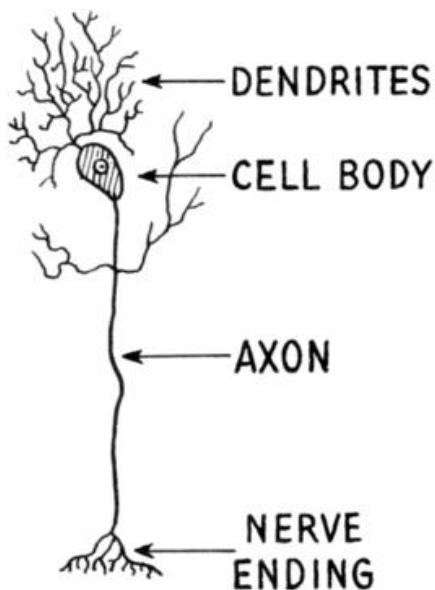


# Electron Micrographs of the Neuropil: Basic Literacy

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## Introduction



[www.newworldencyclopedia.org/entry/Dendrite](http://www.newworldencyclopedia.org/entry/Dendrite)

*Neuropil* is any area in the nervous system composed of mostly unmyelinated axons, dendrites, and glial cell processes that form a synaptically dense region containing a relatively low number of cell bodies. When looking at electron micrographs (EMs) of the neuropil, you should be able to recognize dendrites, axons, and glia, as well as their organelles and intracellular structures, such as postsynaptic density (PSD), mitochondria, smooth endoplasmic reticulum (SER), spine apparatus, polyribosomes, and microtubules.

This video will familiarize you with these structures: [Cruise through Hippocampal Neuropil: Brain Cells Visualized](#).

This tutorial gives more information about synapses: [Structure of Chemical Synapses](#).

## References

- Spacek J. The Atlas of Ultrastructural Neurocytology, <http://synapseweb.clm.utexas.edu/atlas>.
- SynapseWeb anatomy tutorials, <http://synapseweb.clm.utexas.edu/tutorials>.
- Harris KM and Spacek J (2016) Dendrite Structure. In: Stuart et al. (Eds) Dendrites. 3rd Edition, Oxford University Press, Oxford UK. ([PDF](#))

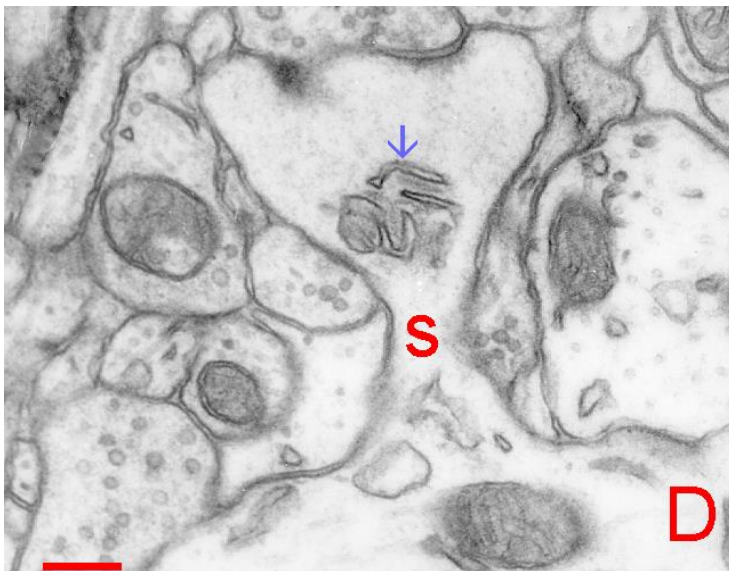
## Dendrites

The primary characteristics of a dendrite are:

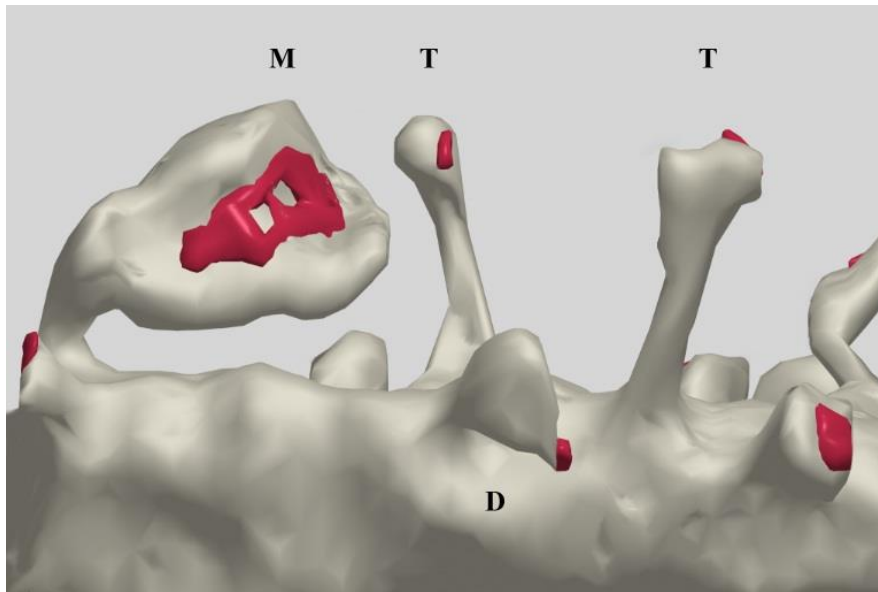
- Spines emerging to form synapses with axons (although some dendrites are nonspiny, and they will have synapses on the dendritic shaft)
- Organelles like mitochondria and SER



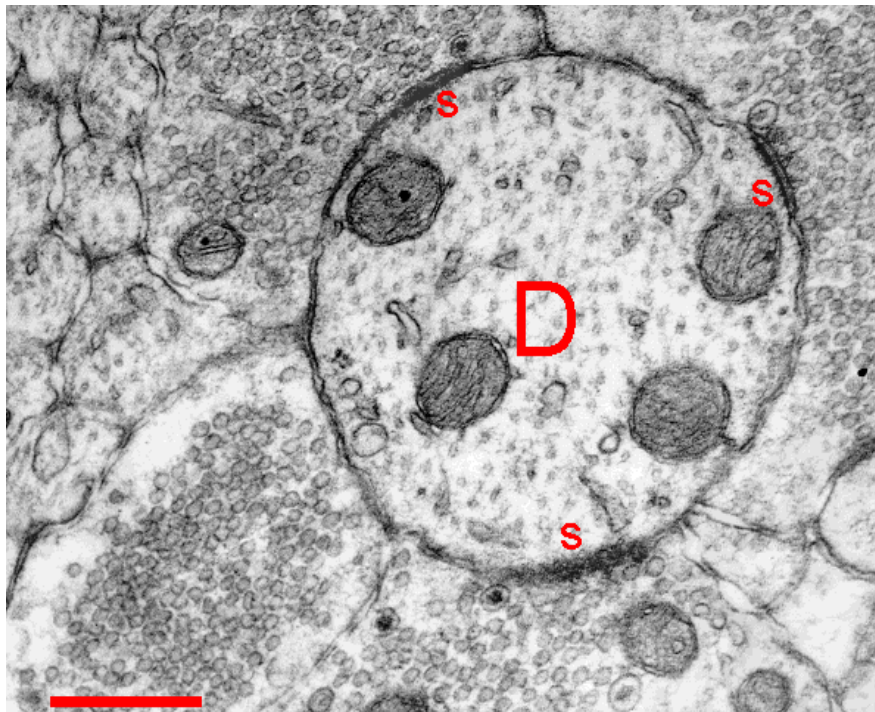
[Atlas Fig. 1.4.1.02](#). Spiny dendrite. Thin dendritic spine (S) with synapse. D - dendritic shaft. The synapse can be identified by the darkly-staining postsynaptic density (PSD) in the spine head and the adjacent vesicles in the axon. Scale = 250 nm. (Rat, hippocampus.)



[Atlas Fig. 1.4.1.03](#). Mushroom-shaped dendritic spine (s) containing a spine apparatus (arrow) in its head. D - dendritic shaft. Scale = 300 nm. (Rat, hippocampus.)



[Atlas Fig. 1.4.1.17](#). Three-dimensional reconstruction of a segment of dendrite (D) with dendritic spines and synapses. T - thin spines with macular synapses, M - mushroom-shaped spine with perforated synapse. (Rat, hippocampus.)

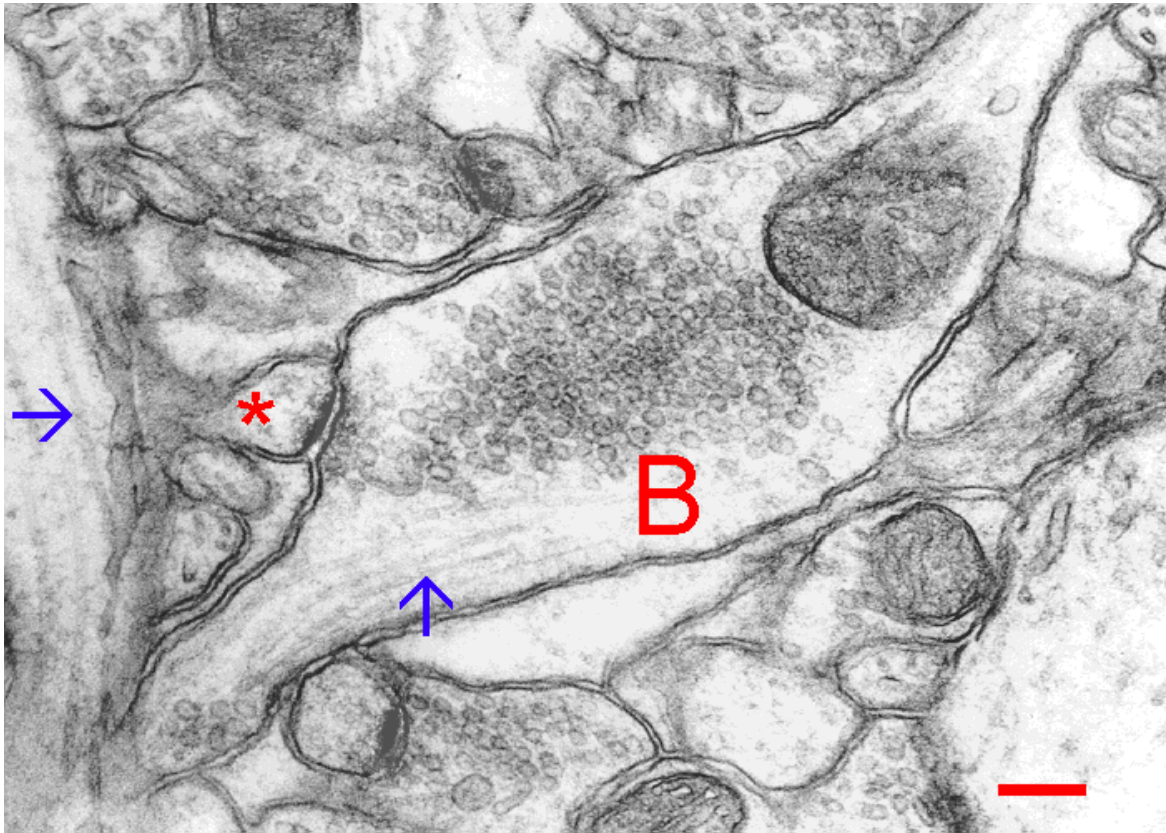


[Atlas Fig. 1.4.06](#). Nonspiny synapse. D - dendrite shaft, S - shaft synapses, with 4 mitochondria in the shaft.

# Axons

The primary characteristics of an axon are:

- Numerous spherical vesicles in the bouton
- Bouton forming synapses with dendrites
- Mitochondria

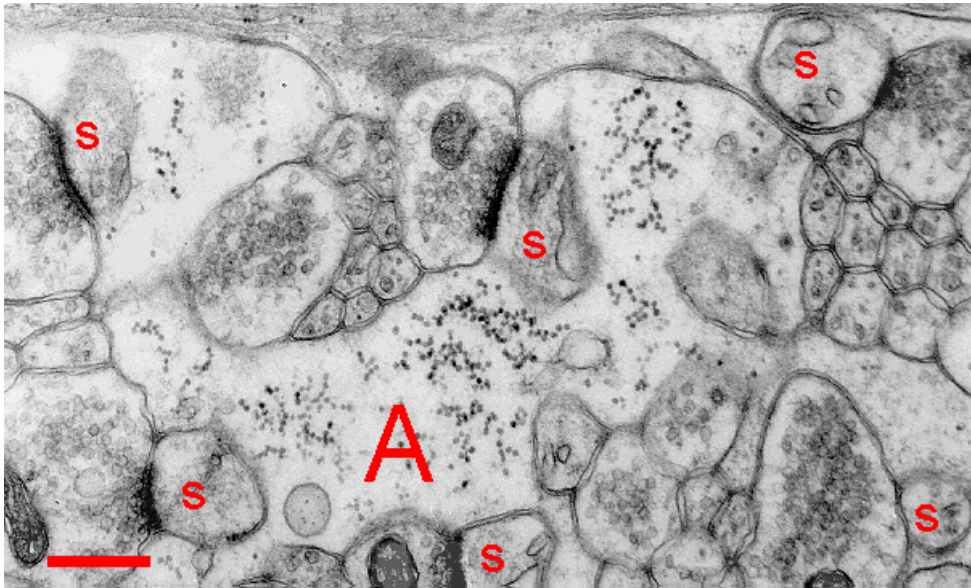


[Atlas Fig. 1.5.02](#). An axon thickened into an en passant bouton (B) making a synapse with a small dendritic spine (asterisk). Longitudinally cut microtubules are marked with arrows. Scale = 300 nm. (Rat, hippocampus.)

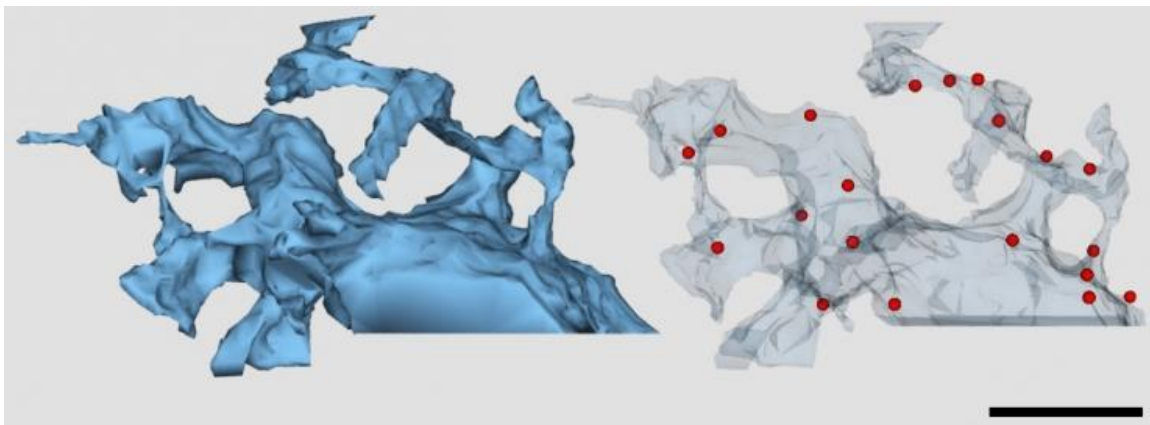
# Glia

The primary characteristics of glia are:

- Pale cytoplasm
- Dark black circular glycogen granules
- Vast interconnected interdigitation -- one astrocyte can fill the entire series



[Atlas Fig. 2.1.12](#). Numerous glycogen particles in the astrocyte process (A), ensheathing all dendritic spines (S). Note that the primary defining characteristics of the astrocyte are pale cytoplasm, glycogen granules, and interdigitation. Scale = 400 nm. (Rabbit, cerebellar cortex.)



[Atlas Fig. 2.1.36](#). 3D reconstruction of an astrocyte. Direct contacts with synaptic clefts are colored in red. Scale = 1  $\mu$ m. (Hippocampus, rat.)

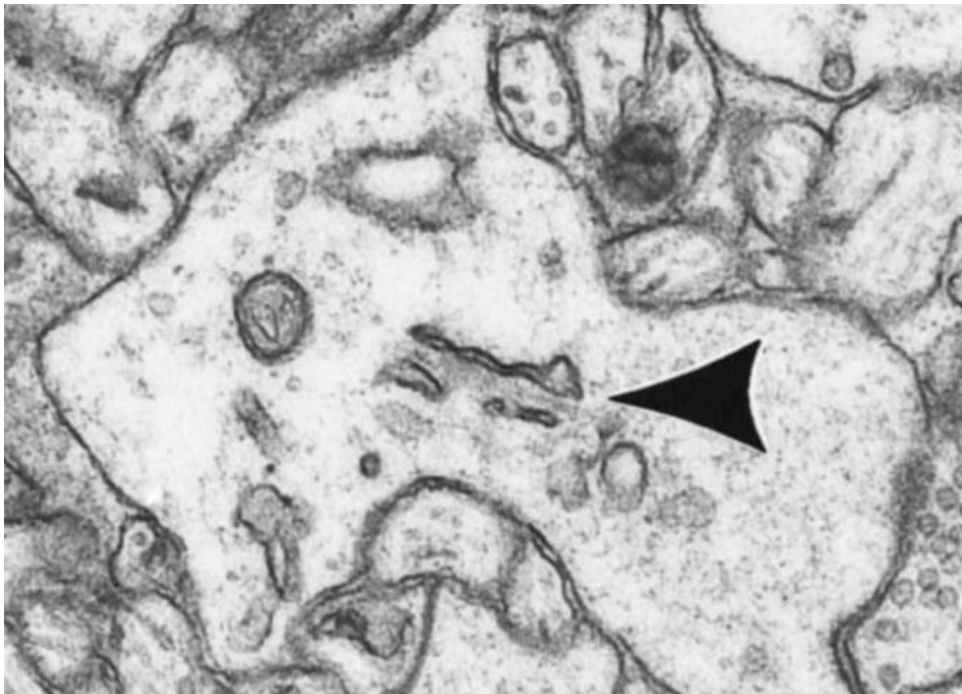
# Organelles

## Mitochondria

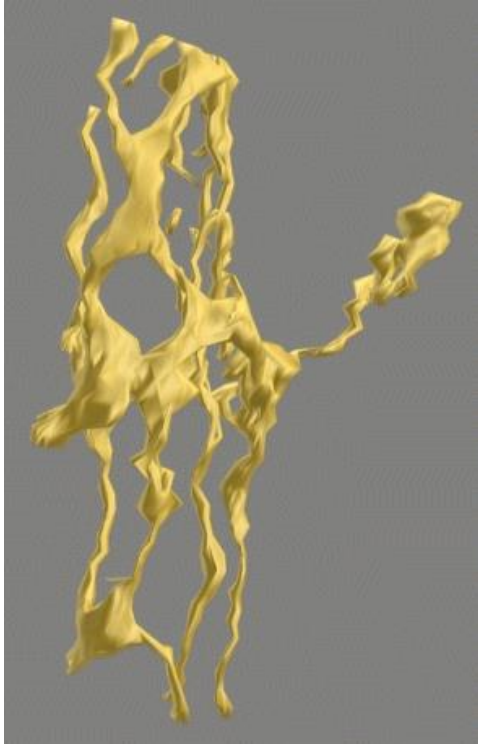


[Atlas Fig. 1.1.4.01](#). Mitochondrion in the cerebellar granule cell, longitudinally sectioned. Mitochondria are large, easily identifiable organelles visible in dendrites and axons. Frequently a mitochondrion traverses the length of the dendrite, and they occasionally branch.

## Smooth Endoplasmic Reticulum (SER)



[From Fig 1 Spacek & Harris 1997](#). Arrowhead points at SER.



[Atlas Fig. 1.1.2.14](#). Three-dimensional reconstruction of smooth endoplasmic reticulum in a dendrite. (Rat, hippocampal stratum radiatum.)

### **Spine Apparatus**



[Fig 2 from Spine Apparatus tutorial](#). Transversally sectioned spine apparatus formed by six flat cisternae and five inner dense plates.



[Fig 6 from Spine Apparatus tutorial](#). Three-dimensional reconstruction of the dendritic spine from the hippocampal stratum radiatum. A perforated excitatory synapse (red) and a macular inhibitory one (blue) are located on the head of the spine. The spine apparatus (yellow) is placed in the head and neck of the spine.