

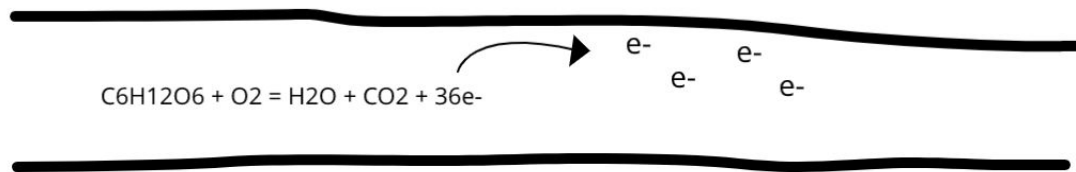
The reverse of photosynthesis as a source for electric currents in neurons

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The brain consumes around 120g glucose per day. That is 0.66 mole, 4×10^{23} molecules. Each molecule releases 36 electrons, so, 1.4308606×10^{25} electrons released per day, $(1.4308606 \times 10^{25} / 86400) = 1.6560887 \times 10^{20}$ electrons per second. $(1.6560887 \times 10^{20} / (6.22 \times 10^{18})) = 26$ ampere. Assuming 100 billion neurons, 26×10^{-11} ampere per neuron, 0.26 nanoamperes, 260 picoampere.

Seems like a possible source for electric current in axons, accounting for why myelin insulation is beneficial, to limit signal decay from leakage of electrons.



The "action potential"

The electrolytes are carriers of electric current, they are not electric current in themselves. Cations like K^+ can accept an electron, then pass it onto another K^+ ion. This lets the electron current flow down the axon. The detachment of potassium ions adsorbed onto protein carboxyl groups (Moore and Roaf, 1908; Ernst and Scheffer, 1928; Ling, 1952) in the resting state is triggered by the electron current, and, it is this increase in conductivity of the protoplasm that carries the current. Besides passing electrons forward and performing "electron transport", K^+ ions also flow out of the axon following their concentration gradient, Na^+ ions flow into the axon along its concentration gradient, and hydronium ions flow into the axon following its osmotic potential (Pollack, 2009), generating the measurable shift in voltage between the extracellular and intracellular medium that has been the subject of intense study since the 1950s.

Nerve impulses are continuous discharges

Axons are electrical wires with the special property that the signal can be "boosted" continuously along the length of the wire. Therefore, it does not have to put in all amperage at once. This property gives nerve impulses low signal decay, because of how losses relate to amperage non-linearly. The signal decays with $I^2 R$, and, R relates linearly to the length of the wire ($R = L / A$, where A is cross-sectional area of the wire.) Dividing the current into two segments, by cutting the length either "boost" has to traverse in half, reduces losses 4-fold, $(I/2)^2 = I^2/4$. More generally, following the same principle, cutting the axon into n segments reduces losses with n^2 . The unique ability of axons to generate electrons at any point along their length, from combustion of glucose in oxygen, both provided in blood from vasa nervorum, lets the central nervous system operate at low amperages. This continuous combustion is not that unlike a bomb fuze allowing action at a distance.

References

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