The reorganization of protein interaction networks during the transition to multicellularity

Dinah R. Davison[1*] and Bradley J.S.C. Olson[1]

[*]Presenting author
[1]Divison of Biology, Kansas State University, Manhattan, KS

The evolution of multicellularity is a major evolutionary transition that requires the reorganization of development. Despite this reorganization, surprisingly little genomic innovation occurs during this transition. This indicates that changes that occur downstream from coding sequences may be central to the evolution of multicellularity. Since interactions among proteins are key to development and changes in these interactions can have important consequences, we examine whether changes in patterns of protein interactions may be central to the evolution of multicellularity. Specifically, we asked whether the organization of protein interaction networks changes during the evolution of multicellularity. We focused on unicellular *Chlamydomonas reinhardtii* and undifferentiated multicellular *Gonium pectorale.* We grew synchronous cultures, flash-froze and then lysed cells, and quantified the protein content. We then ran native PAGE gels and cut the gel lanes into fractions for tandem mass-spectrometry, allowing us to identify which proteins are present in the same complexes. We used this data to construct protein interaction networks, which are networks where the nodes are proteins and the edges are interactions between those proteins. Such networks allow us to examine patterns and relationships among proteins that wouldn't be apparent from studying individual proteins in isolation. We found that the overall structure of *Chlamydomonas* and *Gonium* protein interaction networks are very similar. Both are dense, highly-connected networks that are similarly robust to the random loss of proteins. While the overall structure of protein-protein interaction networks is conserved during the evolution of multicellularity, the position of individual protein homologs in that network changes. We found that both the connectedness and the importance of homologous proteins differs between *Chlamydomonas* and *Gonium.* This indicates that the reorganization of protein interactions may play an important role in the evolution of multicellularity.