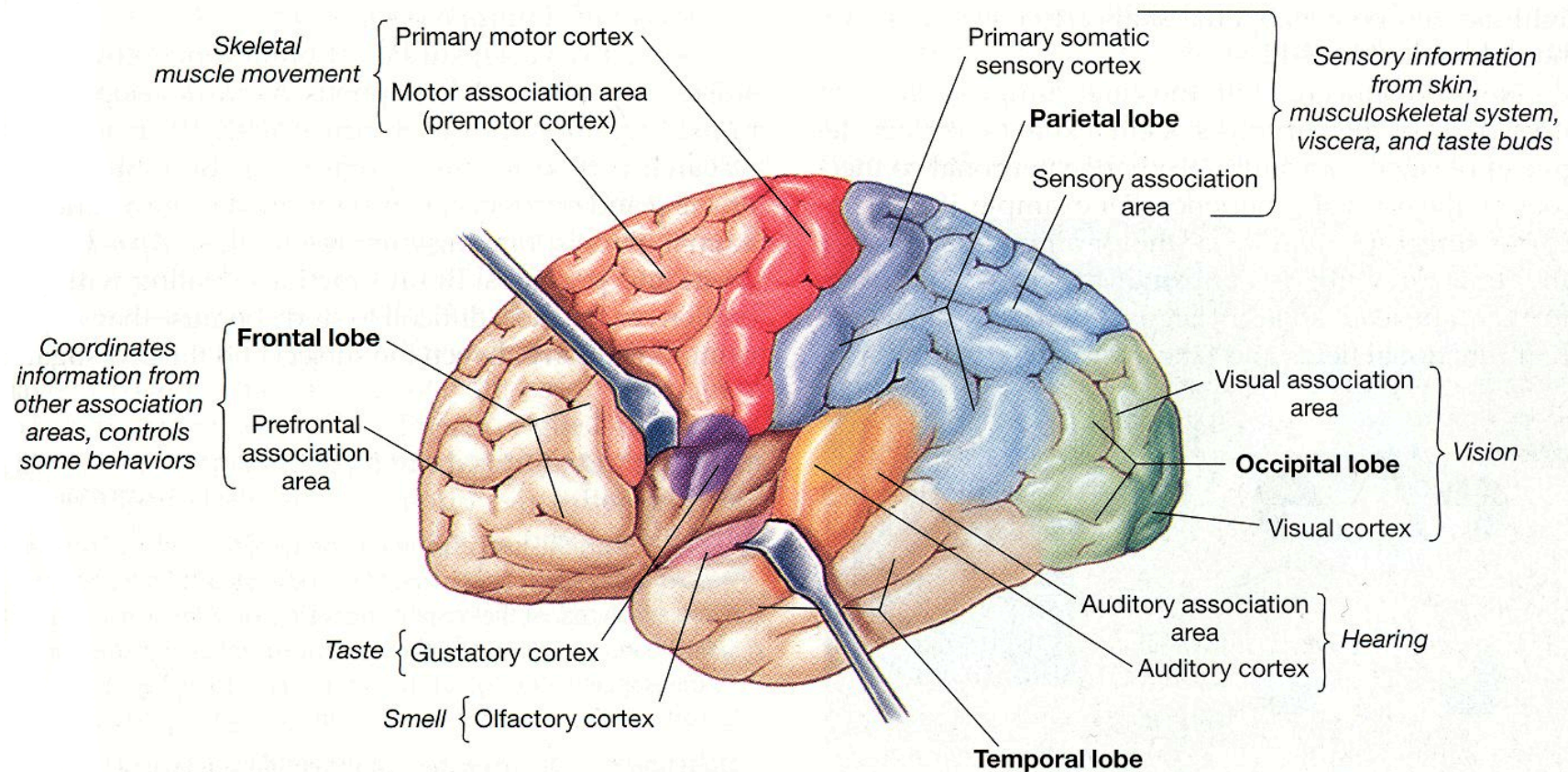
**Taste** is processed in the gustatory cortex (insula),  
beneath the frontal and parietal cortices.





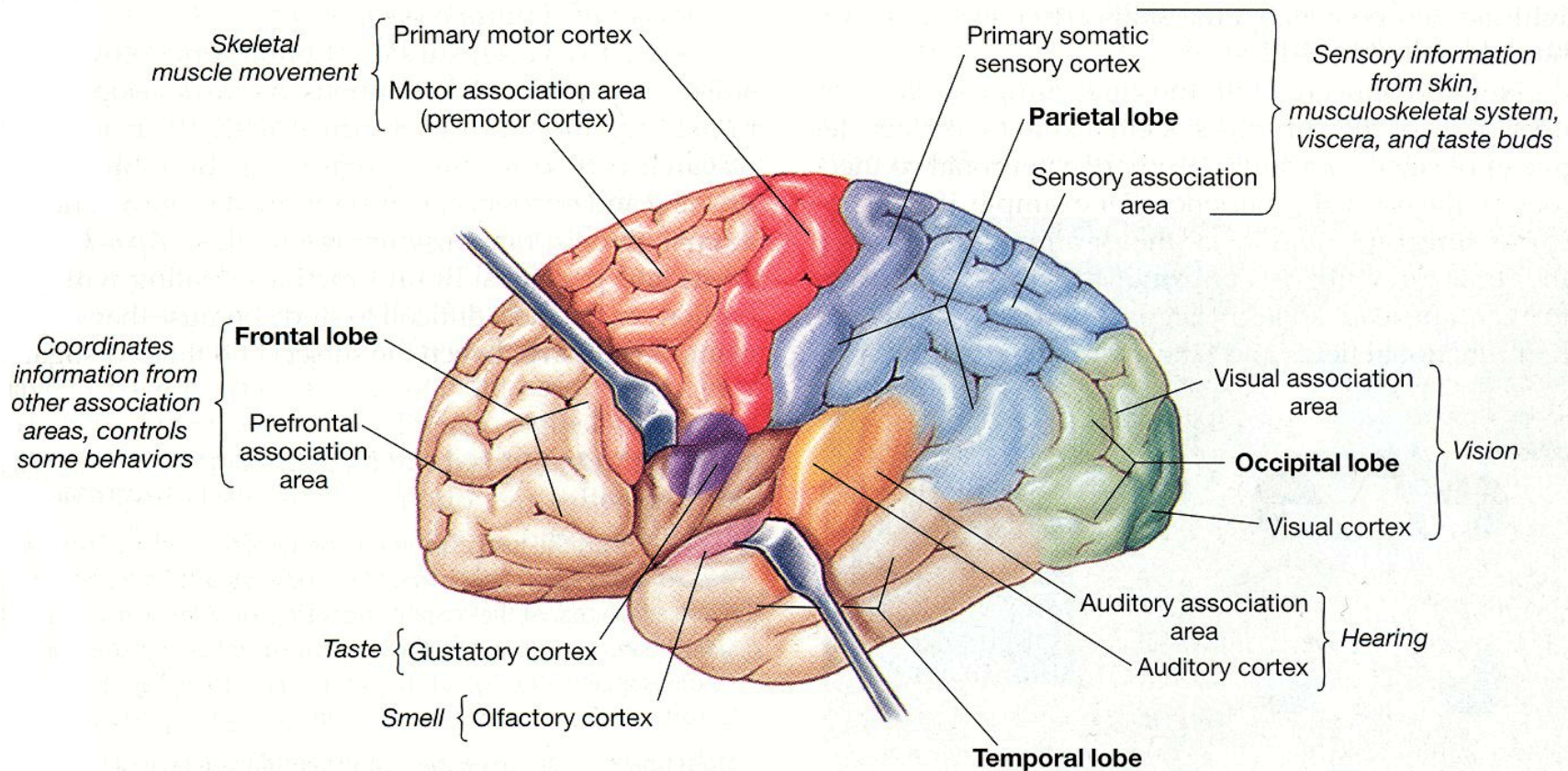
# Cerebral Cortex

**Hearing** is processed in the auditory cortex (**temporal lobe**), also referred to as *Heschl's gyrus*.



# Cerebral Cortex

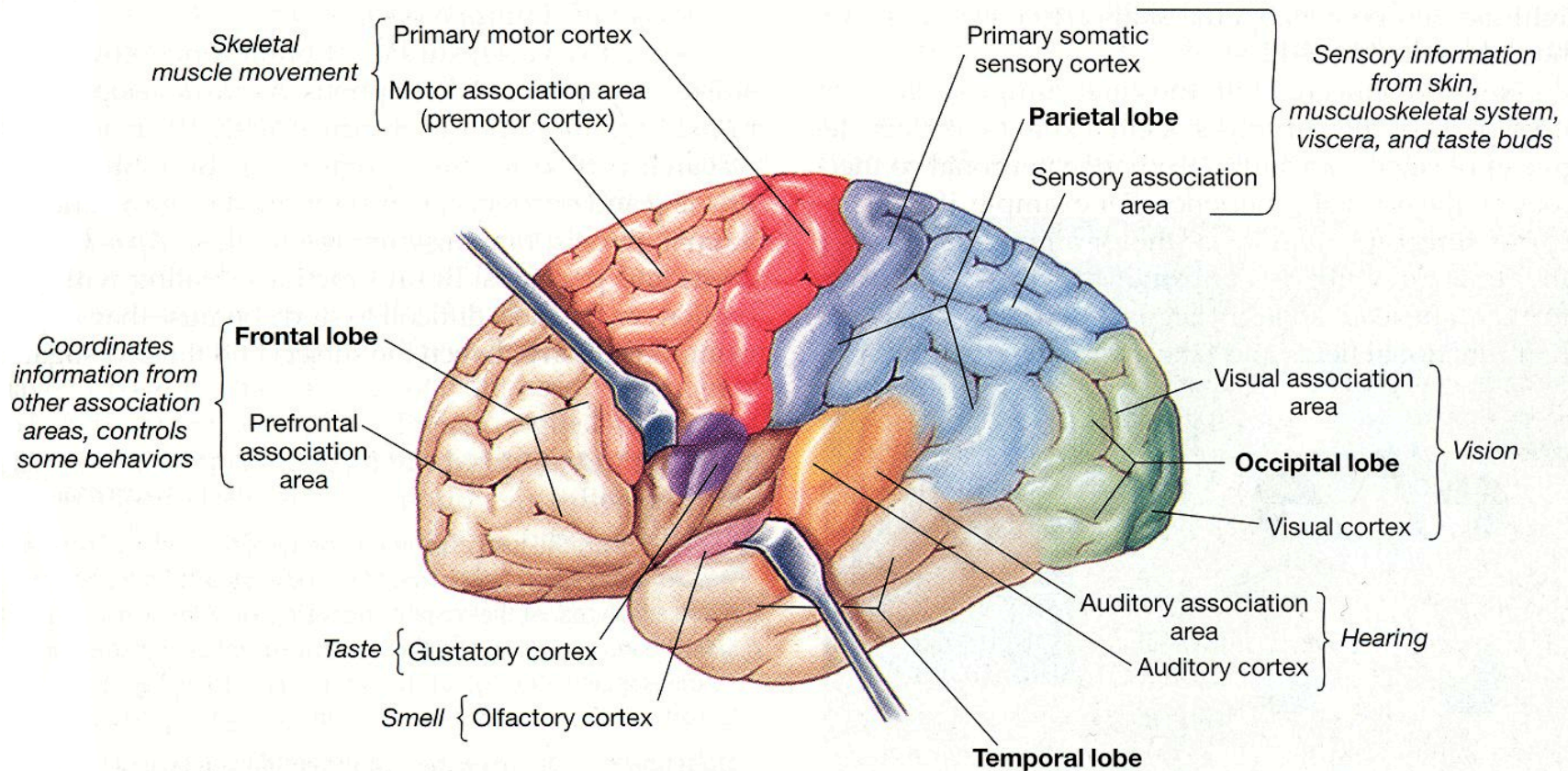
**Smell** is processed in the olfactory cortex (*medial temporal lobe*), a part of the limbic system.





# Cerebral Cortex

**Vision** is processed in the visual cortex (**occipital lobe**).



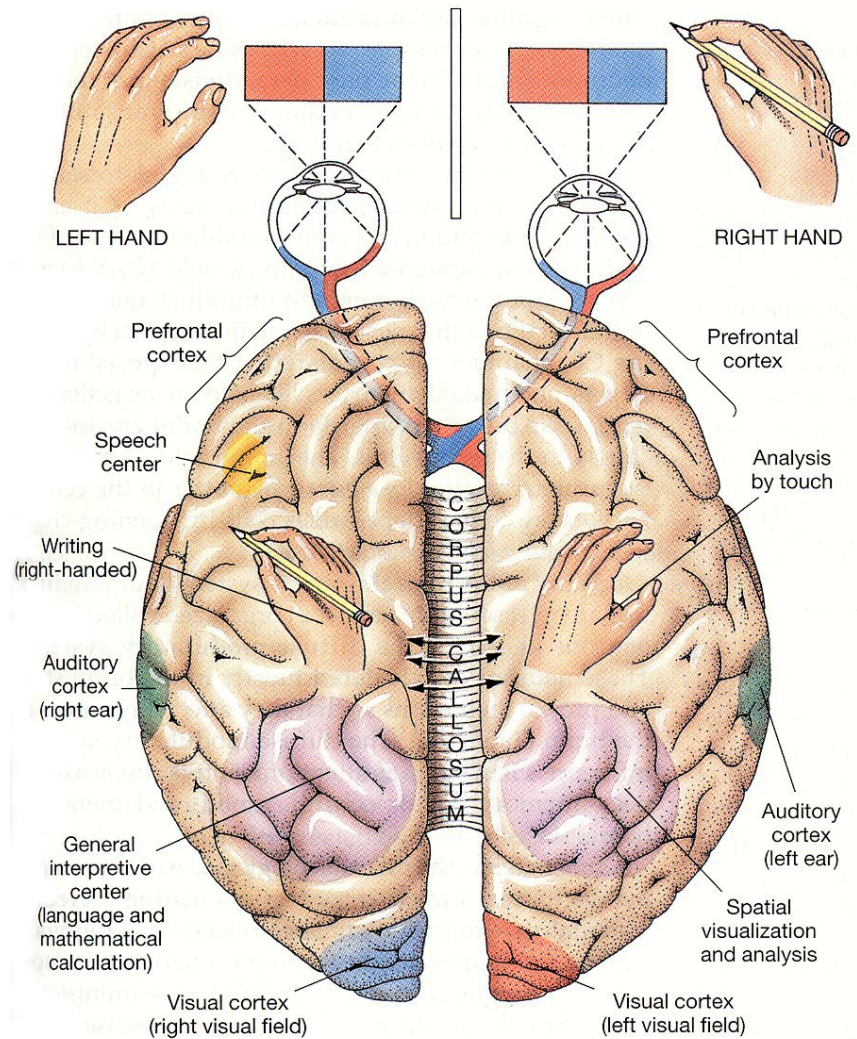


# Cerebral Lateralization

The functional areas in the two hemispheres are not symmetrical.

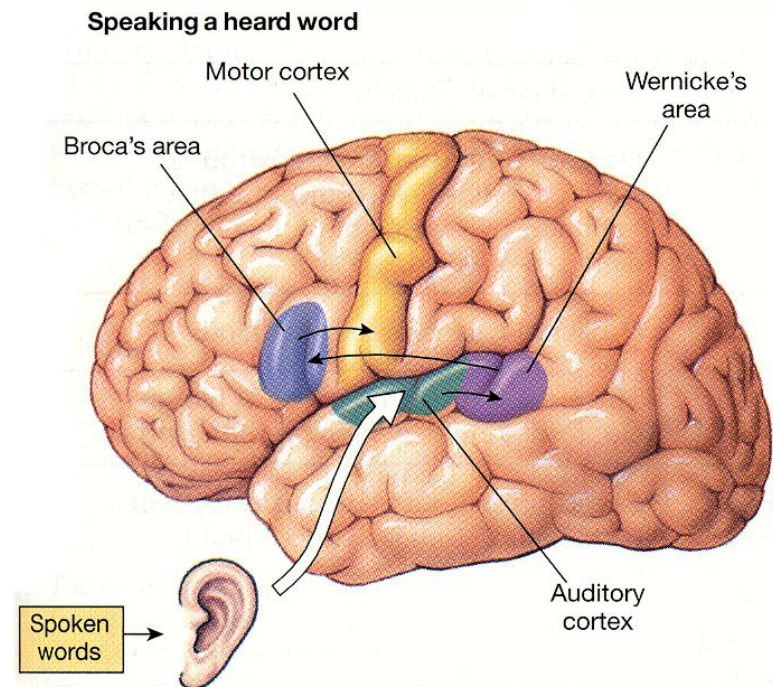
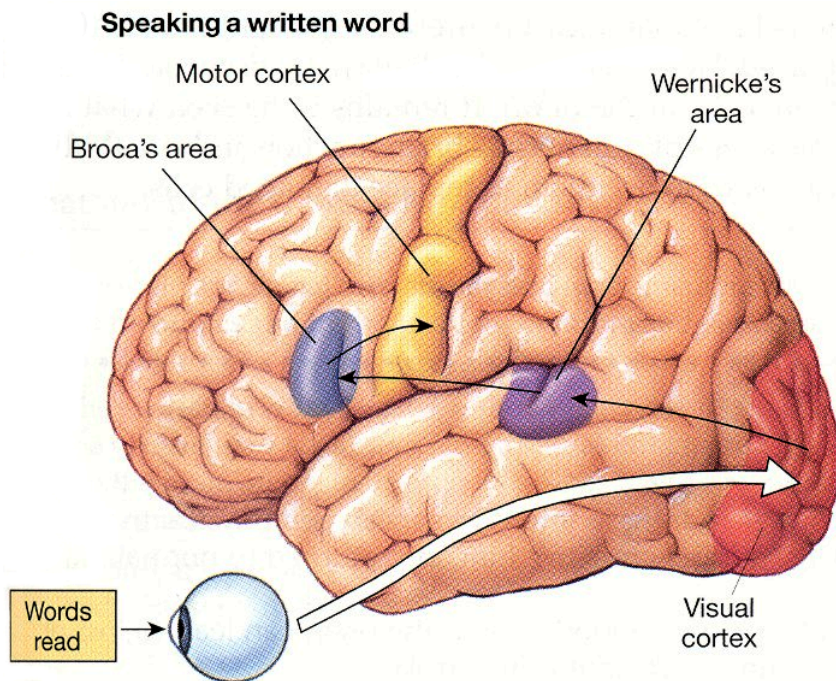
Spatial and musical skills are concentrated on the right.

Language and verbal skills are concentrated on the left.



# Language

Spoken and written words are processed through their respective sensory areas. This audiovisual information is passed to **Wernicke's** area, where it is interpreted, then to **Broca's** area for the coordination of speech and writing.

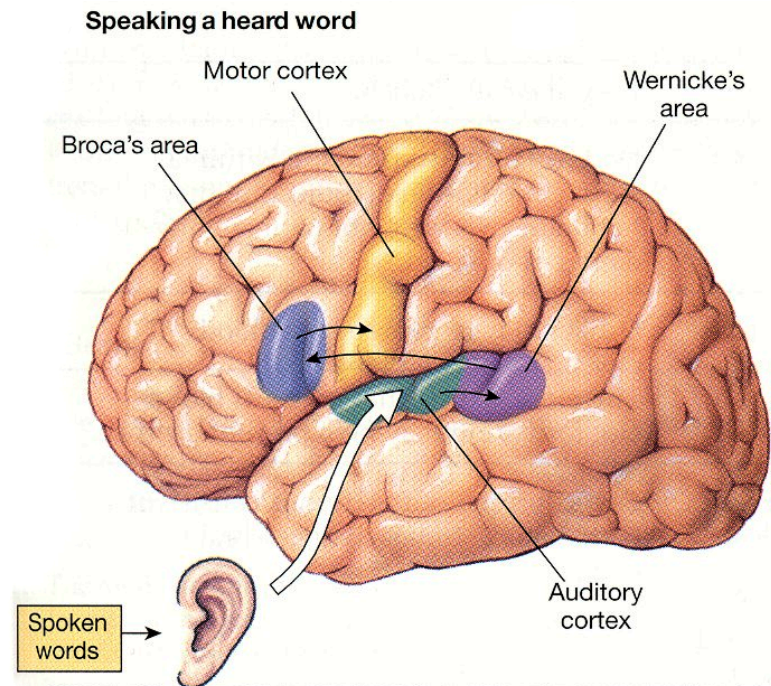
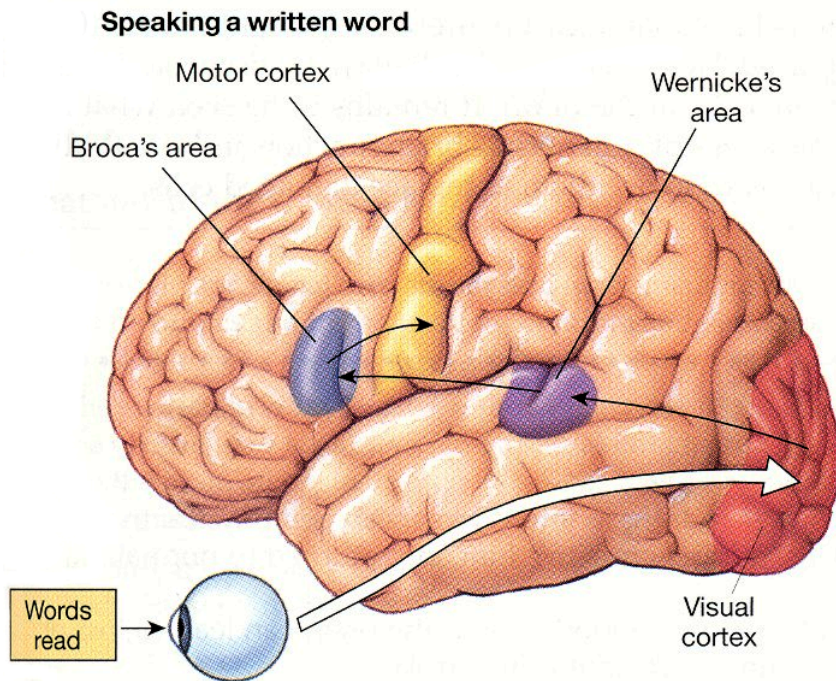




# Language

Damage to **Wernicke's** area disrupts language comprehension (*receptive aphasia*).

Damage to **Broca's** area disrupts language expression (*expressive aphasia*).





# Synesthesia

Mixing of the Senses...

