Homeworks (due 1/28 5pm, Clark 517)

The first two problems are tied to our discussions of physics of chemoreception (read Berg and Purcell 1977 paper)

1. Can a cell in a medium of uniform concentrations increase its material intake by swimming?

2. The motion of the cell will generate an apparent spatial gradient. Calculate this spatial gradient.

The next two problems are related the propulsion in Stokes flow (zero Reynolds number). Read Purcell 1977 paper and Watch Taylor’s video.

3. Purcell's swimmer

Determine the swimming direction of Purcell's three-links swimmer (Fig.~7 in Purcell's paper, attached), and explain what breaks the time reversal symmetry.

4. Reversibility of a solid ring in a Taylor-Couette Flow at zero Reynolds number

Show that a solid ring is reversible in a shear flow at zero Reynolds number. That is, if the motion of the boundary, in this case, the inner cylinder, is reversed completely, the position and the orientation of the ring also reverses. The experimental demo of this is in the video of G.I. Taylor’s lecture on low Reynolds numbers.