Excitatory Post Synaptic Potential

The generation of an EPSP

(a) An action potential arriving in the presynaptic terminal causes the release of neurotransmitter.

(b) The molecules bind to transmitter-gated ion channels in the postsynaptic membrane. If Na enters the postsynaptic cell through the open channels, the membrane will become depolarized.

(c) The resulting change in membrane potential (Vm), as recorded by a microelectrode in the cell, is the **EPSP**.

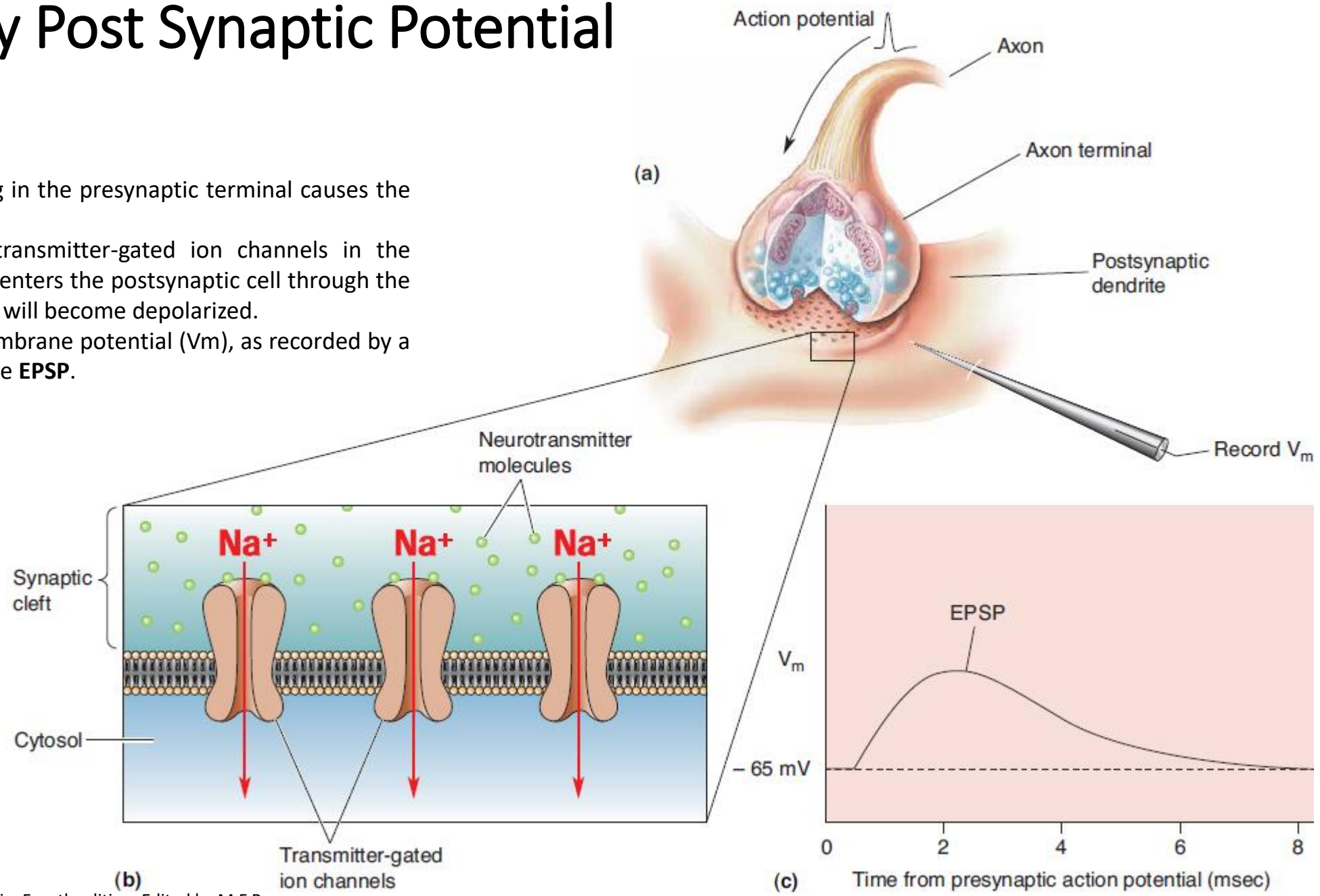


FIGURE 5.15, Neuroscience, exploring the brain, Fourth edition ,Edited by M.F Bear

Inhibitory Post Synaptic Potential

The generation of an IPSP.
(a) An action potential arriving in the presynaptic terminal causes the release of neurotransmitter.
(b) The molecules bind to transmitter-gated ion channels in the postsynaptic membrane. If Cl enters the postsynaptic cell through the open channels, the membrane will become hyperpolarized.
(c) The resulting change in membrane potential (Vm), as recorded by a microelectrode in the cell, is the IPSP

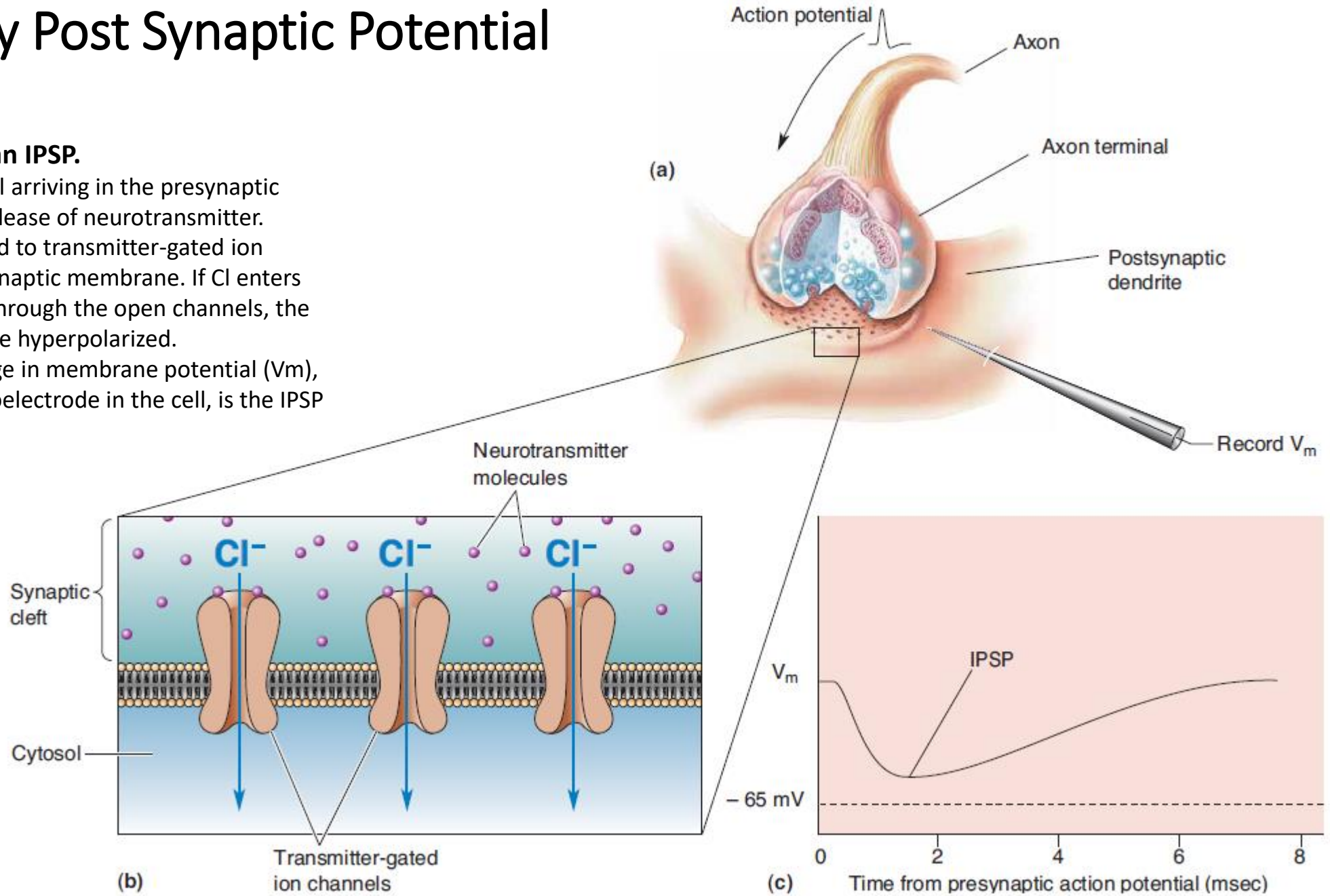
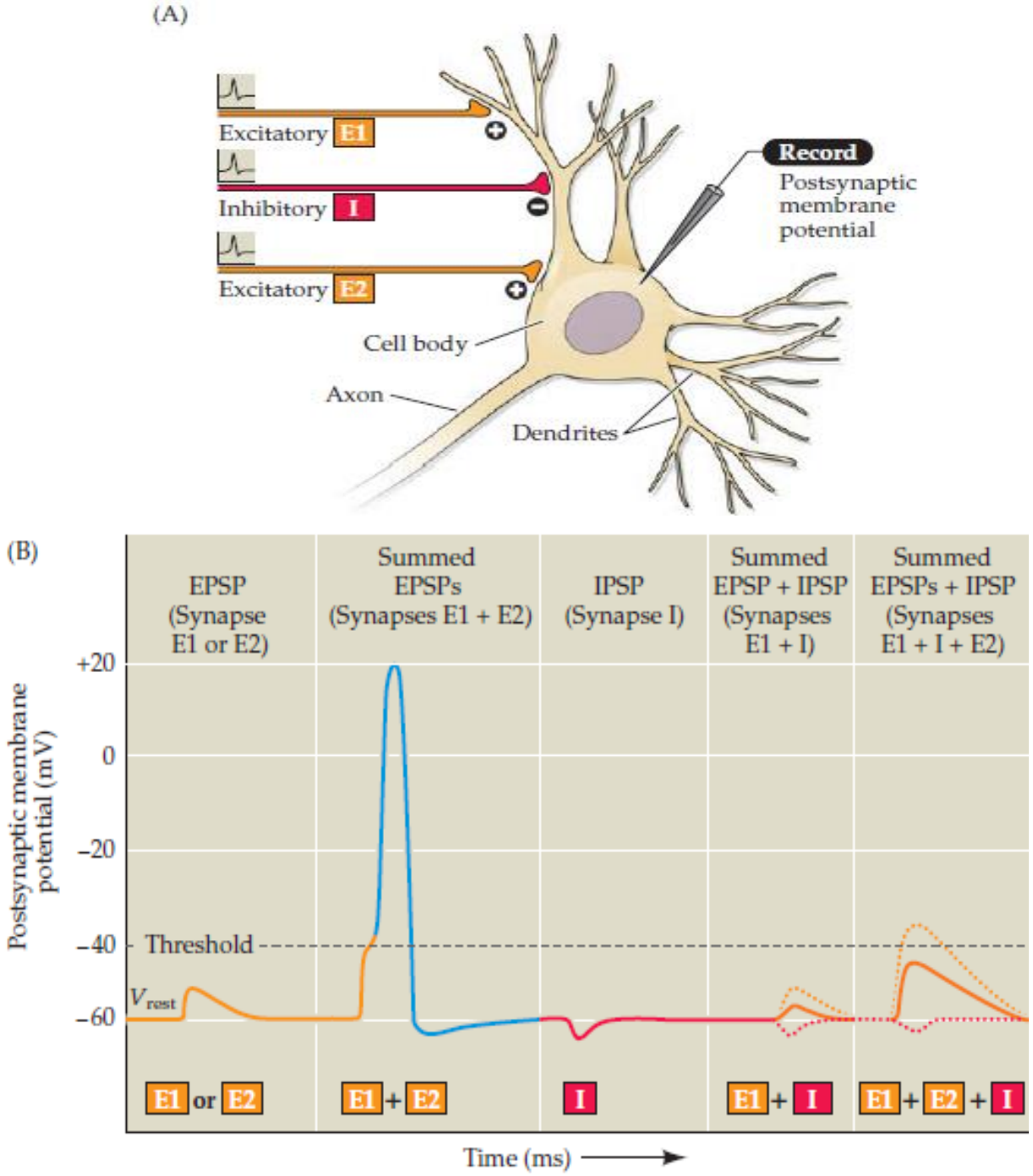
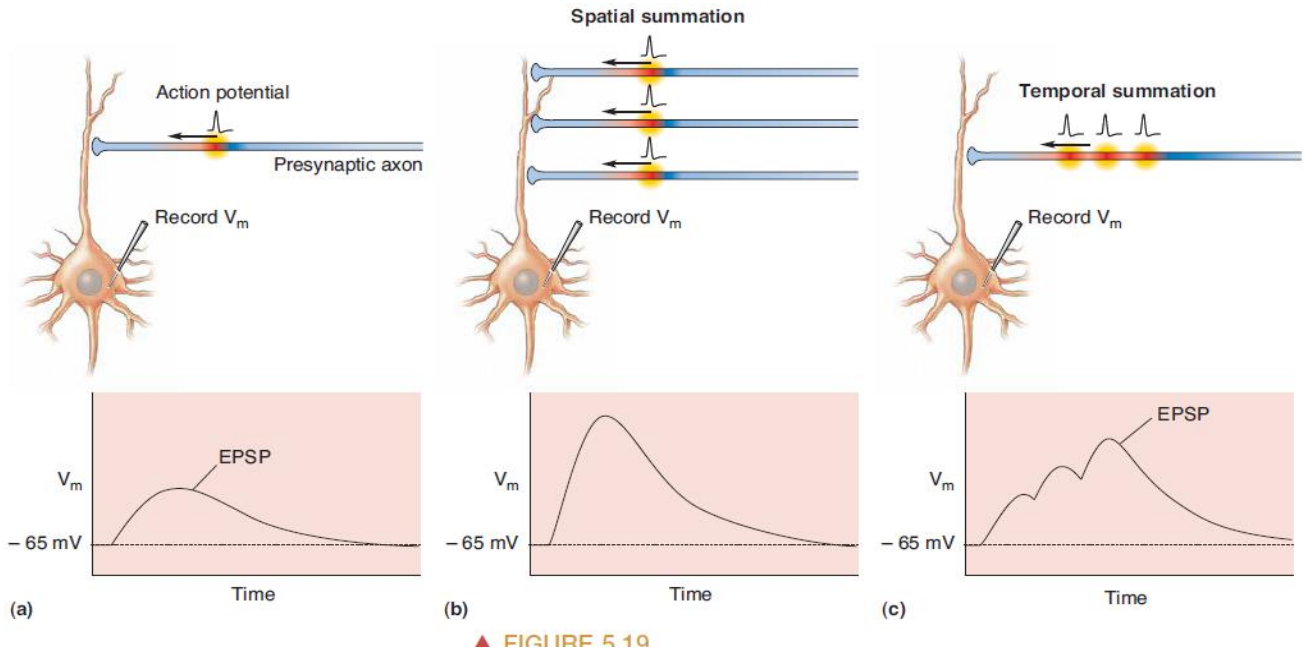


FIGURE 5.16, Neuroscience, exploring the brain, Fourth edition ,Edited by M.F Bear

Summation of postsynaptic potentials

(A) A microelectrode records the postsynaptic potentials produced by the activity of two excitatory synapses (E1 and E2) and an inhibitory synapse (I).
(B) Electrical responses to synaptic activation. Stimulating either excitatory synapse (E1 or E2) produces a subthreshold EPSP, whereas stimulating both synapses at the same time (E1 + E2) produces a supra threshold EPSP that evokes a postsynaptic action potential (shown in blue). Activation of the inhibitory synapse alone (I) results in a hyperpolarizing IPSP. Summing this IPSP (dashed red line) with the EPSP (dashed yellow line) produced by one excitatory synapse (E1 + I) reduces the amplitude of the EPSP (solid orange line), while summing it with the supra threshold EPSP produced by activating synapses E1 and E2 keeps the postsynaptic neuron below threshold, so that no action potential is evoked.





EPSP summation.
(a) A presynaptic action potential triggers a small EPSP in a postsynaptic neuron.
(b) Spatial summation of EPSPs: When two or more presynaptic inputs are active at the same time, their individual EPSPs add together.
(c) Temporal summation of EPSPs: When the same presynaptic fiber fires action potentials in quick succession, the individual EPSPs add together

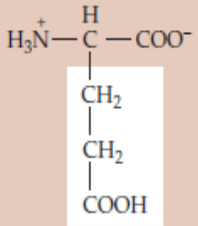
FIGURE 5.19, Neuroscience, exploring the brain, Fourth edition ,Edited by M.F Bear

SMALL-MOLECULE NEUROTRANSMITTERS

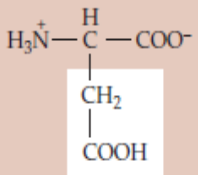
Acetylcholine $(CH_3)_3\overset{+}{N}-CH_2-CH_2-O-\overset{O}{\overset{\|}{C}}-CH_3$

AMINO ACIDS

Glutamate

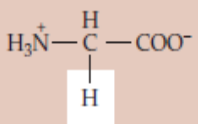


Aspartate



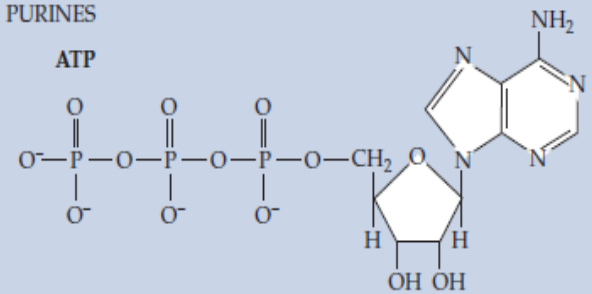
GABA $H_3\overset{+}{N}-CH_2-CH_2-CH_2-COO^-$

Glycine



PURINES

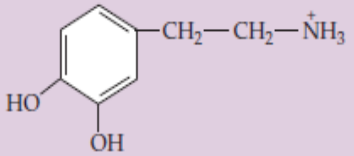
ATP



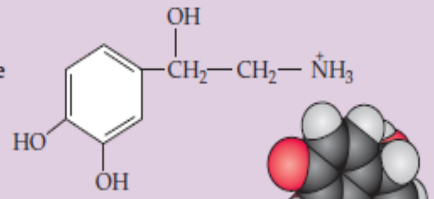
BIOGENIC AMINES

CATECHOLAMINES

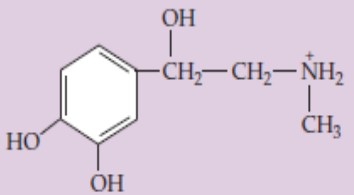
Dopamine



Norepinephrine

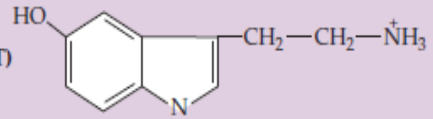


Epinephrine



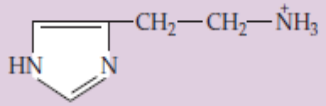
INDOLEAMINE

Serotonin (5-HT)

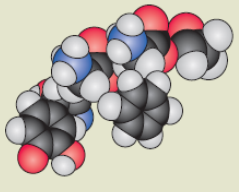


IMIDAZOLEAMINE

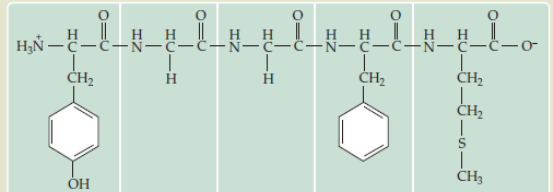
Histamine



PEPTIDE NEUROTRANSMITTERS (more than 100 peptides, usually 3–36 amino acids long)



Example: Methionine enkephalin (Tyr–Gly–Gly–Phe–Met)

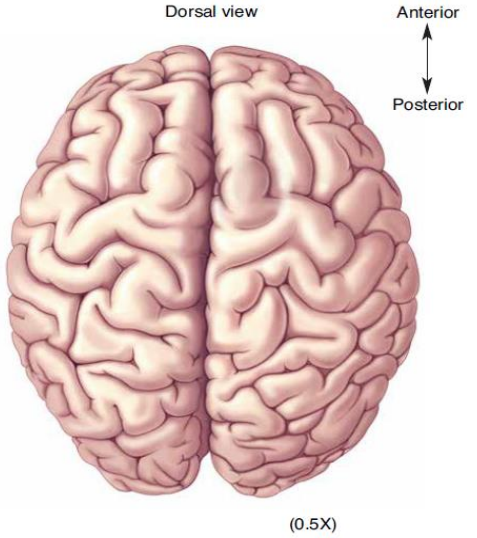


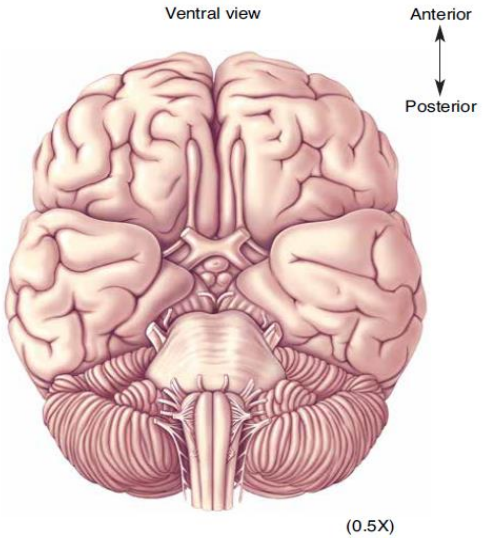
Tyr Gly Gly Phe Met

Neurotransmitter	Postsynaptic effect[a]
ACh	Excitatory
Glutamate	Excitatory
GABA	Inhibitory
Glycine	Inhibitory
Catecholamines (epinephrine, norepinephrine, dopamine)	Excitatory
Serotonin (5-HT)	Excitatory
Histamine	Excitatory
ATP	Excitatory
Neuropeptides	Excitatory and inhibitory
Endocannabinoids	Inhibits inhibition
Nitric oxide	Excitatory and inhibitory

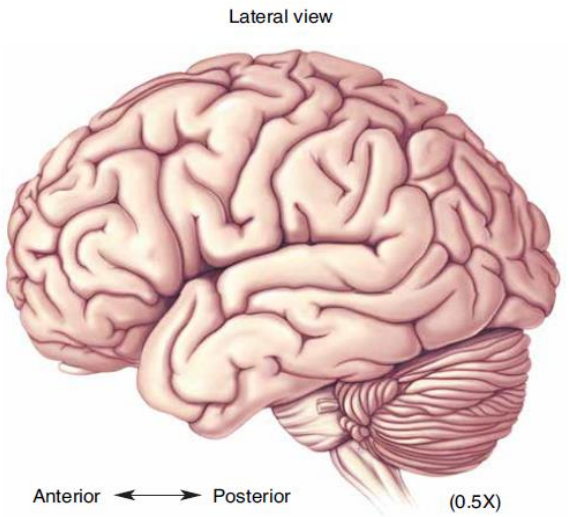
Brief Introduction to Brain anatomy

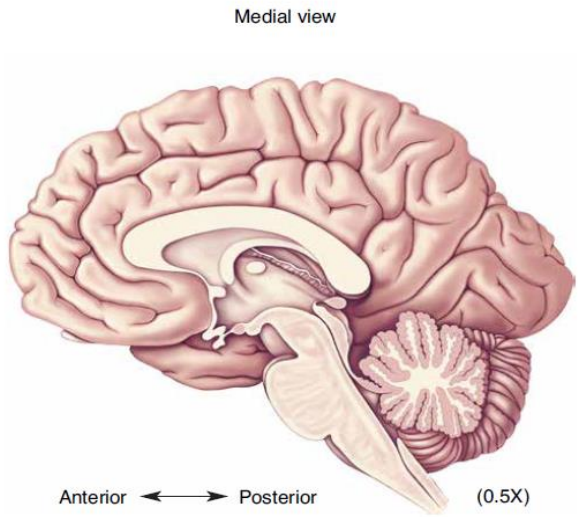
Imagine that you hold in your hands a human brain that has been dissected from the skull. It is wet and spongy, and weighs about 1.4 kilograms (3 pounds). Looking down on the brain's dorsal surface reveals the convoluted surface of the cerebrum. Flipping the brain over shows the complex ventral surface that normally rests on the floor of the skull.





Holding the brain up and looking at its side—the lateral view—shows the "ram's horn" shape of the cerebrum coming off the stalk of the brain stem. The brain stem is shown more clearly if we slice the brain right down the middle and view its medial surface. In the part of the guide that follows, we will name the important structures that are revealed by such an inspection of the brain.





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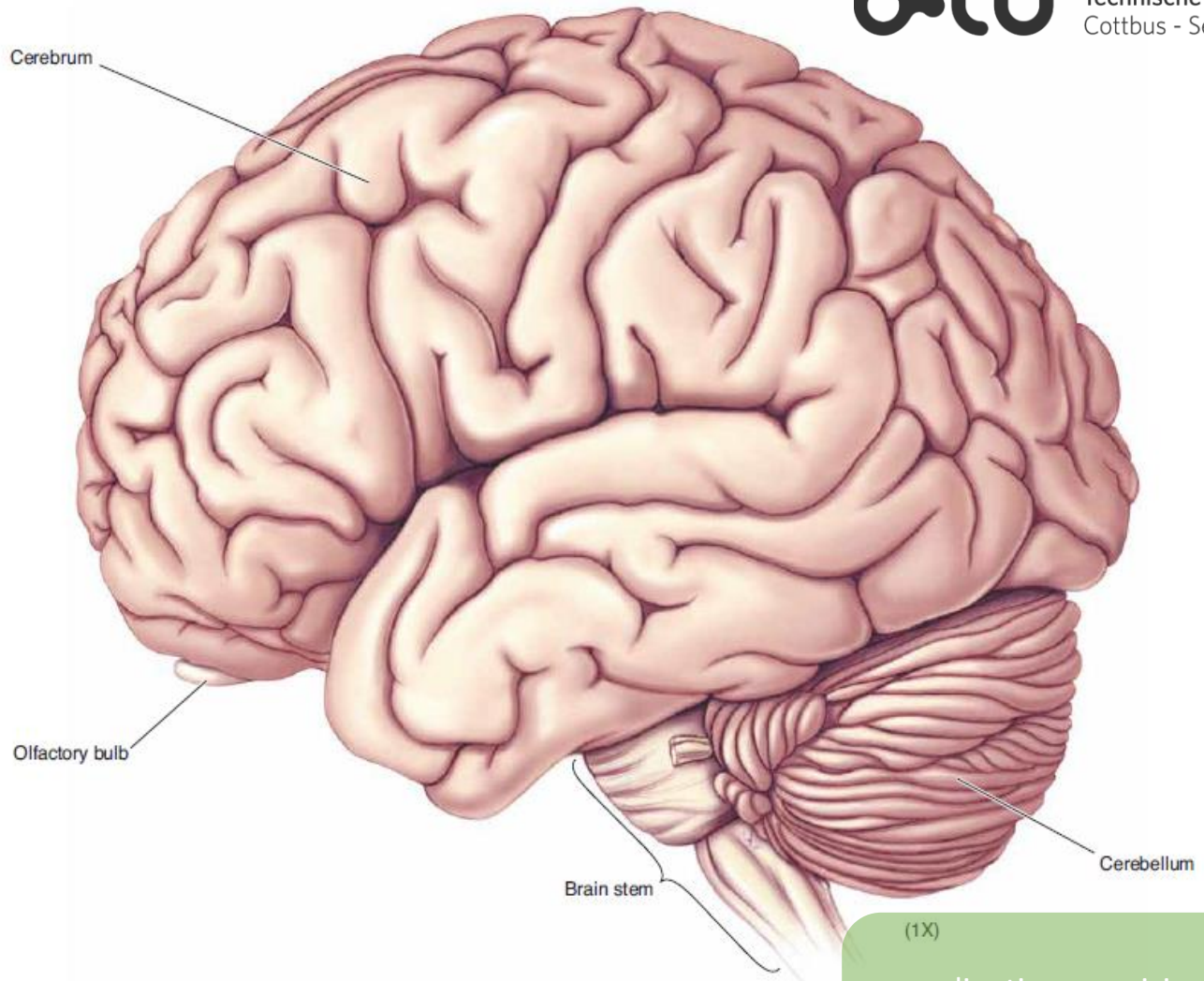
Brief Introduction to Brain anatomy…

Gross inspection reveals the three major parts:
the **large cerebrum**, the brain stem that forms its stalk, and the rippled **cerebellum**. The diminutive olfactory bulb of the cerebrum can also be seen in this lateral view.



coordination, precision and timing of movements, as well as in motor learning

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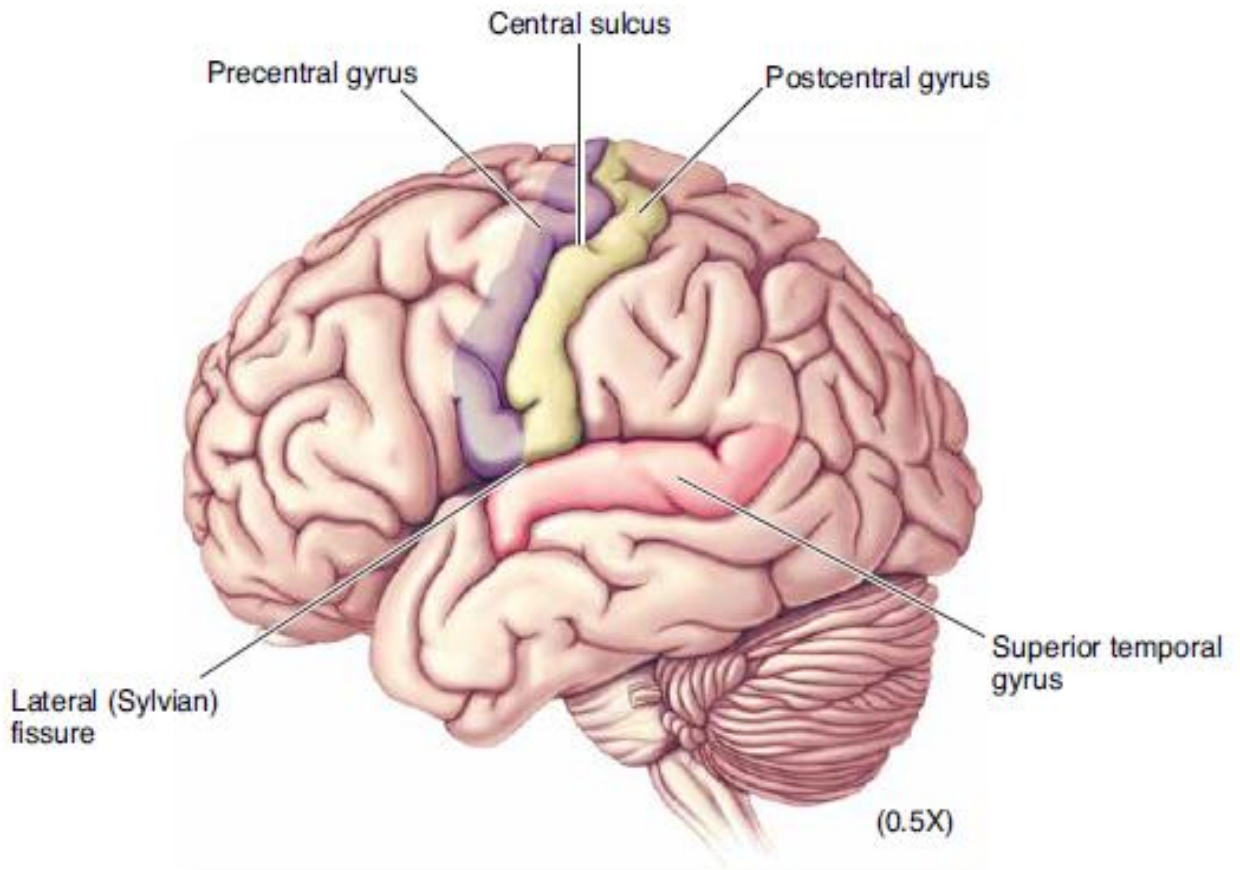
Brief Introduction to Brain anatomy …

Selected Gyri, Sulci, and Fissures. The cerebrum is noteworthy for its convoluted surface. The **bumps are called *gyri***, and the **grooves are called *sulci*** or, if they are especially deep, **fissures**. The precise pattern of gyri and sulci can vary considerably from individual to individual, but many features are common to all human brains. Some of the important landmarks are labeled here. Notice that the **postcentral gyrus** lies immediately posterior to the **central sulcus**, and that the precentral gyrus lies immediately anterior to it. The neurons of the postcentral gyrus are involved in **somatic sensation** (touch), and those of the precentral gyrus control **voluntary movement** . Neurons in the superior temporal gyrus are involved in **audition**).



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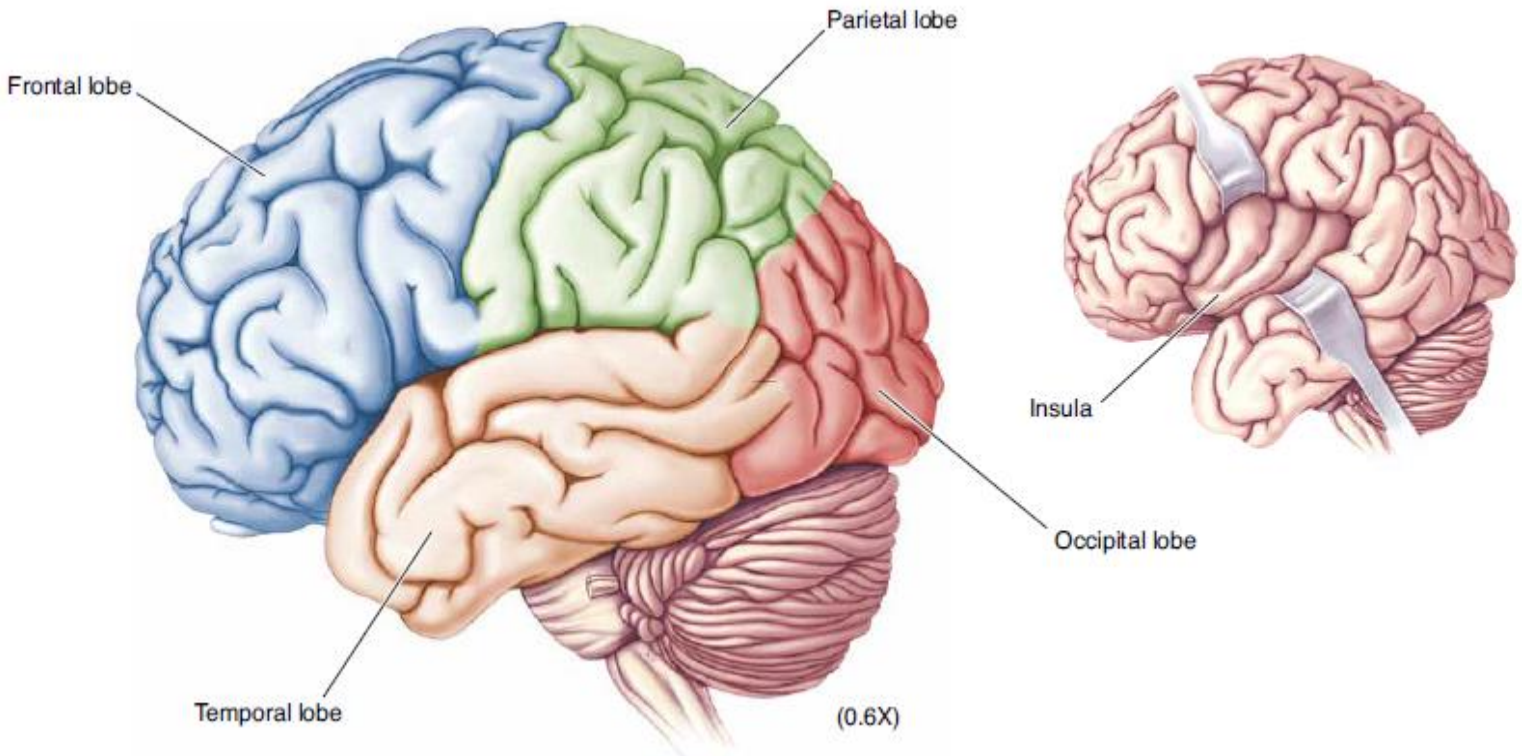
Cerebral Lobes and the Insula

By convention, the cerebrum is subdivided into lobes named after the bones of the skull that lie over them. The central sulcus divides the frontal lobe from the parietal lobe. The temporal lobe lies immediately ventral to the deep lateral (Sylvian) fissure.

The occipital lobe lies at the very back of the cerebrum, bordering both parietal and temporal lobes. A buried piece of the cerebral cortex, called the *insula* (Latin for “island”), is revealed if the margins of the lateral fissure are gently pulled apart (inset). The insula borders and separates the temporal and frontal lobes.



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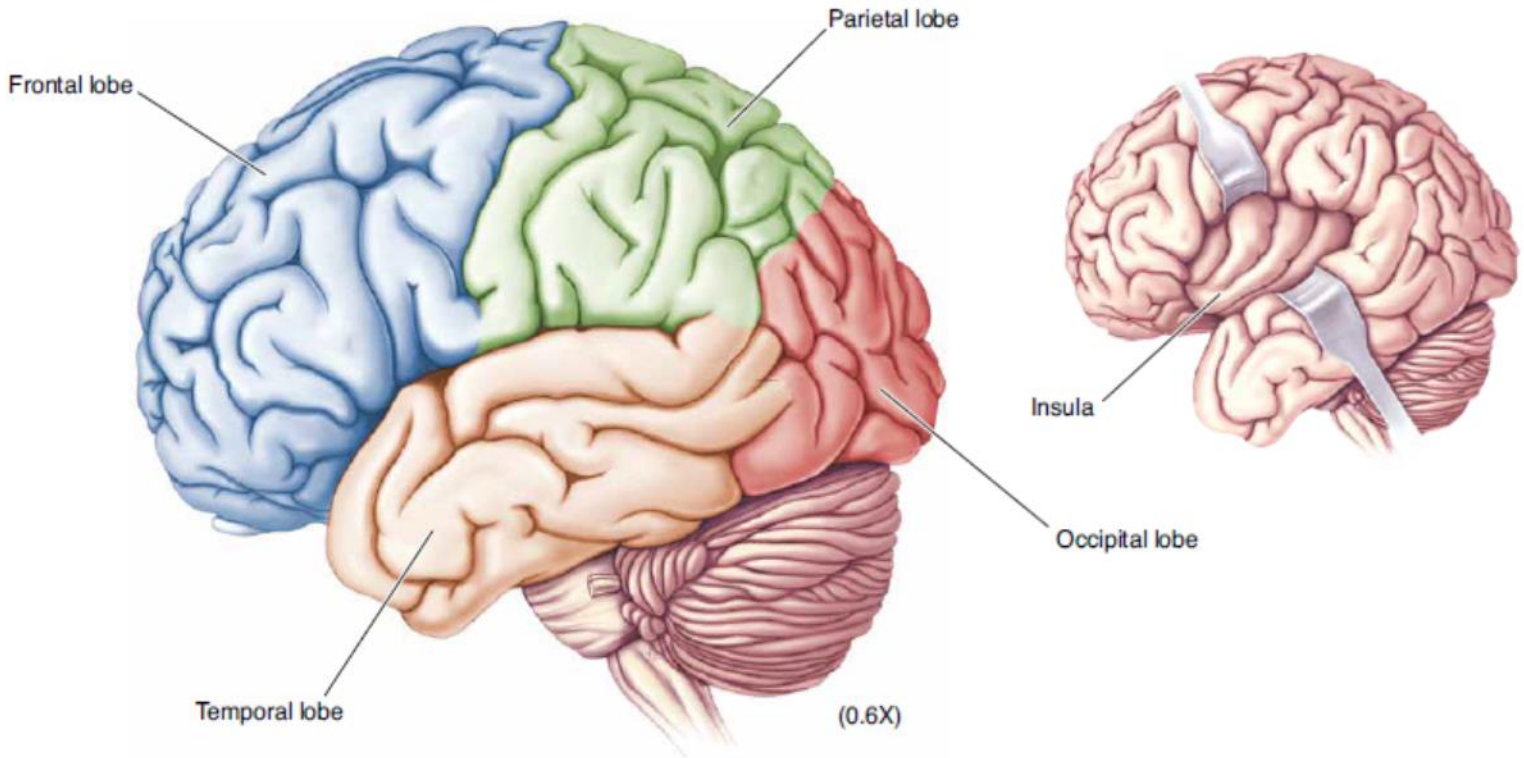
Frontal lobe

Primary motor cortex	**Voluntary** movements
Motor Association cortex	**Planning** , **Sequencing** and **Execution** of movement
Frontal eye field	**Voluntary** eye movements
Pre frontal cortex	**memory, learning, personality, reasoning, judgment, Decision making**



Broca's area	**Speech production**

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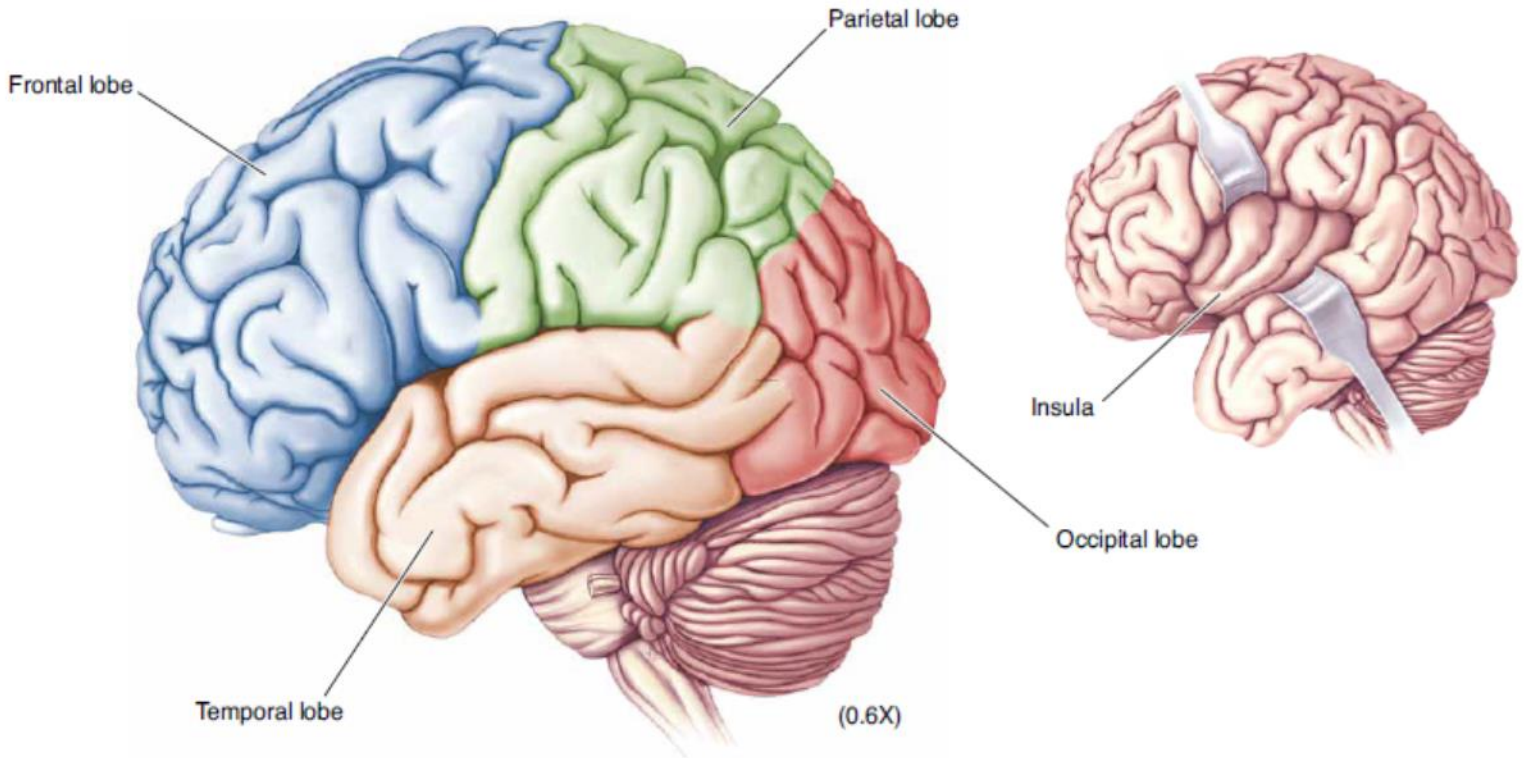
Temporal lobe

Primary auditory cortex	Perception of sound (pitch , frequency, location)
Auditory Association cortex	**Analyzes and , recognition of sound**
Wernicke's Area	Language comprehension
Primary Olfactory cortex	**Awareness of smell**



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Parietal lobe

Primary somatosensory cortex

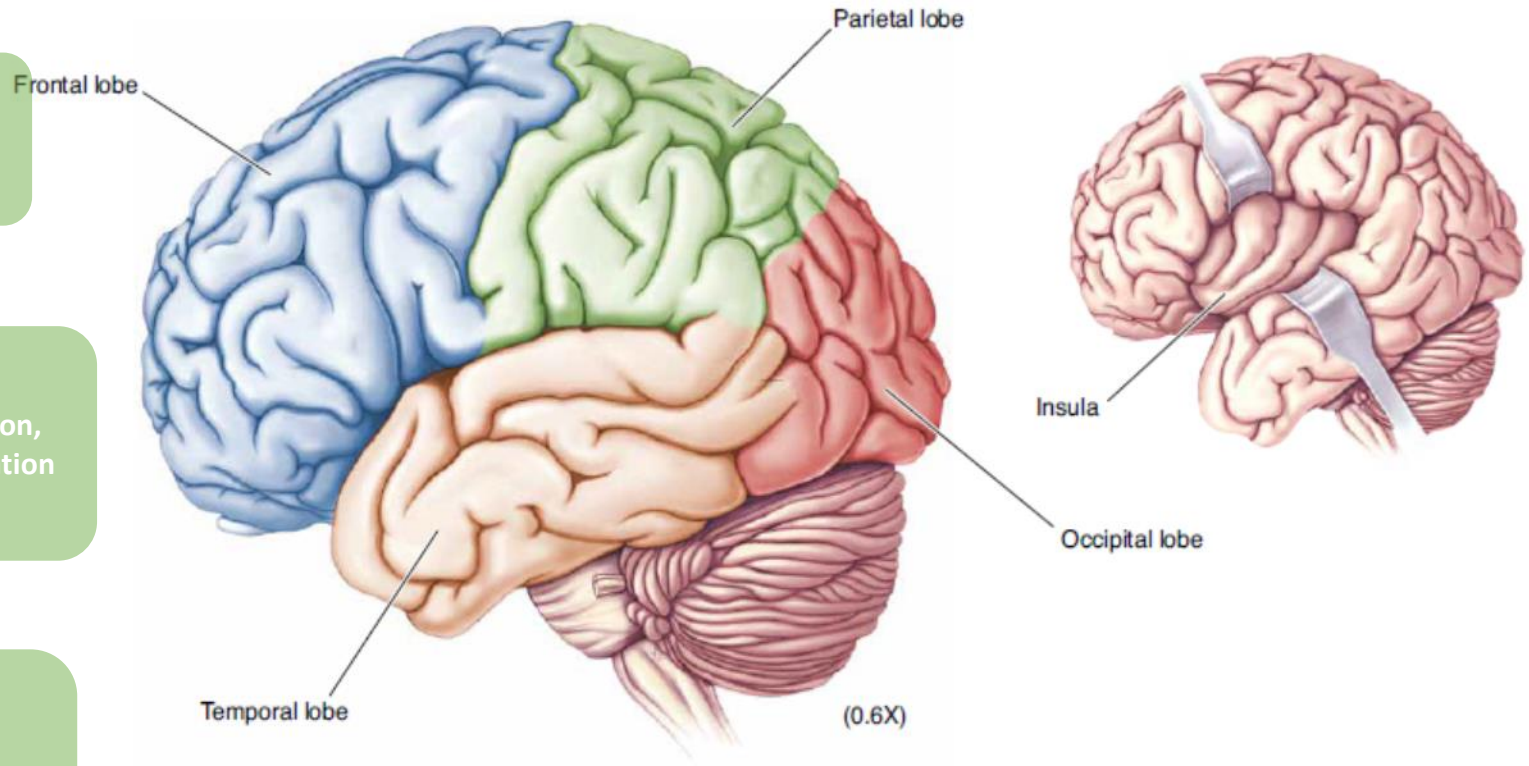
Awareness of somatosensory sensation (Pressure, vibration…)

Primary somatosensory Association cortex

Analyzes of somatic sensation, Recognition of somatic sensation

Posterior Association Area

Multi modal Association (auditory, visual, and somatosensory pathway)
Spatial coordination
Communication with other areas



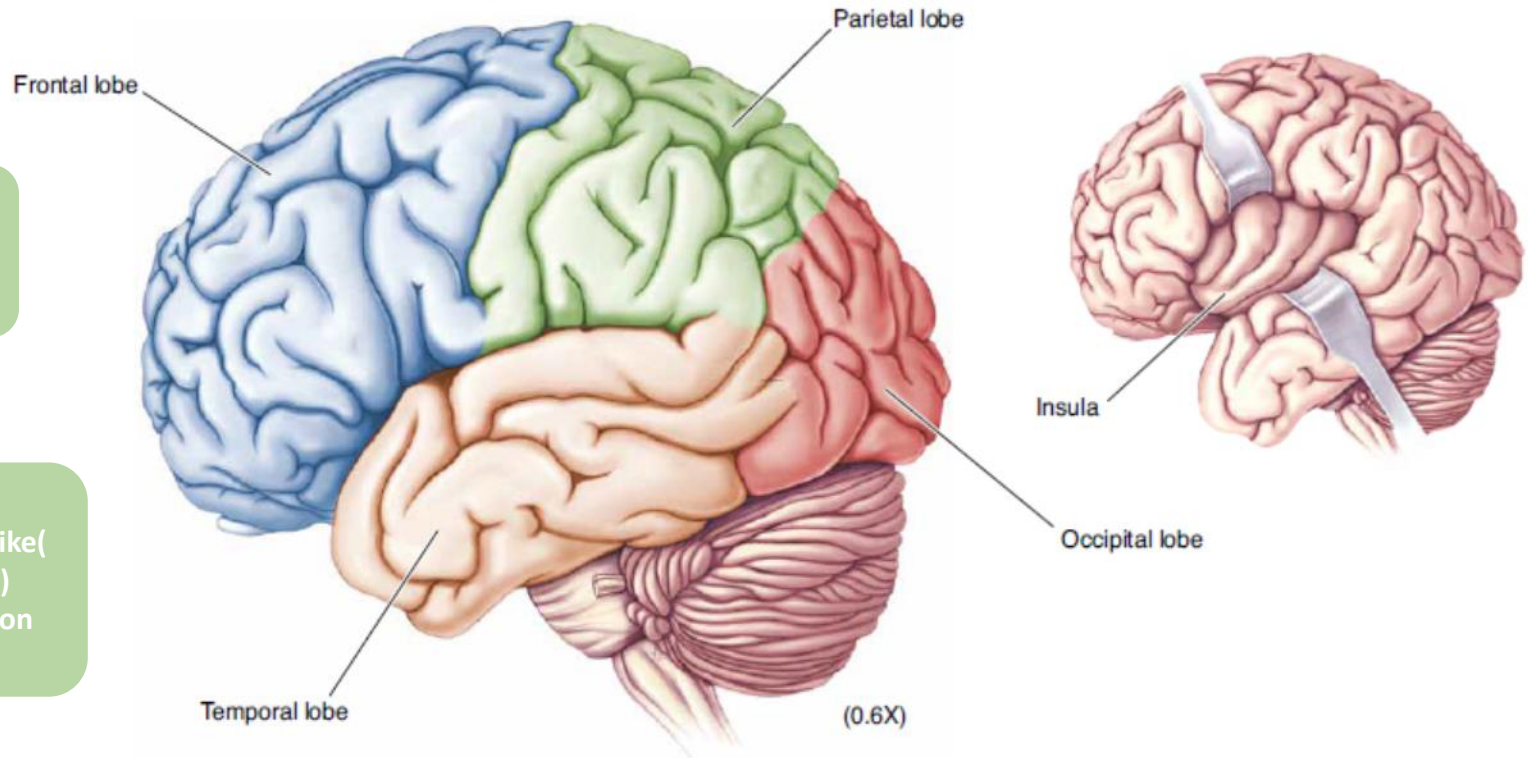
Occipital lobe

Primary visual cortex

Awareness of visual stimuli

visual Association cortex

Analyzes of visual sensation like(color, angle, movements,…) Recognition of visual sensation



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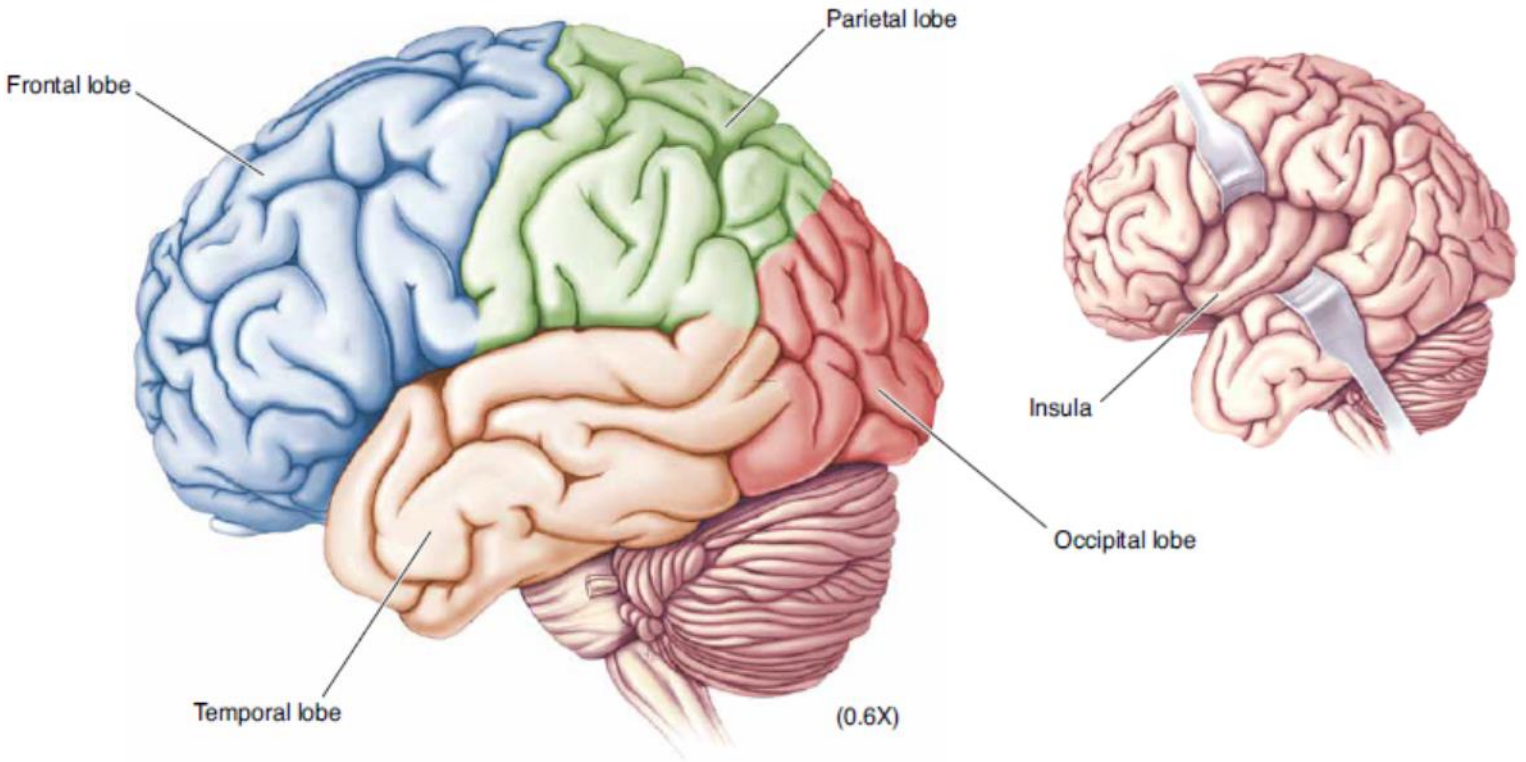
Insula



Gustation cortex — Awareness of tastes

Association Gustation cortex — Analyzes of tests sensation

Visceral sensation — Sensation of pain receptor of the thoracic, pelvic, or abdominal viscera (organs)

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