

Evolving Multicellularity in Digital Organisms through Reproductive Altruism

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The mechanisms by which early multicellular organisms emerged from their unicellular ancestors are fundamental to the biology of complex, differentiated life forms. Previous work suggests that reproductive division of labor between specialized germ and soma cells was central to this evolution in some cases. Here, we use the digital life platform Avida to examine the trade-off between survival and replication in multicellular organisms. Avida uses a grid of self-replicating assembly-like computer programs capable of mutation and evolution to address biological questions computationally. We extend Avida's CompeteDemes framework and modify Avidian organisms to accommodate for organism replication inspired by the Volvocales, a photosynthetic green algae that exists in multicellular forms. Some species of Volvocales address this multi-objective optimization problem by expressing an altruistic gene that causes a parental organism to produce sterile, somatic offspring. Our results indicate that digital organisms are capable of evolving multicellularity within the Avida platform using strategies similar to those observed in nature.