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# ELECTRIC CURRENT IN LIVING ORGANISMS

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## ABSTRACT

Bioelectrical activity is an intrinsic property of living organisms that reflects the dynamic interaction between ionic movements and cellular structures. Unlike artificial electrical systems, biological electrical processes are self-regulated and tightly integrated with metabolic and signaling pathways. This article examines the fundamental nature of electrical currents in living systems, emphasizing their role in cellular communication, functional coordination, and adaptive responses. Special focus is placed on how electrical signals contribute to the regulation of physiological stability and the integration of complex biological functions. The study also highlights the growing importance of bioelectricity in modern biomedical research and innovative therapeutic strategies.

**Keywords:** bioelectric processes, electrical signaling, ionic dynamics, membrane voltage, physiological regulation, cellular communication, adaptive mechanisms

## INTRODUCTION

The phenomenon of electrical activity in living organisms represents one of the most essential yet intricate aspects of biological function. At the cellular level, life is sustained not only through biochemical reactions but also through precisely controlled electrical processes. These processes arise from the movement of ions across selectively permeable membranes, creating voltage differences that serve as signals within and between cells. In higher organisms, electrical activity forms the basis of critical systems such as the nervous and muscular systems, enabling rapid communication and coordinated responses. However, recent research has expanded this understanding by demonstrating that even non-excitable cells maintain bioelectrical states that influence growth, differentiation, and tissue organization. The study of electrical currents in living organisms, therefore, provides a broader perspective on how biological systems operate as integrated networks. By exploring these mechanisms, scientists can better understand the principles underlying health and disease, as well as develop advanced approaches in diagnostics, treatment, and regenerative medicine.

## MATERIALS AND METHODS

This study was conducted using an integrative scientific approach combining theoretical analysis and synthesis of interdisciplinary sources. Academic materials from the fields of biophysics, cellular physiology, and biomedical sciences were systematically reviewed to explore the electrical characteristics of living systems. Particular attention was given to the functional role of transmembrane ion exchange, electrical gradients, and signal propagation mechanisms. Conceptual modeling was used to describe how electrical activity emerges from the interaction between cellular structures and ionic environments. Additionally, comparative evaluation of different tissue types was performed to distinguish variations in electrical behavior between excitable and non-excitable cells.

## RESULTS

The findings indicate that electrical currents in living organisms are not isolated events but part of a continuous and regulated physiological system. It was observed that cells maintain stable electrical conditions through controlled ion permeability and active transport mechanisms. Different cell types exhibit distinct electrical patterns. Excitable cells generate rapid and transient electrical signals, while non-excitable cells demonstrate slower but sustained electrical gradients that influence cellular functions such as proliferation and intracellular communication. Moreover, the results reveal that electrical interactions between cells contribute to the formation of functional networks within tissues. These networks enable coordinated responses and enhance the organism's ability to maintain internal stability under changing environmental conditions.

## DISCUSSION

The obtained results emphasize that bioelectricity should be viewed as a fundamental regulatory system alongside biochemical and genetic processes. Electrical signals provide a fast and efficient means of communication, allowing cells to synchronize their activity and respond to stimuli in a coordinated manner. The distinction between excitable and non-excitable cells highlights the versatility of electrical mechanisms in biology. While rapid signaling is essential for immediate responses, slower electrical processes play a critical role in long-term regulation and structural organization. These insights suggest that disturbances in electrical balance may lead to functional disorders at both cellular and systemic levels. Therefore, deeper understanding of bioelectrical principles could significantly impact the development of new medical technologies, including bioelectronic therapies and advanced diagnostic tools. In summary, electrical activity in living organisms represents a complex and adaptive system that is essential for maintaining life and supporting biological integrity.

## CONCLUSION

In conclusion, electrical activity in living organisms represents a highly organized and adaptive system that plays a central role in maintaining biological integrity. Unlike purely chemical processes, bioelectrical mechanisms provide rapid coordination between cells and tissues, ensuring efficient regulation of physiological functions. The analysis shows that electrical properties are not limited to specialized cells but are a universal feature of life, contributing to both immediate responses and long-term cellular behavior. This dual role highlights the importance of electrical signaling in sustaining homeostasis and enabling organisms to adapt to internal and external changes. Furthermore, the integration of electrical processes with molecular and structural components of cells opens new perspectives in understanding complex biological systems. Continued exploration of bioelectricity may lead to innovative approaches in medical science, particularly in areas such as regenerative medicine, functional diagnostics, and targeted therapies.

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