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# When worms stick together and swim on thin water, what happens and why does it matter?

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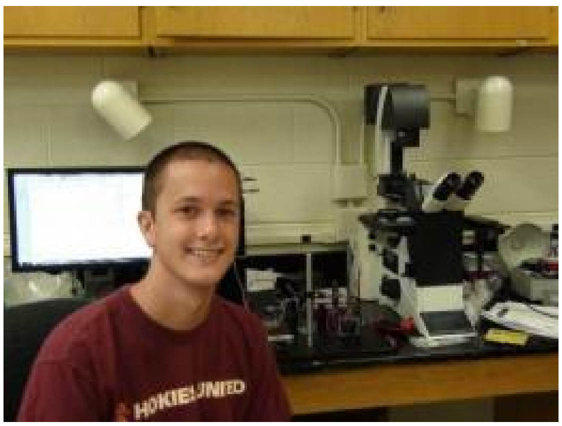

Sean Gart, of Salem, Va., a senior in engineering science and mechanics at Virginia Tech, co-authored the new paper, “The collective motion of nematodes in a thin liquid layer.” His adviser is Sunghwan “Sunny” Jung, an assistant professor of engineering science and mechanics at Virginia Tech. Credit: Virginia Tech Photo

Nematodes, microscopic worms, are making engineers look twice at their ability to exhibit the "Cheerios effect" when they move in a collective motion.

These parasites will actually stick together like Cheerios swimming in milk in a cereal bowl after a chance encounter "due to capillary force." This observation has made Virginia Tech engineers speculate about the possible impacts on the study of biolocomotion.

Their work appears in the journal, Soft Matter, a publication of the Royal Society of Chemistry, the week of Feb. 7. *Soft Matter* is the premier journal in the ongoing multidisciplinary work between physics, material science, and biology.

Two Harvard physicists first defined the Cheerios effect. In 2005, Dominic Vella and Lakshminarayanan Mahadevan wrote an article on this activity, defined by scientists as relating to fluid mechanics, in the Journal of Physics. They cited its usefulness in the study of self-assembly of small structures. Self-assembly is used in the science of nanotechnology.

Dominic Vella who now teaches at the University of Oxford, United Kingdom, collaborated with Sunghwan "Sunny" Jung, an assistant professor of engineering science and mechanics at Virginia Tech, and his student, Sean Gart, of Salem, Va., a senior in engineering science and mechanics, and authored the new paper, "The collective motion of nematodes in a thin liquid layer."

Their work highlights the behaviors of the nematode Panagrellus redivivus, a creature that feeds on bacteria, in a watery liquid layer that is thinner than a human hair. In this environment the nematodes crawl by creating waves that travel backwards down their body, and the force pushes them forward.

"The inspiration for the project came when we observed the nematodes crawling up the side of their container and sticking together. We knew part of the reason for this behavior was due to the capillary force, the same force that causes Cheerios to stick together in a cereal bowl, but we wanted to see whether or not the nematodes moved faster or more efficiently while stuck together," Jung and Gart explained.

"Thin water refers to the air/liquid interface. Like Cheerios in milk, the nematodes are aggregating on top of the air surface, not on the bulk or on the bottom," Jung said.

Gart has been working in Virginia Tech's Biologically Inspired Fluids Laboratory directed by Jung since last summer. Gart found that the nematodes did not crawl faster or more efficiently while stuck together.

"This is an interesting behavior that has not been studied very widely in the biolocomotion field," Jung said. "The result implies that nematodes gain neither a mechanical advantage nor disadvantage by being grouped together. The capillary forces merely keep them together after a chance encounter. This result also extends a better understanding of capillary effects in colloidal particles in engineering systems such as pickering emulsions. These emulsions are stabilized by solid particles. An example would be homogenized milk."

**More information:** http://www.rsc.org/Publishing/Journals/sm/News/impactfactor_2009.asp

Provided by Virginia Tech