Excitation and Conduction

Excitation and conduction
- The STIMULUS for excitation can be electrical, mechanical or chemical
- Two types of potentials are generated: LOCAL and PROPAGATED
- The LOCAL potentials are (depending on location) synaptic, generator, or electrotonic potentials
- The PROPAGATED potentials are action potentials

Resting membrane potentials
- Even though the net charge of the cytoplasm is neutral, all the negative charges line up on the inner lining of the membrane, causing the extra-membrane positive charges to line up on the outside of the cell. This sets up a membrane potential of about 70 millivolts
- In order for a potential difference to be present, two conditions must be met:
  - 1) there must be a concentration gradient: unequal distribution of ions on either side of the membrane
  - 2) the membrane must be permeable to one or more of these ion species
- The resting potential is an equilibrium situation, where the driving force of for the membrane-permeant ions down their concentration gradients across the membrane is EQUAL AND OPPOSITE to the driving force for these ions down their electrical gradients

- In the neurons, Na⁺/K⁺ ATPase sets up a gradient where K⁺ is concentrated inside, and the Na⁺ is concentrated outside.
  - When K⁺ channels are open, K⁺ leaks out of the cell
  - When Na⁺ channels are open, Na⁺ leaks into the cell
  - At rest, there are more K⁺ than Na⁺ channels open.
  - The channels are ion-selective: Na⁺ cannot use the K⁺ channels
  - Therefore, the intracellular and extracellular concentration of potassium is the single most important determinant of resting membrane potential
  - Increasing the extracellular K⁺ concentration reduces the resting membrane potential.
  - Decreasing the extracellular concentration of Na⁺ does little to change the resting membrane potential because at rest the membrane permeability to Na⁺ is very low. However, this does change the magnitude of the action potential (which depends on Na⁺ influx, and so if there is less Na⁺ to influx there will be less change in charge during its influxing.

- Other ions influence the membrane potential; CALCIUM concentration plays a role
- A DECREASE of extracellular calcium increases the excitability of nerve and muscle cells by decreasing the amount of depolarization necessary to trigger the voltage-gated ion channels
- An INCREASE in extracellular calcium instead tends to stabilize the membrane and decrease excitability