Biological Hydrodynamics

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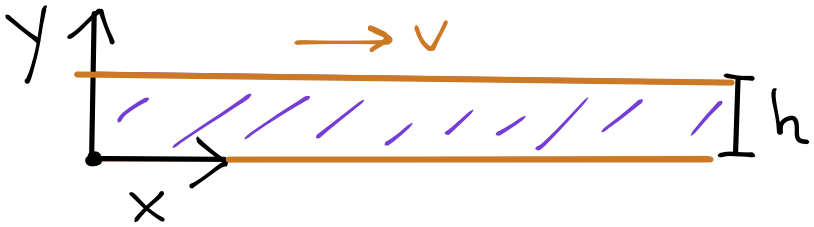
Next Tutorial: Thursday **21th November**, 14:50 - 16:20, MPI PKS Seminar Room 3

Tutorial 4: Couette flow



Consider a layer of an incompressible Newtonian fluid of density ρ and viscosity η that is placed in between two plates that are separated by h. The bottom plate is fixed in space, the top plate moves at a velocity v in the x-direction. There are no-slip boundary conditions at both plates. Pressure is uniform throughout. All variables do not change in the x direction.

1. Use the Stokes' equation for low Reynolds numbers to evaluate the velocity profile $v_x(y)$.

2. Evaluate the stress tensor. Evaluate the drag force on a square area of extent l in x-direction and width Z that the top plate exerts on the bottom plate. By how much does the drag force decrease if you double the separation distance h?

3. What is the drag on the top plate?

4. Calculate the volumetric flow rate Q (the total volume of fluid per unit time that passes through a crossection of width Z). If you double the separation distance h, by what factor do you increase Q?