ST. OLAF PHYSICS DEPARTMENT

COLLOQUIUM SERIES

Fun with the fluid-fluid interface: from snails to Cheerios

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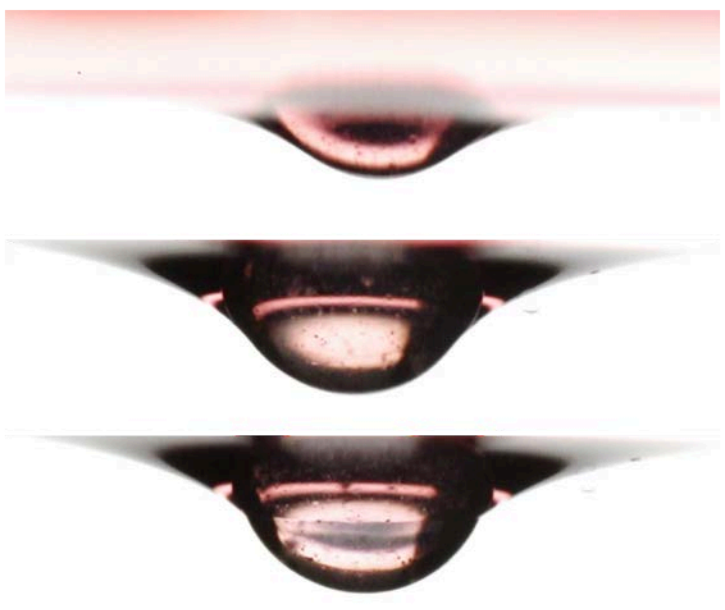

From raindrops to clumping Cheerios in a breakfast bowl, fluid surfaces hold many surprises that enrich the world around us. In this talk, we discuss two phenomena involving the fluid-fluid interface that find inspiration in very different places. First, water snails utilize rhythmic undulations to collect food floating on the water surface. Inspired by this observation, we develop a simplified robotic snail that generates interfacial pumping flows with periodic undulations. Our experiments show that the pumping rate has a non-monotonic dependence on the wave speed of surface undulations. We rationalize this surprising experimental observation with a thin-film model.

Second, known as the Cheerios effect, floating particles tend to aggregate due to surface tension and form a close-packed assembly, or a granular raft. Granular rafts are simple composite materials that exhibit both elastic and granular properties. We compress granular rafts and observe two distinct modes of failure showcasing their dual nature: system-wide buckling and the expulsion of individual particles. We explain our experimental results with a new "composite" model that compares the energies associated with each failure mode.

Wednesday, October 15

3:00 PM | RNS 210