Communication by neurons depends on 2 properties of their cell membrane:

- 1. Resting membrane potential
  - Electrical voltage across the membrane.
- 2. Ion channels in the membrane that can be opened or closed.

Resting Membrane Potential

- Potential energy in the separation of electric charges.
- Ions, rather than electrons, carry the charges.
- Membrane makes a good insulator of ion charges.

Factors contributing to the RMP:

- 1. Distribution of ions across the plasma membrane.
  - Outside membrane:
    - Main cation = Na^+
  - Main anion = Cl-Inside membrane:
    - Main cation = K^-

+

    - Main anion = organic phosphates and amino acids in proteins

Factors contributing to the RMP:

2. Relative permeability of membrane to Na^+ and K^+.

- -K^+ is 50-100 times more permeable than Na^+.
- -Membrane is slightly permeable to Cl^- outside cell.
- Average RMP is –70 mV (millivolts).
- -Charge is related to the inside vs. the outside of the membrane.

Ion Channels

- 2 basic types:
- 1. Leakage (i.e. nongated) -- are always open. Neuron has many more K^+ leakage than Na^+.
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- 2. Gated-- open and close in response to a stimulus.

4 categories of stimuli operate gated channels:

- 1. Voltage -- open in response to a change in the membrane potential.
- 2. Chemical -- respond to a specific chemical stimulus.
- 3. Mechanical pressure
- 4. Light

Action Potential (Nerve Impulse)

- This is a rapid change in membrane potential that involves depolarization followed by a repolarization.
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- Depolarization = loss and reversal of membrane polarization.

Threshold = critical level that causes the membrane to depolarize.

- -About –55 mV.

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- Depolarization
  - -Threshold reached.
  - -Outer activation gate on Na^+ gated channel opens.
  - -About 20,000 Na^+ enter.
  - -Membrane potential changes from –70 to +30 mV.

Action Potential Process

- Repolarization = recovery of RMP.
  - -Inner inactivation gate on Na^+ gated channel closes.
  - -Voltage-gated K^+ channels open.
    - ~Threshold causes these to open, but they do so more slowly than the Na^+ channels.
  - -Membrane potential changes from +30 to –70 mV.
  - -Voltage-gated K^+ channels close.
  - -Outer activation gate on Na^+ gated channels close.

-Inner inactivation gate on Na^+ gated channels open.

Problem

- We've got a lot of Na^+ inside and K^+ outside.
- -Solution = Na^+/K^+ Pump.
  - -3 Na^+ pumped out for every 2 K^+ brought in.

Types of Conduction

- Continuous