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The Hungry Fly: Hydrodynamics of feeding in the common house fly[1] MANU PRAKASH, Junior Fellow, Harvard Society of Fellows, MILES STEELE, Deerfield Academy High School — A large number of insect species feed primarily on a fluid diet. To do so, they must overcome the numerous challenges that arise in the design of high-efficiency, miniature pumps. Although the morphology of insect feeding structures has been described for decades, their dynamics remain largely unknown even in the most well studied species (e.g. fruit fly). Here, we use invivo imaging and microsurgery to elucidate the design principles of feeding structures of the common house fly. Using high-resolution X-ray microscopy, we record invivo flow of sucrose solutions through the body over many hours during fly feeding. Borrowing from microsurgery techniques common in neurophysiology, we are able to perturb the pump to a stall position and thus evaluate function under load conditions. Furthermore, fluid viscosity-dependent feedback is observed for optimal pump performance. As the gut of the fly starts to fill up, feedback from the stretch receptors in the cuticle dictates the effective flow rate. Finally, via comparative analysis between the house fly, blow fly, fruit fly and bumble bees, we highlight the common design principles and the role of interfacial phenomena in feeding.

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