

**EVOLUTIONARY IMPLICATIONS OF THE COLLECTIVE INTELLIGENCE OF CELLS VIA  
DEVELOPMENTAL BIOELECTRIC SIGNALING**

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**ABSTRACT**

Central to the evolutionary process are the genes that are the target of random mutation and the body structure and function upon which selection acts. But the relationship between the genotype and the anatomy is not direct: body form arises as the action of the collective intelligence of cells navigating morphospace. Cells used to be independent organisms, and did not lose their basal intelligence when cooperating to form multicellular bodies. In this talk, I will describe examples of problem-solving by cellular collectives, and show the bioelectric mechanisms that serve as a kind of “cognitive glue” that enables them to act coherently toward specific physiological and anatomical goals. I will describe how these cellular competencies arise during evolution, and explore hypotheses about the many ways in which the intelligence of anatomical homeostasis impacts the rate and direction of evolutionary change. Each of us took the slow, gradual journey across the Cartesian Cut, starting out as a bag of chemicals (an unfertilized egg) and becoming a complex sentient being with self-awareness. This process, on both developmental and evolutionary timescales, offers a fascinating window into the ways in which evolution exploits physics and computation to scale ubiquitous minimal cognition into progressively larger minds.

**Keywords:** evolution, developmental biology, embryo, bioelectricity, regeneration, basal cognition