Introduction to Bioengineering
BIOE/ENGR.80
Stanford University

Spring 2020 Class Slides

Day 16
11 May 2020

Week 5 reprise

CONCEPT
SKILL

DNA sequencing (reading)

- Sequencing-by-synthesis; pore-based

DNA synthesis (writing)

- Phosphoramidite chemistry for low-error rates

Surfing exponentials

- Quantitative change poses, "when's the right time?"

Interconvertibility of matter and information

- DNA R/W together enabling networked bio/technology

Team rules & priority-setting tools

- Impact versus effort; get projects on leading-edge curve

Week 6 look ahead

CONCEPT
SKILL

Diffusion of molecules (space, time, abundances)

Programming patterns in autonomous systems

Programming patterns in living systems

[Team Project]

- Brainstorms (three themes)
- Team Rules

A

BRIEF ACCOUNT

OF

MICROSCOPICAL OBSERVATIONS

Made in the Months of June, July, and August, 1827,

ON THE PARTICLES CONTAINED IN THE POLLEN OF PLANTS;

AND

ON THE GENERAL EXISTENCE OF ACTIVE MOLECULES

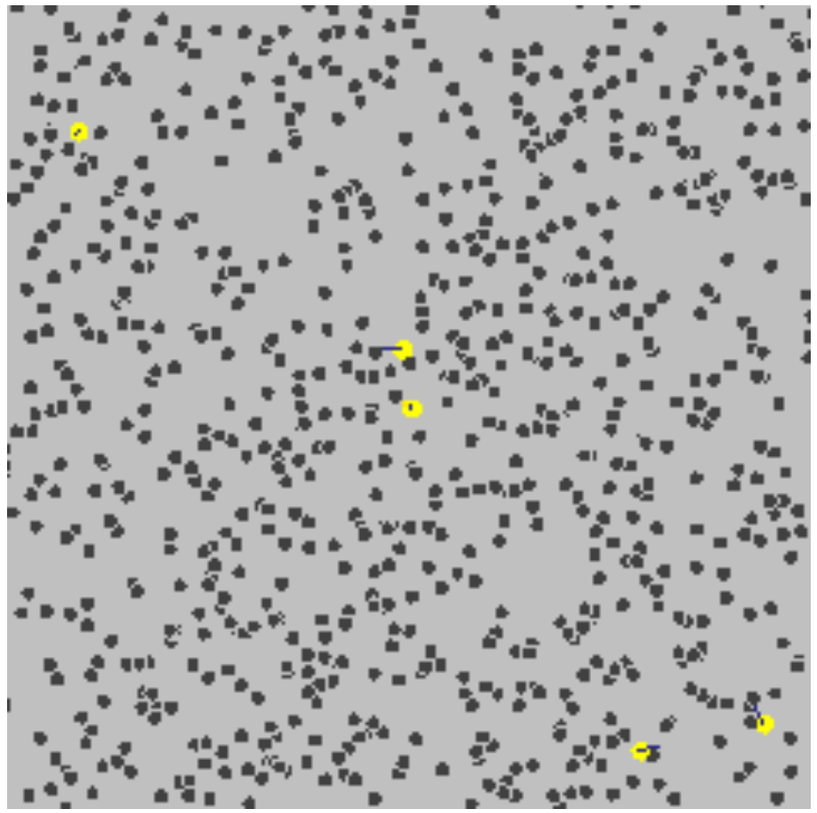
IN ORGANIC AND INORGANIC BODIES.

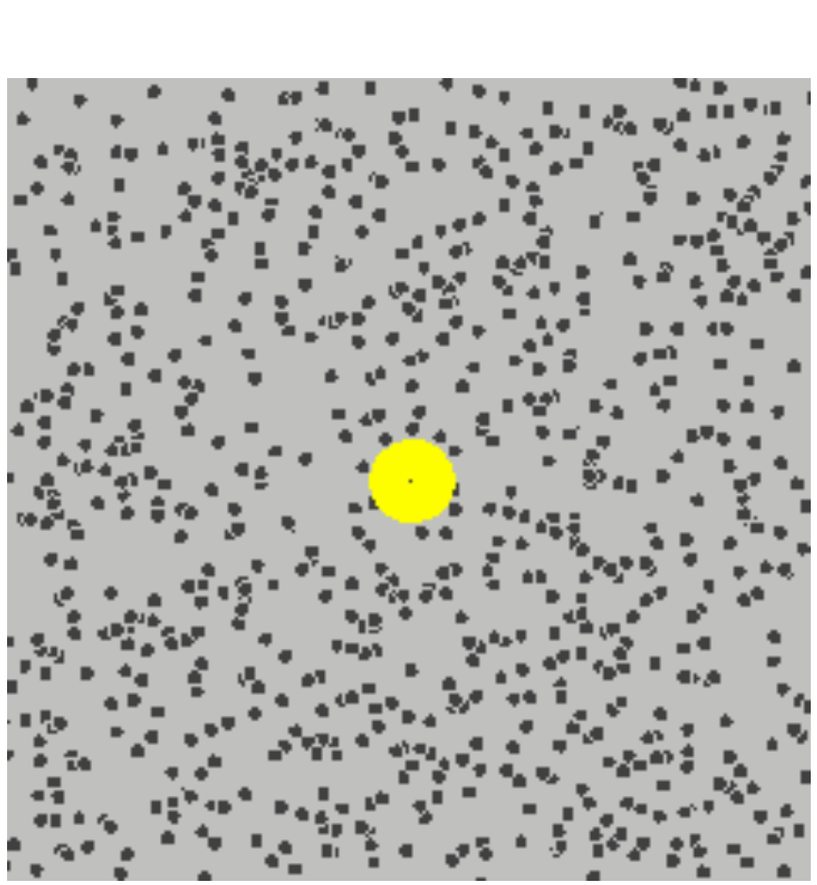
BY

ROBERT BROWN,

F.R.S., Hon. M.R.S.E. and R.I. Acad., V.P.L.S.,

MEMBER OF THE ROYAL ACADEMY OF SCIENCES OF SWEDEN, OF THE ROYAL SOCIETY OF DENMARK, AND OF THE IMPERIAL ACADEMY NATURÆ CURIOSORUM; CORRESPONDING MEMBER OF THE ROYAL INSTITUTES OF FRANCE AND OF THE NETHERLANDS, OF THE IMPERIAL ACADEMY OF SCIENCES AT ST. PETERSBURG, AND OF THE ROYAL ACADEMIES OF PRUSSIA AND BAVARIA, ETC.





https://en.wikipedia.org/wiki/Brownian_motion

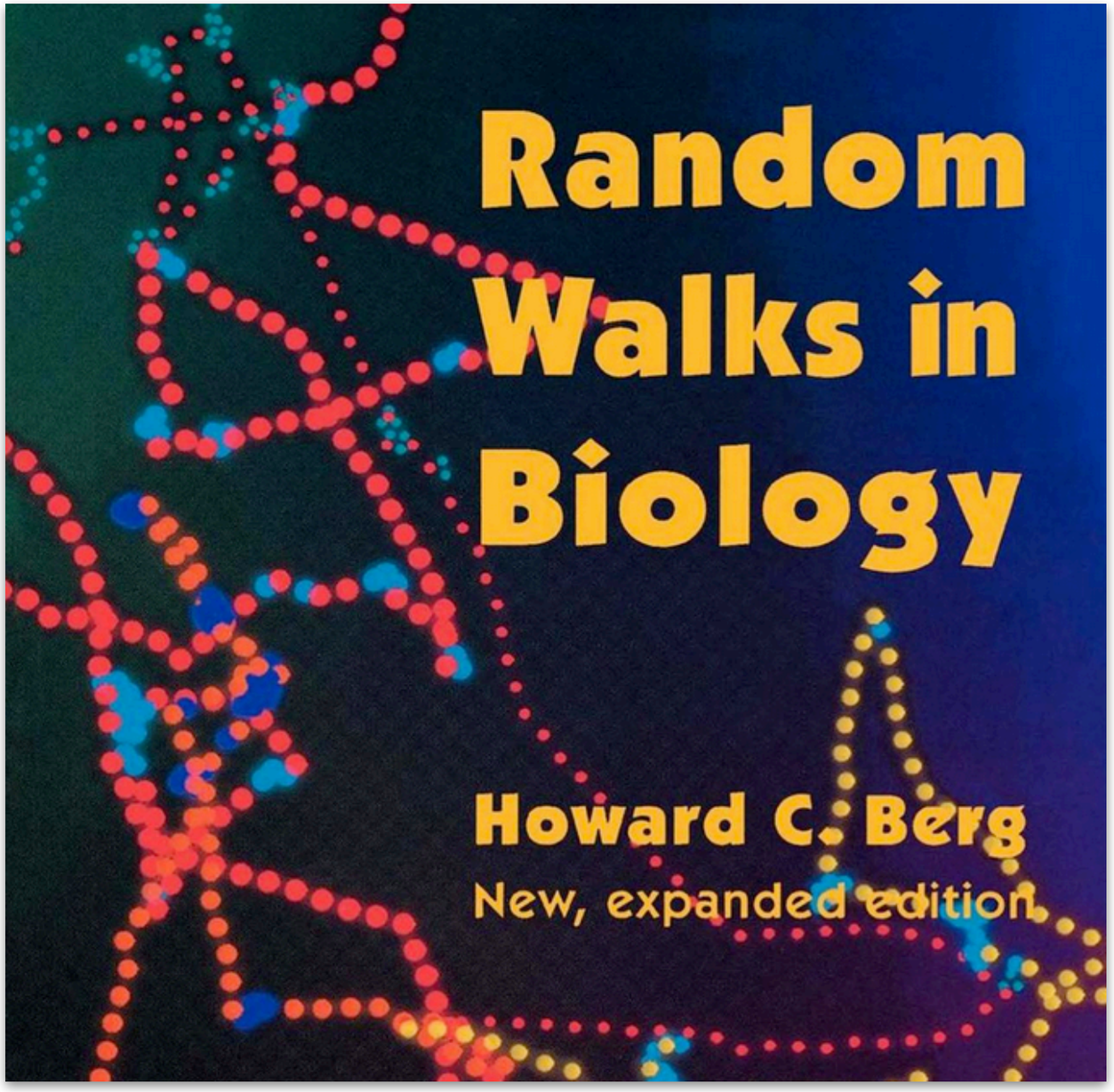
http://sciweb.nybg.org/science2/pdfs/dws/Brownian.pdf

$$\langle x^2 \rangle^{1/2} = (2Dt)^{1/2},$$ 1D

$$\langle r^2 \rangle = 4Dt.$$ 2D

$$\langle r^2 \rangle = 6Dt.$$ 3D

$$D = \frac{k_B T}{6\pi\eta \cdot R}$$



https://www.jstor.org/stable/j.ctv7r40w6

To go twice as far takes four times as long.

A particle that is twice as big, *R*, goes ~0.7 as far.

Diffusing particles spread out over time.

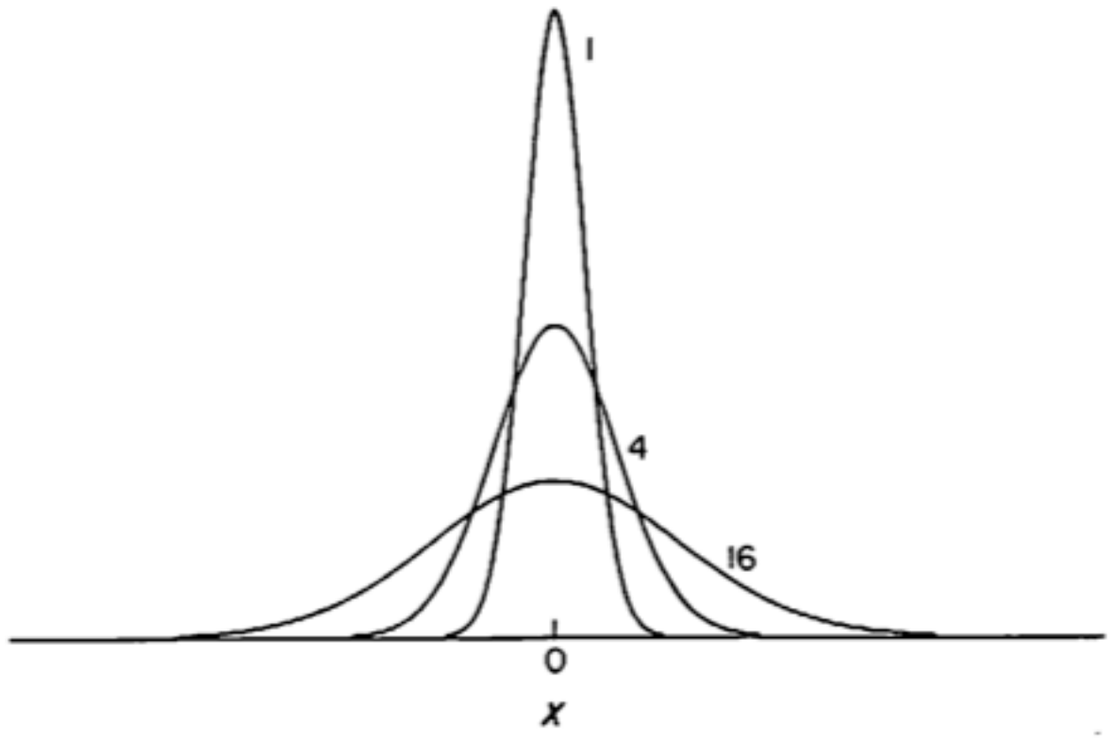
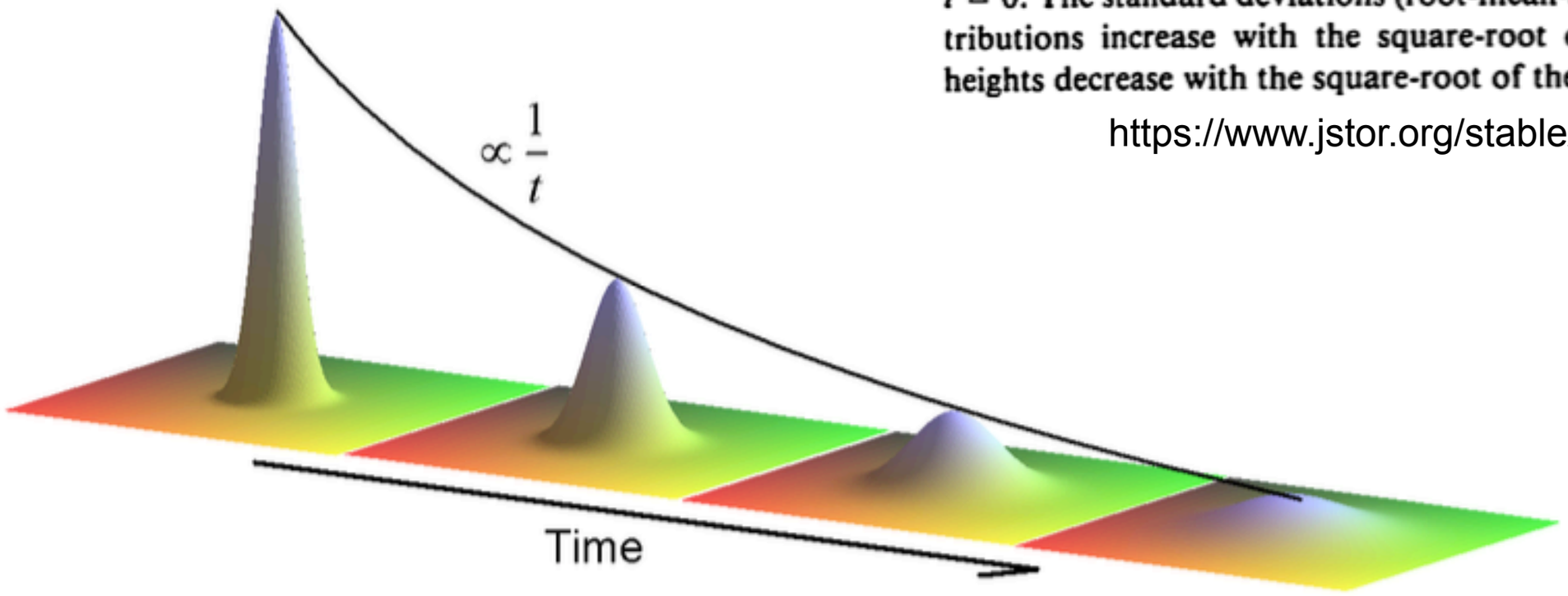


Fig. 1.3. The probability of finding particles at different points x at times $t = 1, 4$, and 16. The particles start out at position $x = 0$ at time $t = 0$. The standard deviations (root-mean-square widths) of the distributions increase with the square-root of the time. Their peak heights decrease with the square-root of the time. See Eq. 1.22.

https://www.jstor.org/stable/j.ctv7r40w6



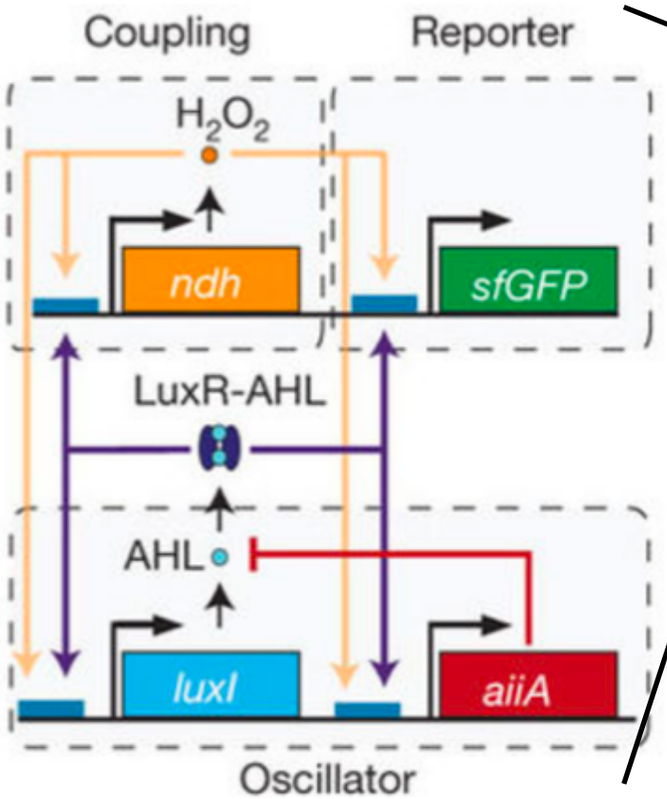
http://rpdata.caltech.edu/courses/aph162/2006/Protocols/diffusion.pdf

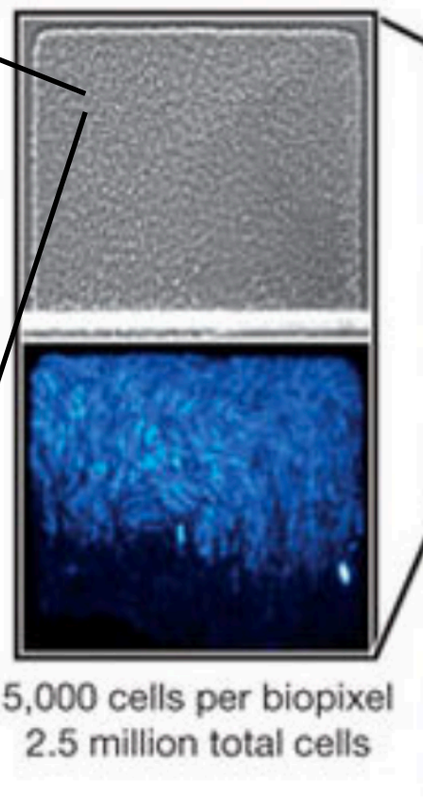
What can we infer about the diffusion of biomolecules in this system?

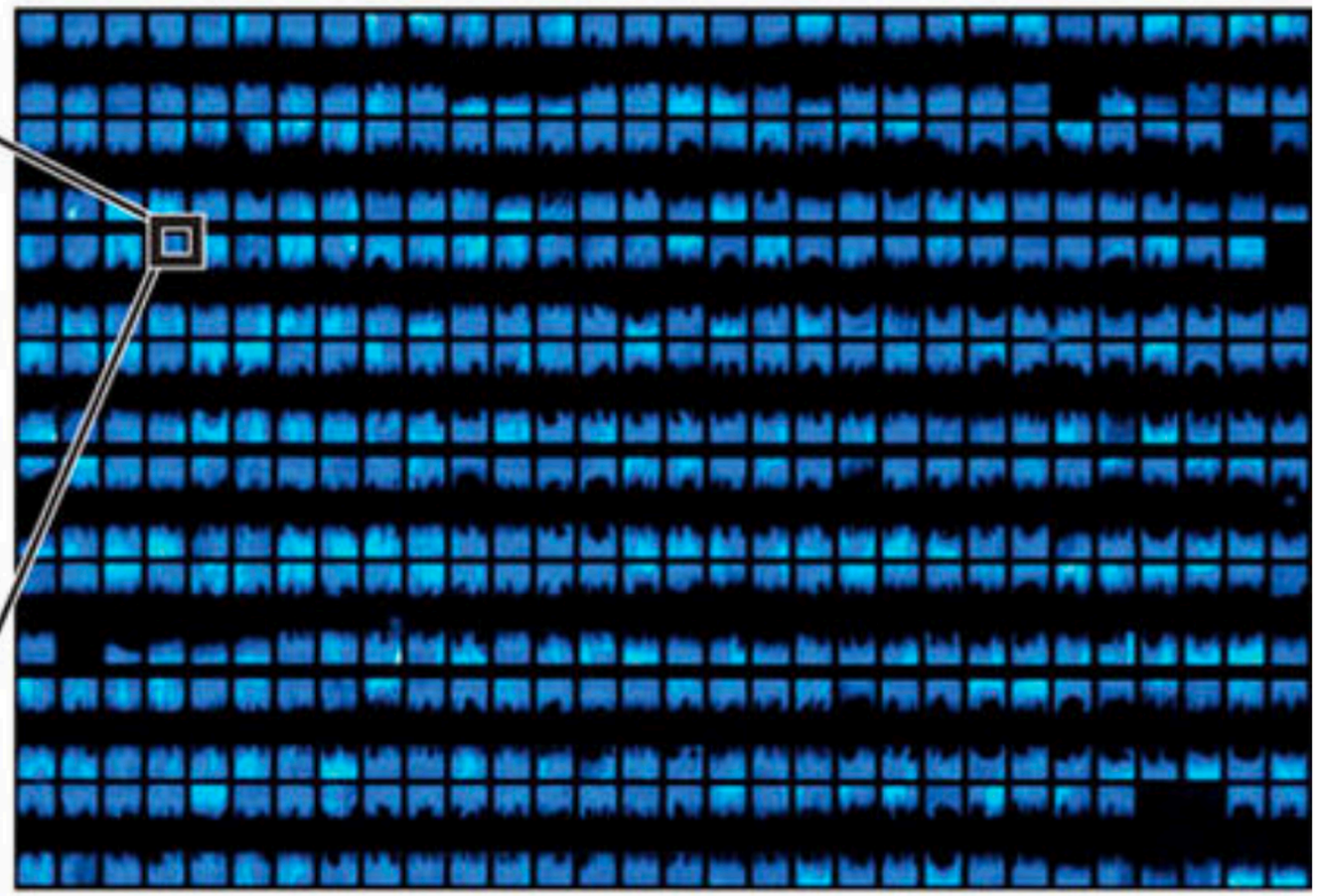
0 min

http://biodynamics.ucsd.edu/

What can we infer about the diffusion of biomolecules in this system?

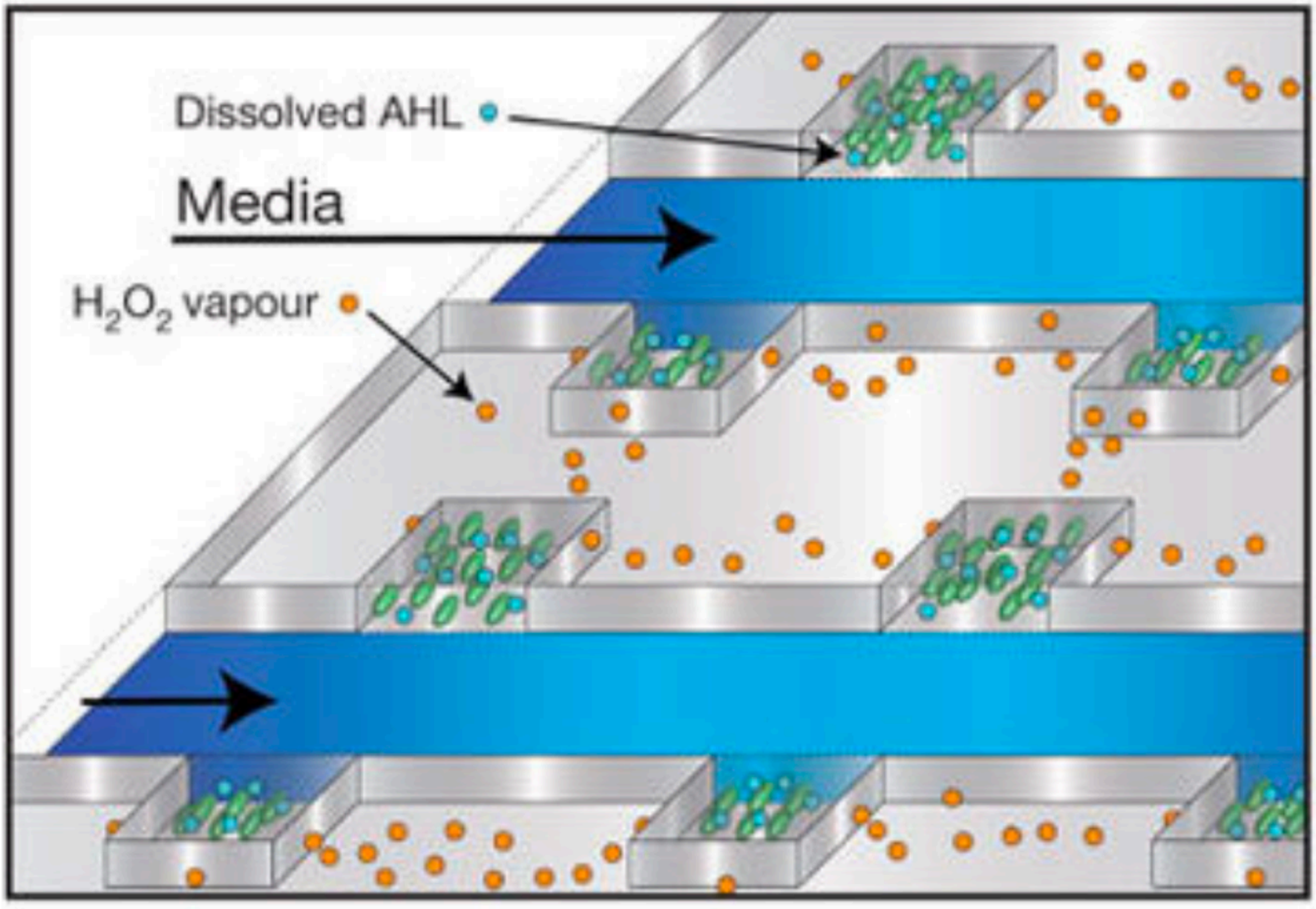






https://www.ncbi.nlm.nih.gov/pubmed/22178928

What can we infer about the diffusion of biomolecules in this system?



https://www.ncbi.nlm.nih.gov/pubmed/22178928

What can we infer about the diffusion of biomolecules in this system?

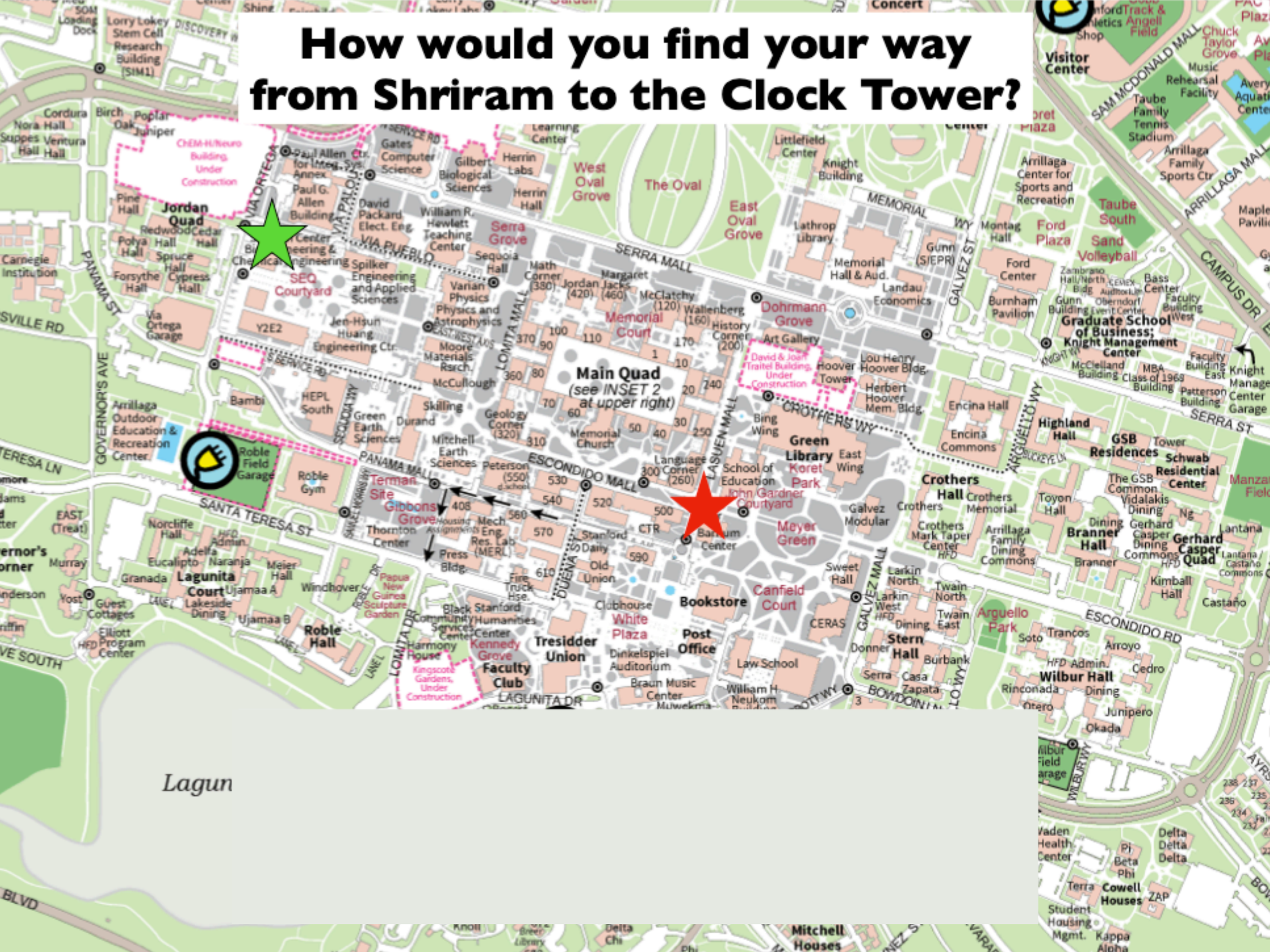
http://biodynamics.ucsd.edu/

What can we infer about the diffusion of biomolecules in this system?

0 min

http://biodynamics.ucsd.edu/

How would you find your way from Shriram to the Clock Tower?

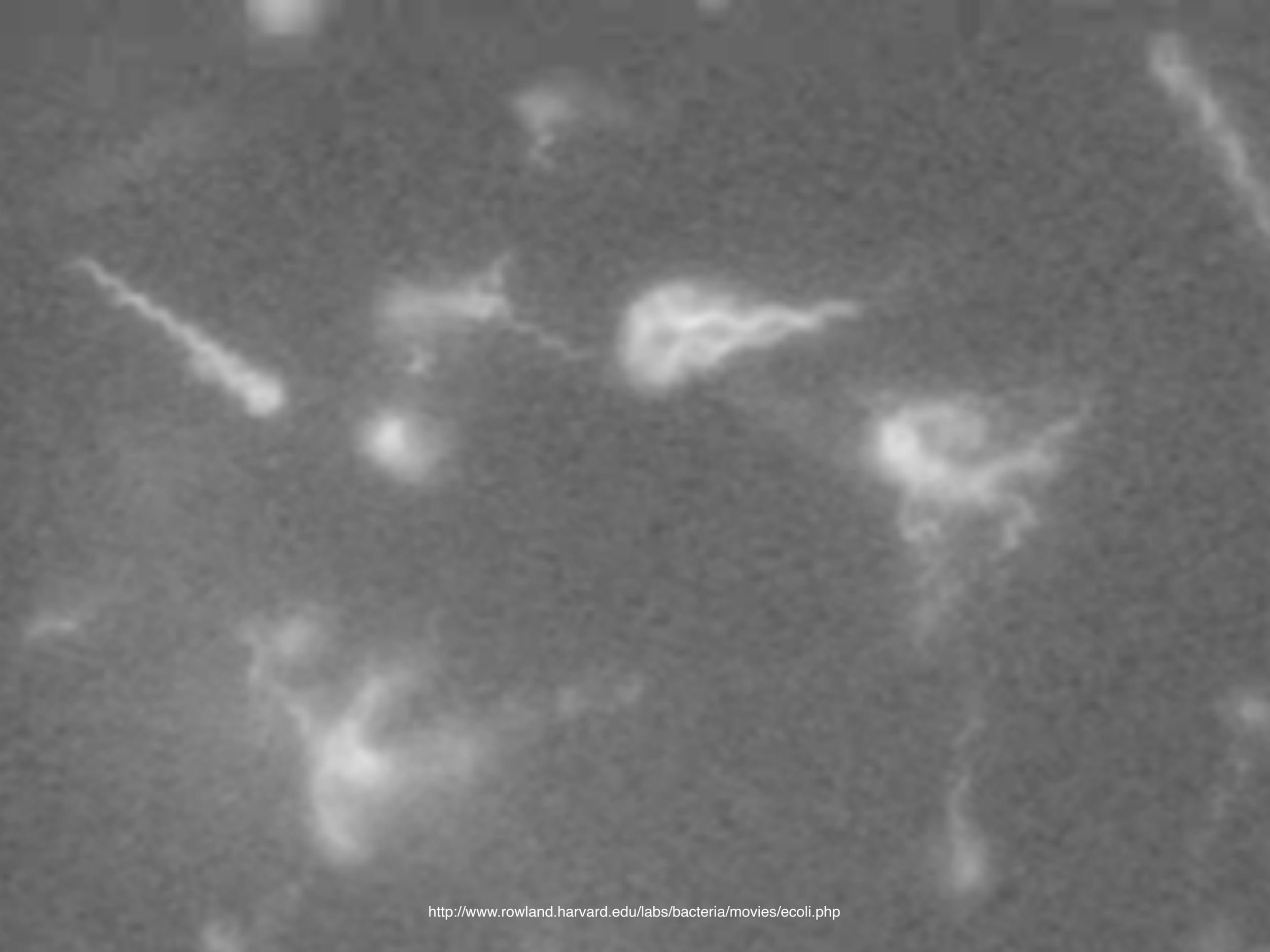


Did you know that *E. coli* routinely solves similar problems?

1. No map
2. No sight
3. No talking (listen only)
4. There's a massive party raging

Bacterial cells swimming near a glass surface, then above the surface

http://www.rowland.harvard.edu/labs/bacteria/movies/ecoli.php



http://www.rowland.harvard.edu/labs/bacteria/movies/ecoli.php