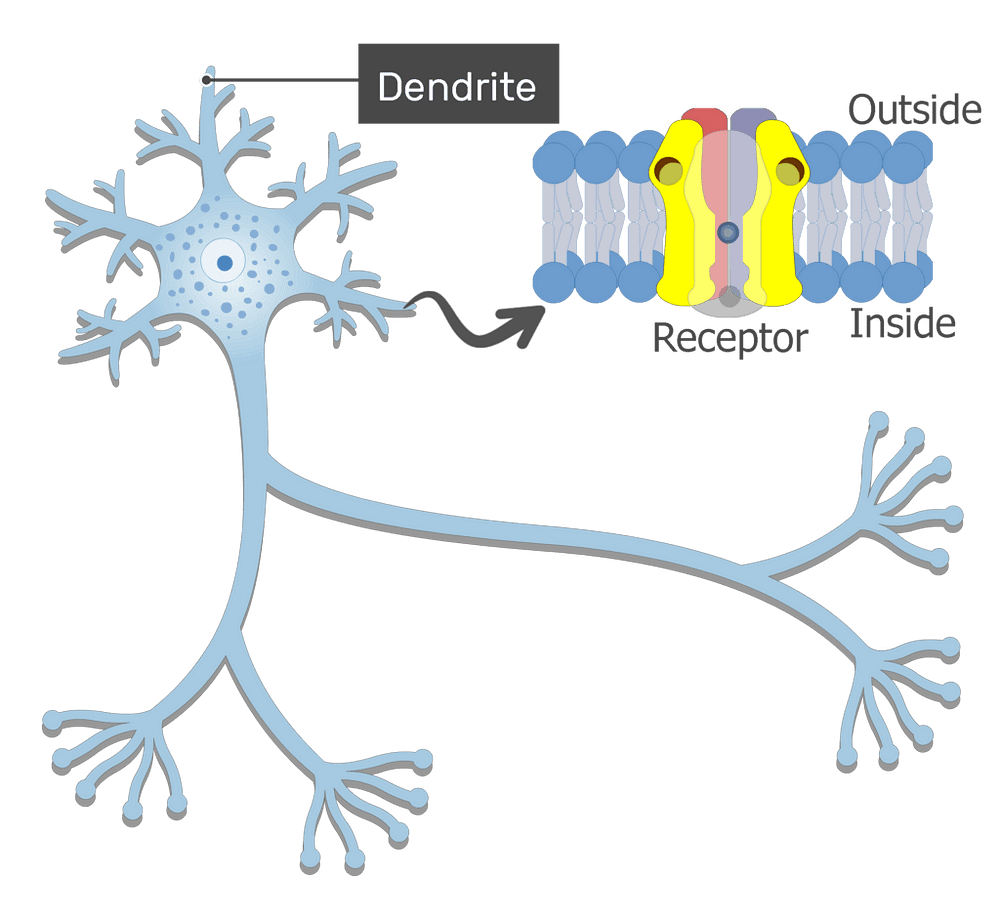
**How Human Brain Works? Unveiling the Biology into Computer Science by Unlocking the Secrete of Human Neuorons, A Cable Theory Perspective on Dendrites**

Let’s talk about neurons, the fundamental building blocks of our brains. These remarkable cells are spread throughout our bodies, enabling us to think, move, and sense the world around us. Each neuron is a complex structure with distinct parts that play crucial roles. We have the *cell body*, which acts as the neuron’s metabolic center, where all the incoming signals are finally integrated. Inside the cell body resides the *nucleus*, the neuron’s control center. Then there are *synapses*, the vital connection points between sending and receiving neurons, where information is exchanged. *Dendrites*, with their tree-like branching structures, reach out and connect with the axons of other neurons, carrying signals towards the cell body. Finally, the *axon*, a long, slender projection, carries signals away from the cell body to the synapses, where they pass information on to the dendrites of other neurons.

Lets go through!

**What are Dendrites?**

At the end of a neuron, you’ll find these finger-like structures called dendrites. They’re like short, branching wires that sprout out from the cell’s main body. This branching pattern is really important, because it dramatically increases the surface area the neuron has to receive incoming information, kind of like a net catching more signals.

Figure 1: Dendrite and its receptor! Think of it like a neuron’s mailbox.

**Structure of Dendrite**

Think of dendrites as the neuron’s little signal-catching branches, like a mini tree around the cell. They’re short and numerous, spreading out to grab messages from other neurons. Inside, they’re packed with all the cell’s machinery, like protein-making factories, to help process and pass along those signals.

**Function of Dendrites**

Dendrites are the structures on the neuron, that function by receiving electrical messages.

* They grab signals, or data, from other neurons.
* Dendrites gather all the incoming information from the axon terminals of other neurons.
* Dendrites conduct these electrical impulses toward the neuron’s main body, the cell body.
* Dendrites collect messages from neurons or nerves throughout the body.
* These messages travel through the nervous system to the brain.
* The brain then sends instructions back through the nervous system, causing our bodies to react to the messages.

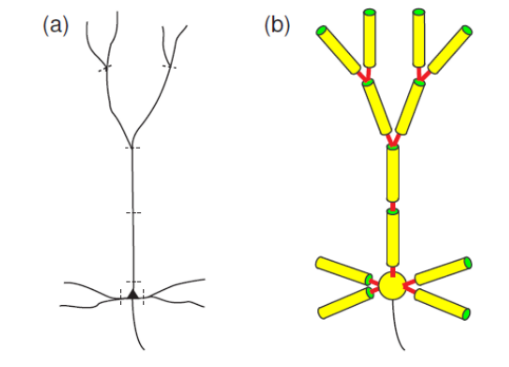
**Dendrites as Cable**

Neurons aren’t just simple on/off switches. They have a sophisticated way of processing information, especially through their intricate dendritic trees. Imagine the dendrites as a complex network of cables, branching out to receive signals from other neurons at various locations. These cables don’t just passively carry signals; they actively integrate them over both space and time.

Neurons aren’t just simple on/off switches. They have a sophisticated way of processing information, especially through their intricate dendritic trees. Imagine the dendrites as a complex network of cables, branching out to receive signals from other neurons at various locations. These ‘cables’ don’t just passively carry signals; they actively integrate them over both space and time.

Now, here is where it gets interesting, many of these dendritic cables have their own voltage-gated channels, which means they can generate their own electrical activity. This leads to nonlinear signal processing and sometimes even dendritic spikes. These spikes aren’t just local events; they can travel, or propagate, either towards the soma or even back out to other distant parts of the dendritic tree. Essentially, the dendrites act as individual computational compartments, each capable of complex signal processing.

Much of the insight can be obtained via simulations, which typically  
replace the continuous dendritic structure in Figure 2 (a) with a network  
of discrete compartments in Figure 2 (b)

Figure 2: A dendritic tree of nueron (a) is replaced by a network of compartments

**Cable Theory**

In essence, cable theory helps us predict how an electrical signal, introduced at one location on a dendrite, will affect the voltage at other locations and at different times. For example, if we send an electrical signal i.e the *current* into one end of the wire, how the *voltage* i.e electrical charge changes along the wire’s length over time. Basically, it shows how the signal weakens as it travels down the dendrite.

The structure of dendrites can be very complex but to approximate their shape in three dimensions we can model them as cylinders. when we consider the inside of the