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REVIEW ARTICLE

A CLOSED NINE-STEPPED CYCLE OF PROTON CONDUCTANCE UNIFIES CELLULAR BIOENERGETICS AND SYSTEMIC PHYSIOLOGY

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ABSTRACT

For more than half a century, proton flow in biology has been treated as a partial process confined to mitochondria. Here we describe a closed nine-stepped cycle of proton conductance that completes this picture by uniting intracellular bioenergetics with systemic physiology. The Ambaga Closed 9-Stepped Cycle tracks every proton and electron from food-derived hydrogen through mitochondrial redox reactions, serum buffering, erythrocyte carbonic exchange, and pulmonary - tissue oxygen substitution, returning the same protons to the next metabolic turn. This continuity fulfills complete proton bookkeeping and integrates the chemiosmotic theory of Mitchell, the binding-change model of Boyer, and the ATP-synthase structure of Walker into a single self-consistent system. The cycle predicts measurable redox-potential transitions (alpha,betta, gamma membrane states) and isotopic proton conservation across compartments. These findings establish a unified framework for energy metabolism, oxygen transport, and soft-drug activation, redefining the proton as the central quantized currency of life.

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INTRODUCTION

Energy transformation is the most fundamental and yet incomplete story in biology. While classical bioenergetic theories - Krebs's cycle, Mitchell's chemiosmotic mechanism, and Boyer and Walker's ATP-synthase models - have revolutionized understanding of oxidative phosphorylation, they leave a conceptual gap: the fate of protons and electrons after mitochondrial ATP synthesis remains unclosed. All known metabolic reactions begin with food-derived hydrogen (CHO → NADH, $FADH_2$), but their proton and electron equivalents are only partly tracked to oxygen reduction. What happens beyond the mitochondrial membrane - how these protons reappear in systemic buffering, oxygen transport, and cellular renewal - has not been explicitly described. The Ambaga Closed 9-Stepped Cycle of Proton Conductance (C9SCPC) was proposed to fill this missing continuity.
It represents the first complete proton bookkeeping model, linking the micro-scale of mitochondrial membranes with the macro-scale of erythrocyte and pulmonary exchange. Each of its nine stages corresponds to an experimentally traceable process governed by membrane redox potential and electrophile - nucleophile complementarity. The C9SCPC asserts that life operates as a closed quantum-biological circuit in which protons and electrons circulate without loss:

- Originating from food molecules
- Transformed through enzymatic and redox potentials
- Equilibrated through bicarbonate buffering and hemoglobin chemistry
- Re-absorbed through oxygen uptake

And returned to mitochondria to begin the next cycle. This closed continuity restores thermodynamic and stoichiometric balance to biological energy accounting and offers a system-wide understanding of oxygen-dependent metabolism.

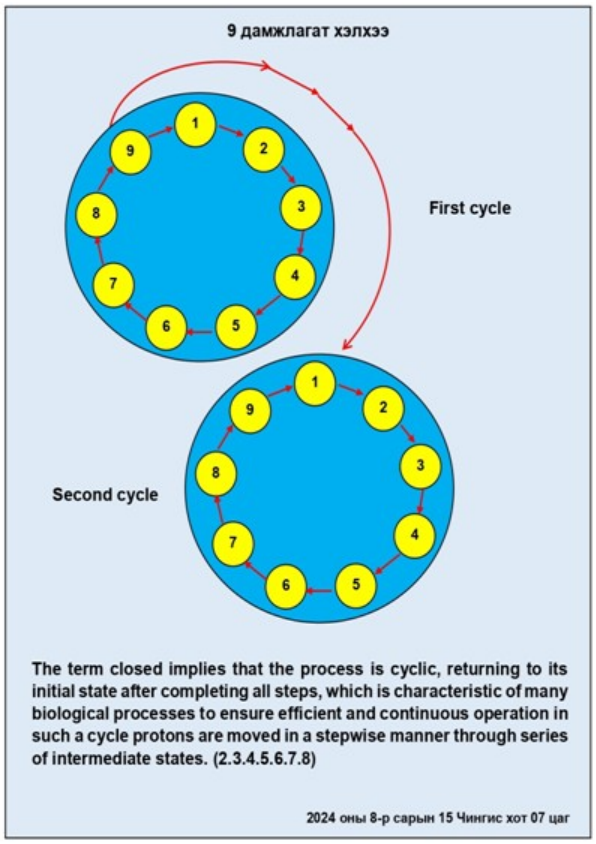
METHODS AND DATA

We used the Model validation, membrane redox potential imaging, Data visualizations.

RESULTS

The chemiosmotic theory (Mitchell, 1961) introduced the concept that a transmembrane proton gradient drives ATP formation. Yet this theory treated proton flow as open-from matrix to intermembrane space - without considering the systemic return path.

Boyer's binding-change model (1977) and Walker's structural elucidation (1997) explained the conformational mechanics of ATP synthase but similarly remained within mitochondrial boundaries. In contrast, the our cycle expands proton dynamics into nine stages that together form a continuous loop, transforming an open, local model into a closed, global system. This extension aligns mitochondrial, serum, erythrocytic, pulmonary, and tissue processes into a single quantitative equation:



Three Versions of the Closed 9-Stepped Cycle of Proton Conductance

Version 1 – Fully Detailed Version (Each Stage Shown Separately)

Food → Donor (CHO) and Metabolic Intermediates. Carbohydrates, fats, and amino acids are broken down into acetyl-CoA and Krebs cycle intermediates. Hydrogen Atom Splitting (NADH, $FADH_2$ Formation). Protons (H^+) and electrons (e^-) are released from hydrogen atoms through NADH/$FADH_2$ formation.

Stage	Compartment	Key Process	Equivalent Phenomenon
1–5	Mitochondria	Donor oxidation → Membrane redox potential → ATP + Heat + H_2O + CO_2	Chemiosmotic + ATP synthase (Mitchell - Boyer - Walker)
6	Mitochondria → Serum	$CO_2 + H_2O \leftrightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$	Carbonic anhydrase buffering
7	Serum ↔ Erythrocyte	H^+ binds Hb; HCO_3^- exchange	Hamburger shift
8	Lung capillary	O_2 uptake via electrophilic substitution	Bohr/Haldane effects
9	Tissue capillary	O_2 release via nucleophilic substitution	Proton return to mitochondrial donors

Electron Transfer Chain Initiation. Electrons enter the mitochondrial inner membrane electron transport system, creating a proton gradient. Proton Pumping to the Intermembrane Space. Electrons reduce cytochrome complexes, while protons are pumped outward, building membrane potential. ATP and Heat Formation (Ambaga Equation Fulfilled). ADP + Pi + O_2 + H^+ → ATP + Heat + CO_2 + H_2O + Matrix H^+- energy is synthesized and balanced. CO_2 and Metabolic Water Exit from Mitochondria. CO_2 diffuses out and reacts with water under carbonic anhydrase to form carbonic acid (H_2CO_3).

Bicarbonate Formation and Hamburger Shift. H_2CO_3 dissociates into H^+ and HCO_3^-; bicarbonate moves into erythrocytes to maintain charge balance. Oxygen Uptake at Pulmonary Capillaries (Electrophilic Substitution). Oxygen binds Fe^{2+} in hemoglobin through electrophilic substitution at the lung–blood interface. Oxygen Release at Tissue Capillaries (Nucleophilic Substitution). Protons and CO_2 act as nucleophiles to release O_2 from hemoglobin; O_2 enters mitochondria to restart the next cycle.

Version 2 - Simplified Functional Representation

- Food Breakdown → Electron and Proton Donors
- Nutrients are transformed into hydrogen-carrying molecules (NADH, $FADH_2$).
- Mitochondrial Electron–Proton Separation
- Electrons move along the respiratory chain; protons are pumped to form the gradient.
- Energy Conversion (ATP + Heat + Water)
- Proton return through ATP synthase produces ATP and heat.
- CO_2 Transport and Blood Buffering
- CO_2 leaves mitochondria → forms HCO_3^- in serum → transported via erythrocytes.
- Systemic Oxygen Exchange
- O_2 uptake (lungs) and O_2 release (tissues) complete the closed proton-electron loop.

Version 3 – Integrated / Condensed Systemic Model

- **Stages 1–5:** Cellular / Mitochondrial Energy Production (Food → ATP → CO_2 + H_2O)
- **Stages 6–7:** Systemic CO_2 Conversion and Buffering (Carbonic Anhydrase + Hamburger Shift)
- **Stages 8–9:** Oxygen Exchange (O_2 Uptake + O_2 Release)

These three domains form one Closed Proton Conductance Cycle linking food, mitochondria, blood buffering, and oxygen exchange as a continuous system of energy and life.

Relation to Quantum Biology: Within this model, the Membrane Redox Potential Three-State Line System (α, β, γ) regulates proton conductance quantum-mechanically.

α-State: electrophilic; promotes oxygen attraction and water formation.
β-State: nucleophilic; supports electron donation and proton pumping.
γ-State: transitional equilibrium; acts as a synchronizer between α and β.

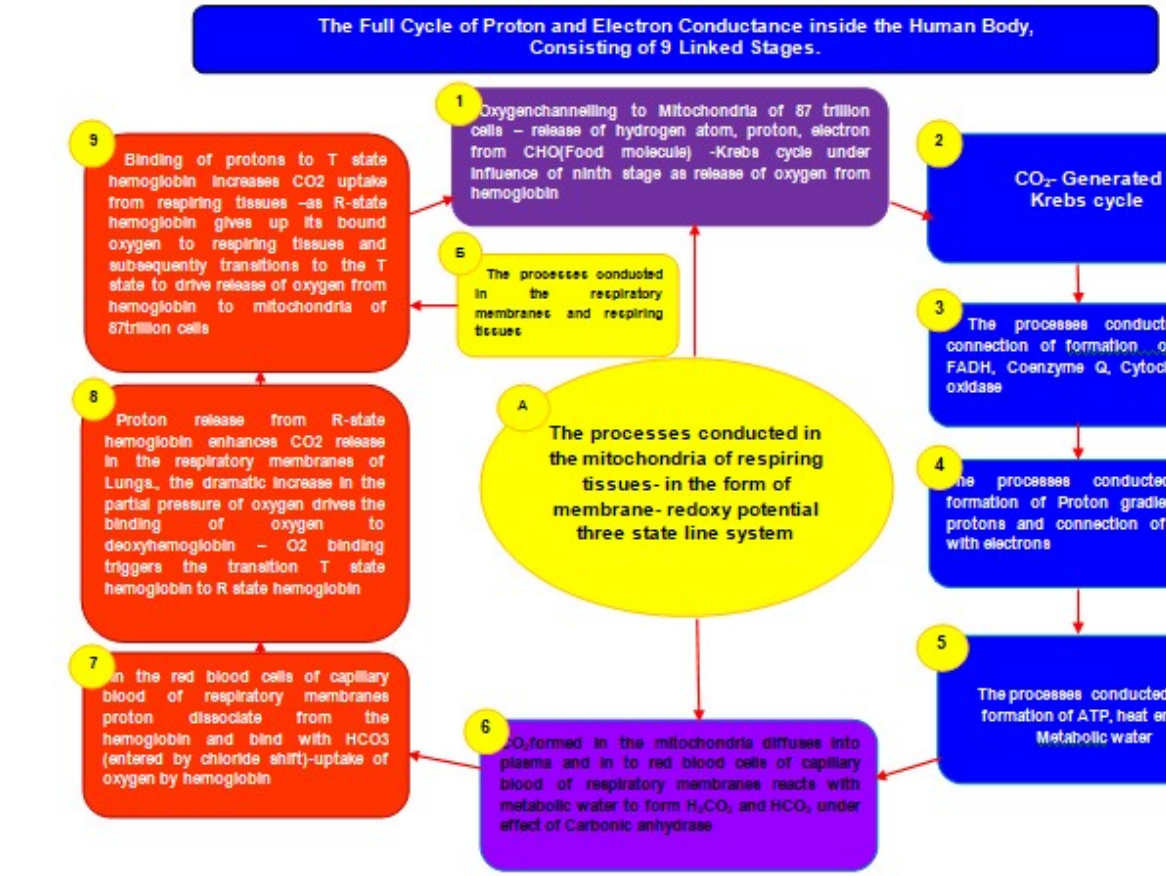
Philosophical and Methodological Context: Following Karl Popper's falsification principle, the Ambaga Cycle is not assumed true but tested by its failure to be disproved. If isotopic and redox experiments cannot break the predicted closure of proton bookkeeping, the cycle stands as a verified natural law. Moreover, the C9SCPC integrates classical and modern frameworks:

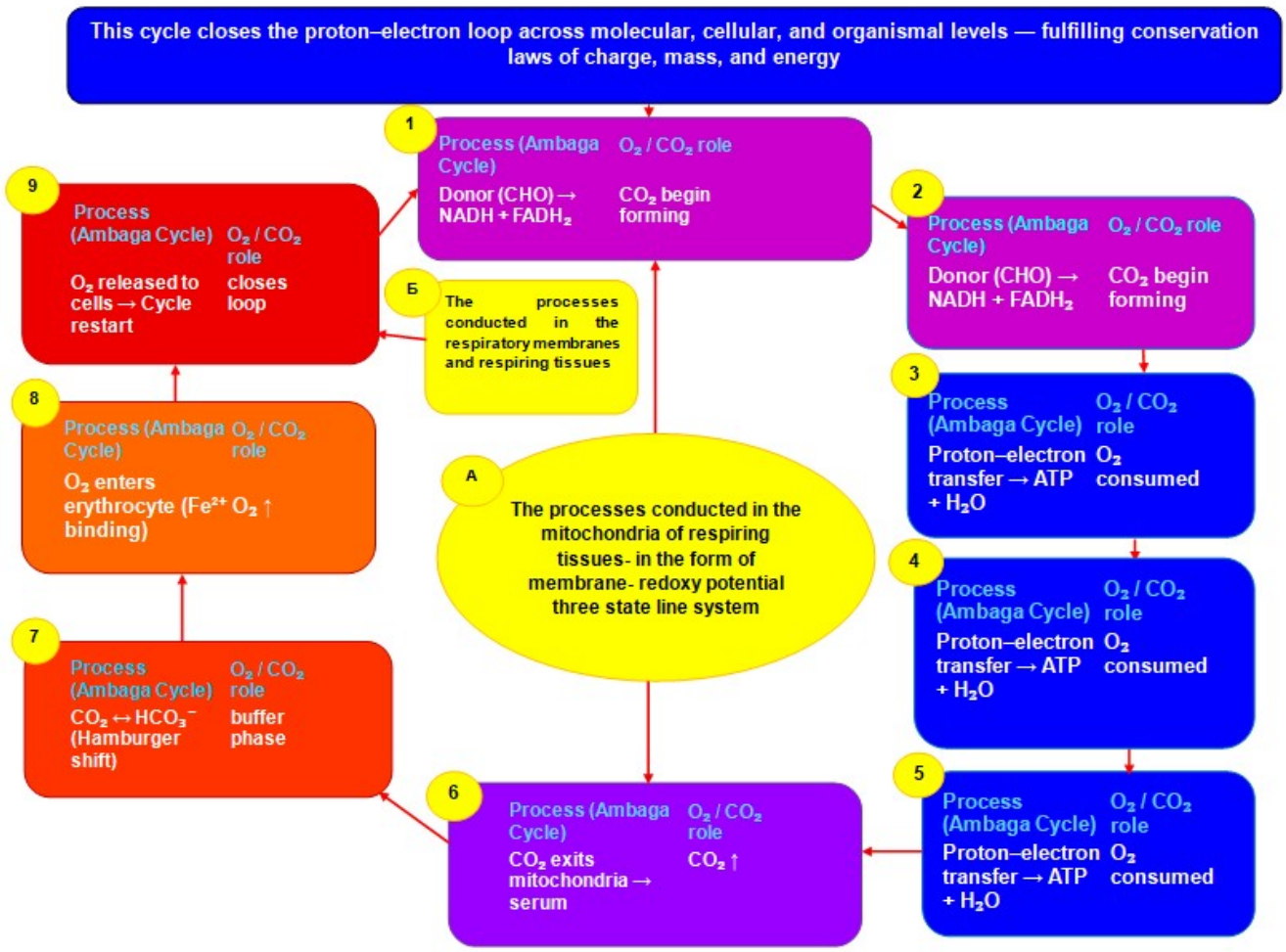
- Krebs Cycle: substrate oxidation (Stages 1–2).
- Mitchell: chemiosmotic proton gradient (Stages 3–5).
- Boyer/Walker: ATP formation mechanism (Stage 5).
- Ambaga: systemic proton return (Stages 6–9).

Thus, Ambaga's discovery does not reject earlier models; it fulfills them by providing closure and continuity across scales.

DISCUSSION

Quantitative proton bookkeeping: every proton released in Stage 2 reappears in Stage 9. Redox potential regulation: three-state membrane system governs α (electrophilic), β (nucleophilic), γ (equilibrium) transitions. Integration: situates Mitchell, Boyer, Walker, Lane theories as open segments within Ambaga's closed system. Pharmacological implications: activation of soft drugs within the same proton cycle. The Ambaga Closed 9-Stepped Cycle fulfills proton - electron conservation from molecule to organism. Provides the long-missing closure uniting biochemistry, physiology, and


The Full Cycle of Proton and Electron Conductance inside the Human Body, Consisting of 9 Linked Stages.
1
Oxygenchannelling to Mitochondria of 87 trillion cells – release of hydrogen atom, proton, electron from CHO(Food molecule) -Krebs cycle under influence of ninth stage as release of oxygen from hemoglobin
2
CO_2- Generated by Krebs cycle
3
The processes conducted with connection of formation of NADH, FADH, Coenzyme Q, Cytochrom C oxidase
4
The processes conducted with formation of Proton gradient from protons and connection of oxygen with electrons
5
The processes conducted with formation of ATP, heat energy, Metabolic water
6
CO_2 formed in the mitochondria diffuses into plasma and in to red blood cells of capillary blood of respiratory membranes reacts with metabolic water to form H_2CO_3 and HCO_3 under effect of Carbonic anhydrase
7
In the red blood cells of capillary blood of respiratory membranes proton dissociate from the hemoglobin and bind with HCO3 (entered by chloride shift)-uptake of oxygen by hemoglobin
8
Proton release from R-state hemoglobin enhances CO2 release in the respiratory membranes of Lungs., the dramatic increase in the partial pressure of oxygen drives the binding of oxygen to deoxyhemoglobin – O2 binding triggers the transition T state hemoglobin to R state hemoglobin
9
Binding of protons to T state hemoglobin increases CO2 uptake from respiring tissues –as R-state hemoglobin gives up its bound oxygen to respiring tissues and subsequently transitions to the T state to drive release of oxygen from hemoglobin to mitochondria of 87trillion cells
A
The processes conducted in the mitochondria of respiring tissues- in the form of membrane- redoxy potential three state line system
Б
The processes conducted in the respiratory membranes and respiring tissues


This cycle closes the proton–electron loop across molecular, cellular, and organismal levels — fulfilling conservation laws of charge, mass, and energy
1
Process (Ambaga Cycle) O_2 / CO_2 role
Donor (CHO) → NADH + $FADH_2$ CO_2 begin forming
2
Process (Ambaga Cycle) O_2 / CO_2 role
Donor (CHO) → NADH + $FADH_2$ CO_2 begin forming
3
Process (Ambaga Cycle) O_2 / CO_2 role
Proton–electron transfer → ATP + H_2O O_2 consumed
4
Process (Ambaga Cycle) O_2 / CO_2 role
Proton–electron transfer → ATP + H_2O O_2 consumed
5
Process (Ambaga Cycle) O_2 / CO_2 role
Proton–electron transfer → ATP + H_2O O_2 consumed
6
Process (Ambaga Cycle) O_2 / CO_2 role
CO_2 exits mitochondria → serum CO_2 ↑
7
Process (Ambaga Cycle) O_2 / CO_2 role
$CO_2 \leftrightarrow HCO_3^-$ (Hamburger shift) buffer phase
8
Process (Ambaga Cycle) O_2 / CO_2 role
O_2 enters erythrocyte (Fe^{2+} O_2 ↑ binding)
9
Process (Ambaga Cycle) O_2 / CO_2 role
O_2 released to cells → Cycle restart closes loop
A
The processes conducted in the mitochondria of respiring tissues- in the form of membrane- redoxy potential three state line system
Б
The processes conducted in the respiratory membranes and respiring tissues

quantum bioenergetics. Offers a new metric for evaluating metabolism, disease, and drug action. Defines proton-based unification of chemistry and biology. May serve as framework for next-generation pharmacology (AmbagaBiotargeting). Opens a "Tree of Proton-Dependent Theories" ending in systemic closure.

Summarize the key novelty: Classical bioenergetics accounts for partial proton flow (up to mitochondrial chemiosmosis). The Ambaga model completes proton bookkeeping, linking mitochondrial, erythrocytic, and systemic oxygen exchange. Demonstrates continuity of proton–electron dynamics through nine linked stages, each experimentally traceable. Integrates Mitchell, Boyer, and Walker theories within a closed, conservative system. Predicts measurable physiological variables (pH buffering, O_2/CO_2 exchange ratios, isotopic H^+ tracing). Implications: fundamental for metabolism, pharmacology, and biomedicine.

REFERENCES

Ambaga M, Tumen-Ulzii A. 2016. Integrated NCM medicine with s-NCM new knowledge, lambert Academic Publishing.

Ambaga M, Tumen-Ulzii A. 2015. The life become dependent from the presence of electrons and protons, which were formed during events called big bang 15 billion years ago, electrons and protons sets the stage for formation of life in the universe

Ambaga M. 2016. The Full Cycle of Proton and Electron Conductance inside the Human Body, Consisting of 9 Linked Stages. *Acad. J. Sci. Res.,* 4(6): 127-131.

Ambaga M. 2016. A new suggestionabout existing of membrane - redoxy potential three state line system between donators and acceptors inside the living cells, *Asian Journal of Science and Technology,* Vol.07, Issue,07,pp.3157-3161.

Ambaga M. 2016. The buffering capacity of erythrocyte membrane surroundings in relation to free protons, formed in the Full Cycle of Proton and Electron Conductance inside the Human Body. *International Journal of Development Research,*Vol 06, Issue, 07, pp. 8458-8461.

Ambaga M. 2016. The Full Cycle of Proton and Electron Conductance inside the Human Body and triple Rlung, Mkhris, Badgan theory of Tibetian Traditional medicine, *International Journal of Current Research,* Vol 8, Issue 08, p.36391-36393.

Ambaga M. 2016. The possibility to drive the membrane - redox potential, a three state line system dependent-full 9 stepped cycle of proton conductance inside human body to favorable directionduring pathological situations.,*International Journal of Current Research,* Vol, Issue, 11, pp 42456-42459, November.

Ambaga M. 2017. The membrane-redox potentials three-state line system dependent -full 9 stepped cycle of proton conductance and the evolution based biological mechanism of oxygen utilization –ATP making bioenergy systems, *World Journal of Scientific Research and Review,* 2017.vol.5,№ 3,march,pp.8-13.

Ambaga M. 2017. The membrane-redox potentials three-state line system dependent -full 9 stepped cycle of proton conductance and the evolution based biological mechanism of organ formation, *World Journal of Scientific Research and Review,* vol.5,№ 3,march,pp.1-7.

Ambaga M. 2017. The membrane-redox potentials three-state line system dependent -full 9 stepped cycle of proton conductance as the universal metabolic formula and the development of all medical thinking during last 3000 years, *Asian Journal of Science and technology,* vol.08,Issue,03,pp.4485-4488, March,

Ambaga M. 2017. The full 9 stepped cycle of proton conductance and the two basic electron, proton dependent metabolic reaction system of obtaining of ATP, *Applied Science and innovative Research,* vol.1,No 1,pp 63-68 .

Ambaga M. 2017. The bioevolution link between the two basic electron, proton dependent metabolic reaction systems of obtaining of ATP, *International Journal of Current Research,* vol 9,issue 06,pp.52182-52185.

Ambaga M. 2017. The genome size and the two basic electron,proton dependent metabolic reaction systems of obtaining of ATP, *International Journal of Current Research,* vol 9,issue 06,pp.52771-52774.

Ambaga M, Tumen-Ulzii A,2017. The full 9 stepped cycle of proton conductanceand antispiral-like evolutionary back steps from second late evolution time equation to first early evolution time equation during some pathology, *International Journal of Current Research,* vol 9,issue 07,pp.54969-54972.

Ambaga M,Tumen-Ulzii A,2017. The full 9 stepped cycle of proton conductanceand the formation of three zones with various degree of disturbances of clockwise normal flow of electrons and protons during shortage of donators and acceptors- *Asian Journal of Science and technology,* vol.08,Issue,08,pp.5346-5349,

Ambaga M,Tumen-Ulzii A,Byuantushig, T, 2024 . The System models of Human body, Lambert

Ambaga M,Tumen-Ulzii A,Byuantushig, T, 2024, The molecular mechanism of the the membrane redoxy potential : a three state dependency closed 9-step stepped cycle of proton conductance, Asian Journal of Science and technology, vol.15,Issue,07,pp.13067 -13070.

Boyer, P. D. "Energy Capture and Use in Plants and Bacteria. Final Technical Report", University of California Los Angeles. UCLA), United States Department of Energy,. December 31, 1993)

Harpers Biochemistry-Twenty second Edition

Kulan Ts, Ambaga M, Chimedragchaa Ch, 2016, Effect of Honey Bee venom (Apis melilifera) on Hyperglycemia and Hyperlipidemia in Alloxan induced Diabetic Rabbits, Journal of Diabetes and Metabolism, v.6, p.507

Nick Lane, and William F. Martin. 2012. The origin of membrane bioenergetics J.cell, http://dx.doi.org/10.1016/ j.cell.2012.11.050.

Nick Lane, The vital question. Energy, Evolution and the origins of Complex life) https://en.wikipedia.org/wiki/ Biosphere

Rubin, E.farber J.L. Essential pathology , second edition

Víctor Sojo, Andrew Pomiankowski, Nick Lane, 2014. A Bioenergetic Basis for Membrane Divergence in Archaea and Bacteria, Published: August 12, 2014, http://dx.doi.org/10.1371/journal.pbio.1001926

Walker, J. E.; Saraste, M; Runswick, M. J.; Gay, N. J. 1982. "Distantly related sequences in the alpha- and beta-subunits of ATP synthase, myosin, kinases and other ATP-requiring enzymes and a common nucleotide binding fold". *The EMBO Journal,* 1(8): 945–51. doi:10.1002/j.1460-2075.1982.tb01276.x. PMC 553140. PMID 6329717

https://en.wikipedia.org/wiki/Thermogenesis

https://en.wikipedia.org/wiki/Glycolysis

https://en.wikipedia.org/wiki/Brown_adipose_tissue

https://www.biologydiscussion.com/biochemistry/lipids-biochemistry/oxidation-of-fatty-acids-biochemistry/72756

https://en.wikipedia.org/wiki/Adenosine_triphosphate

https://en.wikipedia.org/wiki/Bohr_effect

https://en.wikipedia.org/wiki/Haldane_effect

https://en.wikipedia.org/wiki/Pulmonary_circulation

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