

260-2015-09-11-cells

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2015-09-10 16:51:52

Announcements

- Quiz 1 Monday
 - 10 questions/10 points
 - Gross anatomy, levels of analysis, methods, history

Today's Topics

- Wrap-up on gross anatomy
 - Parietal Lobe, etc.
- Cells of the nervous system
 - Glia
 - Neurons

How many neurons and glia?

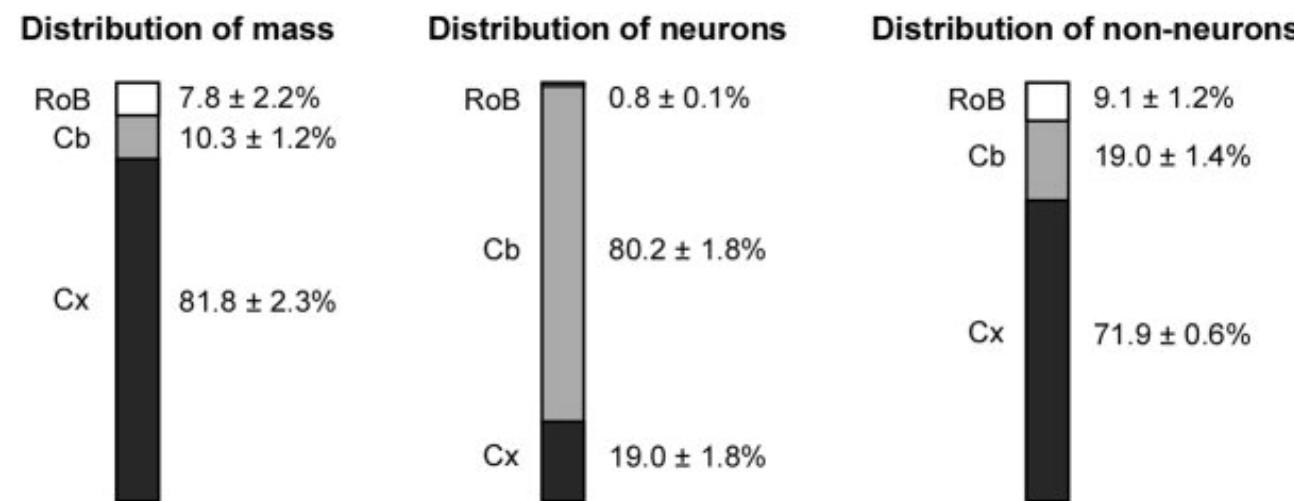
- Old "lore": ~100 billion neurons
- New estimate (Azevedo et al. 2009):
 - ~86 +/- 8 billion neurons
 - 85 +/- 9 billion glia

How many neurons and glia?

"These findings challenge the common view that humans stand out from other primates in their brain composition and indicate that, with regard to numbers of neuronal and nonneuronal cells, the human brain is an isometrically scaled-up primate brain."

(Azevedo et al. 2009)

Mass, Neurons, Non-Neurons



http://onlinelibrary.wiley.com/store/10.1002/cne.21974/asset/image_n/nfig003.jpg?v=1&t=ieeo13r0&s=9c4623d8c99916a78305ac930eb0e0729e8e28b7

(Azevedo et al. 2009)

Could you count to 100 billion?

- How many years to count to 100 billion?
- $60 \text{ s/min} * 60 \text{ min/hr} * 24 \text{ hrs/day} * 365 \text{ days/ yr} = 31,536,000 \text{ s/yr}$
- $1e11 / 31,536,000 = 3,170.97 \text{ years}$

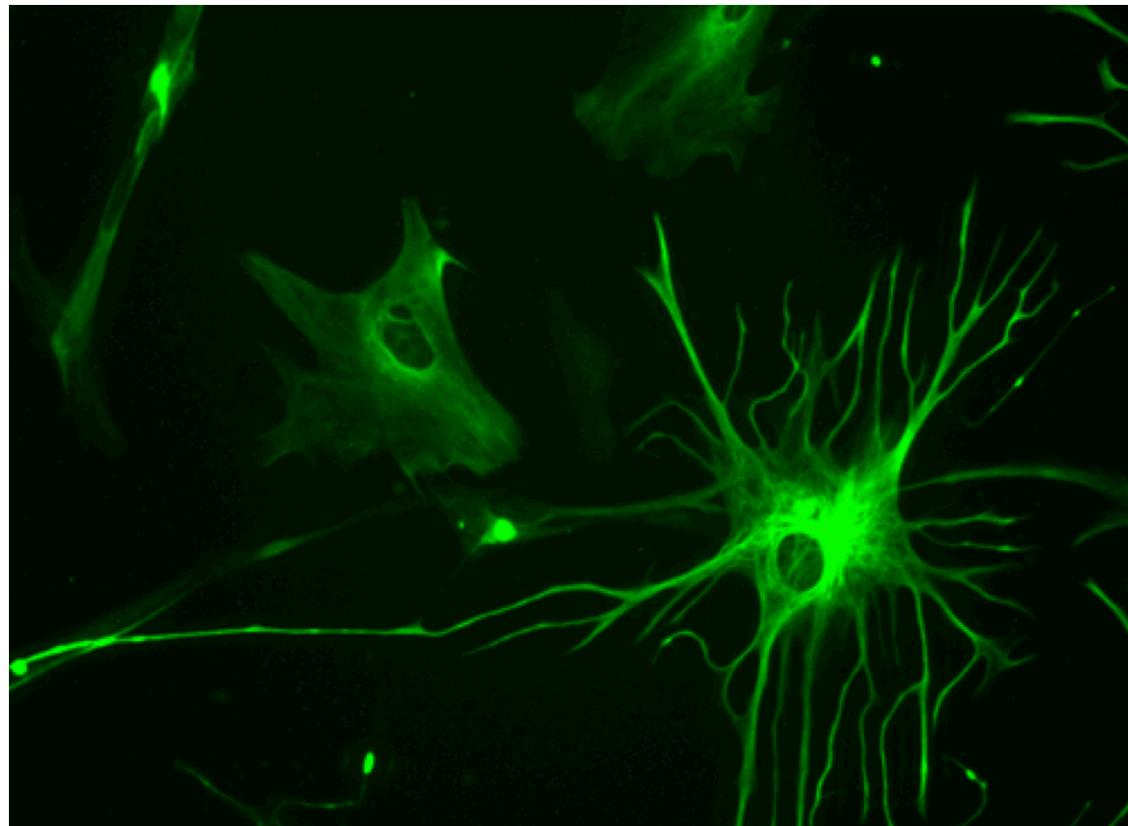
Glia (neuroglia)

- Functions
 - Structural support
 - Metabolic support
 - Brain development

Astrocytes

- "Star-shaped"
- Most numerous cell type
- Physical and metabolic support
 - Blood/brain barrier
 - Ion (Ca⁺⁺/K⁺) buffering
 - Neurotransmitter (e.g., glutamate) buffering
 - Shape early brain development
 - Regulate local blood flow

Astrocytes



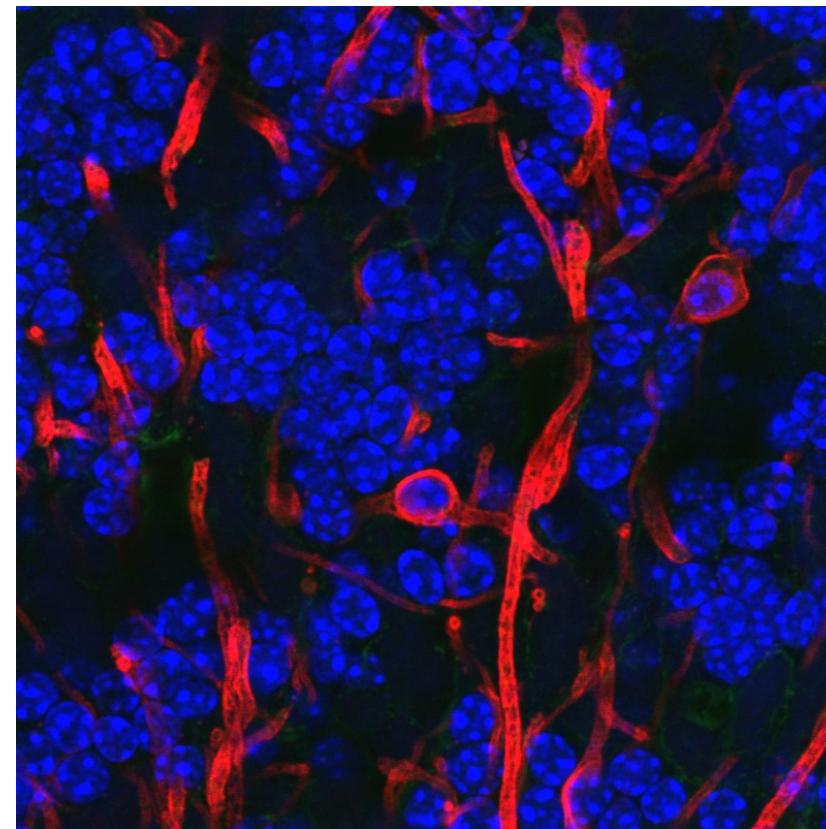
https://upload.wikimedia.org/wikipedia/commons/5/56/Human_astrocyte.png

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Myelinating cells

- Oligodendrocytes
 - In brain and spinal cord (CNS)
 - 1:many neurons
- Schwann cells
 - In PNS
 - 1:1 neuron
 - Facilitate neuro-regeneration

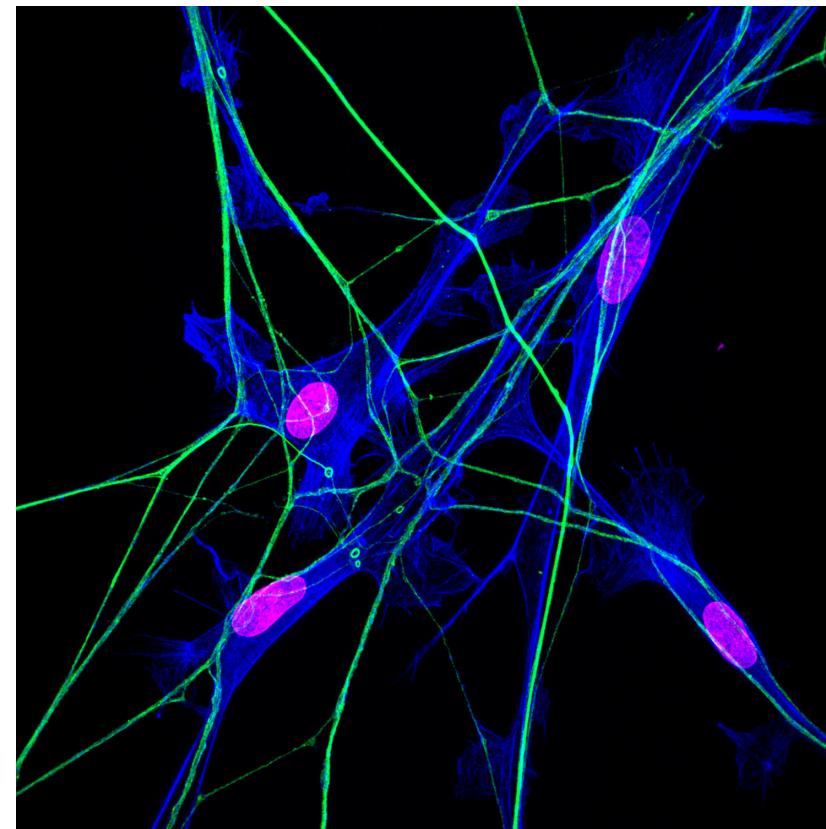
Oligodendrocytes



https://upload.wikimedia.org/wikipedia/commons/thumb/8/8a/Oligodendrocytes_page1-800px-Oligodendrocytes_in_rat_brain.tif.jpg

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Schwann Cells



<http://www.ucl.ac.uk/lmcb/sites/default/files/u9/Figure%201.jpg>

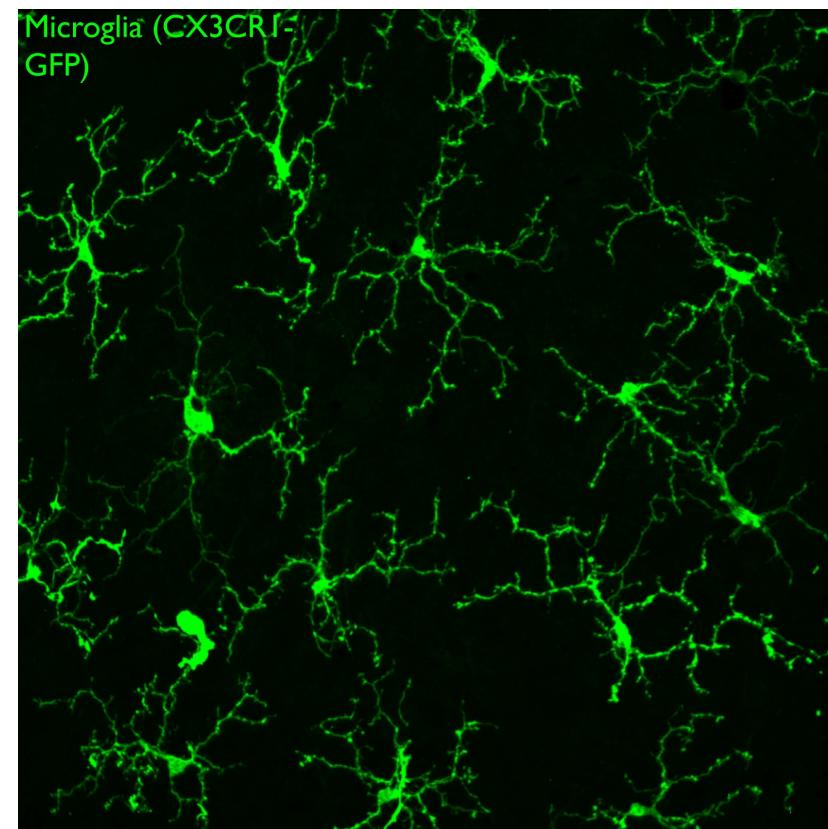
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Microglia

- Phagocytosis
- Clean-up damaged, dead tissue
- Role in 'pruning' of synapses in normal development

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Microglia



<http://www.bioscience.utah.edu/faculty/molecular-biology-faculty/vetter/vetterfig2011.jpg>

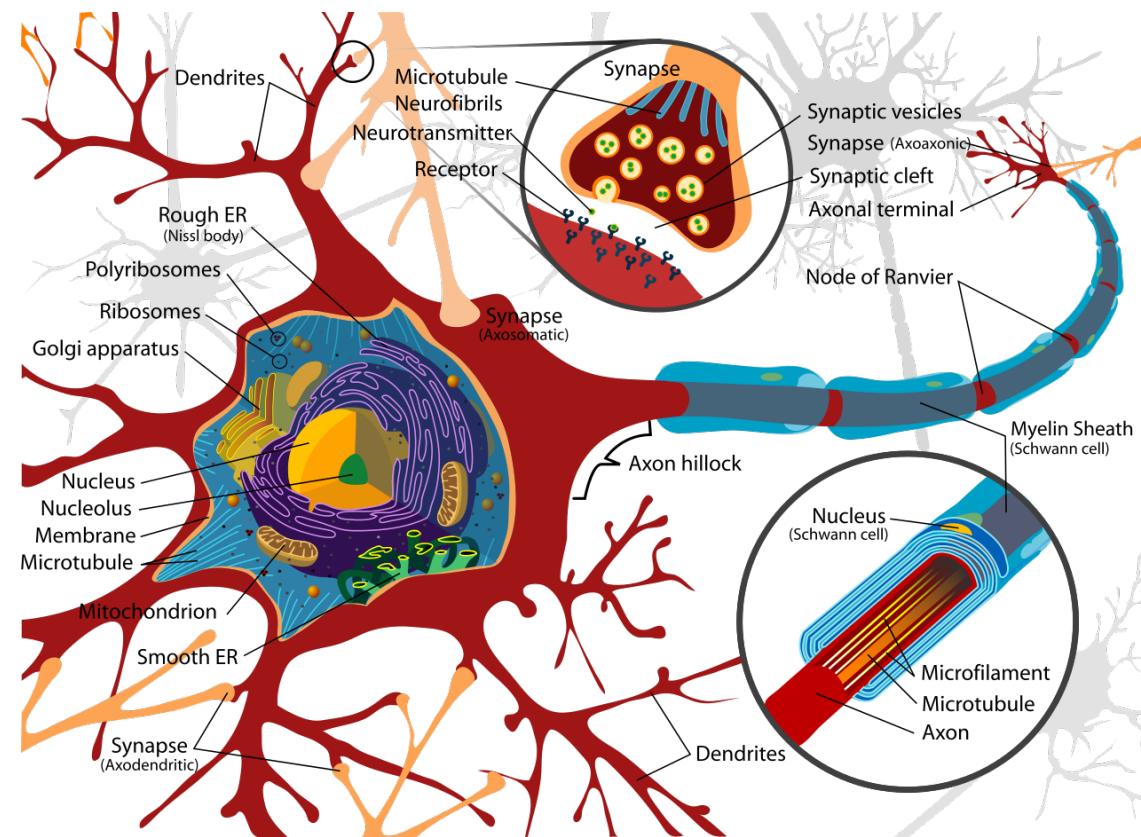
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Macrostructure of neurons

- Dendrites
- Soma
- Axons
- Terminal buttons (boutons)

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Structure of neurons



https://upload.wikimedia.org/wikipedia/commons/thumb/a/a9/Complete_neuron_cell_Complete_neuron_cell_diagram_en.svg.png

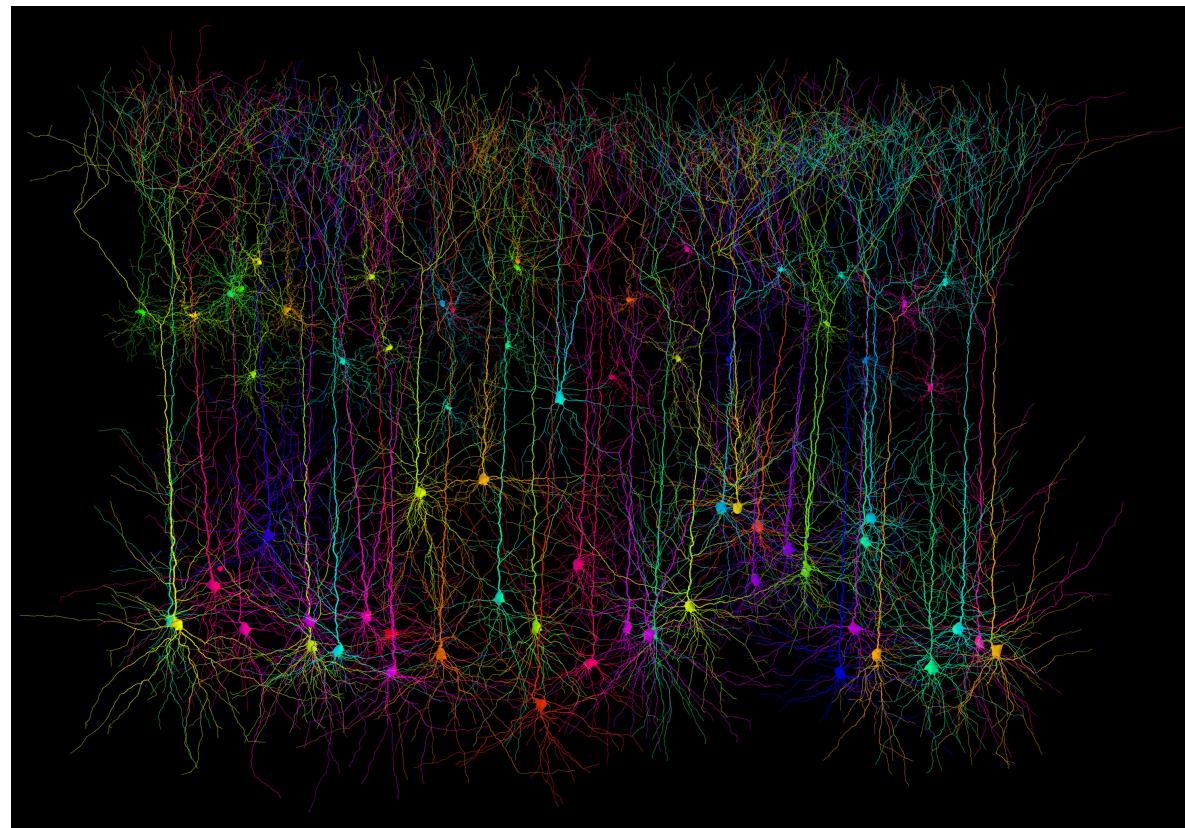
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Dendrites

- Majority of input to neuron
- Passive vs. active
- Spines

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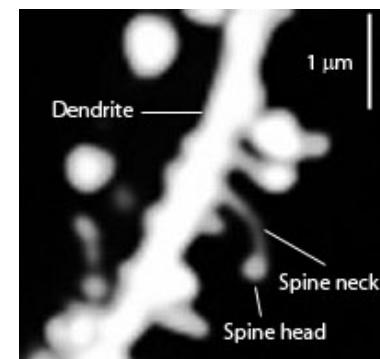
Dendrites



<http://i.livescience.com/images/i/000/058/588/original/brain-cell.jpg?1383065356>

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Dendritic Spines

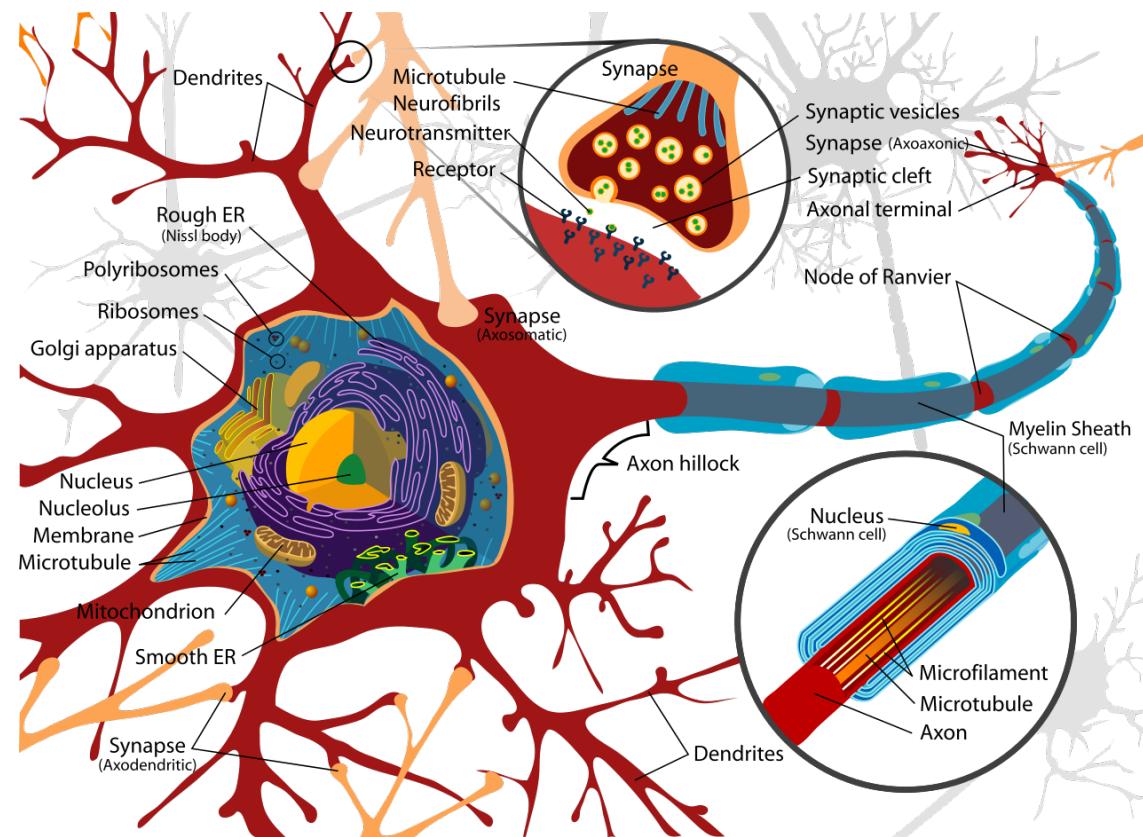


https://upload.wikimedia.org/wikipedia/commons/b/b1/Dendritic_spines.jpg

Soma (cell body)

- Varied shapes
- Nucleus
 - Chromosomes
- Organelles
 - Mitochondria
 - Smooth and Rough Endoplasmic reticulum (ER)

Soma



https://upload.wikimedia.org/wikipedia/commons/thumb/a/a9/Complete_neuron_cell_Complete_neuron_cell_diagram_en.svg.png

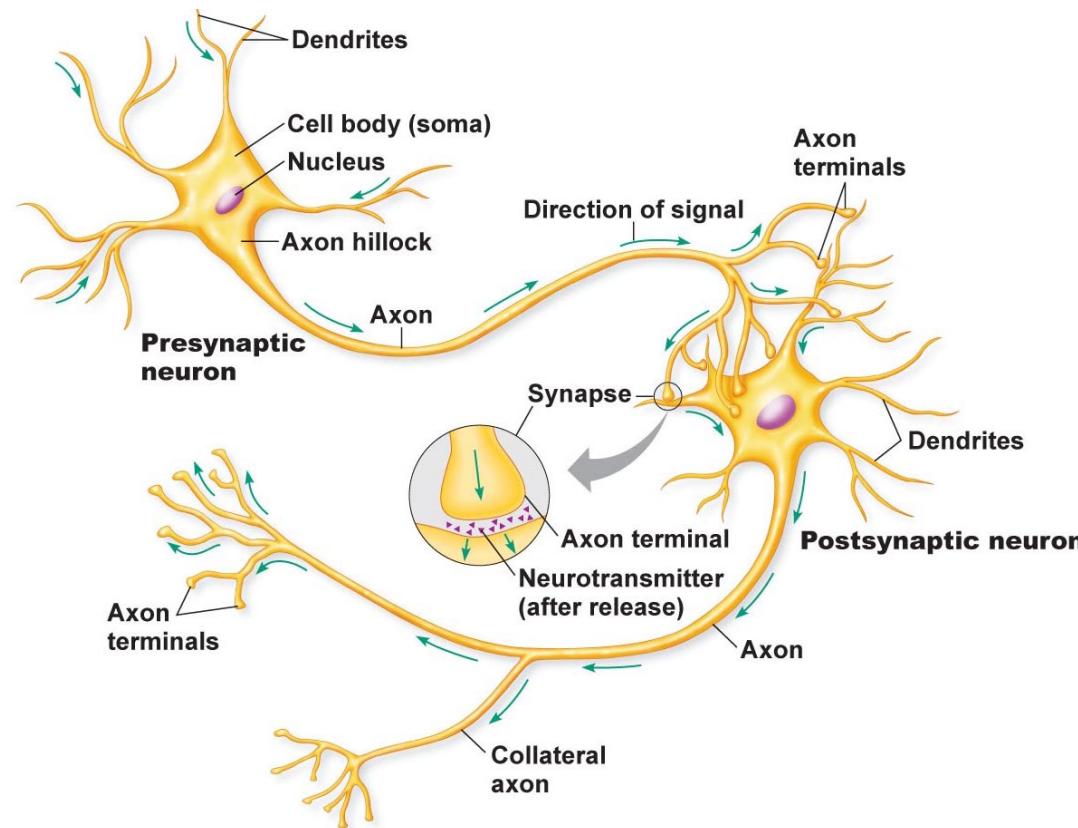
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Axons

- Initial segment
- Nodes of Ranvier
- Terminals

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Axons

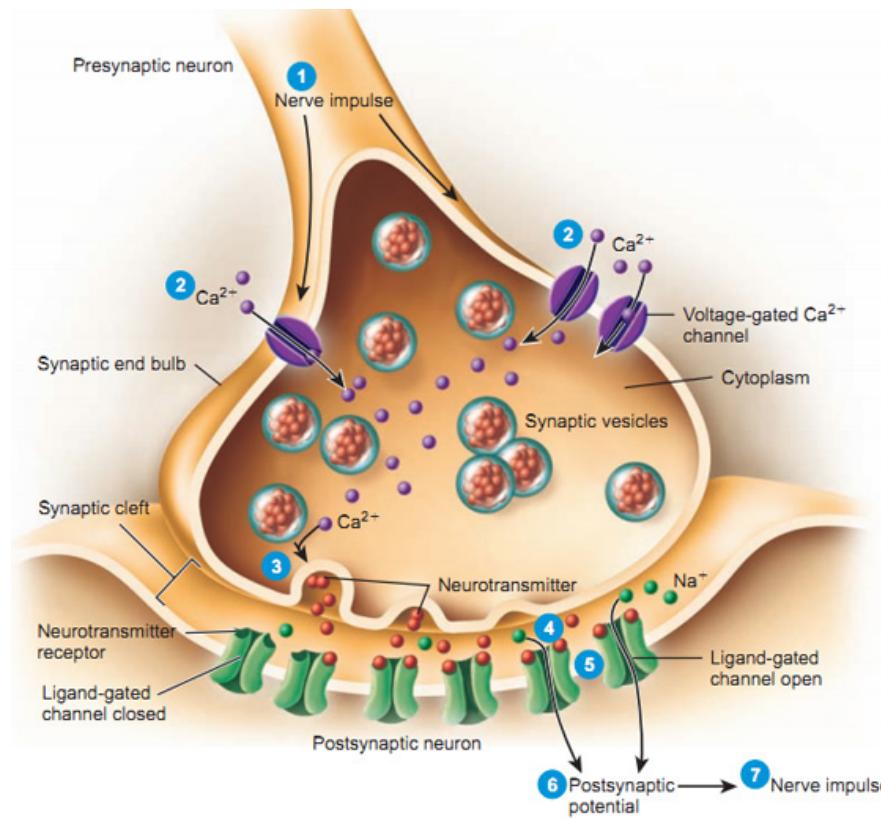


<http://droualb.faculty.mjc.edu/Course%20Materials/Physiology%20101/Chapter%20Nc>

Synaptic bouton (terminal button)

- Synapse (~5-10K per neuron)
- Pre and postsynaptic membranes – Synaptic cleft
- Synaptic vesicles
 - Neurotransmitters
- Autoreceptors & transporters

Synaptic bouton (terminal button)



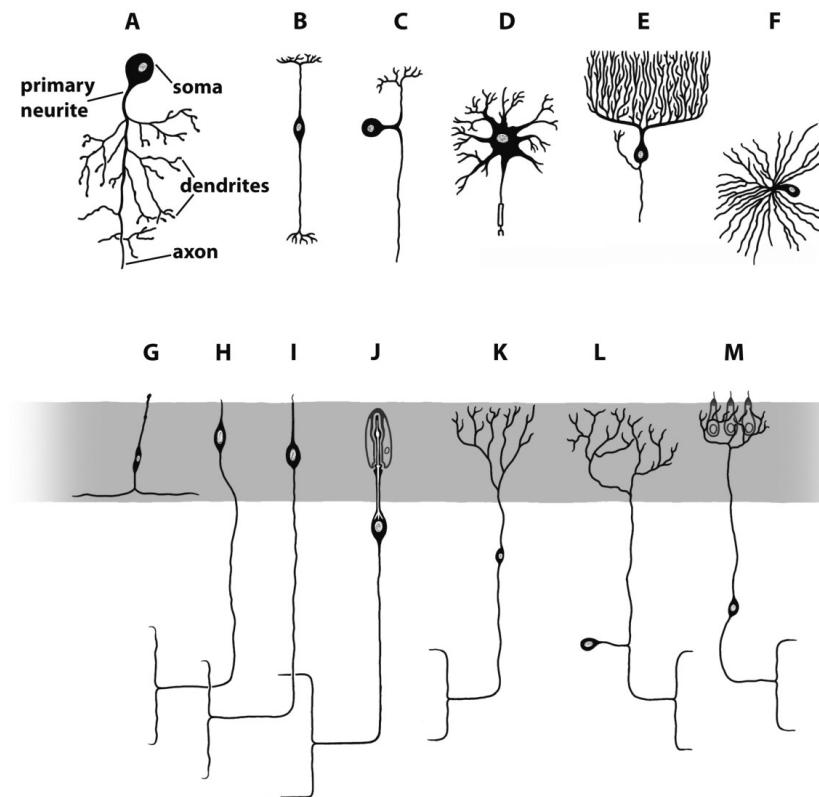
<http://antranik.org/wp-content/uploads/2012/04/synapse.jpg>

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Classifying neurons

- Functional role
 - Input (sensory), output (motor/secretory), interneurons
- Anatomy
 - Unipolar
 - Bipolar
 - Multipolar

Branching types



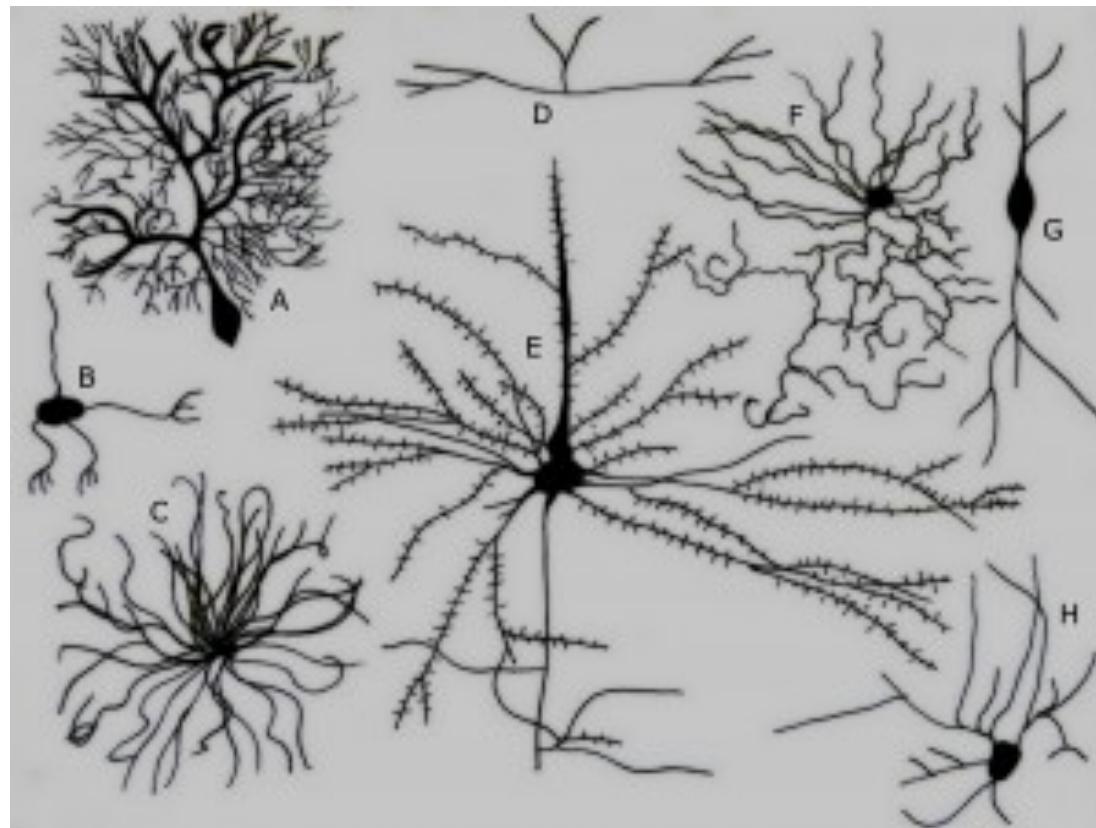
<http://www.frontiersinzoology.com/content/figures/1742-9994-7-29-19-1.jpg>

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Classifying neurons

- By specific anatomy
 - Pyramidal cells
 - Stellate cells
 - Purkinje cells
 - Granule cells

Neurons by type



<http://blogs.scientificamerican.com/brainwaves/files/2012/05/selection-glamor-FINAL-300x225.jpg>

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References

Azevedo, Frederico AC, Ludmila RB Carvalho, Lea T Grinberg, Jos é Marcelo Farfel, Renata EL Ferretti, Renata EP Leite, Roberto Lent, Suzana Herculano-Houzel, and others. 2009. "Equal Numbers of Neuronal and Nonneuronal Cells Make the Human Brain an Isometrically Scaled-up Primate Brain." *Journal of Comparative Neurology* 513 (5). Wiley Online Library: 532–41.