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Direct measurement of local material properties within living embryonic tissues FRIEDHELM SERWANE, ALESSANDRO MONGERA, PAYAM ROWGHANIAN, DAVID KEALHOFER, ADAM LUCIO, ZACHARY HOCKENBERY, OTGER CAMPÀS, University of California, Santa Barbara — The shaping of biological matter requires the control of its mechanical properties across multiple scales, ranging from single molecules to cells and tissues. Despite their relevance, measurements of the mechanical properties of sub-cellular, cellular and supra-cellular structures within living embryos pose severe challenges to existing techniques. We have developed a technique that uses magnetic droplets to measure the mechanical properties of complex fluids, including in situ and in vivo measurements within living embryos,across multiple length and time scales. By actuating the droplets with magnetic fields and recording their deformation we probe the local mechanical properties, at any length scale we choose by varying the droplets' diameter. We use the technique to determine the subcellular mechanics of individual blastomeres of zebrafish embryos, and bridge the gap to the tissue scale by measuring the local viscosity and elasticity of zebrafish embryonic tissues. Using this technique, we show that embryonic zebrafish tissues are viscoelastic with a fluid-like behavior at long time scales. This technique will enable mechanobiology and mechano-transduction studies in vivo, including the study of diseases correlated with tissue stiffness, such as cancer.

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