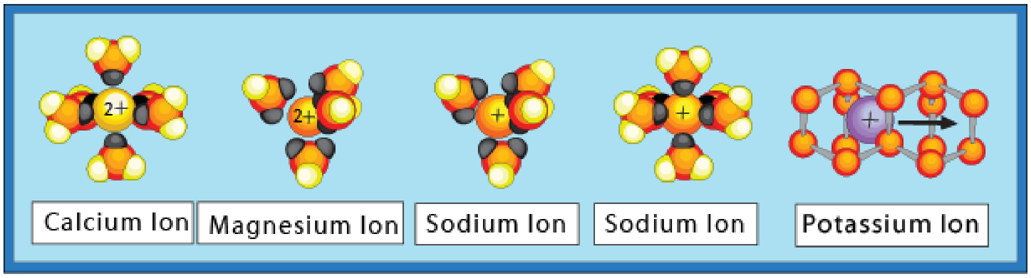
IONS AND LIVING CELLS

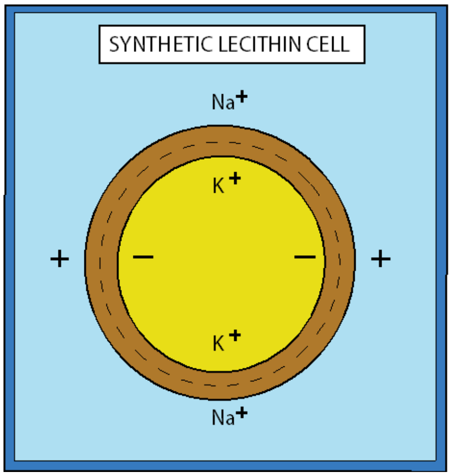
Ions

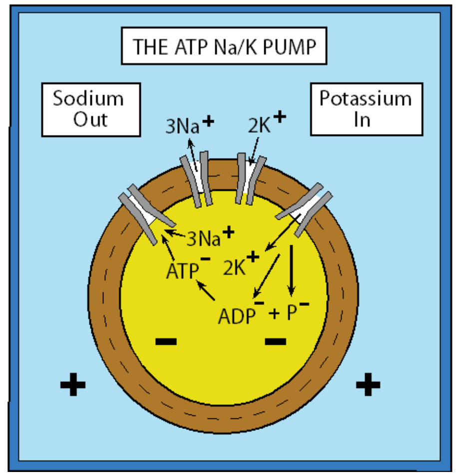


In developing functional cellular systems, nature took full advantage, not only of the spatial linear-bonding properties of water, but of the hydration properties of ions as well.[30] Calcium ions, with their two positive charges, tightly bind six water molecules around them with multiple layers of water molecules around them in spherical forms. Magnesium ion, which is smaller, can accommodate only four. Sodium ion, with its single positive charge, binds either four or six water molecules, depending on the environment, with additional loosely-bound spherical layers of water around them. Potassium ion, which is slightly larger, has eight more electrons circling its positively-charged nucleus. Its nuclear charge is so shielded by electrons that, as mentioned before, it does not bind water molecules – in liquid water it simply forms transient associations as it passes. Sodium ions, with circular spheres of water around them, are excluded from ice while potassium ions pass freely through the lattice.[4]

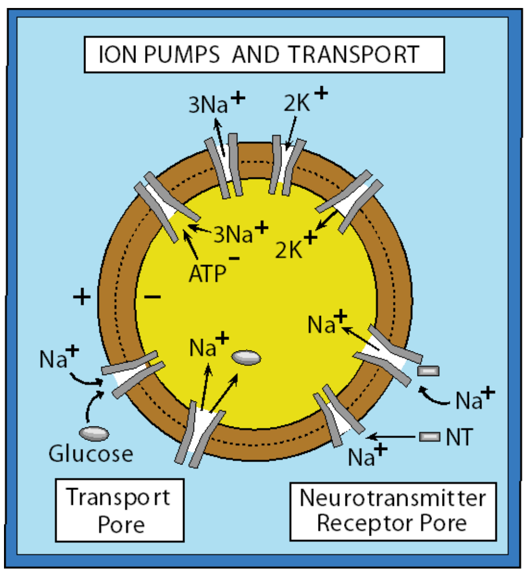
Thus, potassium ions played a critical role in the development of a functional cellular world. Unlike sodium and calcium ions, they do not carry circularly-structured water molecules with them - they move rapidly, breaking up coordinated clusters and increasing the freedom of water so it can assume kinetically-produced linear linear covalent structuring adjacent to surfaces – it penetrates cavities in proteins to relax and form transient bridges between polar and ionic atoms.[23] Sodium ions, on the other hand, dehydrate proteins - they draw water away from surfaces to form their own thermodynamic spheres of hydration. In fact, it was this fundamental difference in hydration properties between sodium and potassium ions which provided a mechanism for the development of living cells.[21] If the phospholipid **lecithin** is mixed with water containing sodium and potassium ions at the same levels as they are in living cells, small synthetic cells are produced.[69] If, now, the levels of ions are measured, potassium ion is found to be slightly higher inside than expected - sodium is slightly higher outside and the cell has a slight negative charge. Many explanations have been presented for this phenomenon but the most reasonable one is that potassium ions accumulate inside to increase hydration freedom in the enclosure space.

Ion Pumps and Living Cells



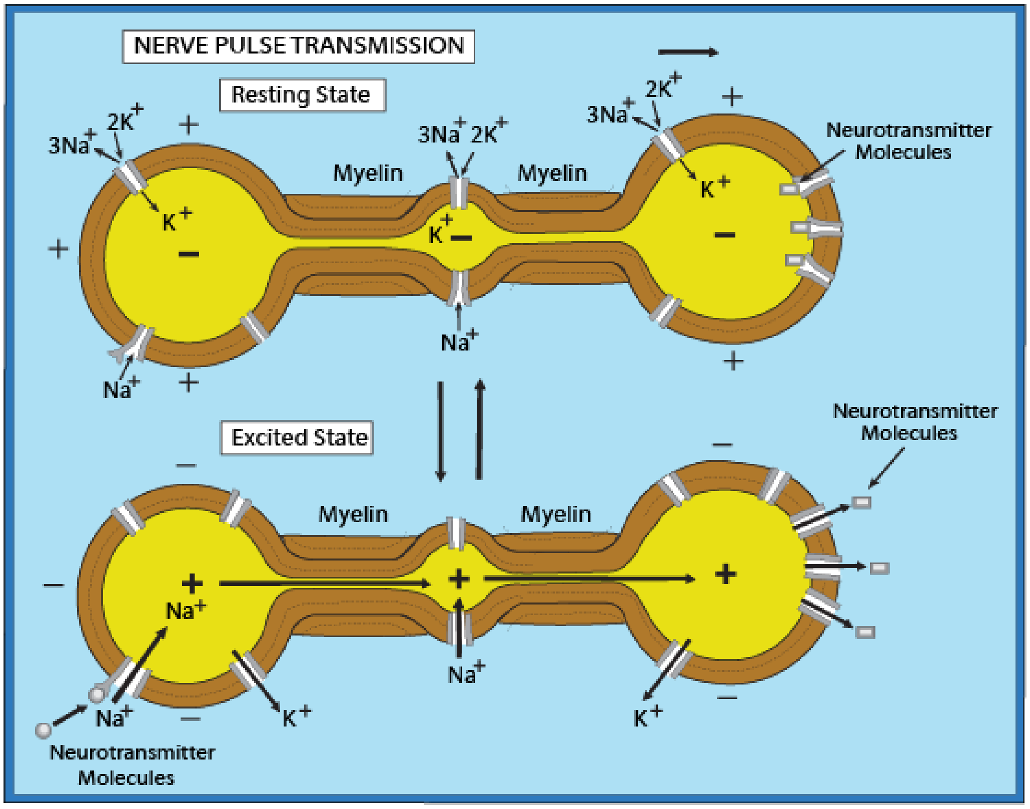


To amplify this natural distribution of ions, membranal proteins developed which could bind an ATP molecule and 3 sodium ions on the inner surface of a pore and, by hydrolyzing the ATP molecule, invert the protein, propel the sodium ions out of the cell, selectively bind two larger potassium ions and bring them in. Of course, as increasing numbers of these two ions were pumped in opposite directions, charge potentials across membranes increased and cells were turned into miniature batteries.



One way this trans-membrane potential was used, was to perform "work" for the cell, Neutral uncharged molecules, like glucose, were bound to a sodium ions in transport pores on the outside of a cell and, as the positively-charged sodium ions were drawn into cells by the negative charge inside, the neutral molecules were brought in with them.[71] By producing transport proteins for selective molecules and ions, cells could control which molecules could enter and which ones could be released.

Nerve Cells



However, ATP energy was also used to communicate. In **Nerve Cells**, sodium ions, once again, are pumped out but, this time, pores of the type described above remained closed. Movement of sodium back into the cell is blocked. As ATP pumps continue to run, a high potential is reached across the membrane. In this highly-charged "**Resting State**," potassium ions inside permit water to penetrate and linearize surfaces - proteins hydrate, linearize and relax. Pores, which bind sodium ions on the outside, open only when specific transmitter molecules bind to receptor sites on outer surfaces. Once pores opened, sodium ions would rush in, polarity is reversed and potassium ions rush out and down the nerve cell – the internal environment changes completely. Sodium ions displace calcium ions from their binding sites, proteins dehydrate and change their shape and function and enzymes are turned on and off.

In this **"Excited State"** potassium ions rush through arms in the verve cells to carry the positive pule to opposite ends where neurotransmitters of the same or different type are released to carry the pulse to neighboring nerve cells and muscles. However, in long myelinated nerve fibers, positive sodium ion discharges in the nerve ending initiate the formation of positive pulses pass which pass through the myelinated axon arm at extremely high speeds to initiate sodium-discharge in a node to amplify the pulse. But, only if the discharge was high enough, positive pulse conduced down the axon. In other words, a positive threshold must be reached before conduction will occur – pulse conduction through the axon is like the on/off passage of electrons through a vacuum cathode ray tube.[21]

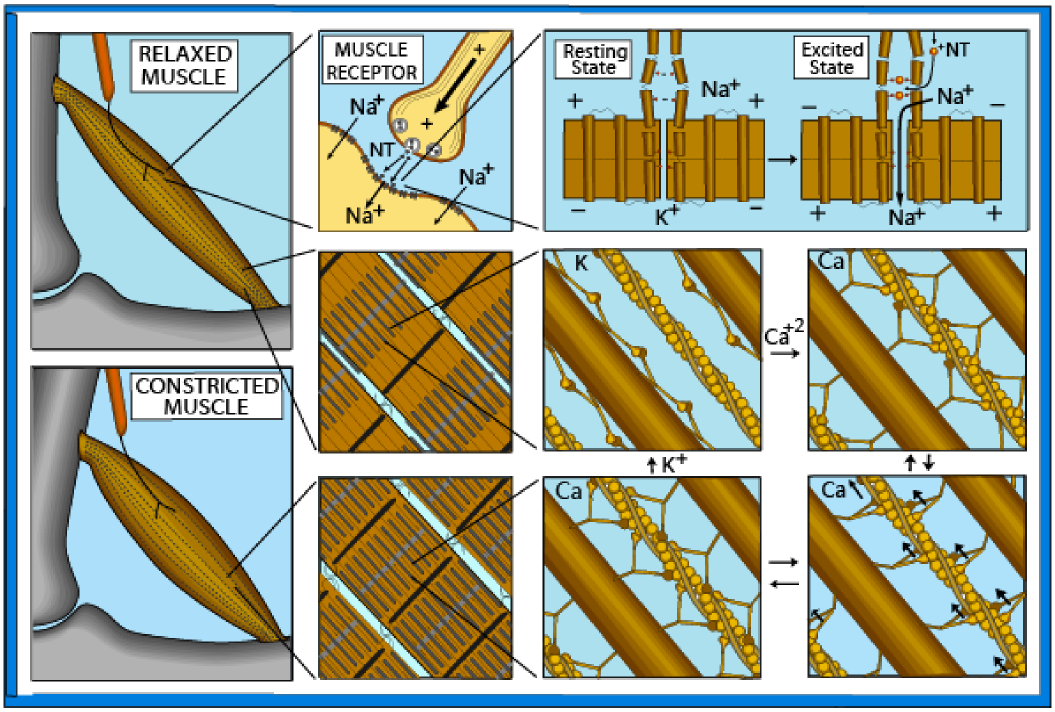
Currently, there is a debate as to how the pulse is conducted through the axon. However, if we look closely at the inner surface of the axonal membrane, we find that nature took full advantage of the fact that the amino-phosphate head-groups on the lecithin/cholesterol complexes along the inner membrane walls are precisely the same distances apart as the covalent dielectric linear hydration trimers which form on the surface. If the positive potential generated at the nerve ending is high enough, water molecules transiently align parallel to the axon along the inner walls and permit positive proton pulses to pass by tunneling through the linearly-ordered surface water at extremely high speeds to nodes and then to the nerve ending. It appears that early nerve cells altered their construction in such a manner that discharges could carried long distances extremely high speeds using protons rather than potassium ions to carry the charge.

Based on the TLH hypothesis, it is the dynamic linearizing property of water along the inner walls of axons which permits nerve cells to communicate between ends and nodes at extremely rapid rates with little or no movement of molecules and minimal loss of energy. In fact, proton transmission is so much more efficient than electron transmission that, if our nerves were composed of metal, we would be combusted by the resistance.

It is important to realize that most communication in our bodies is not performed by electrons but by ions and protons - protons which require water, not metal or solid-state systems, as the media of transport.[21,29] In the **Age of Biotechnology** which is to come, photosynthetic systems of plants will be produced by genetic engineering and provide far more efficient conversion of sunlight into electrical energy. Membrane systems of the electric eel will be used to store high voltage potentials and electrolysis of water into hydrogen and oxygen will be used to store energy. Proton-driven molecular motors and mechanical systems which assemble spontaneously will be used to perform all sorts of medical and nanotechnology tasks.

Muscle Cells

If we continue to follow the neurotransmitter signals of nerves to muscle cells, it is the same type of ATP-powered sodium/potassium pumps which generate high trans-membrane potentials and high levels of intracellular potassium in their **Resting States**.[21,70]



Muscle proteins in their **Resting States** are highly hydrated and relaxed with ATP molecules bound to the protein feet on protein legs bound to large myosin fibers ready to transfer phosphate groups and provide the power for contraction. Calcium ions, which trigger contractions, are stored in sites nearby. When neurotransmitters like acetyl choline trigger the entry of sodium, the character of internal water and molecules change completely. In the **Excited State**, calcium is displaced from its binding sites by sodium, proteins dehydrate and change their shape, calcium triggers the legs to move away from the myosin fibers and, as soon as the feet touch helical beads on thin actin fibers, ATP molecules hydrolyze, release directional energy and swivel the feet around driving actin fibers and end-plates attached to them together. As millions of protein feet draw millions of actin fibers into millions of the large myosin fibers, muscles contract. When neurotransmitter stimulation stops and sodium is pumped out by ATP pumps, muscle cells once again move from their **Excited** to **Resting** states. As potassium ions are pumped in, internal water changes from its ridged excited state, with water thermodynamically-bound spherically around sodium and calcium ions, to a relaxed state with water kinetically forming transient linear elements adjacent to surfaces and potassium ions moving into confined spaces to move water from order toward disorder. The kinetic linearizing property of water produced by potassium ions permits cells to relax, position ATP molecules and feet in proper positions, ready for the next contractive event.

It is incredible to realize that the molecular parts of the living cell not only wrap, assemble and function spontaneously but that ingenious molecular machines appear to have developed spontaneously to perform these functions. Each cell regulates the amount of water within it to coordinate its functions – too much water and efficiency fails, too little and functions slow – if systems are dehydrated and free water is lost, functions are arrested – only to be resumed when the proper amount of free water and transient linear elements of hydration form again.

Although we have attempted to explain how some of the systems might have developed in a spontaneous manner based on the TLH hypothesis, yet, they are so efficient, so beautiful and so rational, that one has to ask: **“What Kind of a Mind must have produced this Work of Art?”** And, indeed, it is a **Work of Art**! - Art composed in a medium which provided the rules for the strokes, for the blending of colors and for the placement of pieces of the puzzle. And, indeed, a puzzle it will always be! We may have words and symbols to communicate and speculate about the puzzle, but we will never have the words to explain the mystery of how it all began and how we are able to be aware of it.