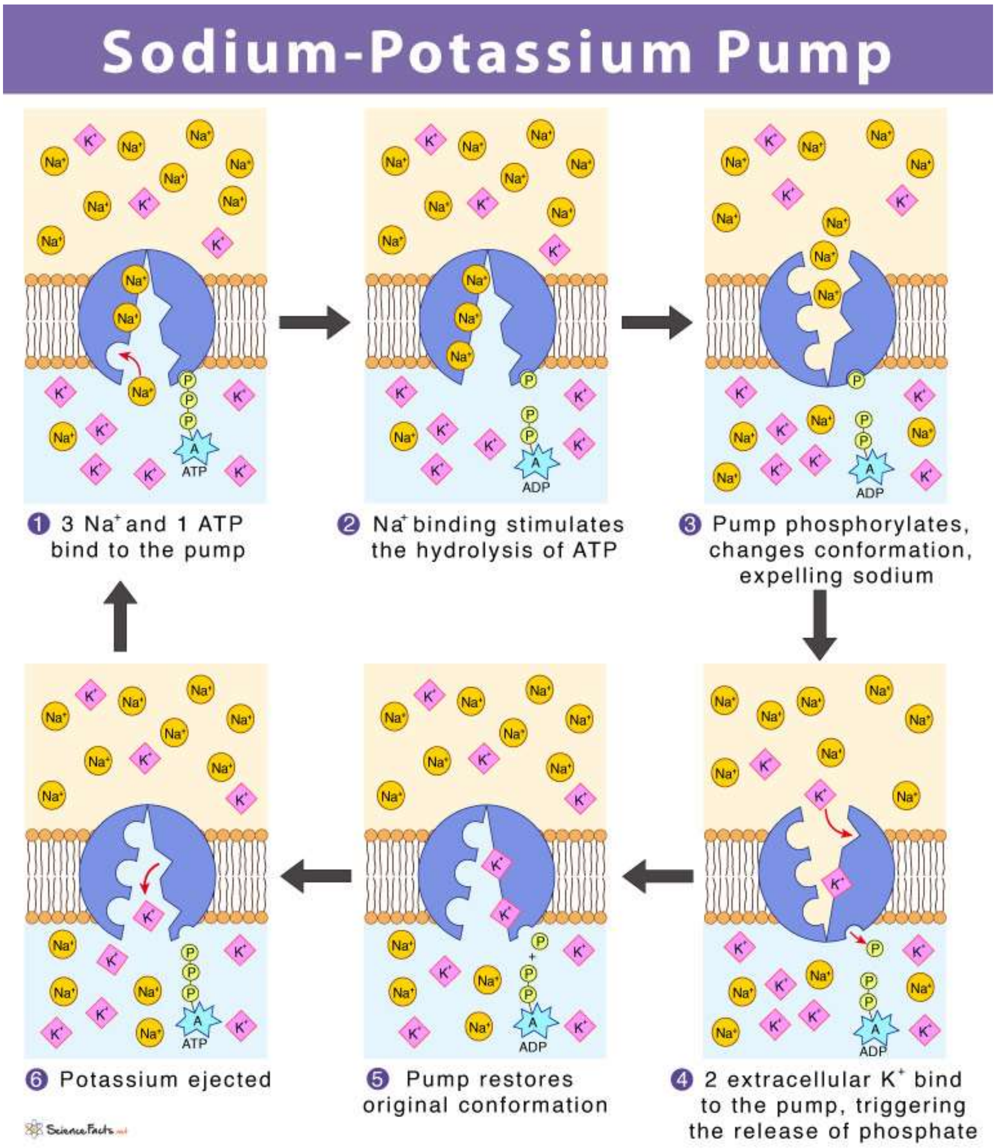
Handout First Class CH4102

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.631	33 **As** Arsenic 74.922	34 **Se** Selenium 78.971	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.798
37 **Rb** Rubidium 85.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.414	49 **In** Indium 114.818	50 **Sn** Tin 118.711	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.294
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.328	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.085	79 **Au** Gold 196.967	80 **Hg** Mercury 200.592	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [278]	110 **Ds** Darmstadtium [281]	111 **Rg** Roentgenium [280]	112 **Cn** Copernicium [285]	113 **Nh** Nihonium [286]	114 **Fl** Flerovium [289]	115 **Mc** Moscovium [289]	116 **Lv** Livermorium [293]	117 **Ts** Tennessine [294]	118 **Og** Oganesson [294]

Lanthanide Series	57 **La** Lanthanum 138.905	58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.243	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.500	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.259	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.055	71 **Lu** Lutetium 174.967
Actinide Series	89 **Ac** Actinium 227.028	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]



- **Maintaining Concentration Gradients**:

  It establishes and maintains the high extracellular sodium and high intracellular potassium concentrations essential for proper cell function.

- **Maintaining Resting Membrane Potential**:

  By pumping ions against their concentration gradients, it plays a critical role in creating and stabilizing the cell's membrane potential.

- **Driving Secondary Active Transport**:

  The sodium gradient it creates serves as the energy source for the cellular uptake of many nutrients and other solutes.

- **Cell Volume Regulation**:

The pump helps balance osmotic pressure and prevent cells from swelling or shrinking excessively.

- **Cellular Signaling**:
  In addition to its pumping function, the Na/K-ATPase also acts as a docking station for various proteins, initiating intracellular signaling pathways that influence cell proliferation, survival, and other cellular processes.

Few examples

1. **WHY RESTING MEMEBRANE POTENTIAL IS IMPORTANT TO MAINTAIN?**

Resting membrane potential creates an electrical gradient across the cell membrane, essential for excitable cells like neurons and muscle cells to generate signals and respond to stimuli.

This potential serves as the baseline state, allowing for rapid, controlled changes in membrane voltage (action potentials) that are necessary for nerve impulse transmission, muscle contraction, and other cellular processes.

The neuron signal cycle relies on changes to its resting potential to create an action potential, which consists of →

Depolarization (membrane becomes less negative),

Repolarization (membrane potential returns to resting state), and

Hyperpolarization (membrane potential becomes even more negative than resting potential).

These phases are driven by the opening and closing of voltage-gated ion channels, allowing sodium (Na+) and potassium (K+) ions to flow across the membrane, ultimately propagating the signal.

1. Resting Membrane Potential (RMP):

- **Definition**: The resting potential is the stable, negative electrical charge across the neuron's membrane when it is not actively sending a signal, typically around -70 millivolts (mV).
- **Mechanism**: This potential is maintained by ion pumps (like the sodium-potassium pump) and ion channels (particularly potassium leak channels) that ensure a higher concentration of potassium inside the cell and a higher concentration of sodium outside.
- **Role**: It provides the baseline from which the neuron can initiate a signal.

2. Signal Triggering & Depolarization:

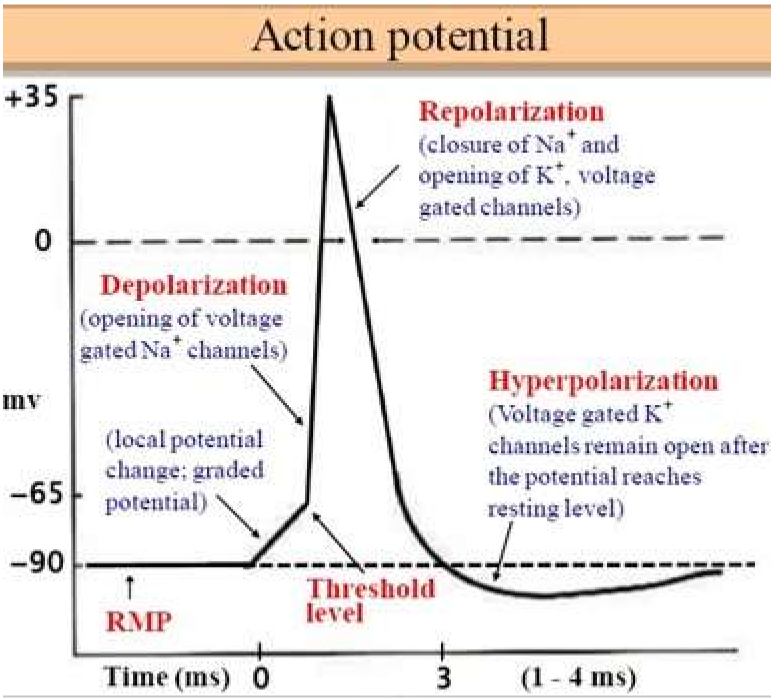
- **Threshold**:

A stimulus causes the membrane potential to become less negative. If this depolarization reaches a specific threshold potential (around -55 mV), it triggers an action potential.

- **Sodium Influx**:

  Reaching the threshold causes voltage-gated sodium channels to open, allowing a rapid influx of positively charged sodium ions into the cell.

- **Outcome**:
  This influx of positive charge further increases the positive charge inside the cell, leading to a rapid and dramatic depolarization.



3. Repolarization:

- **Sodium Channel Inactivation**:

  After about 1 millisecond, the fast-acting sodium channels become inactivated and are unable to open.

- **Potassium Channel Activation**:

  Simultaneously, slower-acting voltage-gated potassium channels open, allowing positively charged potassium ions to flow out of the cell.

- **Outcome**:
  The exit of positive potassium ions reduces the positive charge inside the cell, bringing the membrane potential back down towards the resting state.

4. Hyperpolarization:

- **Potassium Channel Kinetics**:

  The potassium channels have slow kinetics, meaning they remain open slightly longer than necessary to reach the resting potential.

- **Temporary Negative Shift**:

  This delayed closure of potassium channels leads to an excessive outflow of potassium, causing the membrane potential to briefly fall below the resting level, a phase known as hyperpolarization.

- **Outcome**:
  After the potassium channels close and the sodium channels become activated again, the neuron returns to its resting potential, ready to fire another action potential.

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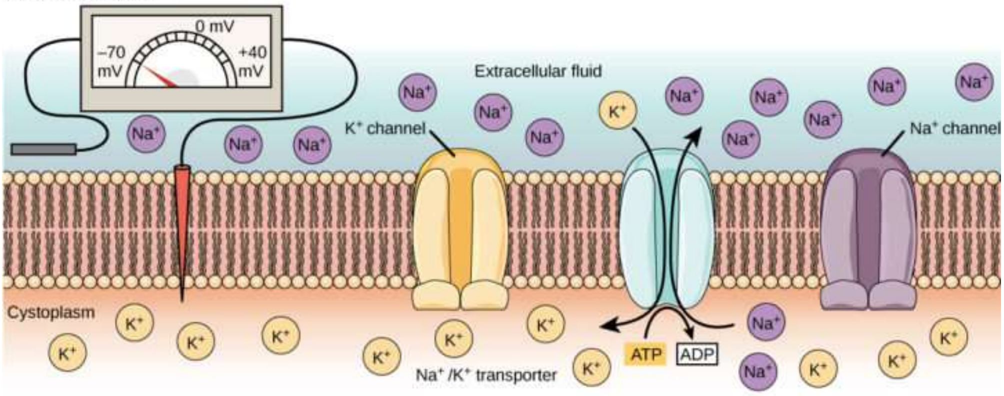
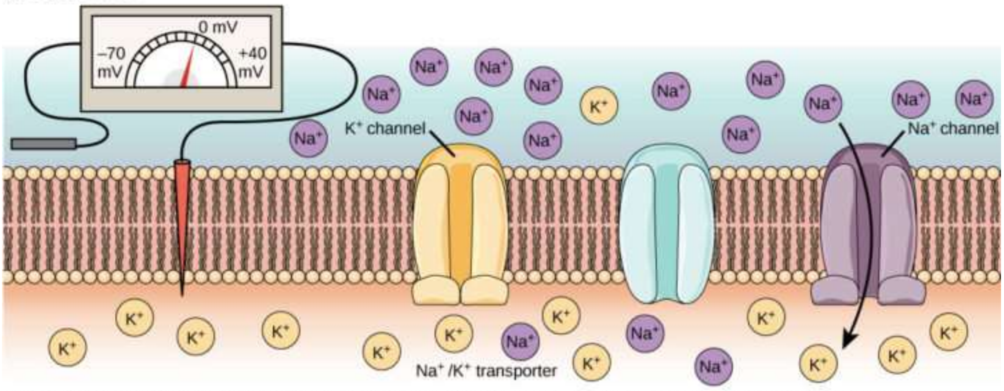
(a) Resting potential



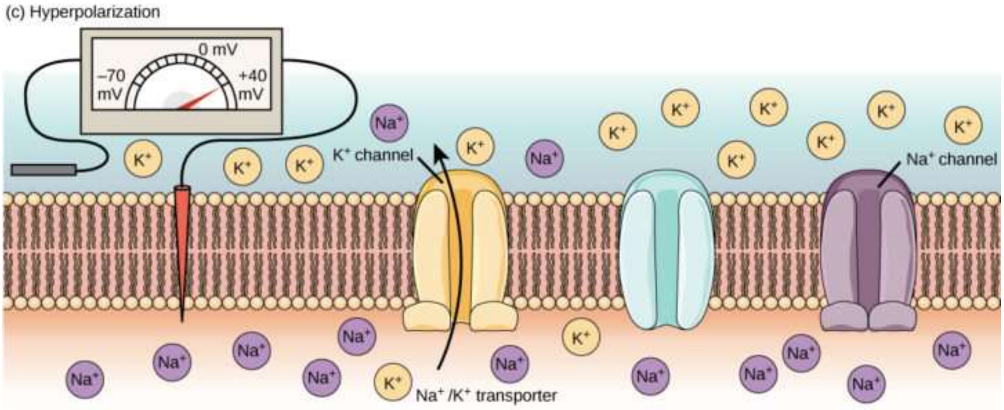
At the resting potential, all voltage-gated Na^+ channels and most voltage-gated K^+ channels are closed. The Na^+/K^+ transporter pumps K^+ ions into the cell and Na^+ ions out.

(b) Depolarization



In response to a depolarization, some Na^+ channels open, allowing Na^+ ions to enter the cell. The membrane starts to depolarize (the charge across the membrane lessens). If the threshold of excitation is reached, all the Na^+ channels open.

(c) Hyperpolarization



At the peak action potential, Na^+ channels close while K^+ channels open. K^+ leaves the cell, and the membrane eventually becomes hyperpolarized.

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SGLT glucose sodium cotransporter:

A sodium-dependent glucose transport diagram shows the sodium-glucose cotransporter (SGLT) moving glucose and sodium ions together into a cell, driven by the sodium gradient maintained by the sodium-potassium pump. In this secondary active transport, the high concentration of sodium outside the cell allows it to move downhill, pulling glucose against its own concentration gradient into the cell, a process vital for nutrient absorption in the intestine and reabsorption in the kidney.