The differentiation of cilia subtypes during early stages of sea urchin (Lytechinus pictus) embryogenesis

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Cilia are ubiquitous and versatile appendages of cells that move fluid over surfaces and sense signals in the environment. Improper ciliary assembly leads to a variety of human diseases including polycystic kidney disease. Because sea urchin embryos elaborate several forms of cilia from one initial type as development progresses, the sea urchin provides an ideal model for studying the process of ciliary differentiation. Our data suggest that cilia on sea urchin embryos change form by rapid retraction and disassembly at mitosis followed by regrowth on daughter cells in a new molecular form.

In sea urchin (Lytechinus pictus) embryos, the onset of ciliogenesis occurs on all blastomeres simultaneously just before hatching and is regulated thereafter in a tissue-specific manner to generate cilia with different lengths, forms, and behaviors. To understand the process of ciliary growth and differentiation during development, we employed heavy metal ion treatments known to trigger developmental fate changes in echinoid embryos¹ in order to enrich for cells with specific cilia types. In control L. pictus embryos at the hatching blastula stage, all blastomeres grow a single motile cilium averaging 18 μm in length to propel the embryo through the water. Confocal microscopy of embryos stained with anti-tubulin of the cilia red. Scale bars = 50 μm.

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