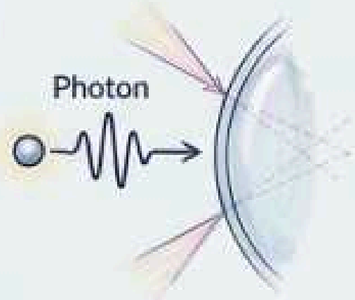
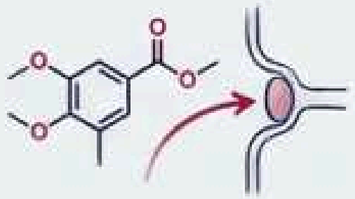
Sensation to Perception: The Universal Pathway

¶ 4.1

The Stimulus

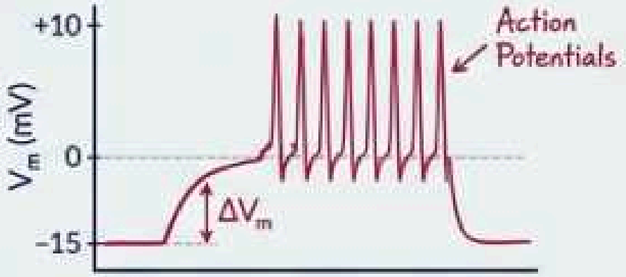


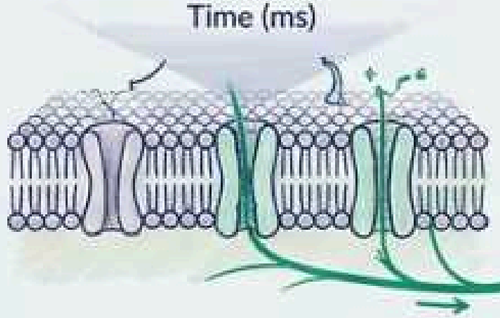




Sensation (Transduction): Receptors convert physical events (light, air molecules, skin deformation) into electrical signals at the cell membrane.

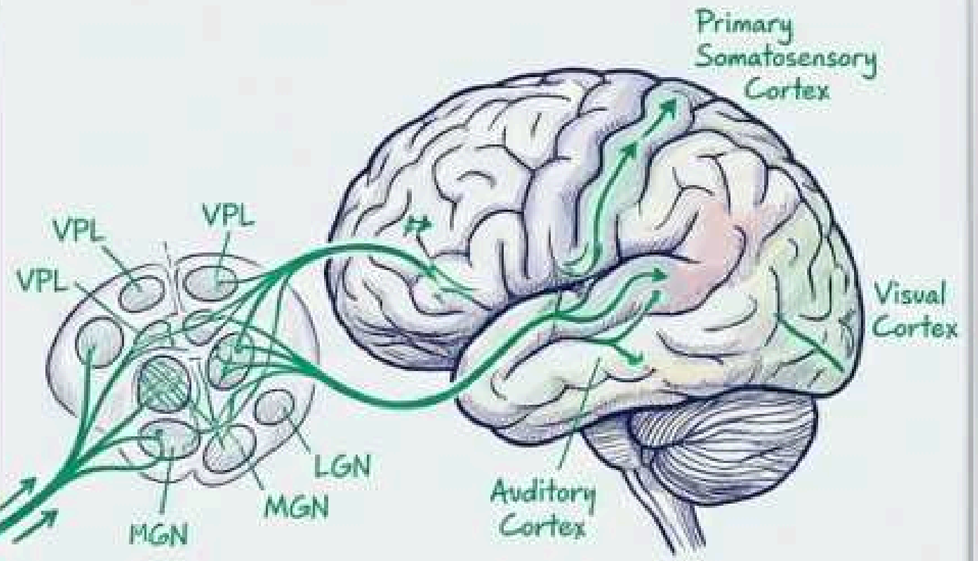
The Receptor





Transmission: Sensory Nerves → Relays (usually the Thalamus)

The Brain

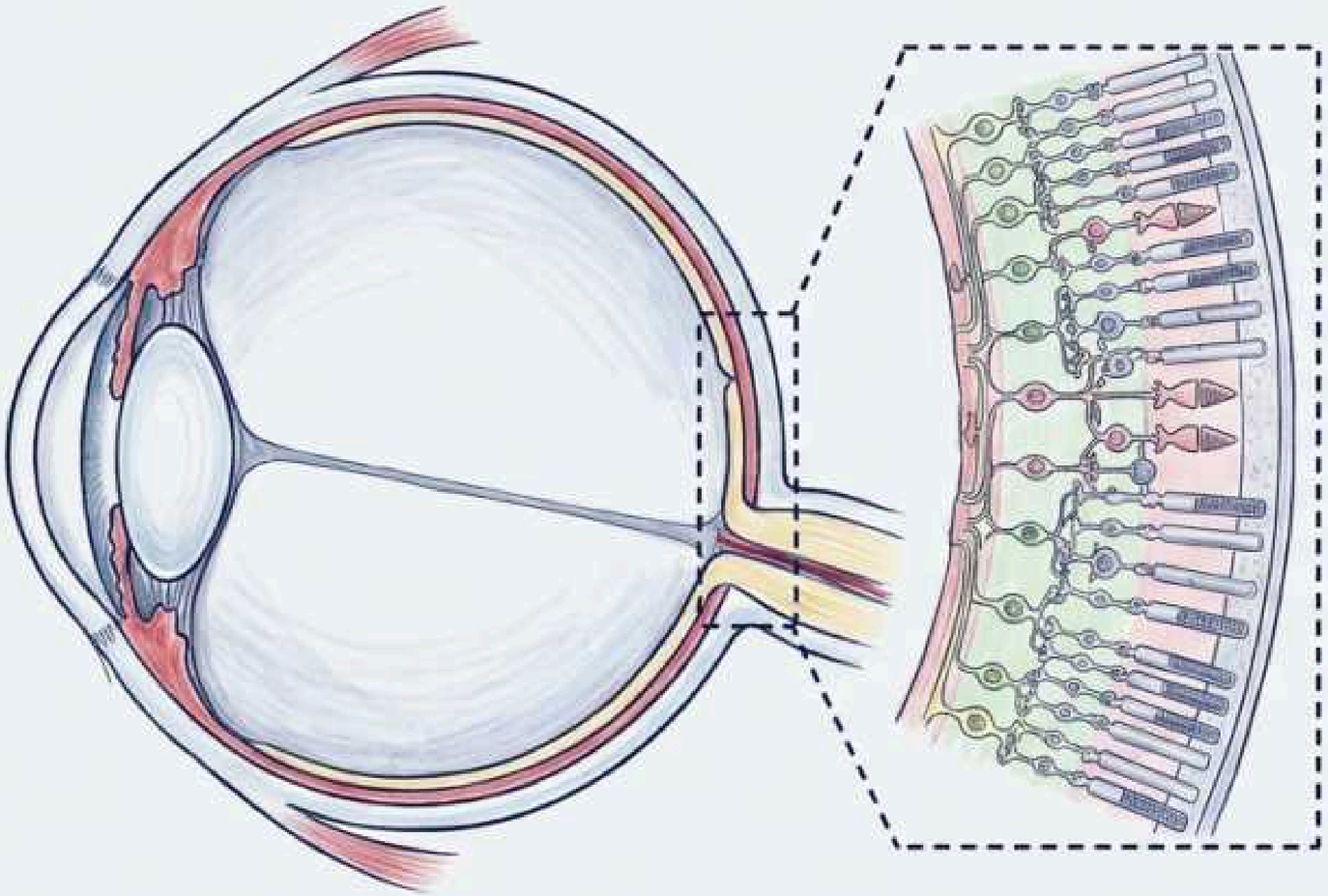


Perception (Construction): Cortical areas extract features to build a usable reality.

Core Insight: The sense organ is the beginning of the story, not the whole of it.

The Retina: Computation, Not Photography

¶ 4.2



Photoreceptor Comparison	
Rods	Cones
Dim light function	Brighter light function
High sensitivity	Color & fine detail
Peripheral distribution	Concentrated in central pit (fovea)

Early Computation Flow

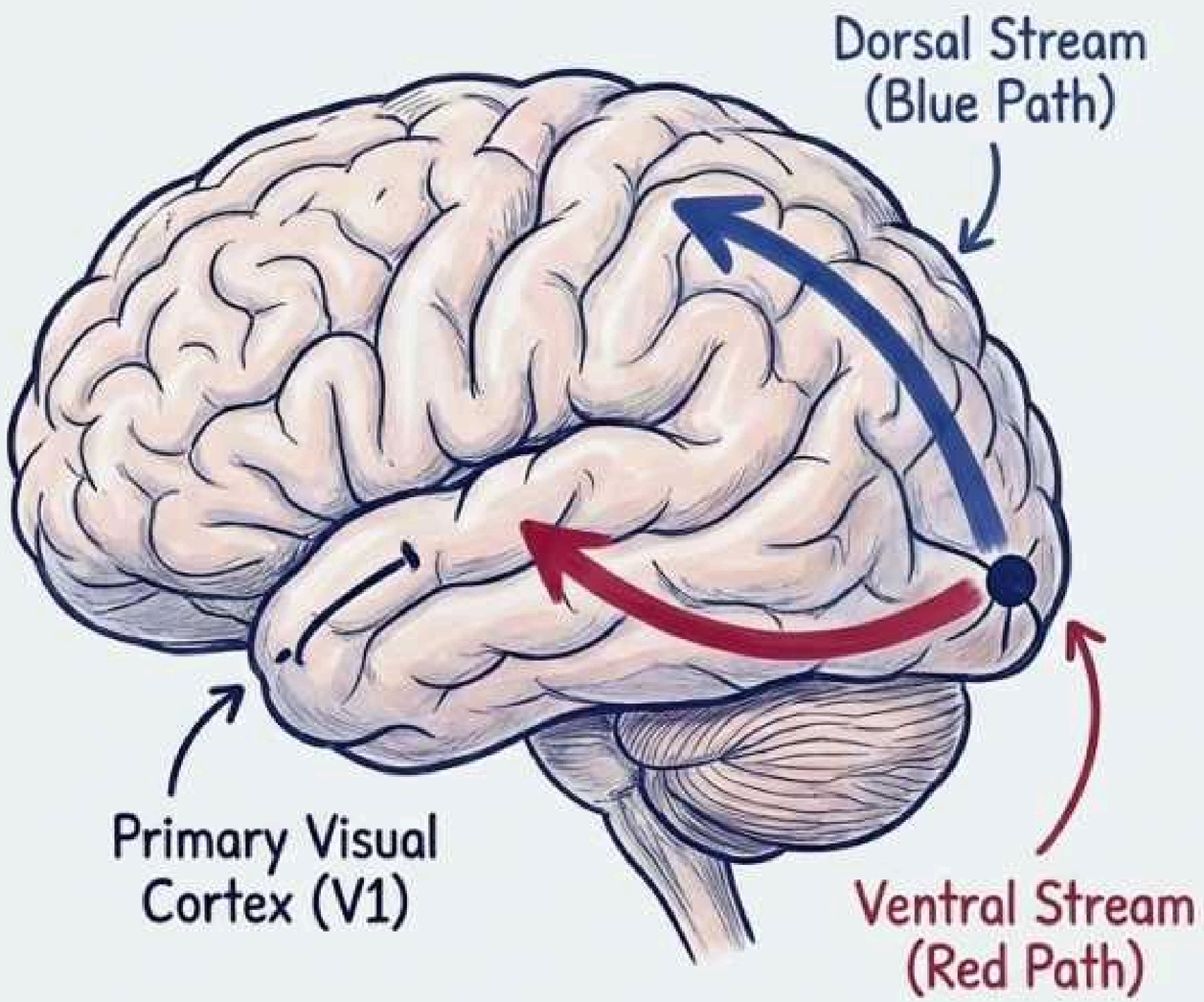


- Key Computations: Cells don't report raw brightness. They calculate:
  - Onset / Offset of light.
  - Contrast within a small spatial patch.

Clinical Note: Retinal disease can sever sight at this very first computational stage.

Visual Cortex: Rebuilding the World

¶ 4.3



Primary Visual Cortex (V1): The first cortical step. Cells respond exclusively to specific edge orientations in specific visual fields (transforming spots of light into geometry).

Division of Labour:

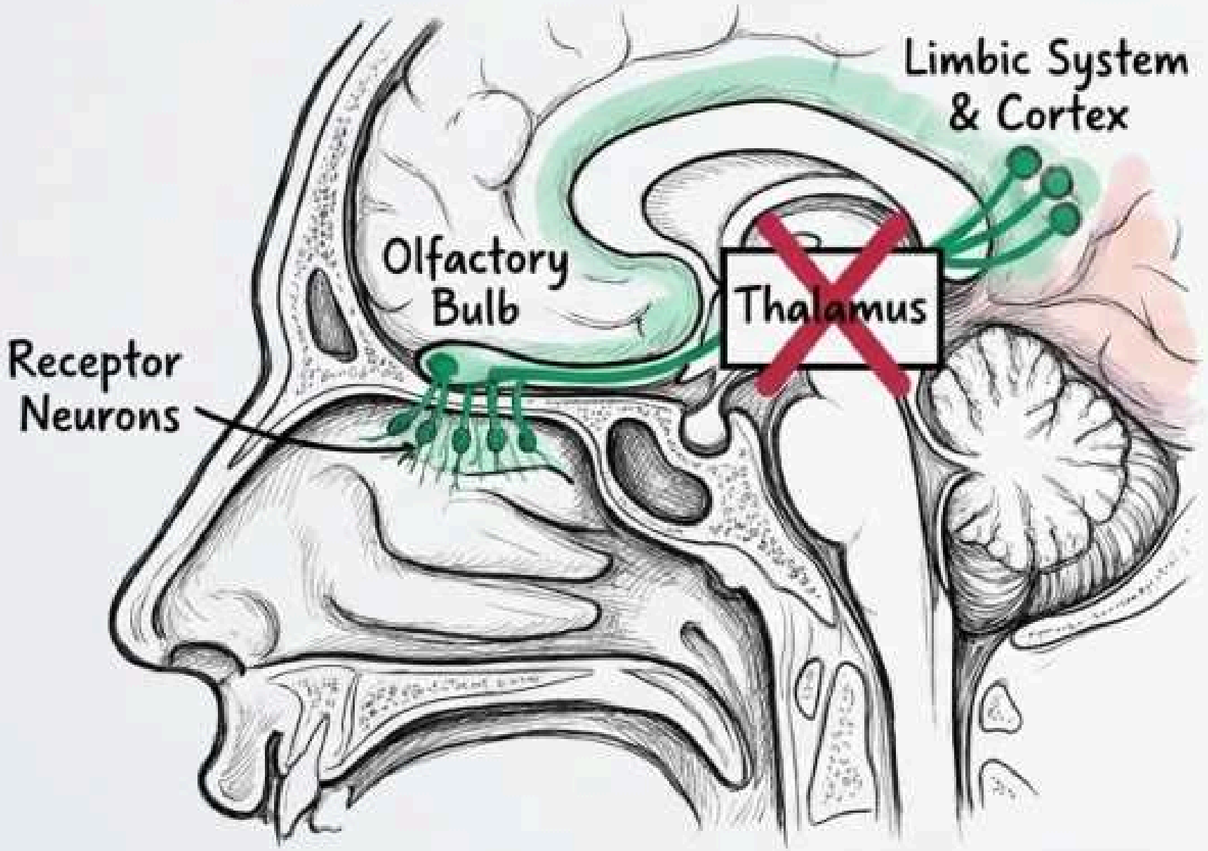
Ventral Stream: The 'What' pathway. Responsible for object and face recognition.

Dorsal Stream: The 'Where / How' pathway. Responsible for spatial location and action planning.

Damage Profiles: Lesions cause highly specific deficits. Damage along these paths can result in a blind spot in the field of view or selective face blindness (prosopagnosia). Seeing is built in stages.

Olfaction: The Chemical Shortcut

¶ 4.4



The Mechanism:
Odorant molecules bind directly to receptor neurons in the nasal lining.
(Humans possess fewer functional receptor genes than many mammals, yet retain a fine-grained sense).

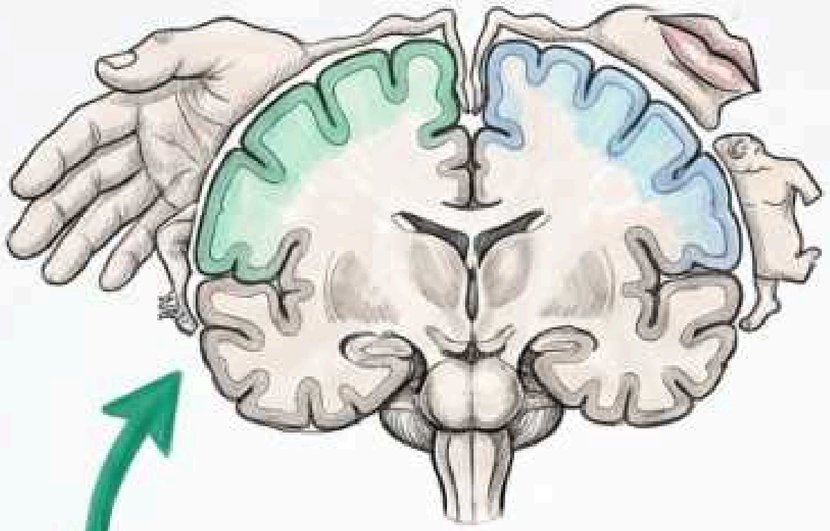
The Anatomical Exception: Axons pass directly to the olfactory bulb → olfactory cortex & limbic structures. No compulsory stop in the thalamus.

The Result:
- Tight bindings to memory and emotion.
- The primary biological driver of what we perceive as “taste”.

Clinical Warning: Sudden loss of smell paired with neurological warning signs requires urgent care, not self-diagnosis.

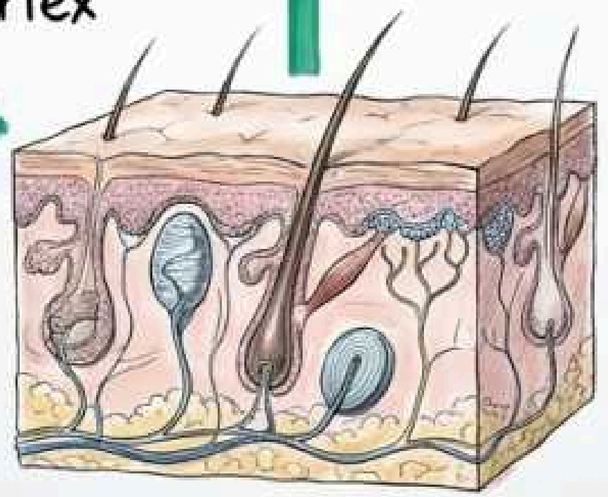
Somatic Sensation: The Plastic Map

¶ 4.5



The Cortical Map: Territory size correlates directly with discrimination fine-tuning (e.g., massive space allocated for the hands and mouth).

Spinal/Cranial Nerves → Thalamus → Somatosensory Cortex



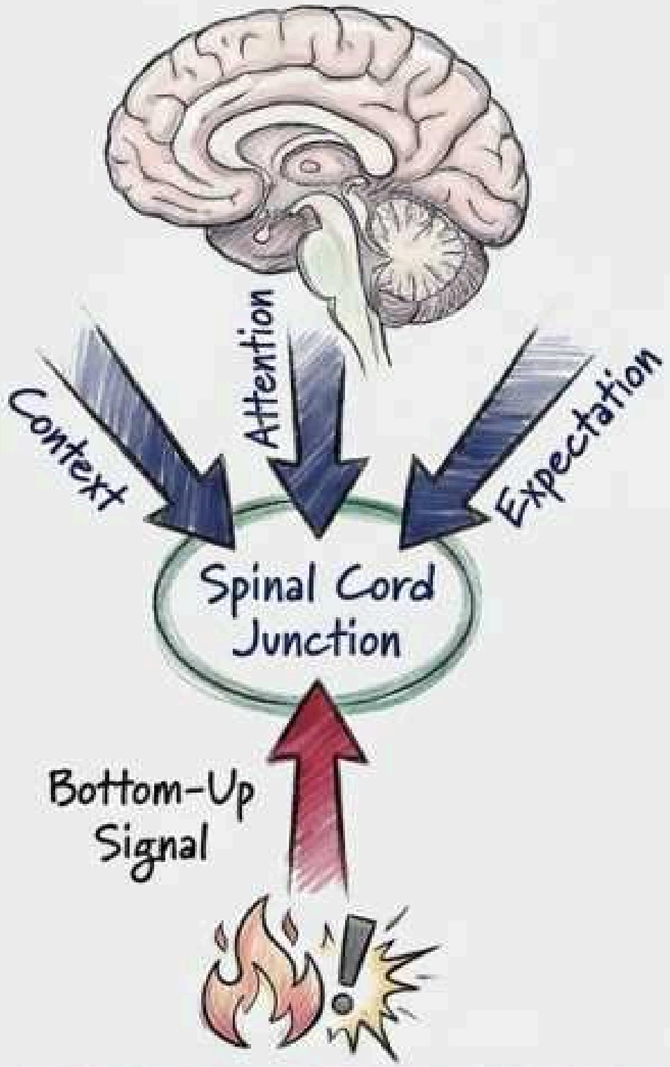
Peripheral Tuning: Distinct receptors for mechanical and thermal events in skin, muscle, and joints.

Core Insight: The map is highly plastic. The combination of position sense and touch is what allows a person to move in the without watching every joint.

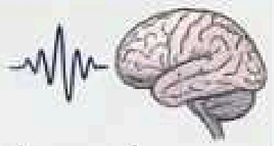
Pain: Contextual Nociception ¶ 4.6

Biological Function:
Specialized fibers report noxious heat, cold, chemical irritation, or strong mechanical force.





Active Modulation:
Signals are heavily modified in the spinal cord and brain. The same injury is felt differently depending on mental state.





Chronic Pain:
Can persist or arise independently of ongoing tissue injury (making it scientifically complex and medically critical).



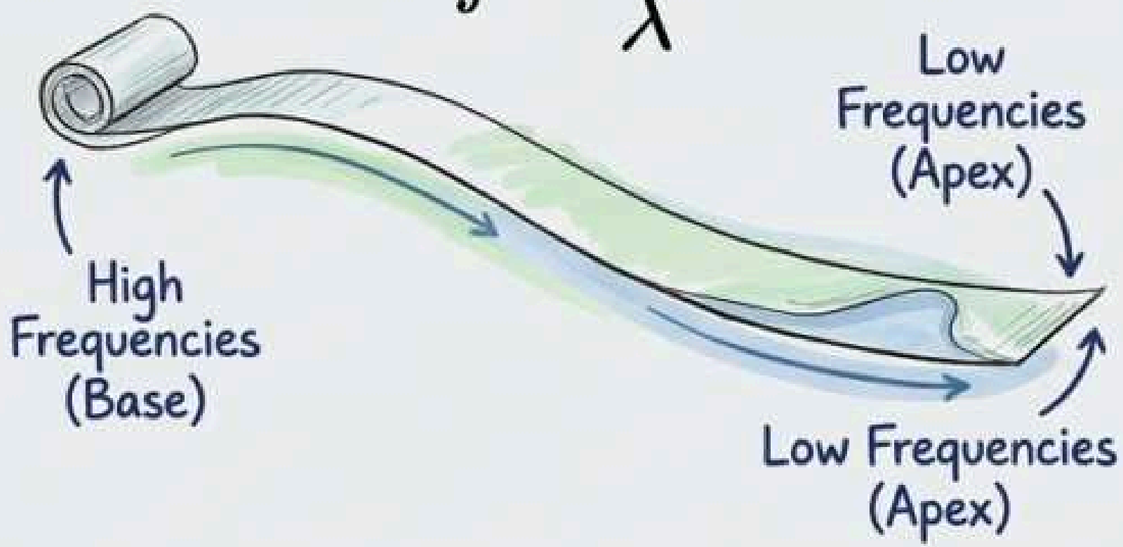


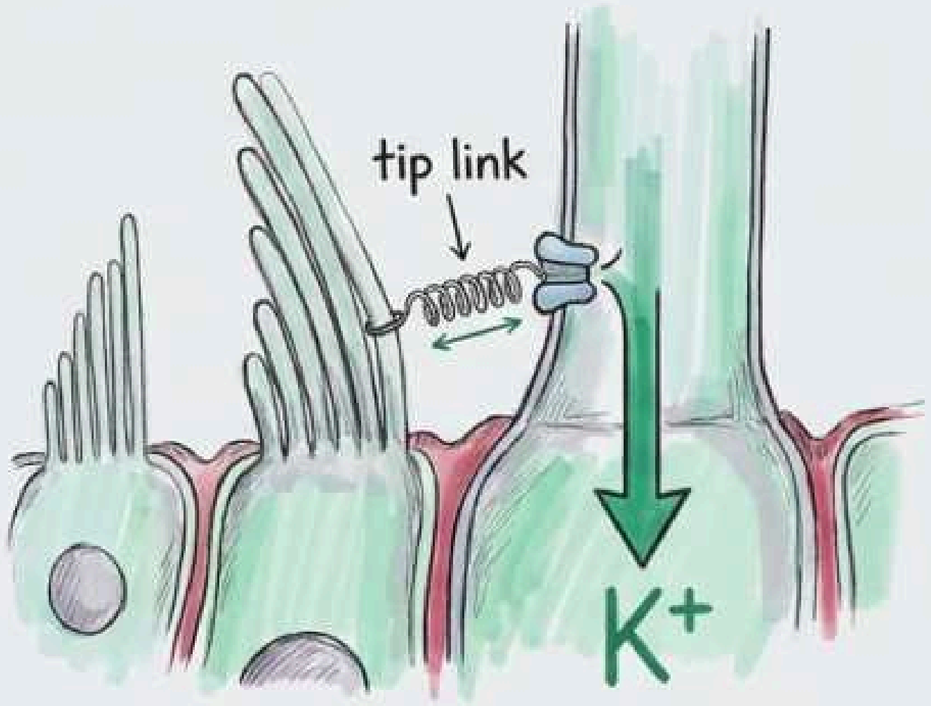
Clinical Note: Severe, sudden, or unexplained pain requires clinical care, not textbook interpretation.

Hearing: Mechanical Transduction

¶ 4.7

$$f = \frac{v}{\lambda}$$





The Traveling Wave: Outer ear → Middle ear bones amplify → Fluid wave generated on the **basilar membrane.**

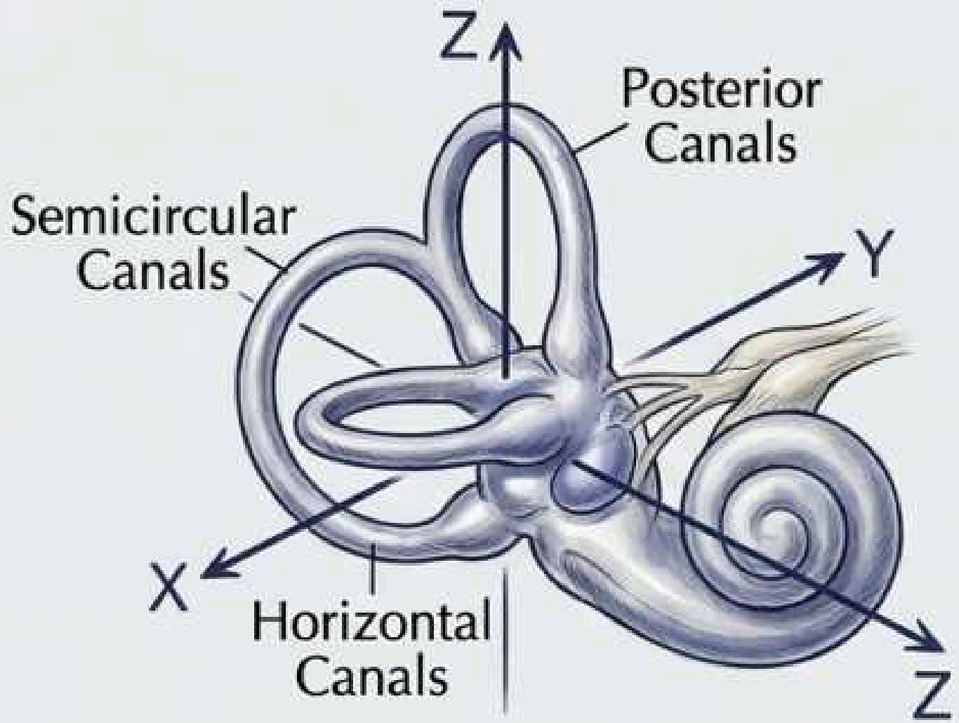
Frequency Mapping: The ear performs **innate frequency analysis; hair cell position** determines frequency sensitivity.

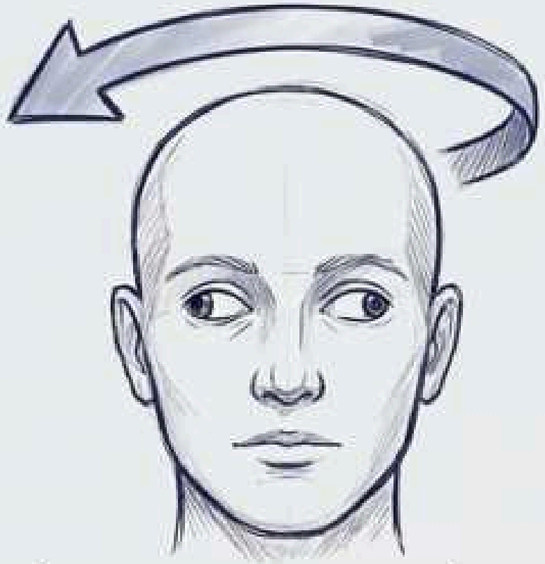
Transduction: Bending tiny hair bundles **mechanically pulls open ion channels** (a focus of Dr. David Corey's leading research).

The Path: Auditory Nerve → Brainstem → Thalamus → Auditory Cortex (where pitch, timing, and location are extracted).

Vestibular Organs: The Anchor of Stability

¶ 4.8





$$\vec{V}_{eye} = -\vec{V}_{head}$$

Semicircular Canals: Detect and report head rotation across three planes.

Otolith Organs: Report linear acceleration, tilt, and the constant pull of gravity.

Core Insight: Vestibular sensation is not a luxury; it is essential for seeing and standing.

Vestibulo-Ocular Reflex (VOR): Moves the eyes in the exact opposite direction to a head turn, ensuring the retinal image remains steady enough to see.

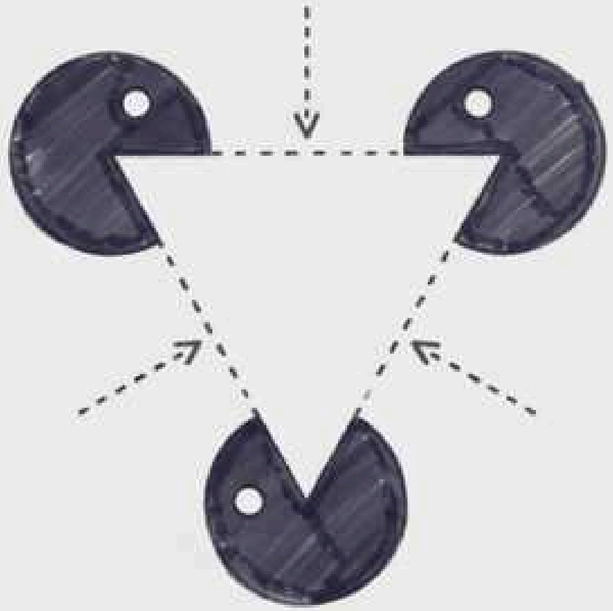
Clinical Warning: Vertigo (the false sense of motion) paired with stroke warning signs (¶ 0.3) demands immediate clinical evaluation.

Perception: Building a World

¶4.9



= Perception



Transduction vs. Perception:
The brain does not passively record. Sense organs are not cameras or microphones attached to a passive hard drive.

The Construction Process:
Colors, faces, spoken words, and limb positions are end-products of multiple stages of comparison and memory.

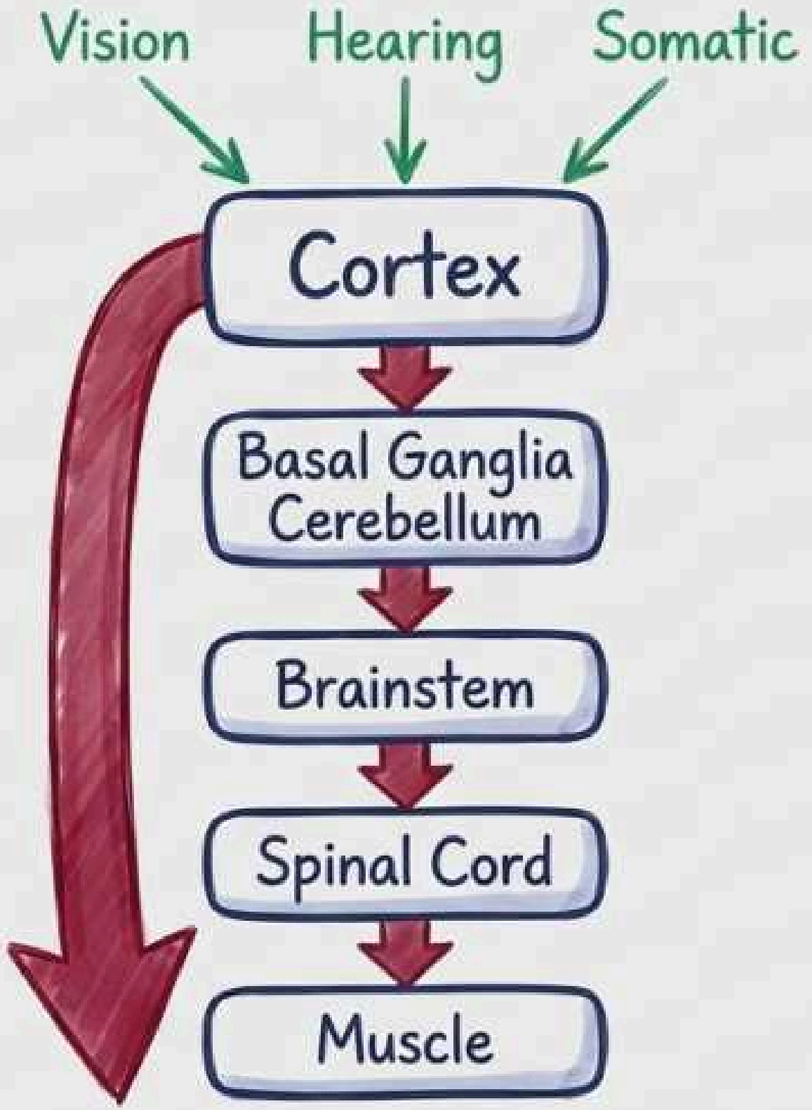
The Purpose of Illusions:
They are not mere tricks. They are crucial clues revealing the hidden assumptions our sensory systems rely upon when incoming data is incomplete.

Beyond Sensation: The Motor Hierarchy

¶ 4.10

Further Sensory Study

Dive deeper via Grokipedia and texts (retina, higher visual processing, pain, auditory coding, vestibular systems).



Preview of Lecture 5

- Transitioning from sensing the world to moving in it.
- **Upcoming Focus:** The top-down motor hierarchy.
- **Clinical Scope:** An encyclopaedic overview of Parkinson's disease and motor neuron disease (no doses, no procedures, no patient examination instruction).