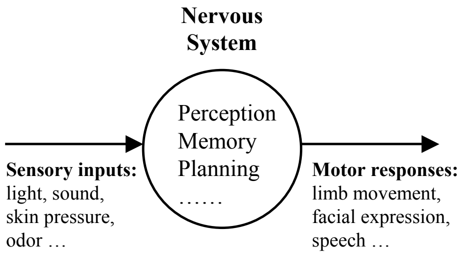
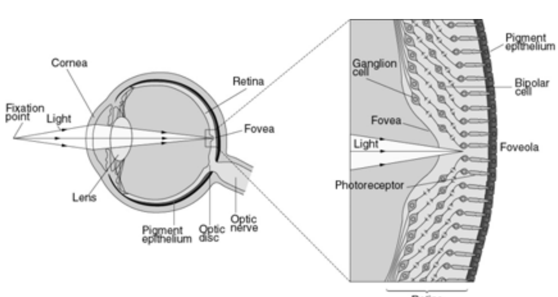


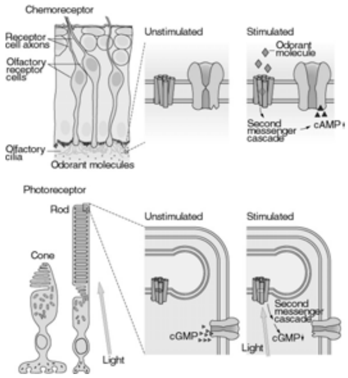
Sensory Systems

Modality	Stimulus	Receptor Class	Receptors
Vision	Light	Photoreceptors	Rods, cones
Audition	Sound	Mechanoreceptor	Hair cells (cochlea)
Vestibular	Gravity, acceleration	Mechanoreceptors	Hair cells (vestibular labyrinth)
Somatic			Dorsal root ganglion neurons
Touch	Pressure	Mechanoreceptor	Cutaneous mechanoreceptors
Proprioception	Displacement	Mechanoreceptor	Muscle and joint receptors
Temperature	Thermal	Thermoreceptor	Cold and warm receptors
Pain	Chemical, thermal, or mechanical	Chemoreceptor, themoreceptor, or mechanoreceptor	Chemical, thermal, and mechanical nociceptors
Itch	Chemical	Chemoreceptor	Chemical nociceptor
Taste	Chemical	Chemoreceptor	Taste buds
Smell	Chemical	Chemoreceptor	Olfactory sensory neurons

Light Projection on Retina



Transduction



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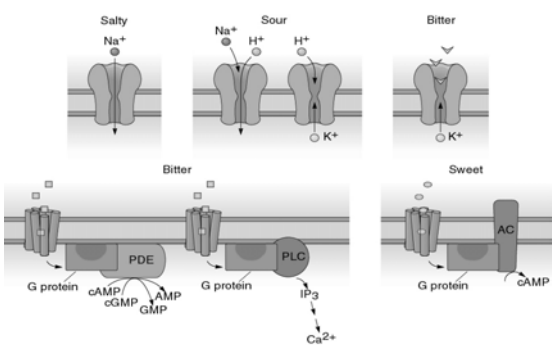
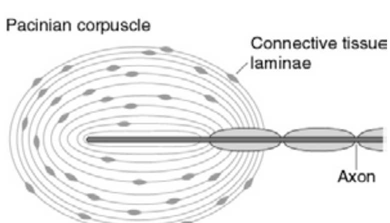
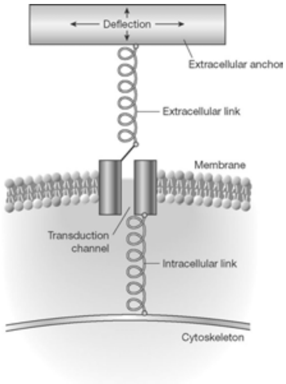
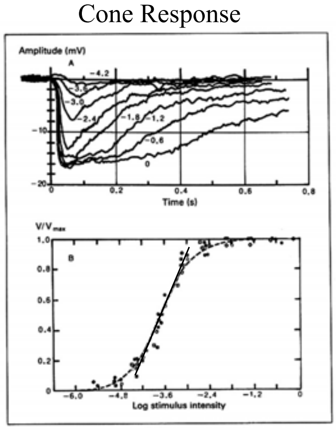




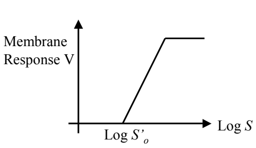
Transduction

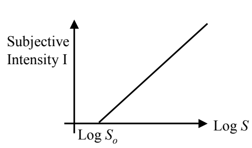


Cone Response



Fechner's Law





$V = A' \log (S/S'_o)$ for the linear range

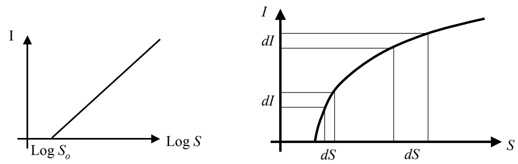
S: Physical stimulus intensity
S'_o: Threshold stimulus intensity
A': Constant

Fechner's law:

$I = A \log (S/S_o)$ for $S > S_o$
$I = 0$ for $S < S_o$

S: Physical stimulus intensity
S_o: Threshold stimulus intensity
A: Constant

Weber's Law



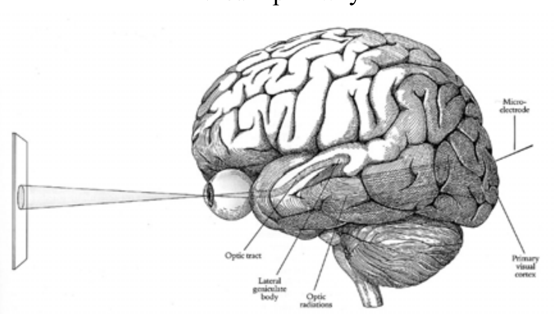
Fechner's law: $I = A \log (S/S_o)$

Differentiate: $dI = A\ dS/S$

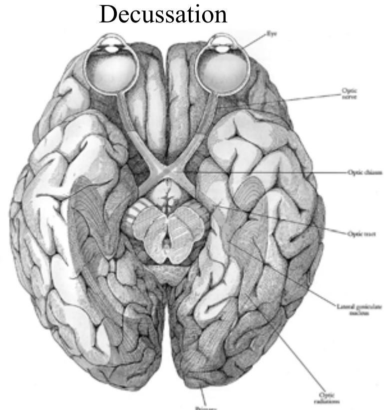
dS needed to get a fixed dI: $dS = (dI/A)\ S$

Weber's Law: $dS = K\ S$ where $K = dI/A$

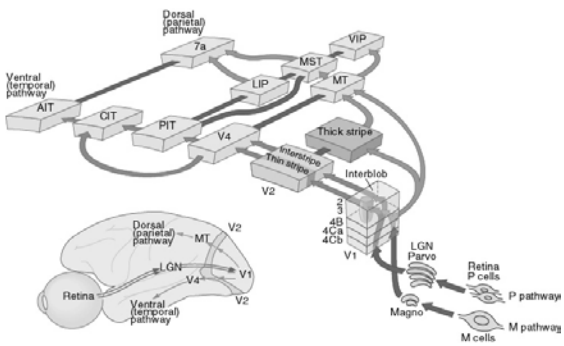
Visual pathway

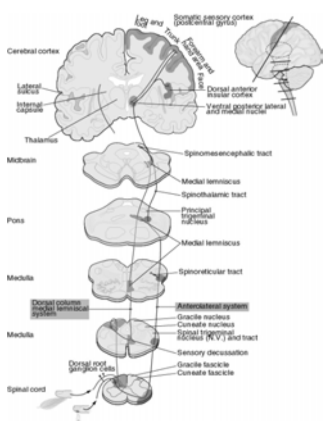


Decussation

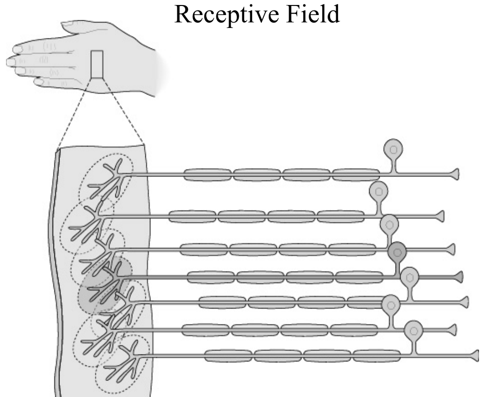


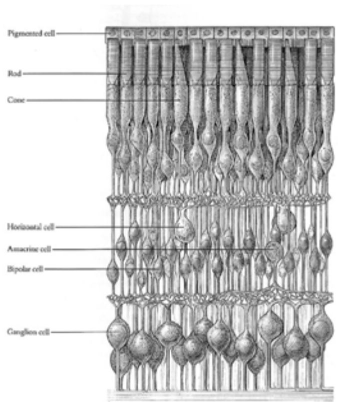
Hierarchical and Parallel Processing

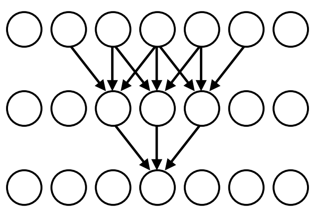


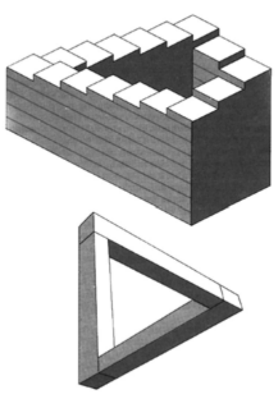


Receptive Field

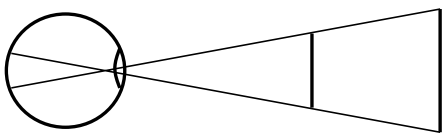



Pigmented cell
Rod
Cone
Horizontal cell
Amacrine cell
Bipolar cell
Ganglion cell

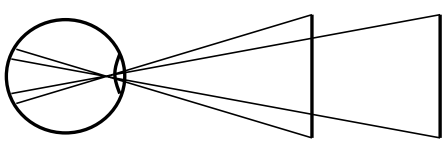




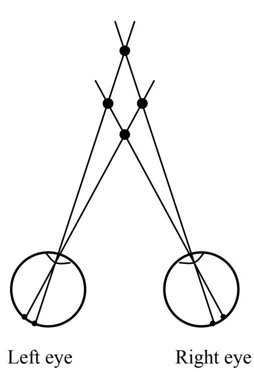
Geometry of Projection



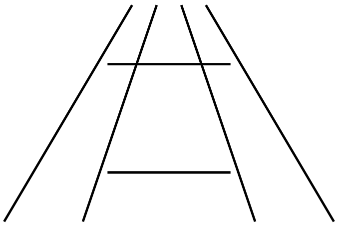
Geometry of Projection



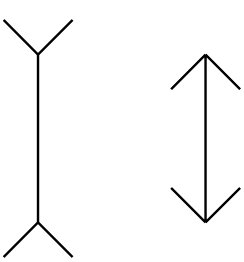
Retinal image size is inversely proportional to distance



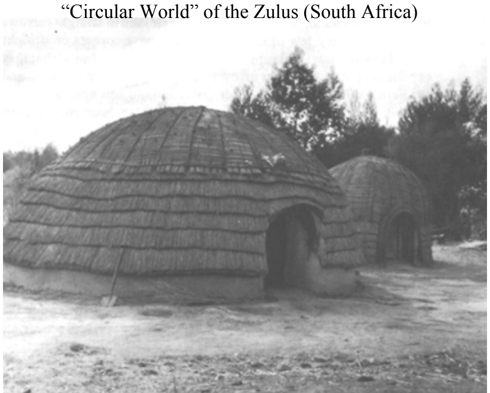
Ponzo's Illusion



Muller-Lyer Illusion



"Circular World" of the Zulus (South Africa)



David Marr's Concept of a Computational Theory for Understanding an Information Processing Task in the Brain

We cannot understand how a bird flies by only studying its wings, but need, in addition, an aerodynamic theory of lift generation by the flow patterns around the wings.

We cannot understand how a computer works by only studying the transistors on the circuit boards and their connections, but need, in addition, concepts of operating system, data structure, and application programs.

David Marr's Concept of a Computational Theory for Understanding an Information Processing Task in the Brain

Therefore, even if some day we had complete knowledge of every molecule in the brain, and could record the electrical activities of every cell at any time, we would still not understand how the brain processes information. We need, in addition, a computational theory which specifies how the electrical signals carried by a large number of neurons could act in concert to solve a certain perceptual problem.