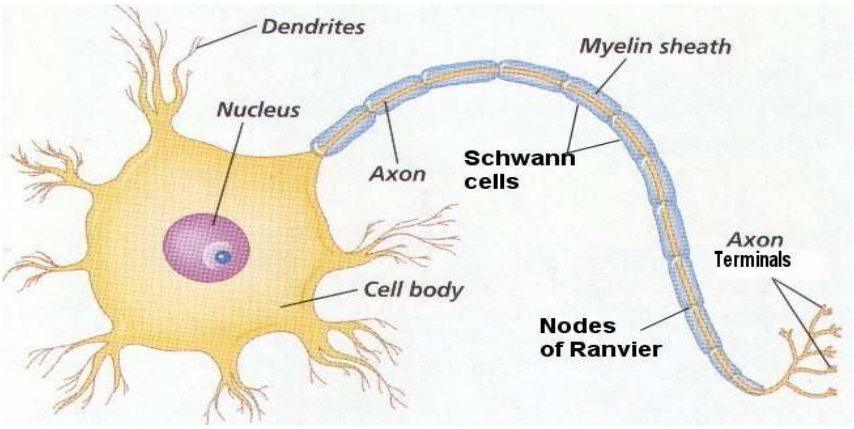
Teacher Notes

Connect the Neurons!

Neurons, the principal cells in the central nervous system, send messages from one part of the cell to another using electrical signals. The *dendrites* are the input part of the neuron. These short branched processes gather information from other neurons and send electrical signals (*synaptic potentials*) to the *soma* (*cell body*).

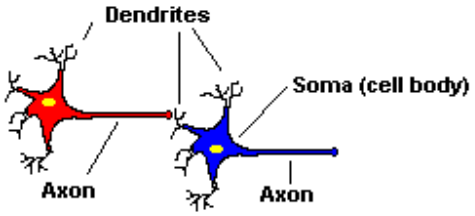


The soma adds up all the signals from the dendrites. When this summed signal gets big enough (reaches the soma's *threshold*), the soma produces one large electrical signal (*action potential*) as output, and sends it down the axon (longest process of the neuron) to pass this information to distant neurons or muscle cells.

In the central nervous system, neurons don't actually touch each other. When the electrical signal (*action potential*) reaches the end of the axon (*axon terminal*), it cannot be used to signal the dendrite of the next, neighboring neuron. Instead, the axon terminal sends a chemical signal (*neurotransmitter*) out into the space between the axon terminal and the dendrites on the next neuron. This space is called the *synapse*.

The neurotransmitter spreads across the space between the neurons and is sensed by the dendrites of the next neuron. When these dendrites "taste" the presence of the neurotransmitter, they generate new electrical impulses (*synaptic potentials*) that are then sent to their soma. The action potential is considered an "All or Nothing" event: either the electrical signal goes down the axon, or it doesn't.

The strength of the synaptic potentials do vary. Many things influence the strength of the synaptic potentials. When one practices a new skill or thought, the synapses in those circuits are strengthened. Conversely, unused synapses can loose strength. We believe this forms the basis for learning and memory.



from Eric Chudler/synapse.html

Synaptic transmission is terminated in one of three ways.

- The neurotransmitters move away in the space between neurons.
- The neurotransmitters are recycled by being taken back up into the nerve terminal.
- The neurotransmitters are chemically broken down into smaller chemicals that cannot be sensed by dendrites.

Thus, neurotransmitters stimulate dendrites only for a short amount of time after they are released.

Some neurotransmitters generate electrical potentials (depolarizations) in the post-synaptic neurons that move the soma closer to threshold. These neurotransmitters and the neurons that contain them are excitatory. They communicate a need to continue to send the electrical message forward along the pathway or chain of neurons.

Some neurotransmitters generate electrical potentials (hyperpolarizations) in the post-synaptic neurons that move the soma farther away from threshold. These neurotransmitters and the neurons that contain them are inhibitory. They prevent or inhibit other electrical signals from moving forward along a pathway or chain of neurons.

Combinations of excitatory and inhibitory neurons create the pathways, chains, or circuits of neurons that control each nervous system function. Appropriately placed inhibitory neurons result in fine control of the output of a neuronal circuit and consequent behaviors.