Functional Microanatomy of Neurons

There are three most significant cells in CNS- Neurons(for signal transmission), Neuroglia(for structural support, protection, other simple metabolism required), and Vascular endothelium(for blood flow across the brain). Neurons like other cells contain an abundance of the endoplasmic reticulum(for lipids and protein synthesis), mitochondria(large energy requirement for homeostasis), etc. A typical neuron contains a cell body(50 microns), dendrites(approx 100 microns, receives the signal), and axons(sends out signal). Dendrites increase the surface area to accommodate more inputs, each of them contain a mushroom or filament-shaped structure called the spine which are primary regions for synaptic contact. Some neurons may have very few spines reducing the input intake. Pyramid neurons in the cerebral cortex have one major dendrite(apical dendrite) growing at the apex of a cell body, other dendrites of the same cell are called basal dendrites. Multipolar neurons grow dendrites in all directions rather than primarily at the apex. Axon length may even extend to few meters depending on their function, e.g. a motor neuron connected from the Spinal cord to Knee. Axons conduct the electrical signal in the form of action potential and redistribute them to other cells at its end(the boutons), called the synaptic junctions, which are of two types- one that transfers charged molecules to other cells, carrying an electrical signal, other than transfers a neurotransmitter molecule to other cells, comprising a chemical signal. White matter contains axons and glial cells, gray matter contains dendrite, cell body, or synapses as well. Oligodendrocyte(a type of neuroglia) insulates the axons as they travel together in the white matter. Pyramid neurons are a type of projection neurons and they’re so-called because they grow axons that project outward from the cell body over a considerable distance. Axons may have many local branches as well before their end, transferring signals to nearby neurons throughout their length. The opposite of projection neurons are interneurons, don’t project too far. Interneurons are of two types- Excitatory and Inhibitory. The gray matter may contain both projection and interneuron. Projection neurons are excitatory(make their synaptic partners more likely to transmit the signal). The interneuron Stellate cell are inhibitory. One particular e.g. called “Knee Jerk Reflex” or “Myotactic reflex” gives a better picture of interneuron importance, a sensory neuron(the afferent neurons) is connected from the Knee muscle(it’s cell body in dorsal root ganglia) to the spinal cord to bring in a signal, a motor neuron(efferent neurons) to carry out signal from the spinal cord to Knee. During a reflex on the patella tendon, the quadriceps have to contract, antagonist/hamstring muscle has to relax, so the inhibitory effect of the interneuron on the motor neurons that carry out the signals is more on the antagonist's muscle to suppress the contraction effect.