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Unhatched larvae of the sand dollar *Echinarchinus parma* in response to exposure to reduced salinity. Development to the larval stage while still within the fertilization envelope (seen here as fine circles around each embryo) has not previously been reported in any echinoderm species. (photo by Jonathan Allen)

Change for a Sand Dollar
Sea urchins and sand dollars have been prized study subjects for developmental biologists for over 130 years. But in the countless hours spent observing their embryos, no one had ever seen what Frances Armstrong saw in the summer of 2011: a delay of hatching by embryos until they became larvae. Instead of hatching at the blastula stage, essentially a swimming ball of cells, embryos continued to grow and develop within the protective envelope that arises after fertilization. When hatching did occur, the animals emerged as the pluteus larvae characteristic of sea urchins and sand dollars: bilaterally symmetrical organisms with pairs of arms supported by skeletal rods, a mouth, esophagus, stomach and anus. This simple but unexpected observation during an undergraduate research project led to a series of experiments by Armstrong and her co-authors, Holly Blackburn (another undergraduate) and Dr. Jonathan Allen from the College of William and Mary, on the induction of this novel response. What they found was that delayed hatching can be brought on by exposure to salinities and temperatures that are well within the range naturally encountered by these organisms. Lowering salinity had a particularly strong effect on the likelihood of delayed hatching. Importantly, the delay of hatching reported was not merely a slowing of development, but rather development continued normally and offspring hatched at a later stage. The consequences of remaining unhatched through additional phases of development are unclear, but the phenomenon likely affects many aspects of larval ecology, including dispersal, food acquisition and predator avoidance. The primary significance of this work is to highlight that very little is known about how animals respond to environmental variation during development, even in a group that has been a model system for developmental biologists for more than a century. This article appears in the February issue of *The American Naturalist* (http://www.jstor.org/stable/10.1086/668829)