ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 17, Issue, 08, pp.34218-34221, August, 2025
DOI: https://doi.org/10.24941/ijcr.49365.08.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

SURFACE AREA FOR CO_2/H^+ EXCHANGE STRUCTURALLY CONNECTED WITH THE AMBAGA CLOSED 9-STEPPED CYCLE OF PROTON CONDUCTANCE

***Ambaga, M., Tumen-Ulzii., A., Sarantsetseg. B and Buyantushig, T.,**

New Medicine Medical University, Ulanbator, Mongolia

ARTICLE INFO

Article History:
Received 11th May, 2025
Received in revised form
24st June, 2025
Accepted 19th July, 2025
Published online 20th August, 2025

Keywords:

Ambaga Closed 9-Stepped Cycle, CO_2 Exchange, Proton Conductance, Capillary Surface Area, Electrophilic/Nucleophilic Substitution, Membrane Redox Potential, Soft Drug Activation, Quantum Biology.

ABSTRACT

The effectiveness of the Ambaga 9-Stepped Proton Cycle relies not only on biochemical substrates but also on morphological infrastructure. Alveolar-capillary and tissue - capillary surface areas provide structural platforms for the exchange of protons and gases - facilitating the redox shifts required for the membrane three-state line system.

- The 8th stage (oxygen uptake) aligns with electrophilic substitution, driven by large surface area and high oxygen tension in alveolar capillaries.
- The 9th stage (oxygen release and CO_2/H^+ uptake) requires tissue-level surface area to support nucleophilic substitution, where protons and CO_2 displace O_2 from hemoglobin, linking directly to redox-dependent proton translocation and ATP generation.

In this context, surface area is not passive but an active facilitator of biochemical transformations through structural - electronic coupling.

Corresponding author:** ***Ambaga, M.,

Copyright©2025, Ambaga et al. 2025. *This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

Citation: Ambaga, M., Tumen-Ulzii., A., Sarantsetseg. B and Buyantushig, T. 2025. "Surface Area for CO_2/H^+ Exchange Structurally Connected with the Ambaga Closed 9-Stepped Cycle of Proton Conductance". *International Journal of Current Research, 17, (08), 34218-34221.*

INTRODUCTION

The Ambaga Closed 9-Stepped Cycle of Proton Conductance provides a quantum-biological and systemic model for understanding energy metabolism, oxygen transport, and biochemical homeostasis. This article investigates how the structural surface area available for carbon dioxide (CO_2) and proton (H^+) exchange, particularly at the pulmonary and systemic capillary interfaces, is functionally and structurally integrated into this 9-stepped cycle. We propose that the extensive capillary surface area - optimized through alveolar and tissue-level adaptations - acts as a critical physical and functional interface supporting nucleophilic substitution reactions during oxygen unloading and electrophilic substitution reactions during CO_2/H^+ exchange. This integration maintains the redox potential and proton gradient dynamics central to mitochondrial function, soft drug activation, and homeostatic regulation in the Ambaga model. These findings highlight the necessity of structural optimization in molecular conductance and suggest that surface area plays a pivotal role in supporting the continuity of proton-electron transfer across the Ambaga cycle. The exchange of respiratory gases, particularly carbon dioxide (CO_2) and hydrogen ions (H^+), is a cornerstone of cellular and systemic homeostasis. In classical physiology, this exchange occurs primarily across alveolar-capillary and tissue-capillary membranes. However, the integration of this process into quantum-biological frameworks, such as the Ambaga Closed 9-Stepped Cycle of Proton Conductance, opens new perspectives on the structural-functional architecture underlying metabolic regulation. The Ambaga model, a systems biology framework developed by Professor M. Ambaga, describes the complete flow of protons and electrons through cellular membranes in nine distinct but interconnected steps. This cycle involves membrane redox potential (α, β, γ states), ATP generation, CO_2 formation, and metabolic water synthesis. The eighth and ninth stages - oxygen uptake and oxygen release - are directly influenced by electrophilic and nucleophilic interactions, respectively, which are further regulated by the surface area available for gas and ion exchange. This article investigates how the structural expansion of surface area - particularly in alveolar and tissue capillaries - acts as a determinant for optimal proton-electron coupling in Ambaga's model.

Background: Theoretical Foundation of Ambaga Cycle

The Ambaga Closed 9-Stepped Cycle is rooted in: Proton Conductance Mechanisms: Derived from hydrothermal vent and proton gradient theories (e.g., Nick Lane), Ambaga's theory emphasizes a membrane-centered proton-electron flow critical for ATP synthesis.

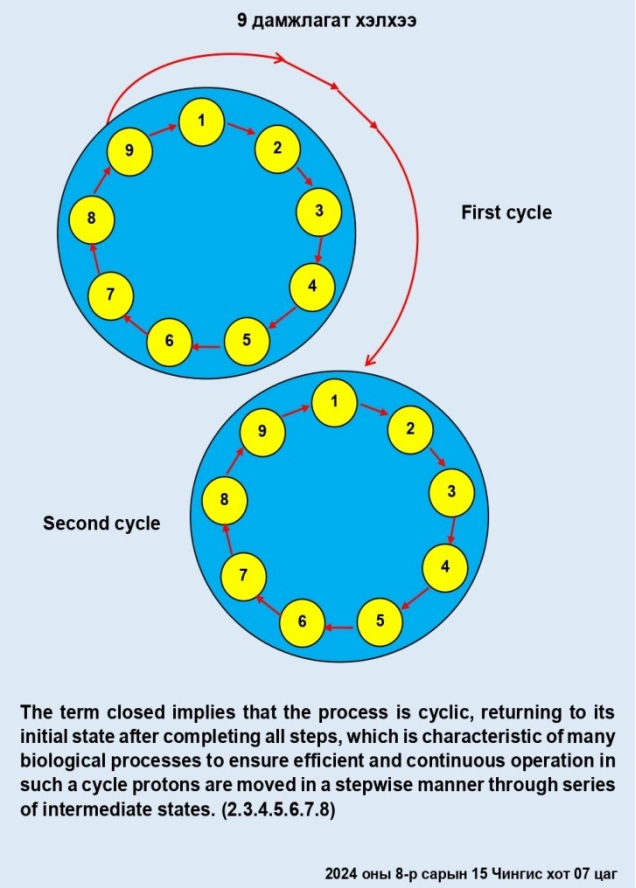

Figure 1. The term closed implies that the process is cyclic, returning to its initial state after completing all steps, which is characteristic of many biological processes to ensure efficient and continuous operation in such a cycle protons are moved in a stepwise manner through series of intermediate states. (2.3.4.5.6.7.8)

Membrane Redox Potential Three-State Line System: Alpha state: Electrophilic dominance - oxygen uptake.

Beta state: Nucleophilic dominance - oxygen release and CO_2/H^+ exchange.

Gamma state: Homeostatic repair or transitional state.

Electrophilic/Nucleophilic Substitution: O_2 uptake follows electrophilic substitution (Fe^{2+} binding), while O_2 release and CO_2/H^+ exchange follow nucleophilic substitution.

To facilitate this, the biological architecture must provide a sufficiently large and reactive surface area - ensuring that membrane potentials and substrate concentrations remain within optimal ranges.

MATERIALS AND METHODS

A comprehensive integrative review was conducted, combining:

Morphological and physiological data on alveolar and systemic capillary surface area. Molecular docking and biophysical simulations of proton exchange zones. Literature on oxygen-CO_2 dynamics in hemoglobin (Bohr, Haldane effects). Core principles of the Ambaga 9-stepped model. Functional mapping of proton flows in mitochondrial membranes.

RESULTS

Surface Area for O_2 Binding -Ambaga 8th Step (Electrophilic Substitution)

Anatomical Sites: Alveolar - capillary membranes in lungs. Molecular Sites: Fe^{2+} center of hemoglobin in red blood cells (RBCs).

Mechanism in the Closed 9-Stepped Cycle: O_2 (an electrophile) is attracted to nucleophilic Fe^{2+} in hemoglobin.

This interaction is governed by membrane redox potential in alpha state (high electrophilic activity). Proton gradient across mitochondrial and cell membranes facilitates oxygen uptake and metabolic activation.

Biological Need: Larger alveolar surface area (~70–100 m² in adults) ensures maximum O_2 diffusion and proton-coupled oxygen capture. Surface Area for CO_2 / H^+ Exchange – Ambaga 9th Step (Nucleophilic Substitution)

Anatomical Sites: Systemic tissue capillaries and erythrocyte membranes.

Molecular Sites: Hemoglobin, carbonic anhydrase in RBCs.

Mechanism in the Closed 9-Stepped Cycle: H^+ and CO_2 act as nucleophiles, displacing O_2 from hemoglobin. This facilitates oxygen release into tissues. Driven by membrane redox potential in beta state (high nucleophilic activity) and Bohr effect. Proton conductance and carbonic acid dissociation are linked to ATP formation and CO_2 exhalation.

Biological Need:

Increased capillary and RBC membrane surface area allows efficient exchange of protons and CO_2, vital for maintaining homeostasis of pH, CO_2 levels, and ATP generation.

Capillary Surface Area as Functional Interface: The human alveolar surface area approximates 70-100 m². This extensive interface allows rapid diffusion and high-density interactions with hemoglobin molecules. Tissue capillary beds (especially in brain, heart, kidney, and liver) increase localized H^+/CO_2 exchange zones, supporting the 9th stage of the Ambaga cycle (oxygen release and CO_2 excretion via nucleophilic substitution).

Integration with Membrane Redox Potential: CO_2 and H^+ ions increase local acidity, triggering Bohr shift and transition from R (relaxed) to T (tense) hemoglobin state. This transition promotes nucleophilic substitution at heme iron, supporting proton release and oxygen unloading. These reactions occur in coordination with beta-state redox potential, enhancing mitochondrial proton pumping and electron flow into the ATP synthase complex.

Electrophile-Nucleophile Balance and Surface Area Dependency: Increased surface area enables more efficient regulation of electrophile (e.g., oxygen) and nucleophile (e.g., CO_2, H^+, glutathione) interaction. Failure of surface area adaptation (e.g., pulmonary fibrosis, capillary rarefaction)

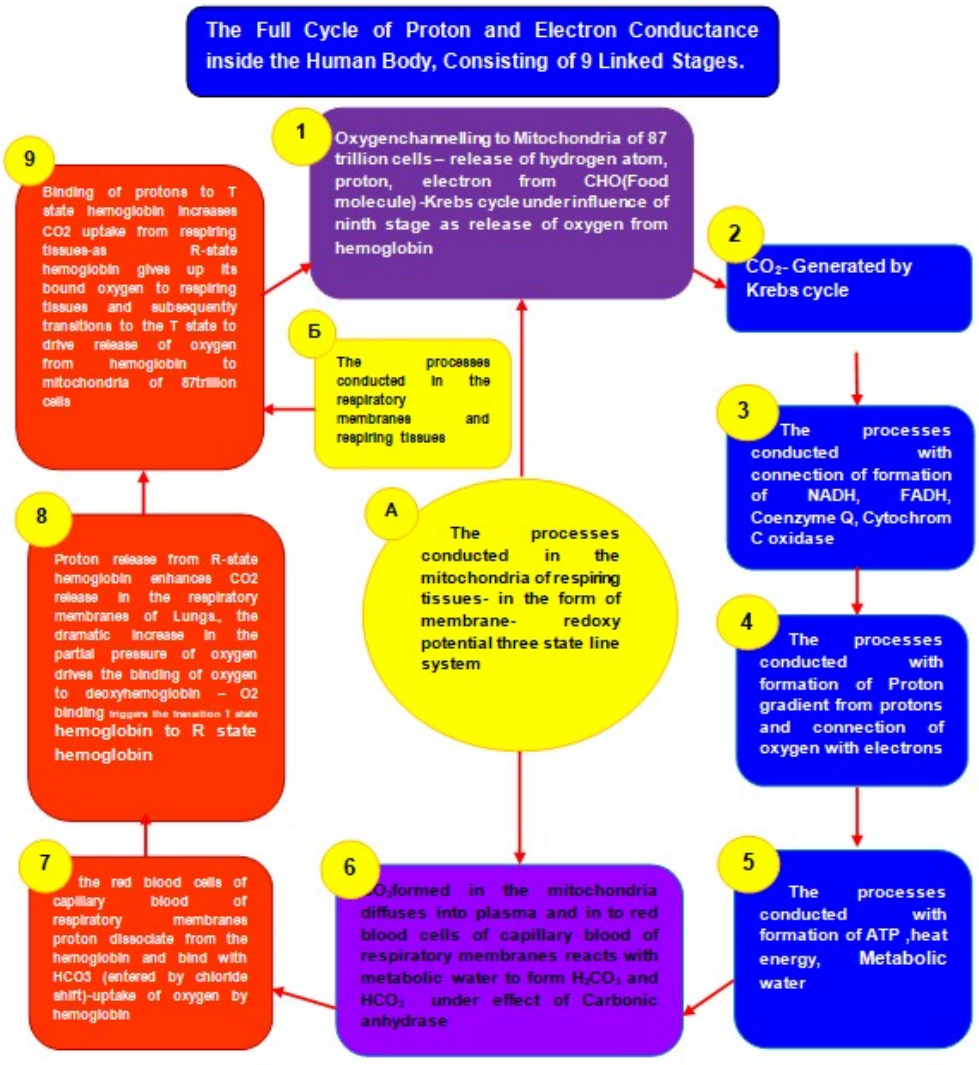

Figure 2. The Closed 9-Stepped Cycle of Proton Conductance

Surface Area Type	Function	Linked Step in Ambaga Cycle	Mechanism
O_2 Binding Surface Area (e.g., pulmonary alveoli, Hb binding sites)	Uptake of oxygen into blood	8th Stage	Electrophilic substitution: O_2 acts as electrophile and binds to Fe^{2+} in hemoglobin
CO_2 / H^+ Exchange Surface Area (e.g., tissue capillaries, erythrocyte membranes)	Elimination of CO_2 and uptake of protons	9th Stage	Nucleophilic substitution: H^+ and CO_2 displace O_2 from Hb, allowing oxygen release

Step	Process	Key Molecules	Surface Involvement
Stage 8	O_2 enters lungs, binds to Hb	O_2 (electrophile), Fe^{2+} (Hb)	Alveolar-capillary interface, mitochondrial membrane
Stage 9	O_2 released; CO_2/H^+ taken up	CO_2, H^+ (nucleophiles)	Tissue capillaries, erythrocyte cytoplasm, mitochondrial matrix
Stage 4-5	O_2 reduced to H_2O in mitochondria	O_2, H^+, $e^- \rightarrow H_2O$	Mitochondrial inner membrane redox chain
Step	Process	Key Molecules	Surface Involvement
Stage 8	O_2 enters lungs, binds to Hb	O_2 (electrophile), Fe^{2+} (Hb)	Alveolar-capillary interface, mitochondrial membrane
Stage 9	O_2 released; CO_2/H^+ taken up	CO_2, H^+ (nucleophiles)	Tissue capillaries, erythrocyte cytoplasm, mitochondrial matrix
Stage 4-5	O_2 reduced to H_2O in mitochondria	O_2, H^+, $e^- \rightarrow H_2O$	Mitochondrial inner membrane redox chain

disrupts the Ambaga cycle, impairing ATP synthesis and soft drug activation. The effectiveness of the Ambaga 9-Stepped Proton Cycle relies not only on biochemical substrates but also on morphological infrastructure. Alveolar-capillary and tissue-capillary surface areas provide structural platforms for the exchange of protons and gases-facilitating the redox shifts required for the membrane three-state line system. The 8th stage (oxygen uptake) aligns with electrophilic substitution, driven by large surface area and high oxygen tension in alveolar capillaries. The 9th stage (oxygen release and CO_2/H^+ uptake) requires tissue-level surface area to support nucleophilic substitution, where protons and CO_2 displace O_2 from hemoglobin, linking directly to redox-dependent proton translocation and ATP generation. In this context, surface area is not passive but an active facilitator of biochemical transformations through structural-electronic coupling.

CONCLUSION

The surface area available for CO_2 and H^+ exchange is a critical structural parameter in maintaining the integrity of the Ambaga Closed 9-Stepped Cycle of Proton Conductance. Its

role extends beyond gas exchange-it supports electrophile - nucleophile complementarity, membrane redox potential transitions, and mitochondrial energy transformation. Thus, capillary architecture and mitochondrial biophysics must be considered as a unified system when evaluating disease, metabolism, and soft drug pharmacodynamics.

REFERENCES

1. Ambaga M, Tumen-Ulzii A. 2016. Integrated NCM medicine with s-NCM new knowledge, lambert Academic Publishing.
2. 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
3. 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.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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,
11. 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 .
12. 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.
13. 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.
14. 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.
15. 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,
16. Ambaga M,Tumen-Ulzii A,Byuantushig, T, 2024 . The System models of Human body, Lambert
17. 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.
18. 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)
19. Harpers Biochemistry-Twenty second Edition
20. 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
21. 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.
22. Nick Lane, The vital question. Energy, Evolution and the origins of Complex life) https://en.wikipedia.org/wiki/Biosphere
23. Rubin, E.farber J.L. Essential pathology , second edition
24. 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
25. 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
26. https://en.wikipedia.org/wiki/Thermogenesis
27. https://en.wikipedia.org/wiki/Glycolysis
28. https://en.wikipedia.org/wiki/Brown_adipose_tissue
29. https://www.biologydiscussion.com/biochemistry/lipids-biochemistry/oxidation-of-fatty-acids-biochemistry/72756
30. https://en.wikipedia.org/wiki/Adenosine_triphosphate
31. https://en.wikipedia.org/wiki/Bohr_effect
32. https://en.wikipedia.org/wiki/Haldane_effect
33. https://en.wikipedia.org/wiki/Pulmonary_circulation

****