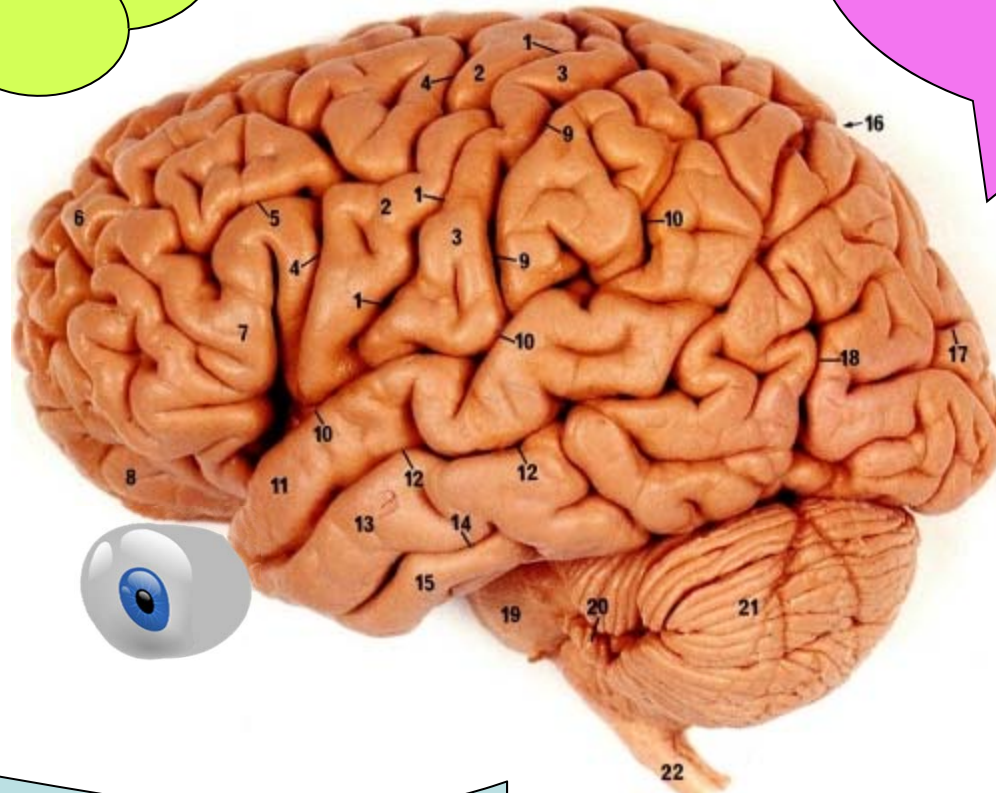
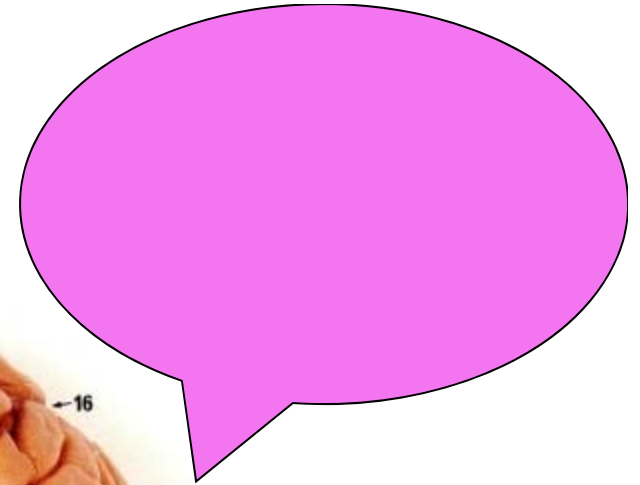




Neuronal Communication

Mary ET Boyle, Ph.D.

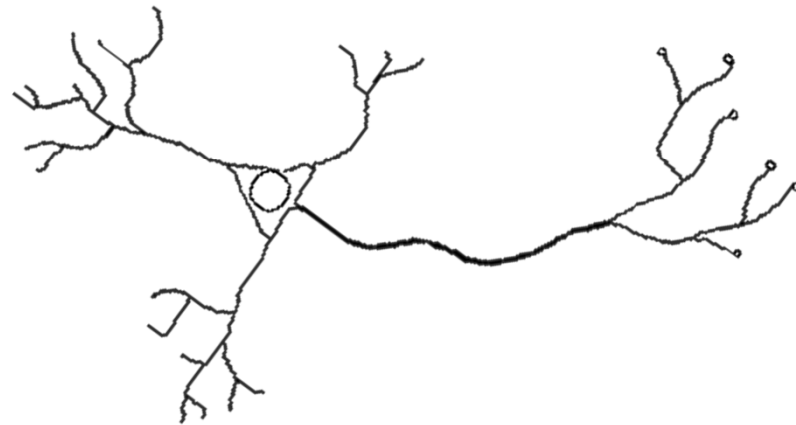


“A brain is what a brain does.”

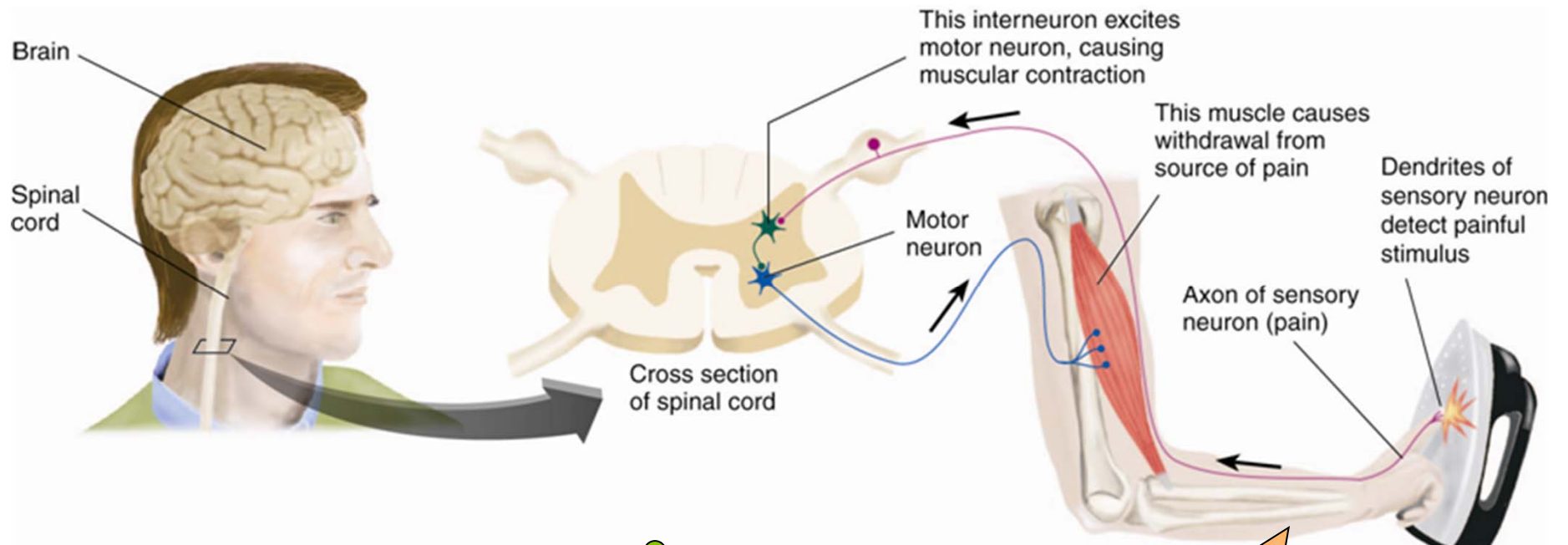


Communication within a Neuron

- Measuring Electrical Potentials of Axons
- The Membrane Potential
- The Action Potential
- Conduction of the Action Potential



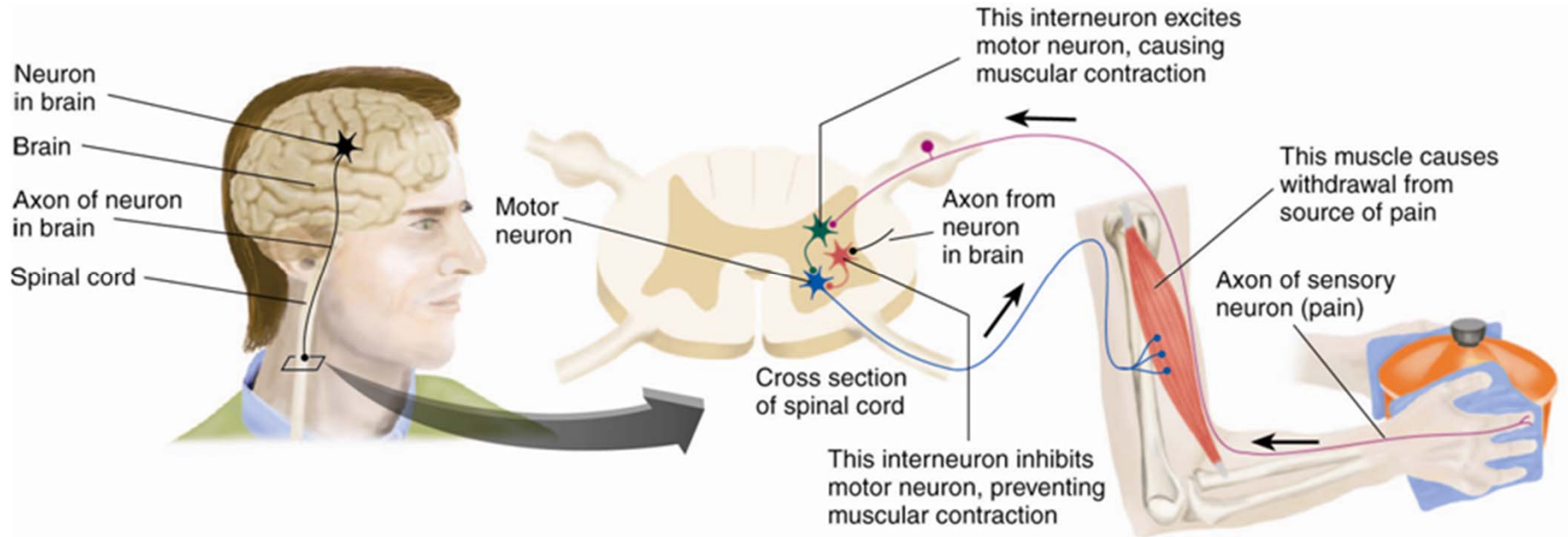
The withdrawal reflex



neural circuits

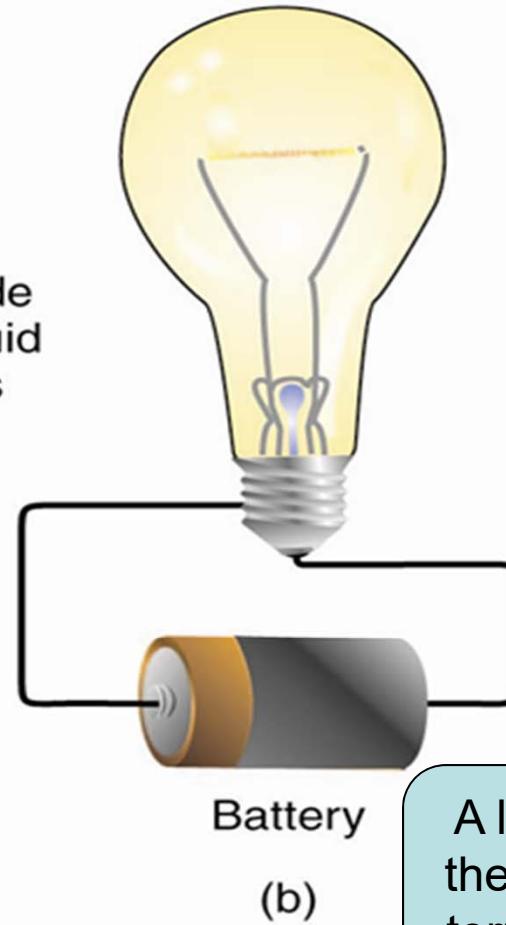
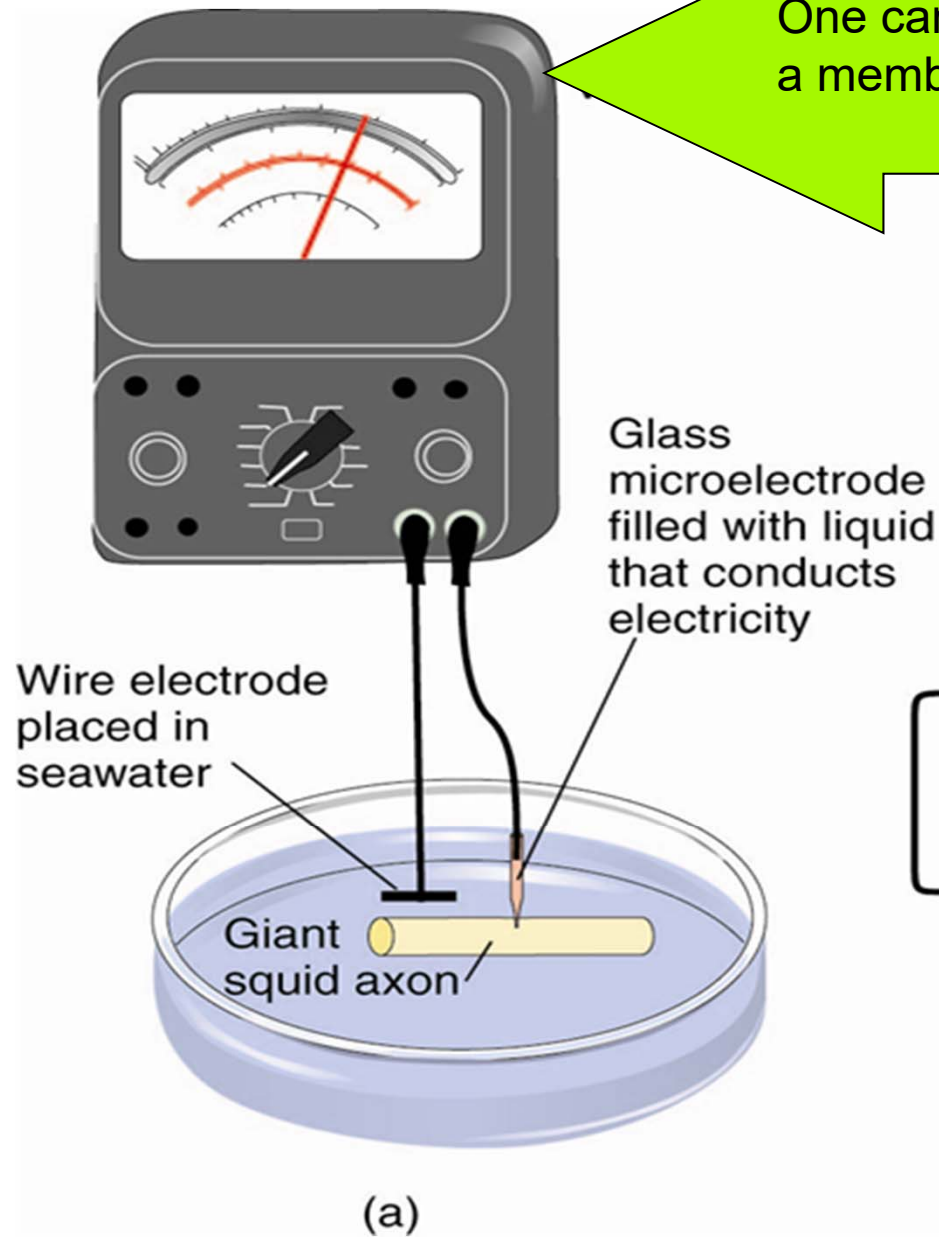
excitatory effects

Inhibiting the withdrawal reflex

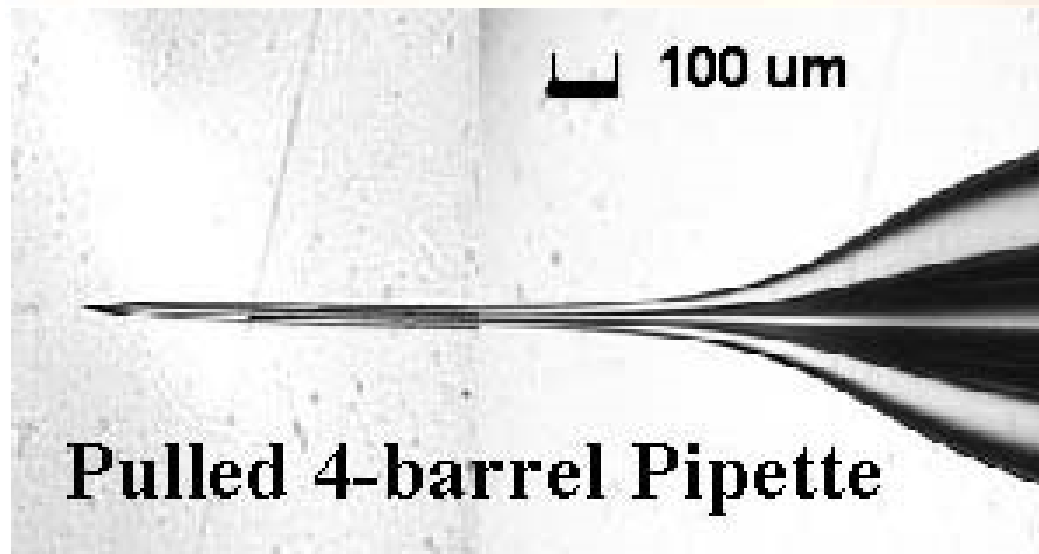
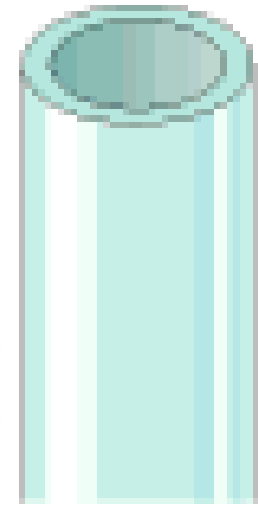


The brain inhibited the motor neuron to prevent the dish from dropping.

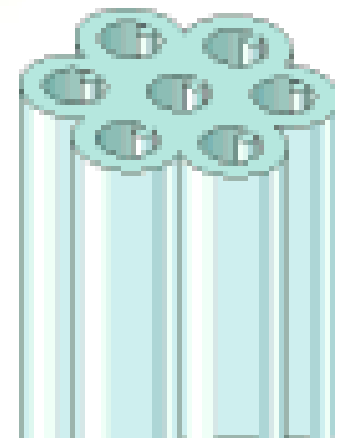
One can measure the electrical charge across a membrane of an axon by using a voltmeter.

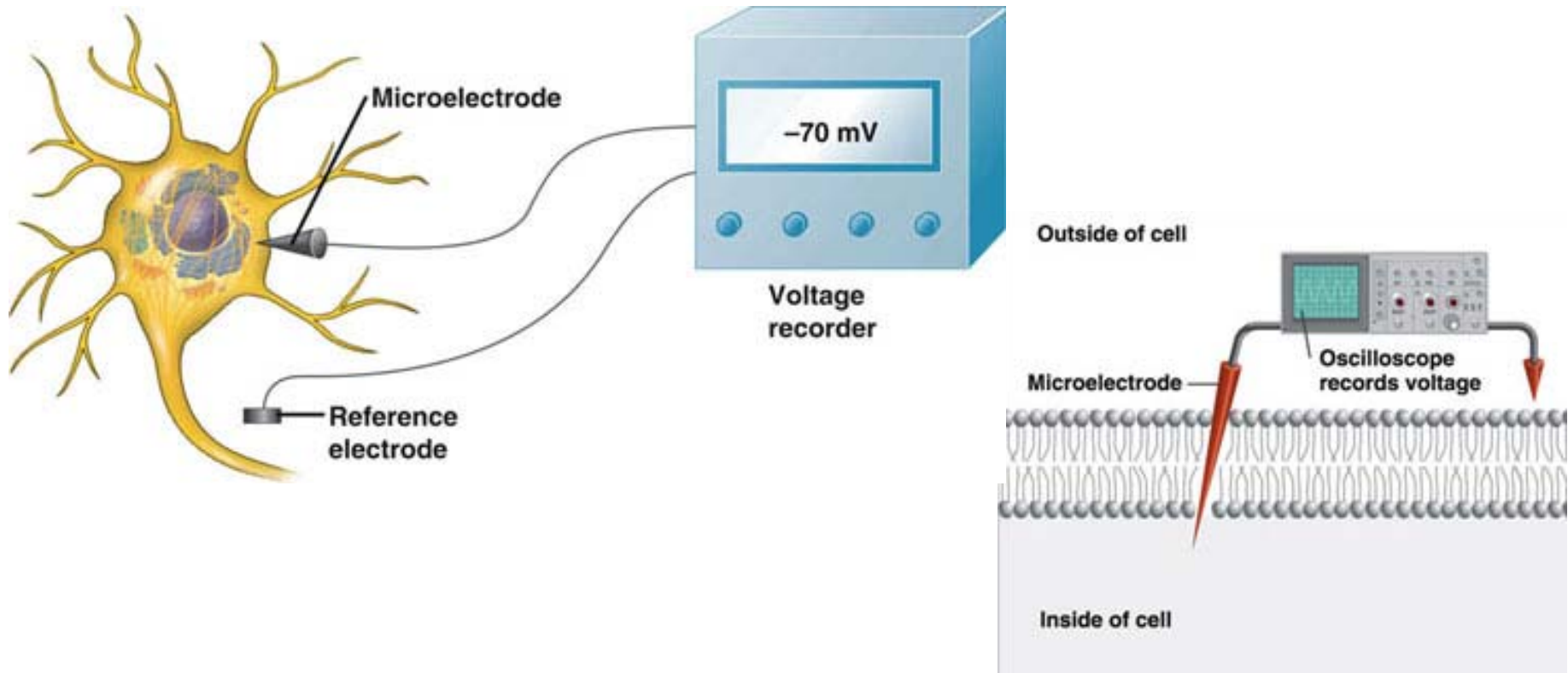


A light bulb detecting the charge across the terminals of a battery.

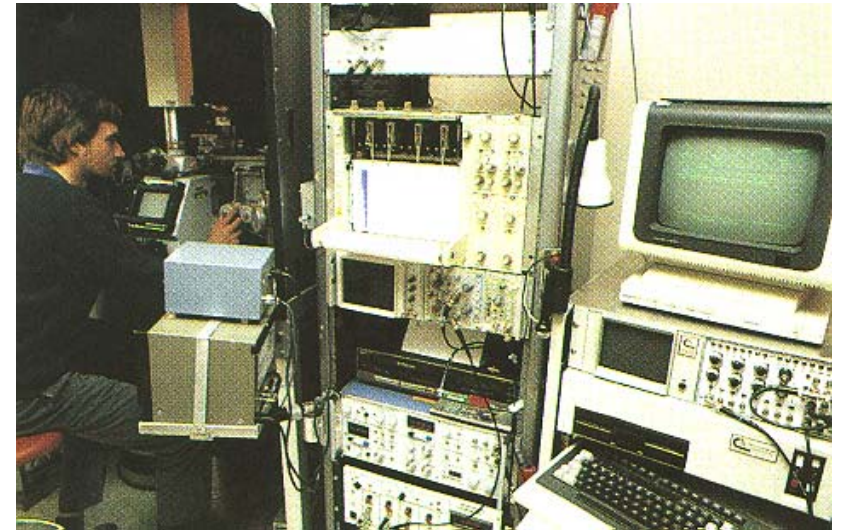
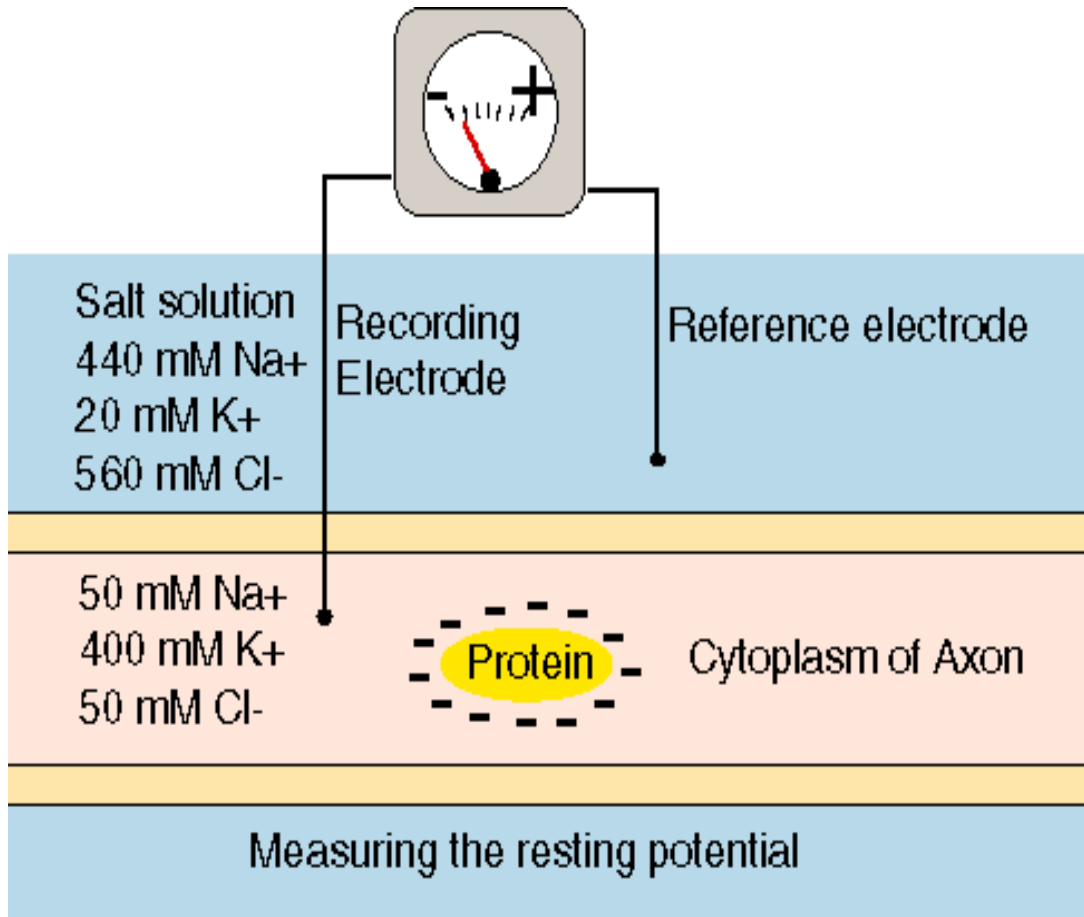


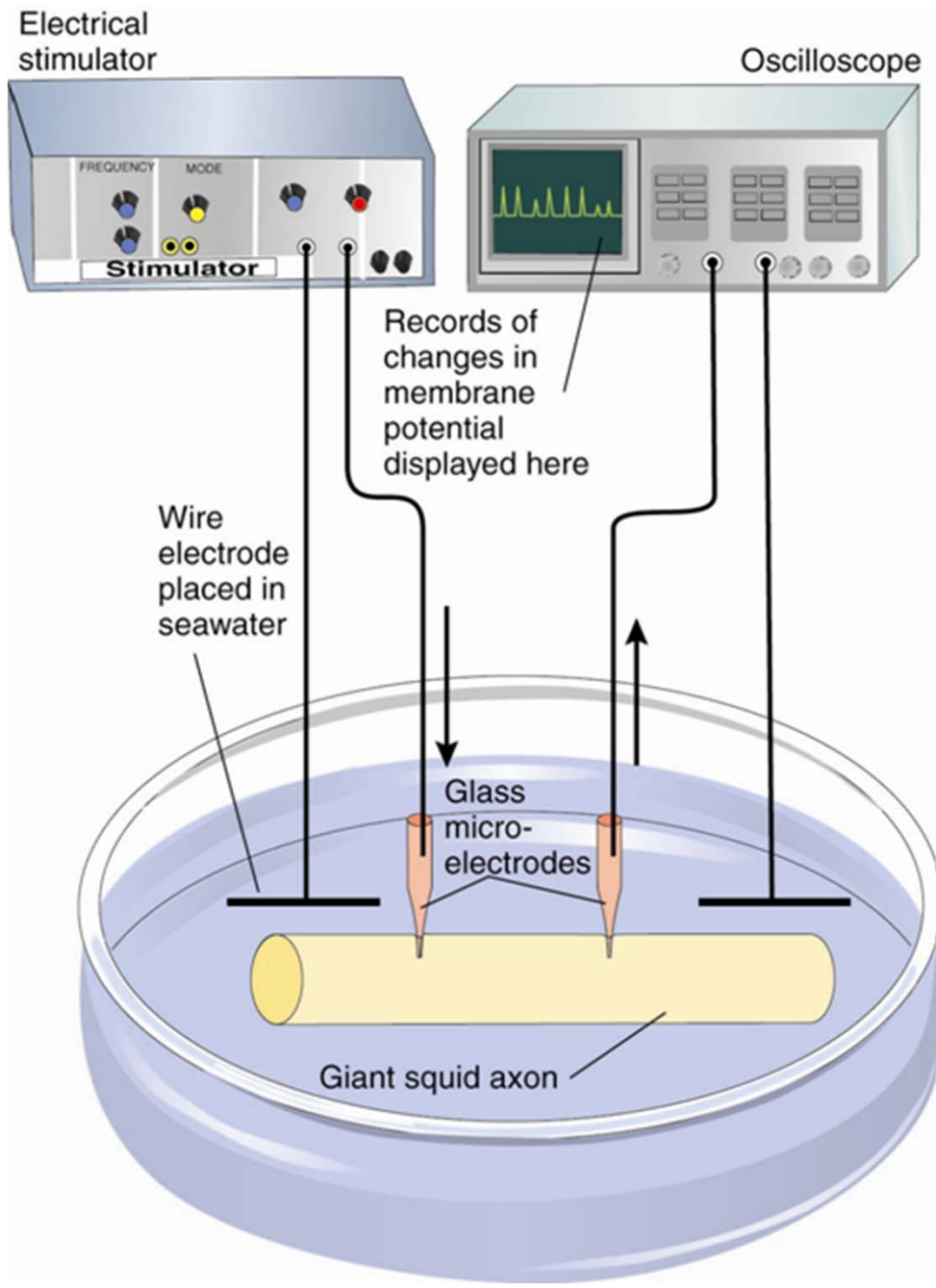
Pulled 4-barrel Pipette

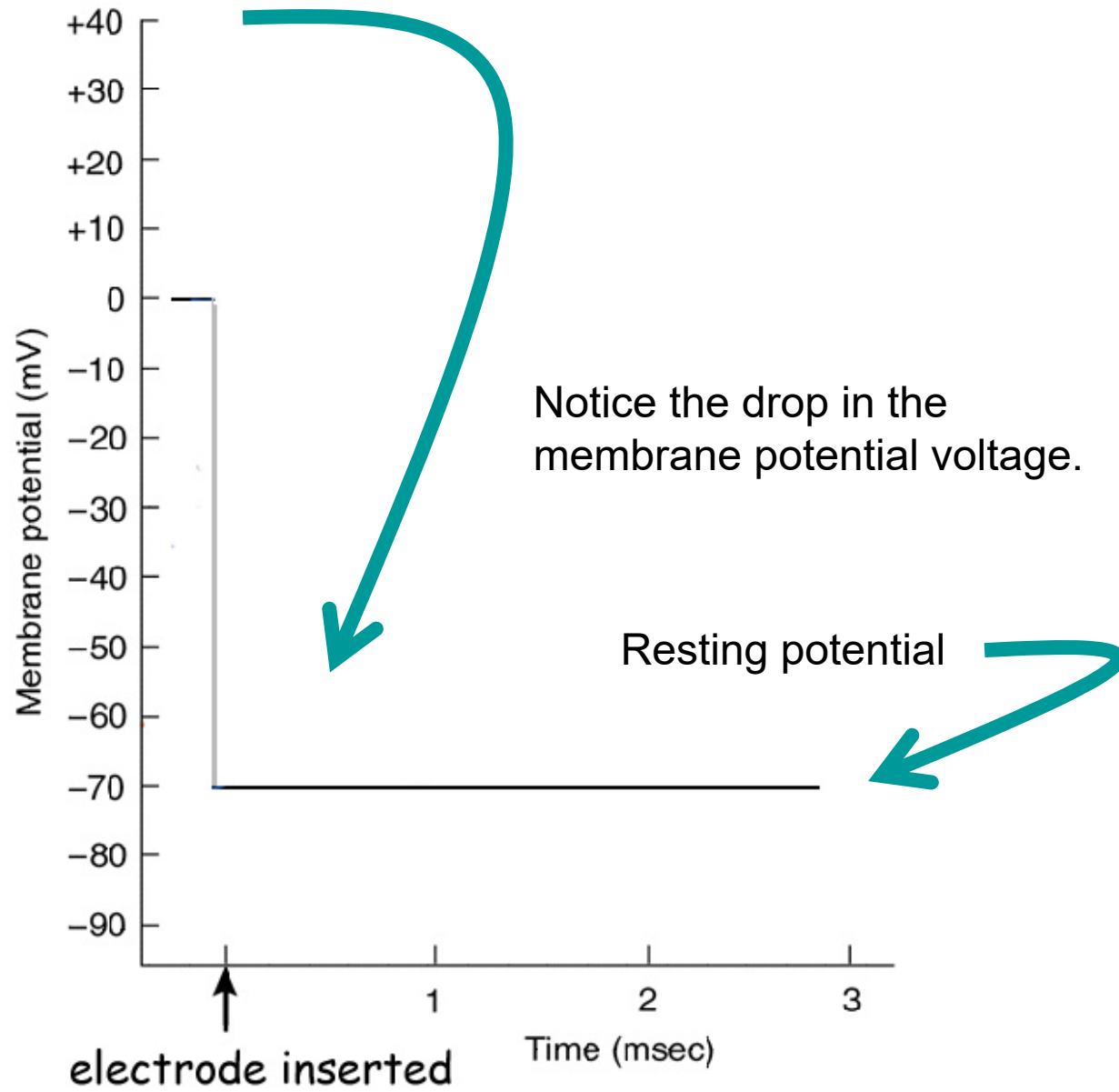


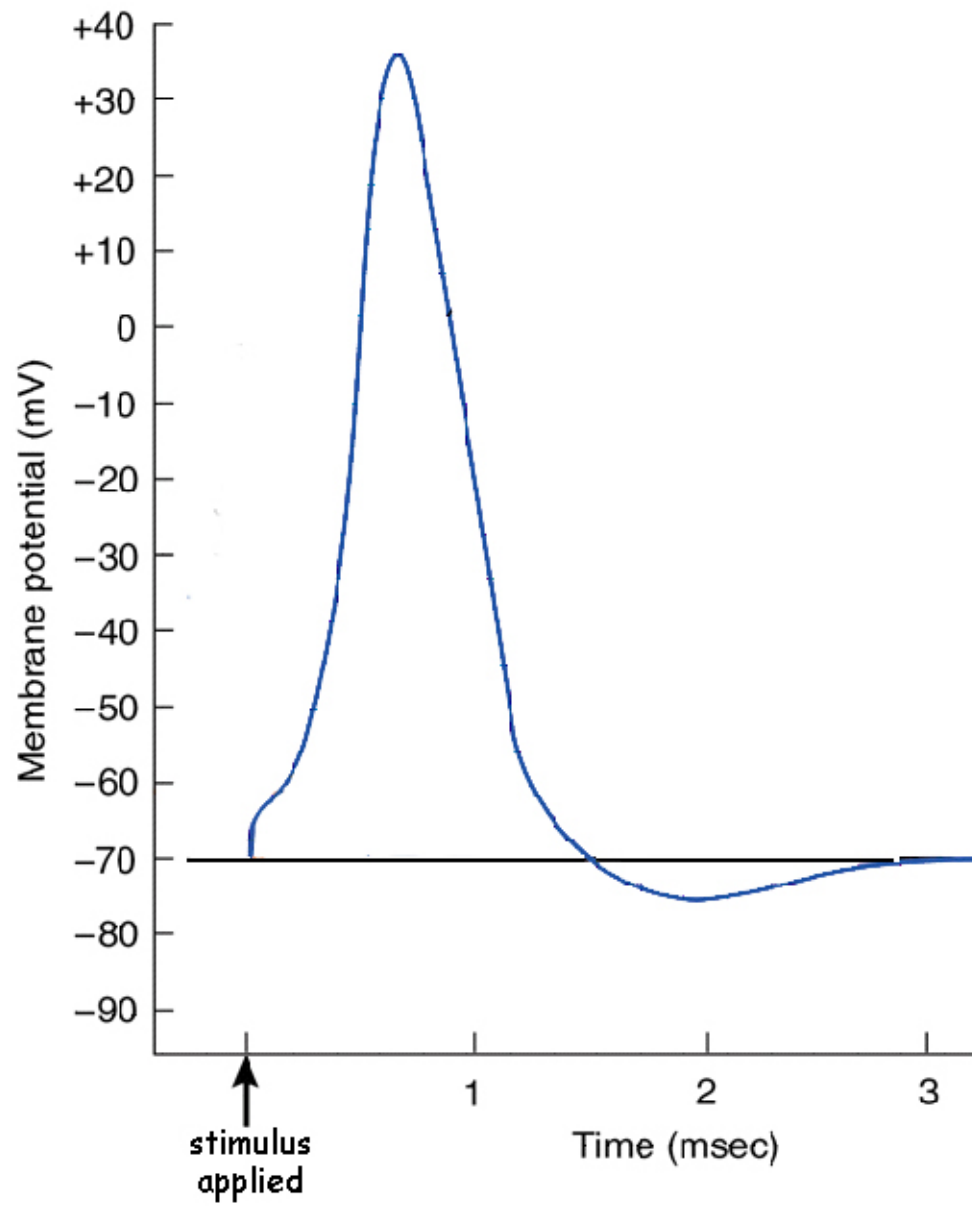


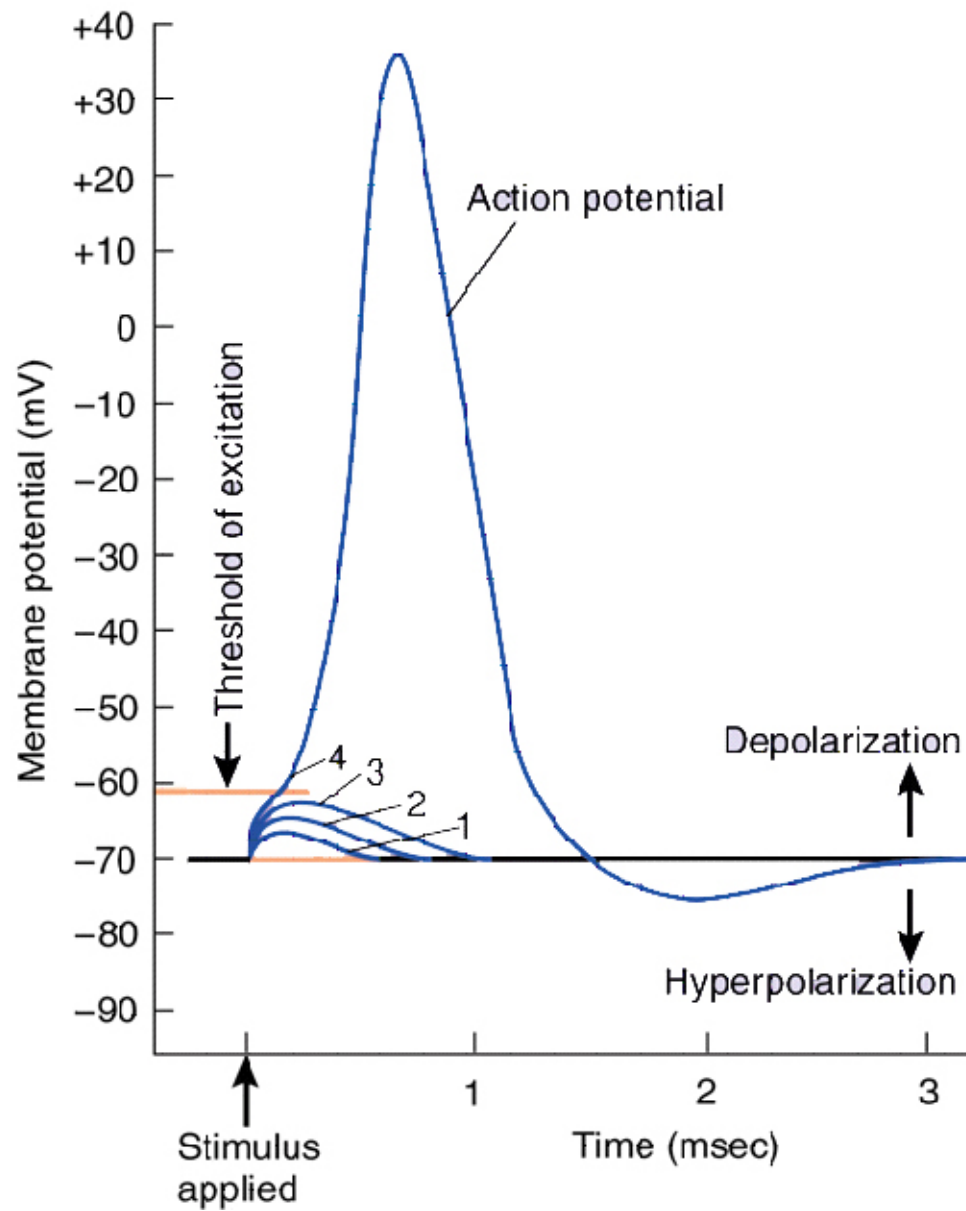
potential - (in electrical terms) is amount of electrical charge at one point in an electric circuit compared to some other point in the same circuit measured with a voltmeter

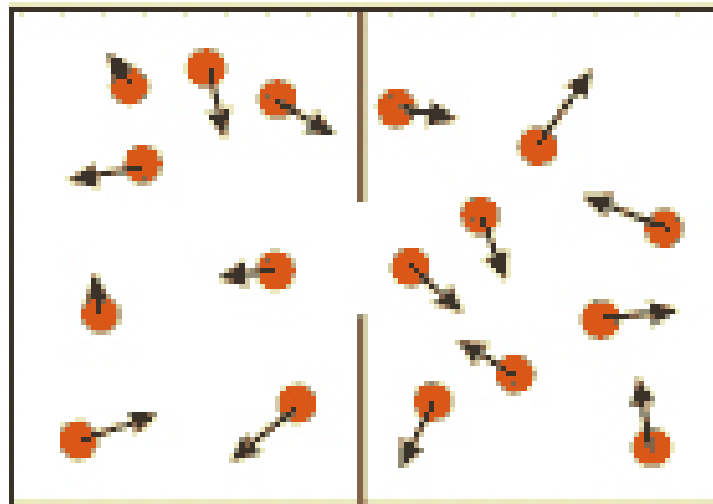
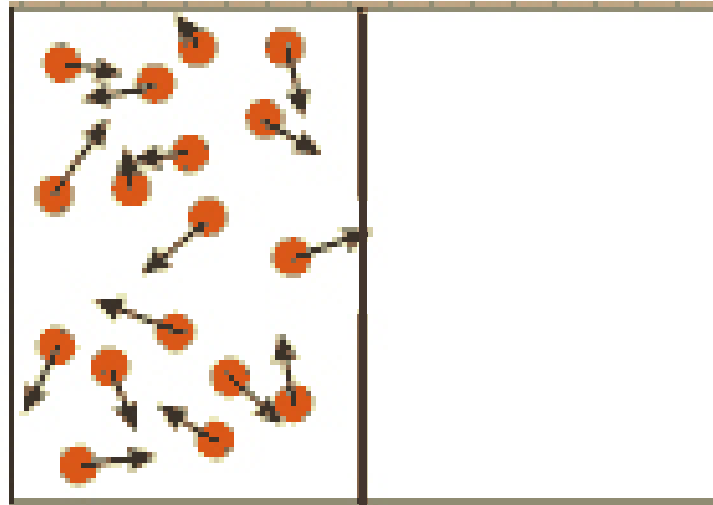




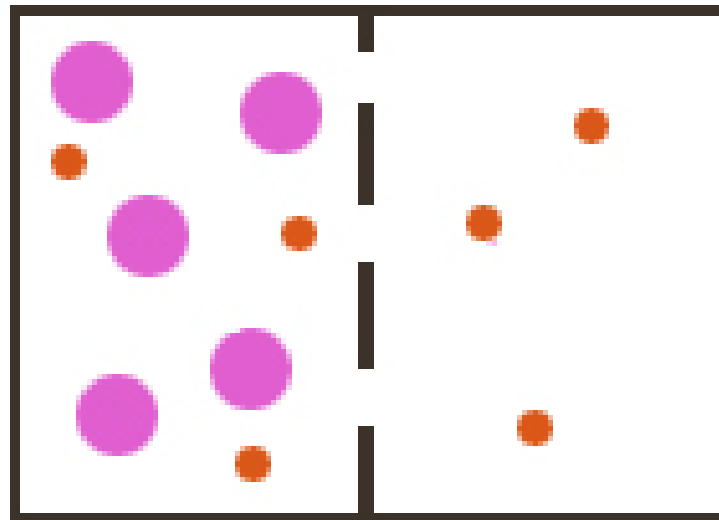
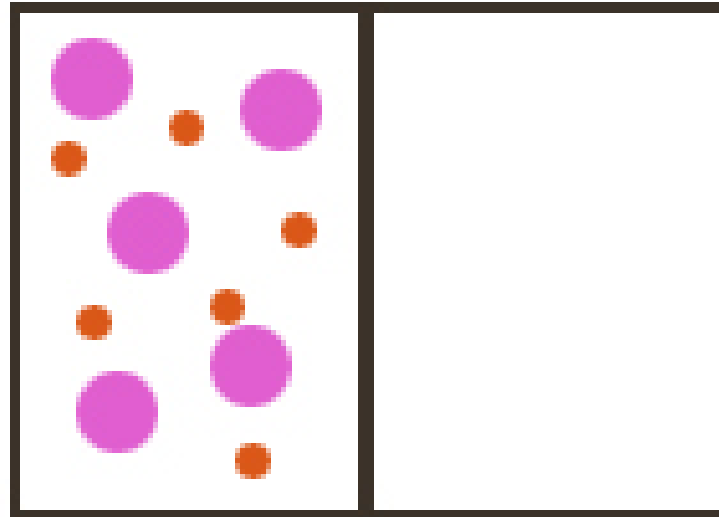




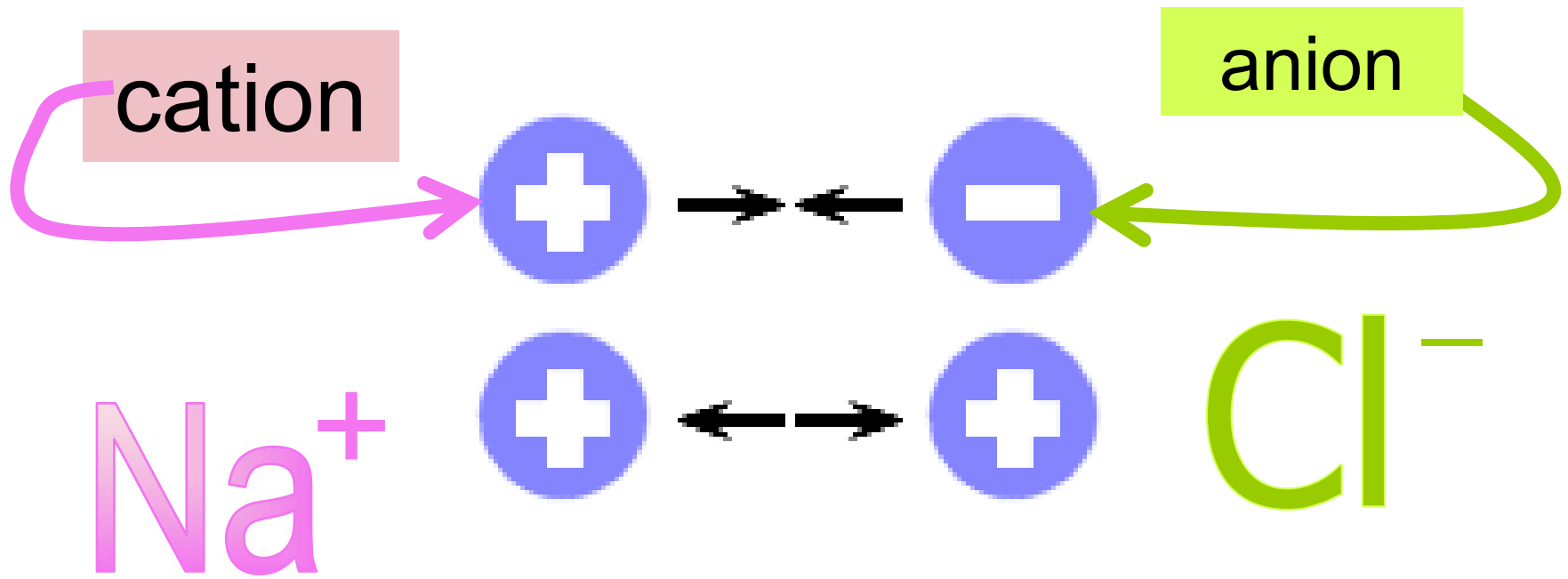




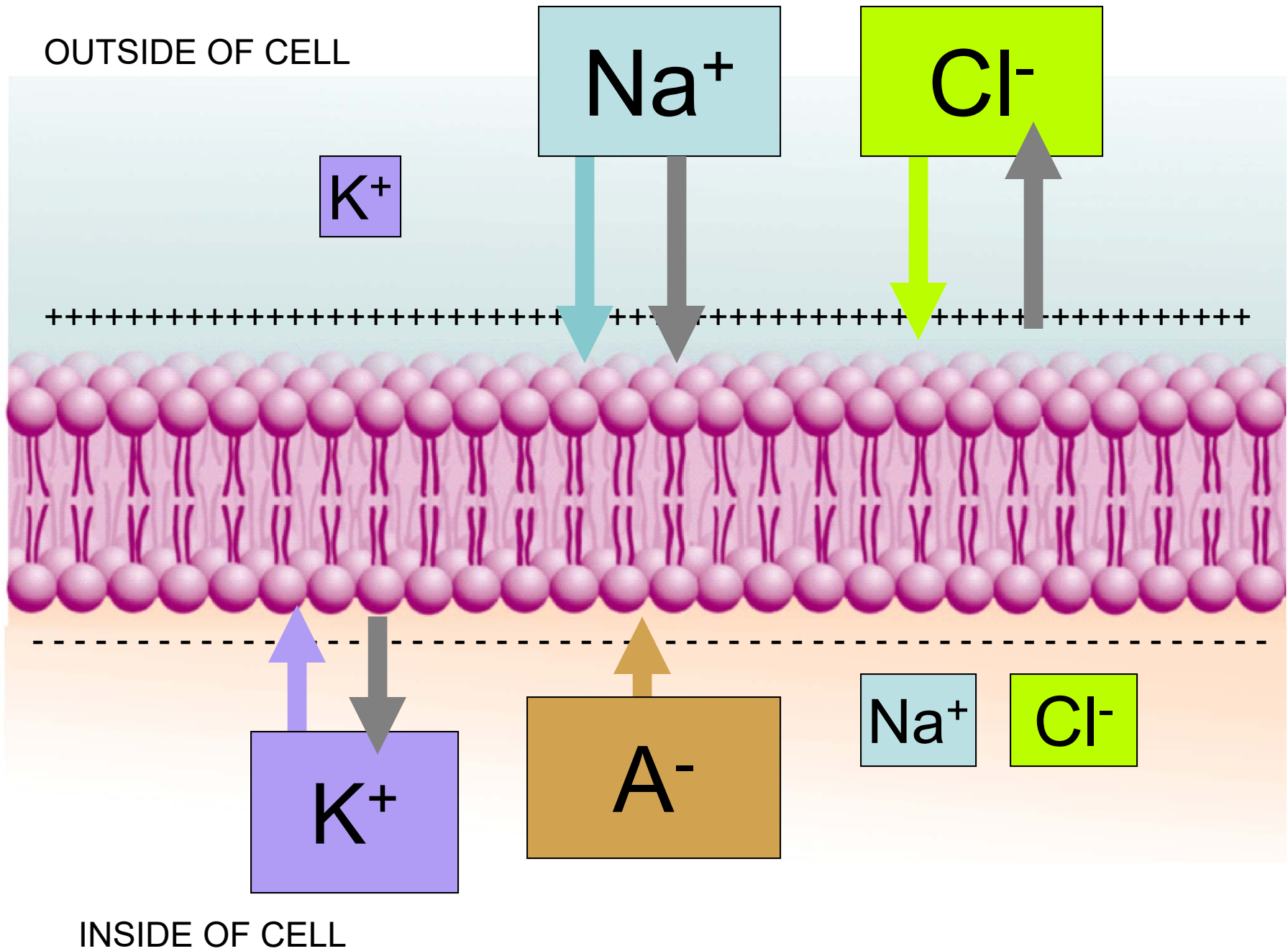
diffusion

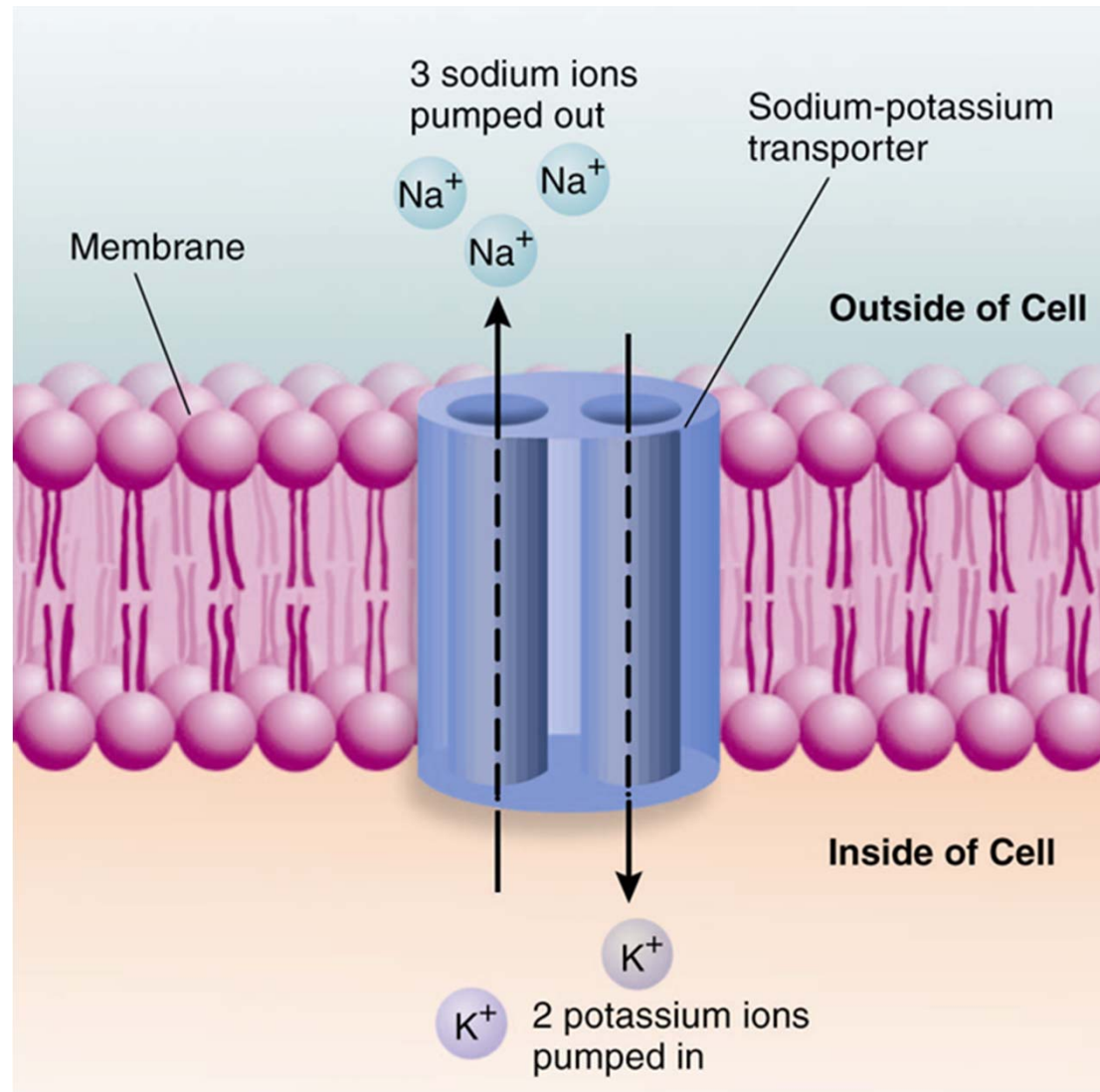


selective
permeability



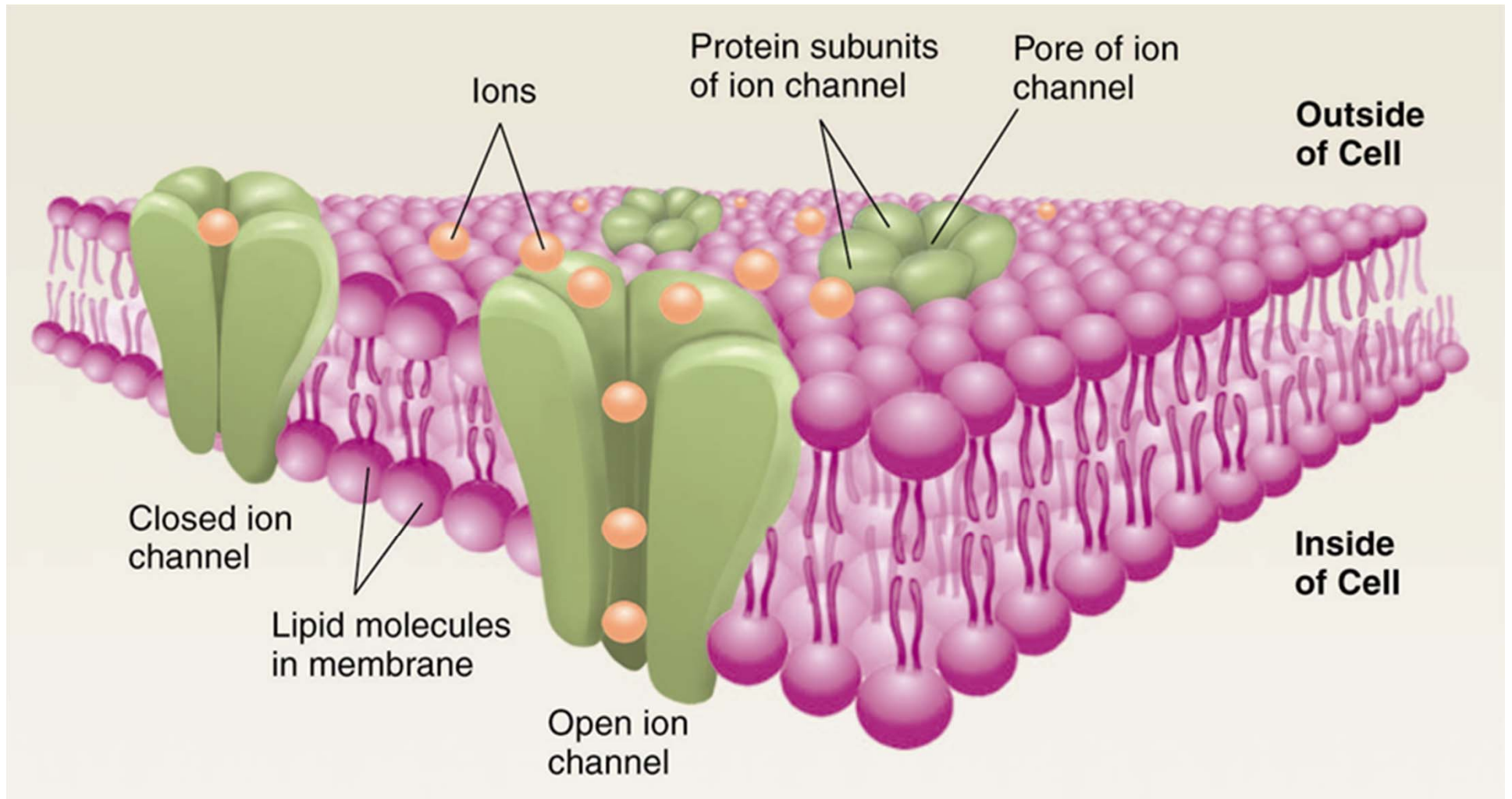
ELECTROSTATIC
PRESSURE





Na-K Pump Animation

<http://highered.mcgraw-hill.com/olc/dl/120068/bio03.swf>



- **electrode**
 - A conductive medium that can be used to apply electrical stimulation or to record electrical potentials.
- **microelectrode**
 - A very fine electrode, generally used to record activity of individual neurons.
- **membrane potential**
 - The electrical charge across a cell membrane; the difference in electrical potential inside and outside the cell.
- **oscilloscope**
 - A laboratory instrument that is capable of displaying a graph of voltage as a function of time on the face of a cathode ray tube.

- **resting potential**
 - The membrane potential of a neuron when it is not being altered by excitatory or inhibitory postsynaptic potential; approximately -70 mV in the giant squid axon.
- **depolarization**
 - Reduction (toward zero) of the membrane potential of a cell from its normal resting potential.
- **hyperpolarization**
 - An increase in the membrane potential of a cell, relative to the normal resting potential.
- **action potential**
 - The brief electrical impulses that provide the basis for conduction of information along an axon.

- **threshold of excitation**
 - The value of the membrane potential that must be reached to produce an action potential.
- **diffusion**
 - Movement of molecules from regions of high concentration to regions of low concentration.
- **electrolyte**
 - An aqueous solution of a material that ionizes - namely, a soluble acid, base, or salt.
- **ion**
 - A charged molecule. Cations are positively charged, and anions are negatively charged.

- **electrostatic pressure**
 - The attractive force between atomic particles charged with opposite signs or repulsive force between atomic particles charged with the same charge.
- **intracellular fluid**
 - The fluid contained within cells.
- **extracellular fluid**
 - Body fluids located outside of cells.
- **sodium-potassium transporter**
 - A protein found in the membrane of all cells that extrudes sodium ions from and transports potassium ions into the cell.

- ion channel
 - A specialized protein molecule that permits specific ions to enter or leave cells.
- voltage-dependent ion channel
 - An ion channel that opens or closes according to the value of the membrane potential.
- all-or-none law
 - The principle that once an action potential is triggered in an axon, it is propagated, without decrement, to the end of the fiber.
- rate law
 - The principle that variations in the intensity of a stimulus or other information being transmitted in an axon are represented by variations in the rate at which that axon fires.

- cable properties
 - The passive conduction of electrical current, in a decremental fashion, down the length of an axon.
- saltatory conduction
 - Conduction of action potentials by myelinated axons. The action potential appears to jump from one node of Ranvier to the next.

- postsynaptic potential
 - Alterations in the membrane potential of a postsynaptic neuron, produced by liberation of neurotransmitter at the synapse.
- binding site
 - The location on a receptor protein to which a ligand binds.
- ligand
 - A chemical that binds with the binding site of a receptor.
- dendritic spine
 - A small bud on the surface of a dendrite with which a terminal button of another neuron forms a synapse.

- **presynaptic membrane**
 - The membrane of a terminal button that lies adjacent to the postsynaptic membrane and through which the neurotransmitter is released.
- **postsynaptic membrane**
 - The cell membrane opposite the terminal button in a synapse; the membrane of the cell that receives the message.
- **synaptic cleft**
 - The space between the presynaptic membrane and the postsynaptic membrane.
- **synaptic vesicle**
 - A small, hollow, beadlike structure found in terminal buttons, contains molecules of a transmitter.

- **release zone**
 - A region of the interior of the presynaptic membrane of a synapse to which synaptic vesicles attach and release their neurotransmitter into the synaptic cleft.
- **postsynaptic receptor**
 - A receptor molecule in the postsynaptic membrane of a synapse that contains a binding site for a neurotransmitter.
- **neurotransmitter-dependent ion channel**
 - An ion channel that opens when a molecule of a neurotransmitter binds with a postsynaptic receptor.
- **ionotropic receptor**
 - A receptor that contains a binding site for a neurotransmitter and an ion channel that opens when a molecule of the neurotransmitter attaches to the binding site.

- **metabotropic receptor**
 - A receptor that contains a binding site for a neurotransmitter; activates an enzyme that begins a series of events that opens an ion channel elsewhere in the membrane of the cell when a molecule of the neurotransmitter attaches to the binding site.
- **G protein**
 - A protein coupled to a metabotropic receptor; conveys messages to other molecules when a ligand binds with and activates the receptor.
- **second messenger**
 - A chemical produced when a G protein activates an enzyme; carries a signal that results in the opening of the ion channel or causes other events to occur in the cell.

- excitatory potential (EPSEP)
 - An excitatory depolarization of the postsynaptic membrane of a synapse caused by the liberation of a neurotransmitter by the terminal button.
- inhibitory postsynaptic potential (IPSP)
 - An inhibitory hyperpolarization of the postsynaptic membrane of a synapse caused by the liberation of a neurotransmitter by the terminal button.

- reuptake
 - The reentry of a neurotransmitter just liberated by a terminal button back through its membrane, this terminating the postsynaptic potential.
- enzymatic deactivation
 - The destruction of a neurotransmitter by an enzyme after its release - for example, the destruction of acetylcholine by acetylcholinesterase.
- acetylcholine (ACh)
 - A neurotransmitter found in the brain, spinal cord, and parts of the peripheral nervous system; responsible for muscular contraction.
- acetylcholinesterase (AChE)
 - The enzyme that destroys acetylcholine soon after it is liberated by the terminal buttons, thus terminating the postsynaptic potential.

- **neural integration**
 - The process by which inhibitory and excitatory potentials summate and control the rate of firing of a neuron.
- **autoreceptor**
 - A receptor molecule located on a neuron that responds to the neurotransmitter released by that neuron.
- **presynaptic inhibition**
 - The action of a presynaptic terminal button in an axoaxonic synapse; reduces the amount of neurotransmitter released by the postsynaptic terminal button.
- **presynaptic facilitation**
 - The action of a presynaptic terminal button in an axoaxonic synapse; increases the amount of neurotransmitter released by the postsynaptic terminal button.

- **gap junction**
 - A special junction between cells that permits direct communication by means of electrical coupling.
- **neuromodulator**
 - A naturally secreted substance that acts like a neurotransmitter except that it is not restricted to the synaptic cleft but diffuses through the extracellular fluid.
- **peptide**
 - A chain of amino acids joined together by peptide bonds. Most neuromodulators, and some hormones, consist of peptide molecules.
- **hormone**
 - A chemical substances that is released by an endrodrine gland that has effects on target cells in other organs.

- endocrine gland
 - A gland that liberates its secretions into the extracellular fluid around capillaries and hence into the bloodstream.
- steroid
 - A chemical of low molecular weight, derived from cholesterol. Steroid hormones affect their target cells by attaching to receptors found within the nucleus.
- target cell
 - The type of cell that is directly affected by a hormone or other chemical agent.