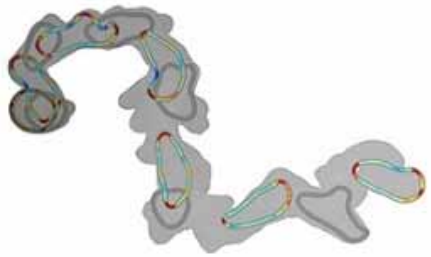
Physics 131- Fundamentals of Physics for Biologists I



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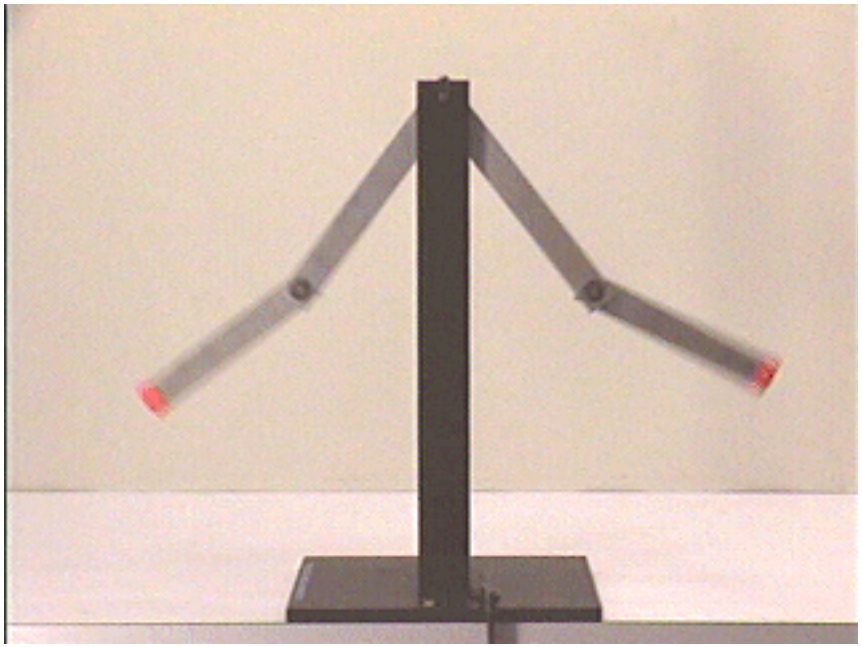
Video: Simulation of Blood Clotting Protein binding to a

Outline

- Chaos
- Fick's law
  - The kinetic theory of diffusion
- Gradients
  - Gradient driven flow

- Why not study everything starting from Newton's laws?

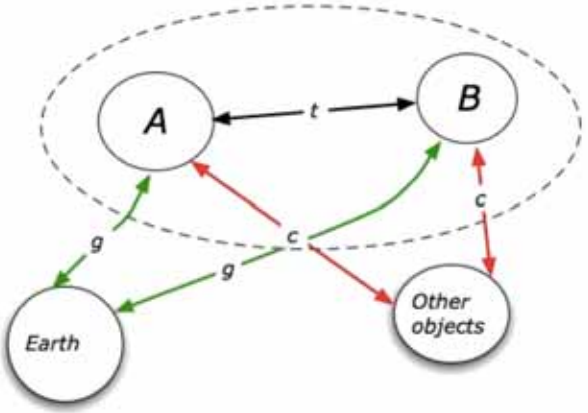
Example: Double pendulum



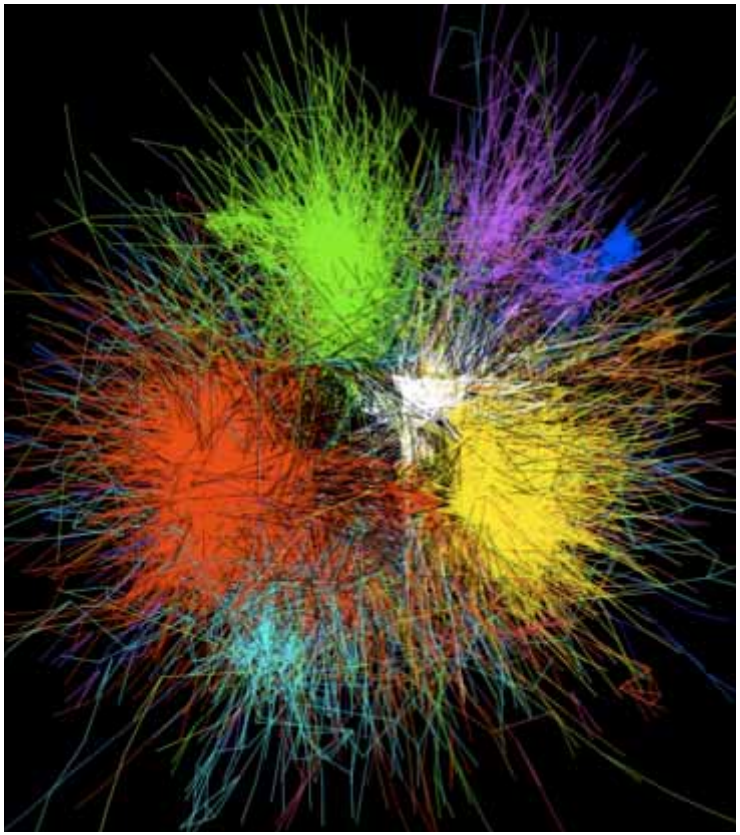
Chaos

- Its impossible to predict motion very accurately if interactions and objects become more complex

- So far we have studied about 1-5 objects.

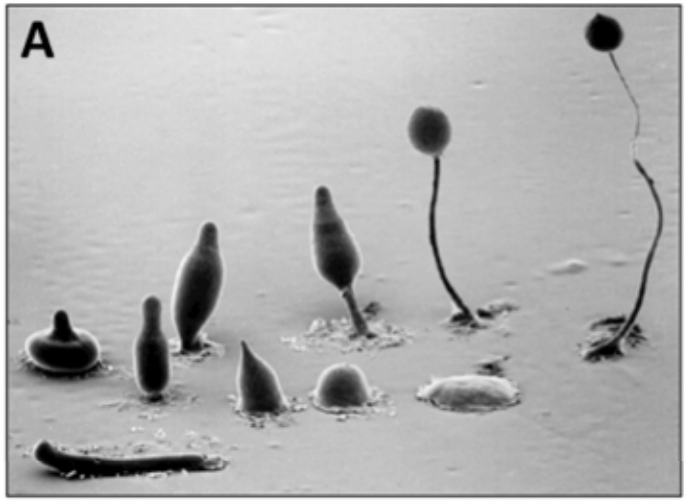


- to study cells, fluids,etc
  - LOTS of objects
  - MANY interactions



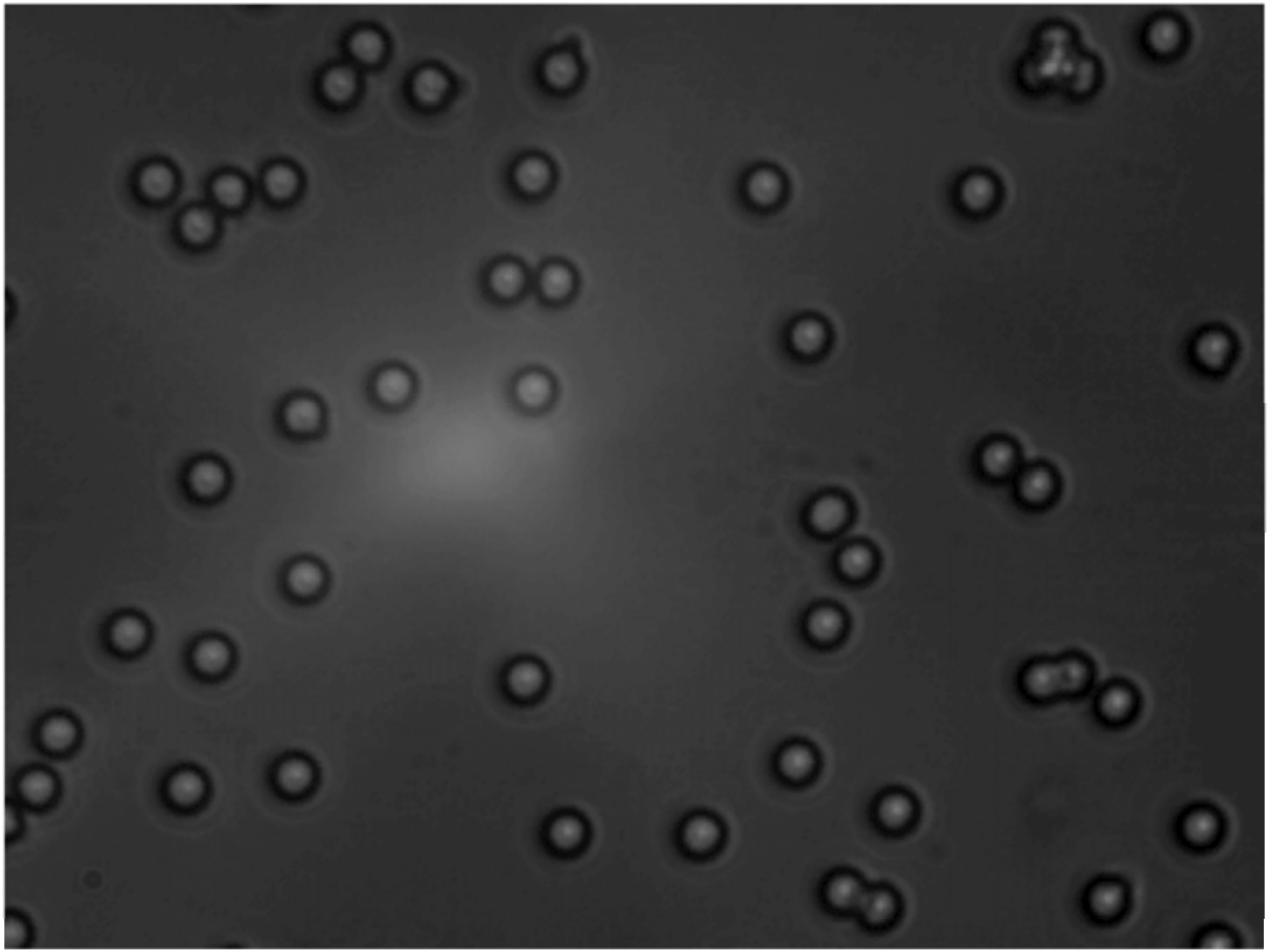
Biological Example of Emergence

Spores



Brain

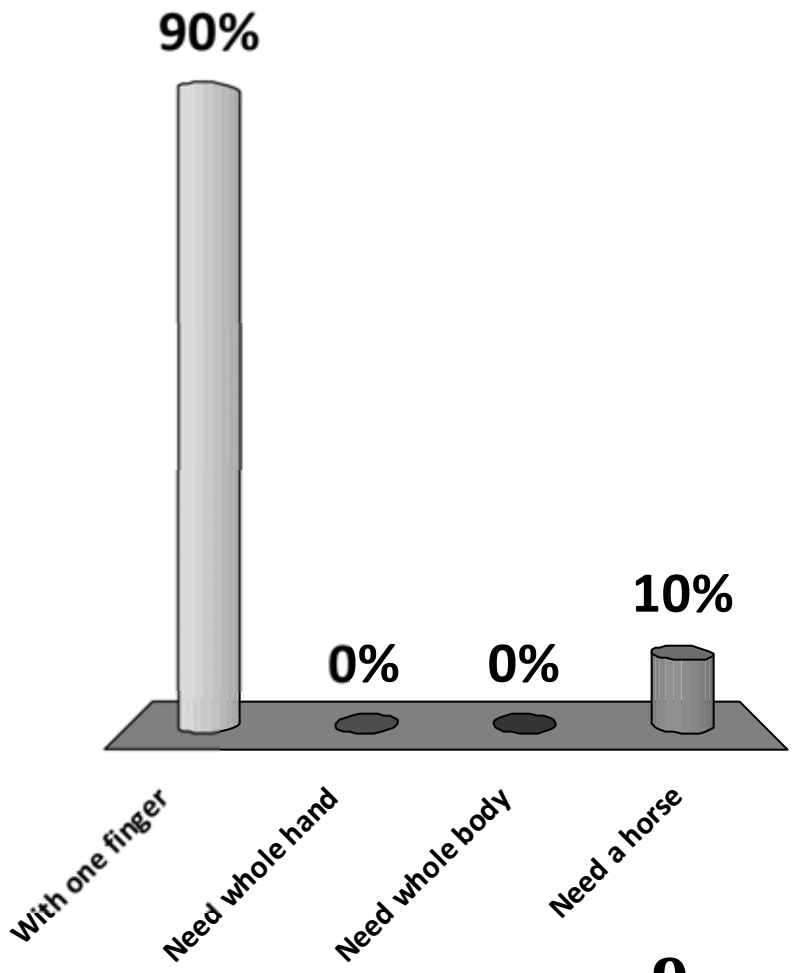
Random Motion



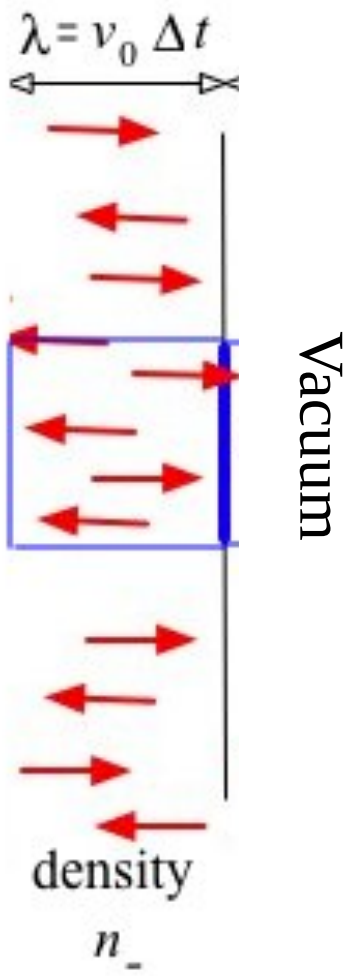
- Can I think about this process in terms of Newton's laws?
- If the trajectories are unpredictable after a few collisions, what can I say about the motion?
- Is this jiggling really similar to collisions of billard balls? Does it carry momentum? Do collisions exert a force?

How easy is it to move a sheet of paper, against the pushing from air molecules bouncing against the sheet?

1. With one finger
2. Need whole hand
3. Need whole body
4. Need a horse

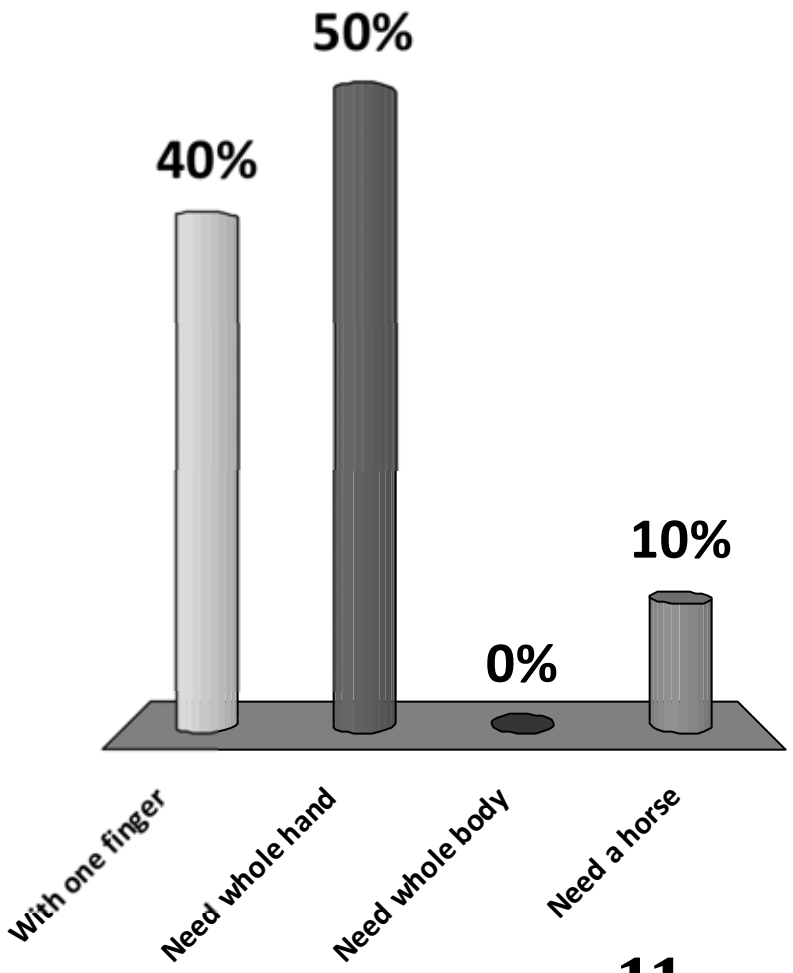


- An extreme example: Vacuum on the right side!
- More atoms want to move to the right than to the left!



How easy is it to move a sheet of paper now?

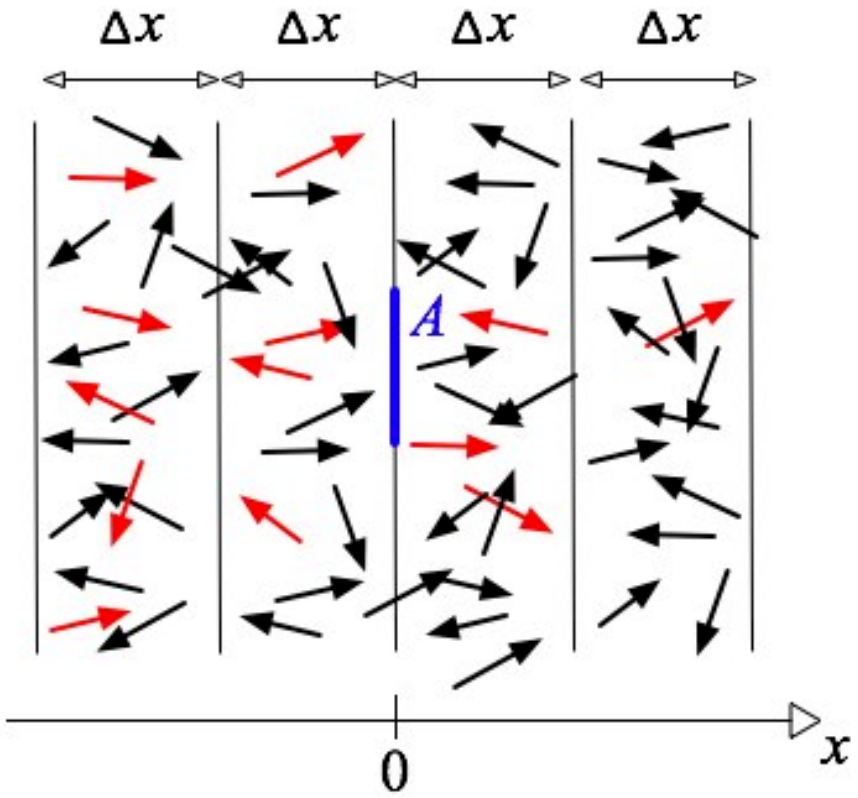
1. With one finger
2. Need whole hand
3. Need whole body
4. Need a horse



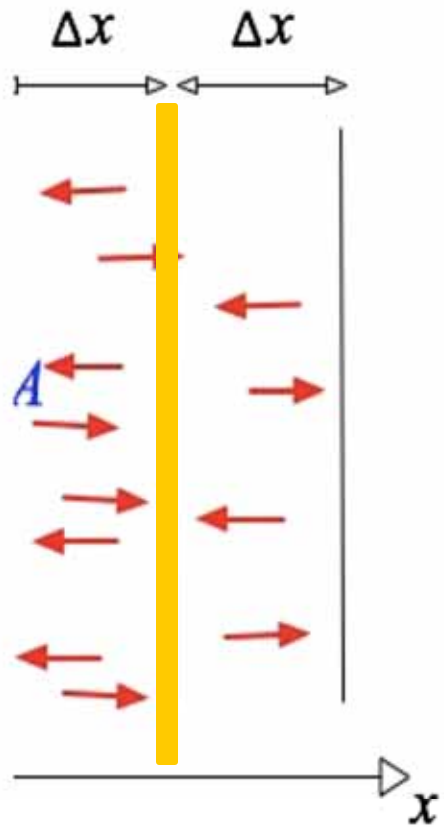
- Why is the paper not torn to shreds by such forces from BOTH sides?

Diffusion:
Fick's law (1D analysis)

- Uniform fluid containing (red) molecules with a varying concentration.
- Fluid molecules jiggle the (red) molecules around.



Atoms move randomly in two containers. More atoms are on the left than on the right of a yellow gate. When the gate is suddenly lifted, some of the randomly moving atoms travel across the gate.



1. More go to the right
2. More go to the left
3. Equal amount goes left and right in random motion
4. Not enough information