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Stanley Corrsin Award Talk: Fluid Mechanics of Fungi and Slime

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There are interesting fluid mechanics problems everywhere, even in the most lowly and hidden corners of forest floors. Here I discuss some questions we have been working on in recent years involving fungi and slime. A critical issue for the ecology of fungi and slime is nutrient availability: nutrient sources are highly heterogeneous, and strategies are necessary to find food when it runs out. In the fungal phylum *Ascomycota*, spore dispersal is the primary mechanism for finding new food sources. The defining feature of this phylum is the ascus, a fluid filled sac from which spores are ejected, through a build up in osmotic pressure. We outline the (largely fluid mechanical) design constraints on this ejection strategy, and demonstrate how it provides strong constraints for the diverse morphologies of spores and asci found in nature. The core of the argument revisits a classical problem in elastohydrodynamic lubrication from a different perspective. A completely different strategy for finding new nutrient is found by slime molds and fungi that stretch out – as a single organism– over enormous areas (up to hectares) over forest floors. As a model problem we study the slime mold *Physarum polycephalum*,which forages with a large network of connected tubes on the forest floors. Localized regions in the network find nutrient sources and then pump the nutrients throughout the entire organism. We discuss fluid mechanical mechanisms for coordinating this transport, which generalize peristalsis to pumping in a heterogeneous network. We give a preliminary discussion to how physarum can detect a nutrient source and pump the nutrient throughout the organism.