Evolutionary History of Genes Underlying Cellular Differentiation in the Volvocine Algae.

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Abstract: The hierarchical organization of life arises from the integration of lower level units into new higher level individuals. The foremost example of such evolutionary transitions in individuality (ETIs) is the transition from single-celled to multicellular organisms. A key step in the ETI from single-celled to multicellular is the evolution of specialized somatic cells[1]. Somatic cells give up reproduction for the benefit of the group thus transferring the level of selection from the cell level to the group level[1]. The volvocine green algae provide an excellent model system to study the ETI from unicellular to multicellular because they range from single celled *Chlamydomonas* to *Volvox* species with thousands of cells and two distinct cell types. In *Volvox carteri* somatic cell differentiation is controlled by the *regA* gene, a putative transcription factor thought to control chloroplast biogenesis[2]. *regA* is part of a tandem duplication of four to five *regA*-like genes known as the *reg* cluster[3,4]. While previous work has found the *reg* cluster in disparate *Volvox* species[4], the origin and distribution of the *reg* cluster in the volvocine algae is unknown. We used cosmid cloning and sequencing to search for the *reg* cluster from diverse volvocine algae species both with and without somatic cells. We found that the *reg* cluster arose early in the evolution of multicellularity in the volvocine green algae and is present in species lacking specialized somatic cells. Thus the genetic basis for cellular differentiation arose prior to the evolution of specialized cell types in this group. Understanding the evolutionary history of the *reg* cluster will provide useful insights into how the genetic basis for complexity arises..

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