Highly regulated growth in the Ediacara macrofossil *Dickinsonia costata* and implications for the early evolution of animals. S. D. Evans[1], M. L. Droser and J. G. Gehling[2], [1] Department of Earth Sciences, University of California at Riverside, 900 University Ave, Riverside, CA, 92521, [2] South Australia Museum, University of Adelaide, North Terrace, Adelaide, South Australia 5000, Australia.

Introduction: The early evolution of animal life is recorded in the soft body fossils of the Ediacara Biota [1,2]. While rare Ediacaran aged taxa can be assigned to known animal groups, the majority have unresolved affinities within modern classification schemes [1,3], leaving large gaps in our understanding of the early evolution of complex animal life on this planet. It has recently been predicted that this group of early animals should contain extinct lineages that utilized some of the gene regulatory networks found in bilaterians but do not fit within known metazoan phyla [4]. Despite this knowledge, most attempts to classify Ediacara taxa have focused on shoehorning them into modern groupings and have thus proved largely unsuccessful and contentious.

Dickinsonia (figure 1) is an abundant member of the Ediacara Biota in South Australia that has uncertain affinities, with varied interpretations including fungi [5], annelids [6], placozoans [7] and bilaterians [8]. This organisms is also unique amongst the Ediacara Biota in that it was apparently bilaterally symmetrical, likely mobile, and possibly fed via osmotrophy [7,9]. Here we present analysis of the morphology and growth of over 900 specimens of *Dickinsonia costata* from the Flinders ranges and surrounding areas in South Australia in order to asses where it fits in the early evolution of complex, multicellular life.

Morphological observations demonstrate that *D. costata* was a bilaterally symmetric, modular organism without any evidence for internal anatomy. Quantitative evaluation of the growth and development of this fossil taxa suggest that it grew isometrically with respect to length and width to maintain a high surface area to volume ratio. We also show that growth was achieved via the posterior addition and subsequent expansion of modules in a complex yet surprisingly well-regulated pattern constrained to maintain an ovoid morphology. Our data also indicate that modules where fixed at both the midline and outer margin of *D. costata*, suggesting that it possessed some type of pliable yet tough outer membrane.

The suite of morphological characters identified herein, along with regulated, complex growth patterns suggests that *Dickinsonia* contains some of the features common to all bilaterians but not the full package of characters necessary for a bilaterian classification. Instead we suggest that the overlap in characters between bilaterians and *Dickinsonia* reflect the utilization of gene regulatory networks common to most metazoan phyla. Our data then imply that this organism represents an extinct clade located between sponges and the last common ancestor of Protostomes and Deuterostomes, and likely belongs within the Eumetazoa.

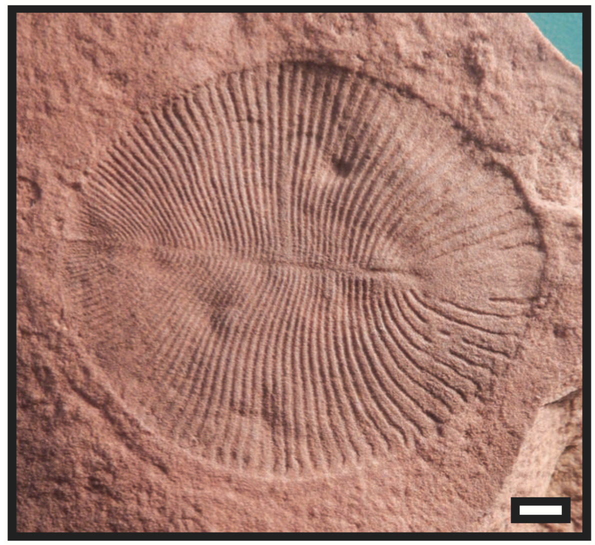

Figure 1: *Dickinsonia costata* from the South Australia Museum. SAM P40135. Scale bar is 1 cm.

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