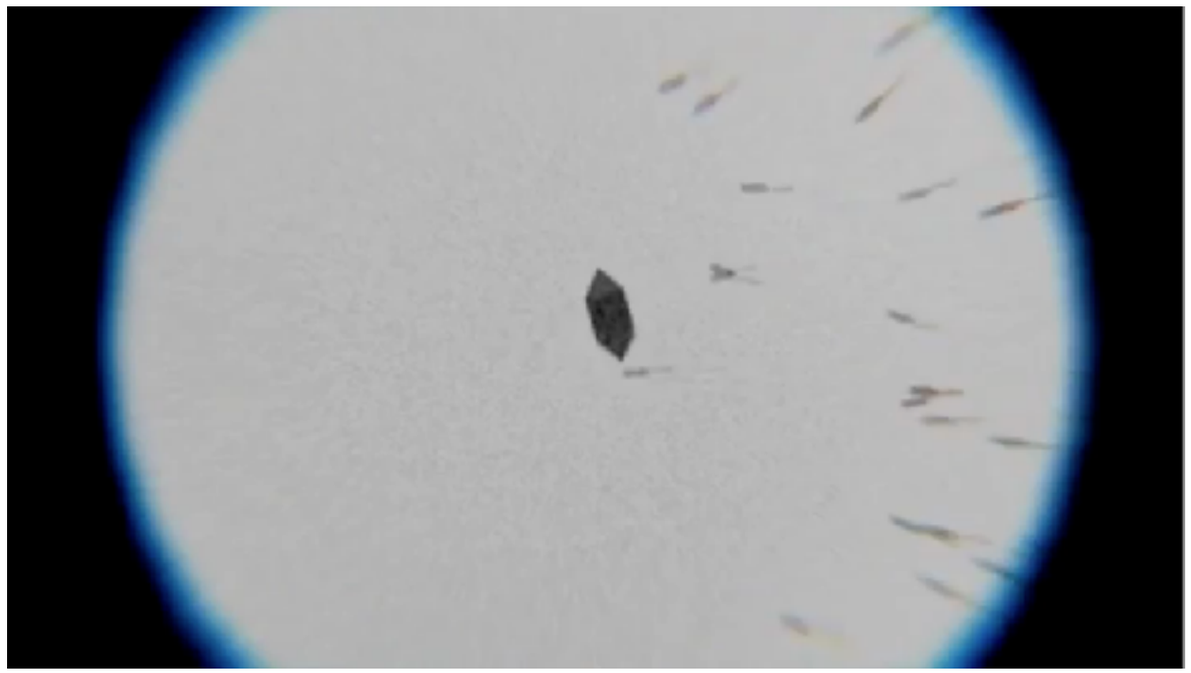
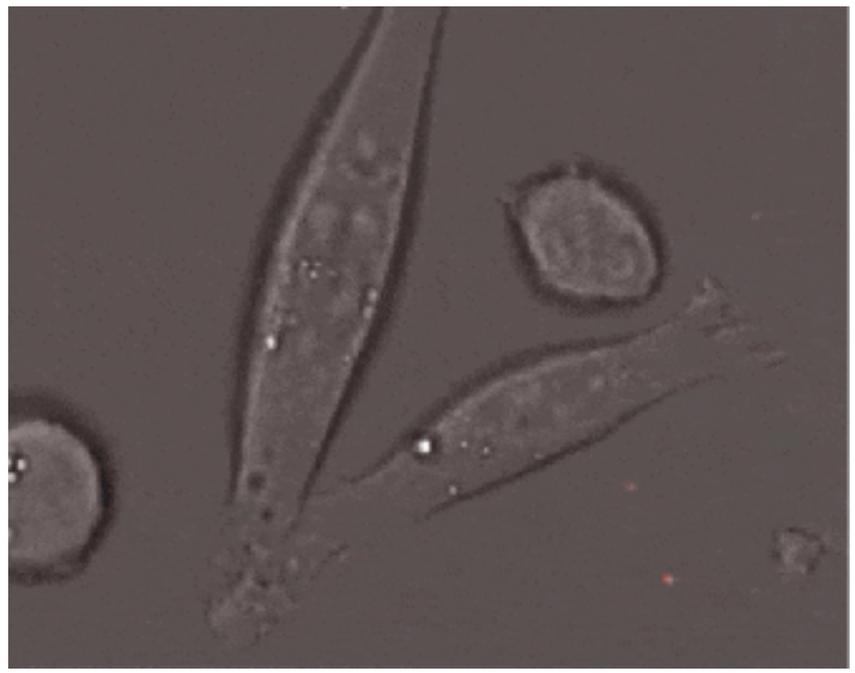
Physics 1A: Classical mechanics & Thermodynamics (NB1140)

Course overview

1. How and why things move

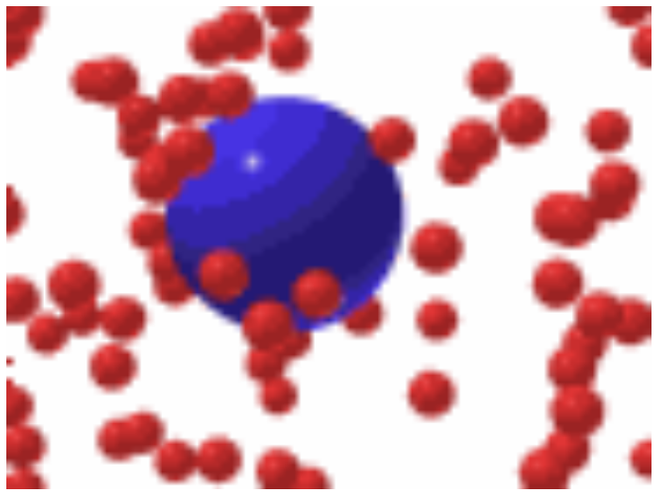


Source: Ribosome Studio, https://youtu.be/F6QMU3KD7zw



From http://cen.chempics.org/

2. How to get energy and create order from randomness



http://physics-animations.com/Physics/English/thermo.htm

15 November 2016

Lectures

Instructor: Hyun Youk

email: hyouk.physics1a@gmail.com
(I will try to answer in the same day)

course webpage: www.youklab.org/teaching/physics1a.html
(I will upload everything here, **not** on Blackboard site)

Lectures: @13:45 ~ 15:45

Tuesdays	in	Aula zaal D
Wednesdays	in	Building 58 (Franklinzaal + Watermanzaal)

official course website (not blackboard)

Physics 1A :: Classical mecha

www.youklab.org/teaching/physics1a.html

Apps | Home - Research P... | The Lab Servant - L...

[Refresh This Page]
Last updated on *November 15, 2016* at *12:13* (CET).

NB1140: Physics 1A - Classical mechanics and thermodynamics

Lecturer: Hyun Youk [hyouk.physics1a@gmail.com]

Lectures: Tuesdays 13:45 - 15:45, Aula Collegezaal D
Wednesdays 13:45 - 15:45, Building 58 Franklinzaal (A2.050) and Watermanzaal (A2.110) combined

Problem solving sections by the Teaching Assistants (TAs): All in building 58. Each student attends only one section.

Max Betjes - Franklinzaal (A2.050) - / **Before midterm exam:** Wed. 15:45 - 16:45 / **After midterm exam:** Wed. 16:45 - 17:45
Tim Allertz - Watermanzaal (A2.110) - / **Before midterm exam:** Wed. 15:45 - 16:45 / **After midterm exam** Wed. 16:45 - 17:45
Teun Huijben - Projectruimte (B2.100) - / **Before midterm exam:** Wed. 15:45 - 16:45 / **After midterm exam** Wed. 16:45 - 17:45
Renske Voerman - Projectruimte (B2.160) - / **Before midterm exam:** Wed. 15:45 - 16:45 / **After midterm exam:** Wed. 16:45 - 17:45

Hirad Daneshpour - Franklinzaal (A2.050) - / **Before midterm exam:** Wed. 16:45 - 17:45 / **After midterm exam:** Wed. 15:45 - 16:45
Federico Fanalista - Watermanzaal (A2.110) - / **Before midterm exam:** Wed. 16:45 - 17:45 / **After midterm exam:** Wed. 15:45 - 16:45
Diego Gomez-Alvarez - Projectruimte (B2.100) - / **Before midterm exam:** Wed. 16:45 - 17:45 / **After midterm exam:** Wed. 15:45 - 16:45
Nisha Klein - Projectruimte (B2.160) - / **Before midterm exam:** Wed. 16:45 - 17:45 / **After midterm exam:** Wed. 15:45 - 16:45

[Course syllabus (PDF)]

Announcements:

[15 November, 16]: Lecture 1 slides posted (for 15 Nov.).

[14 November, 16]: Lecture 1 notes posted (for 15 Nov.).

[12 November, 16]: List of Mastering Physics problems (chapters 2-12) and Problem set 1 posted.

[5 October, 16]: Welcome to the course web page for Physics 1A. Throught the course, I will post everything from our course such as slides, problem sets, and lecture notes here.

Lecture notes and slides:

- Lecture 1 - [notes][slides] (15 November, 2016)

Problem sets:

- Problem set 1 (week 1: 14~18 November, 2016)

Mastering Physics:

- List of Mastering Physics problems (Chapters 2~12)

Quizzes:

Solutions to problem sets:

Exams:

Problem solving sessions

Teaching Assistants: (TAs x 8)

Before the midterm exam

Wednesdays @15:45 ~ 16:45	Max Betjes	(Franklinzaal - A2.050)
	Tim Allertz	(Watermanzaal - A2.110)
	Teun Huijben	(Projectruimte - B2.100)
	Renske Voerman	(Projectruimte - B2.160)
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	Federico Fanalista	(Watermanzaal - A2.110)
	Diego Gomez-Alvarez	(Projectruimte - B2.100)
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Problem solving sessions

Teaching Assistants: (TAs x 8)

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	Renske Voerman	(Projectruimte - B2.160)

Grading scheme

Weekly problem sets:	0 %	
Mastering Physics:	5 %	(web-based problems)
Problem solving sessions with your TA:	5 %	(Attendance + Participation)
Quiz 1:	5 %	(23 Nov. 2016)
Quiz 2:	5 %	(7 Dec. 2016)
Midterm exam:	35 or 45 %	(14 Dec. 2016)
Quiz 3:	5 %	(11 Jan. 2017)
Quiz 4:	5 %	(25 Jan. 2017)
Final exam:	35 or 45 %	(1 Feb. 2017)

Weekly problem sets: 0%

- New problem set on course webpage every Monday
- Each Monday, solution to previous week's problems go on web
- You are told which problems from the problem set will appear in the following week's quiz.

- ~1/3 of midterm and final exam problems will be identical or similar to problems in the problem sets
- Answers are already given to many of the problems.
- Important: ***How*** you get the answer, **not** the final answer itself.

Mastering Physics: 5%

- Mastering Physics access code (if you didn't buy it):

ISSWEU-KAROO-CUTCH-DIVAN-CABBY-SOUSE

(register online at: www.masteringphysics.com)

Enroll in the following course:

course ID: *TUDELFTPHYSICS1A2016*

Make sure you enter your name + student ID # correctly!

- All "mastering physics sessions" for the midterm are now online
- Answer at least 50% of the questions (for each session)
- Each session corresponds to a book chapter.
- **No** penalty for wrong answers
- Based on **effort**: you get 0, or 1.25%, or 2.5% (before midterm)

0, or 1.25%, or 2.5% (after midterm)

Quiz (x 4): 20%

- 5% per quiz, every two weeks
- 2 quizzes before midterm exam, 2 quizzes after midterm exam
- Each quiz is 10 minutes, at beginning of problem solving session
- You know beforehand which question will be on each quiz
- To many problems, you are given the answer.
- On Monday, solutions posted
  (but not the solutions to problems that will be on the quiz on Wed.)
- Spend the time, try to solve **by yourself**, ***before*** looking at solutions
- Important: ***How*** you get the answer, **not** the final answer itself.

Midterm exam: 35% or 45%

- 3-hour exam on Wednesday 14 December 2016
- No need to register beforehand

- Worth 35% if Quiz 1 + Quiz 2 grade is high
- Worth 45% if Quiz 1 + Quiz 2 grade is low

- Covers all material that you learned **before** the midterm exam

- 1/3 are identical / similar to problem set questions
- 1/3 are identical / similar to mastering physics questions
- 1/3 are new problems (but doable if you know the other 2/3)

No surprises: If you spent time on Mastering Physics + Problem sets

Final exam: 35% or 45%

- 3-hour exam on 1 February 2017
- Must register beforehand

- Worth 35% if Quiz 3 + Quiz 4 grade is high
- Worth 45% if Quiz 3 + Quiz 4 grade is low

- Covers all material that you learned **after** the midterm exam

- 1/3 are identical / similar to problem set questions
- 1/3 are identical / similar to mastering physics questions
- 1/3 are new problems (but doable if you know the other 2/3)

No surprises: If you spent time on Mastering Physics + Problem sets

Attendance & participation in TAs' sections: 5%

- Goals: - Learn problem solving techniques
  - See example problems being solved

- Get to know your TA
- TA is randomly assigned to you.
- Go to your own section; **No** credit if you go to another TA

- Your TA is there to help you solve problems
  (not there to just give you answers)

- Quizzes are at the beginning of your TA's section
- Your TA grades your Quizzes

- Your TA gives you either 0, or 2.5%, or 5%
  (for attendance & participation)

Goals of this course

1. Get comfortable with doing math with **symbols**
(Move away from calculators, move towards algebra with symbols)

2. Learn to **derive** formulas, from just a **few basic rules** of physics
(Step-by-step calculations to final answer.)

3. **No** more: memorizing / looking up formulas
and then plugging in numbers

4. Develop **skills** and **confidence** in **problem solving**
(through practice, practice, practice …)

Before each lecture

- Read and try the problems in the book on your own

  (See course outline for schedule of topics & book chapters)

During sessions with your TA

- Ask for help with problem solving.

  Good: “How do you do this kind of problem?”

  Bad: “What is the answer to this problem?”

During lectures

- Practice derivations using symbols
- Learn applications to biology
- Ask questions

Who are these people?

What do these people have in common?

Galileo Galilei

1564-1642

René Descartes

1596-1650

Euclid

?? to ~ 300 BCE

Answer: These and others never understood most of what you'll learn in this course

Galileo Galilei

1564-1642

René Descartes

1596-1650

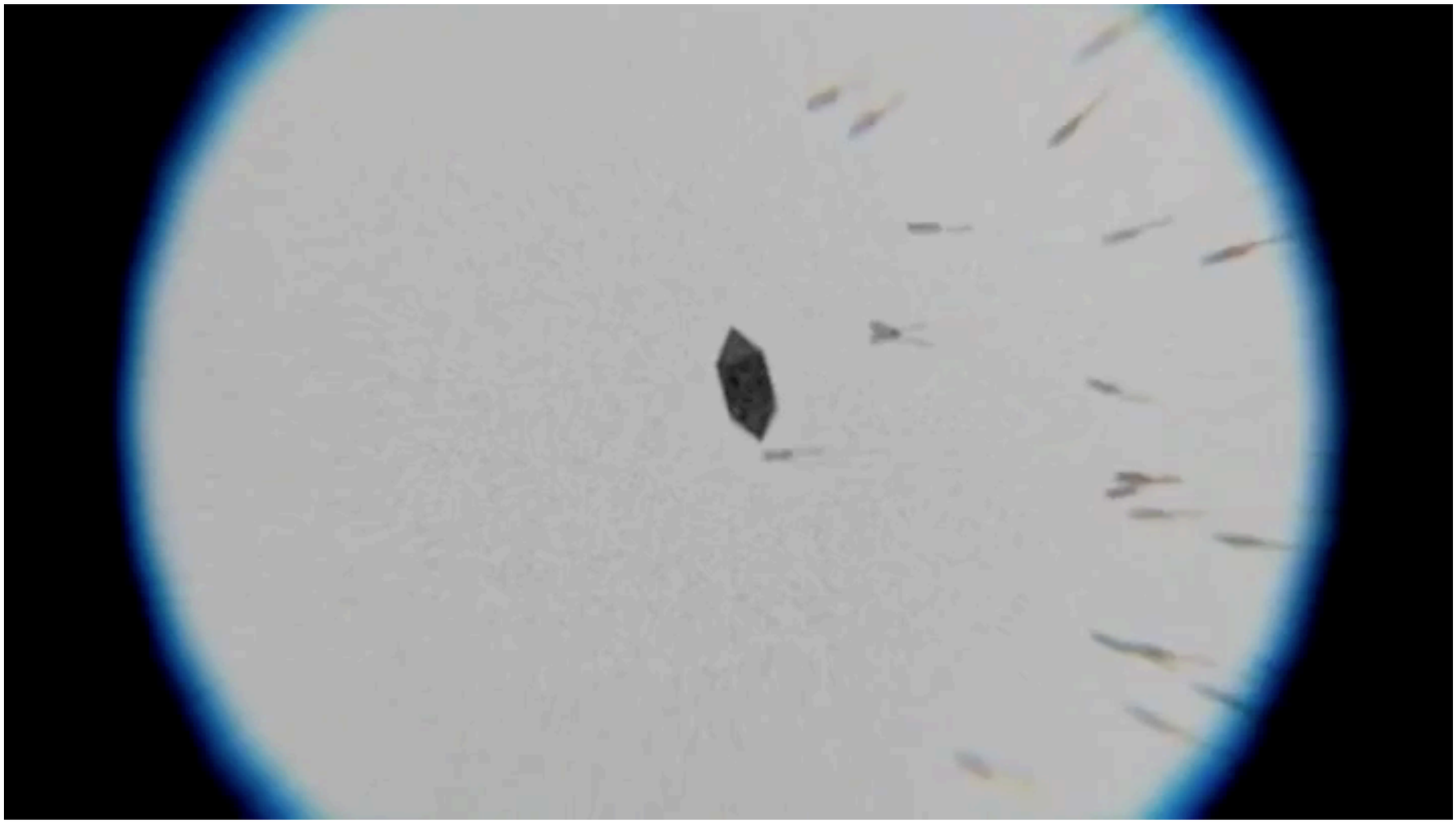
Euclid

?? to ~ 300 BCE

Contents of this course

Mathematical description of motion: Living and non-living world

Chemotaxis: Bacterium *E. coli* swimming towards sugar crystal

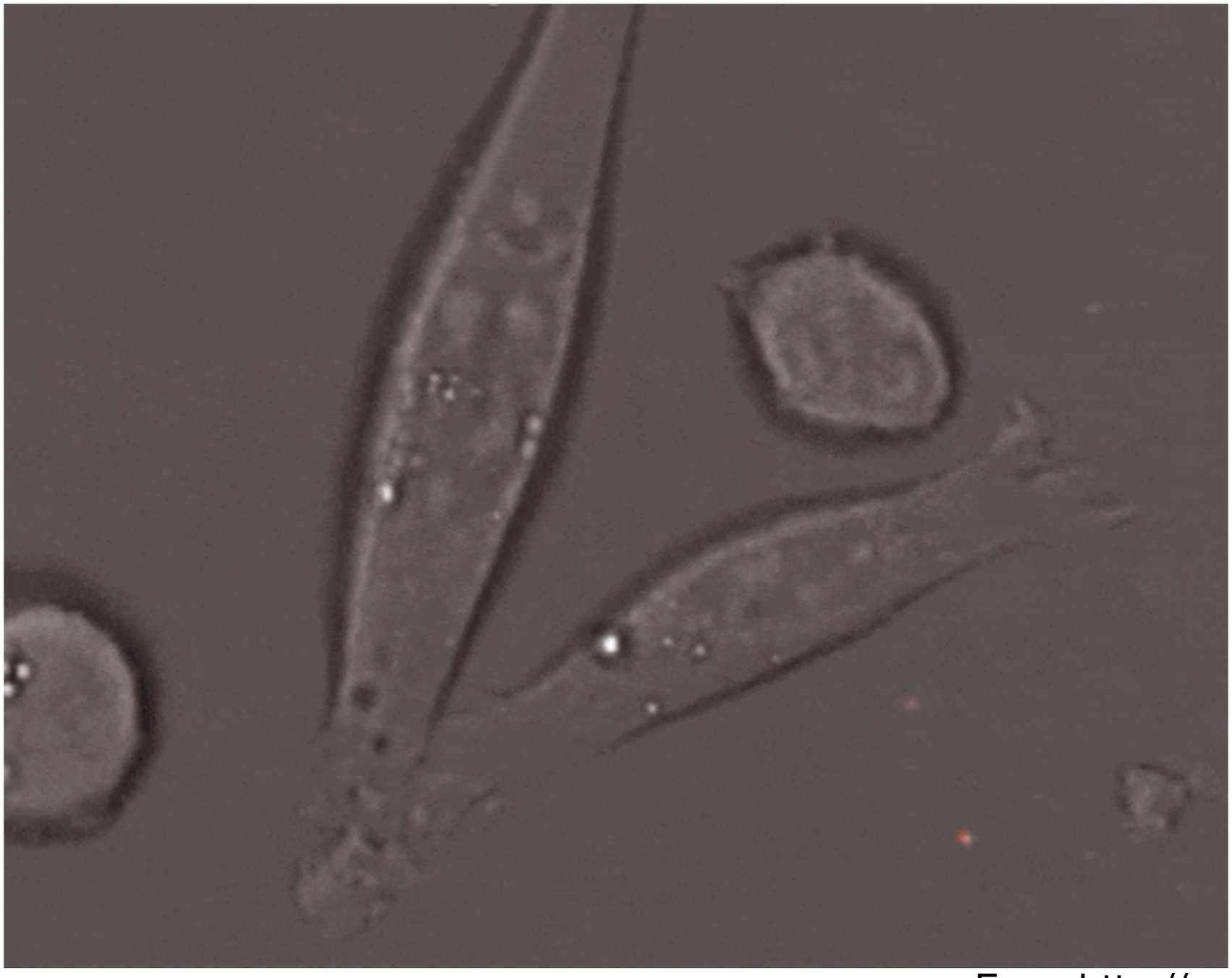


Source: Ribosome Studio, https://youtu.be/F6QMU3KD7zw

Contents of this course

Mathematical description of motion: Living and non-living world

Chemotaxis: T-cell swims to and kills a cancer cell

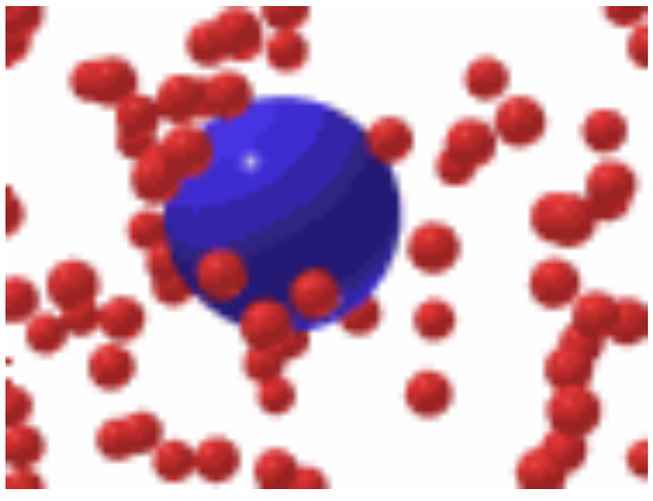


From http://cen.chempics.org/

Contents of this course

Thermodynamics: Order from heat and molecular chaos

Diffusion: Blue particle constantly bombarded by red particles



http://physics-animations.com/Physics/English/thermo.htm

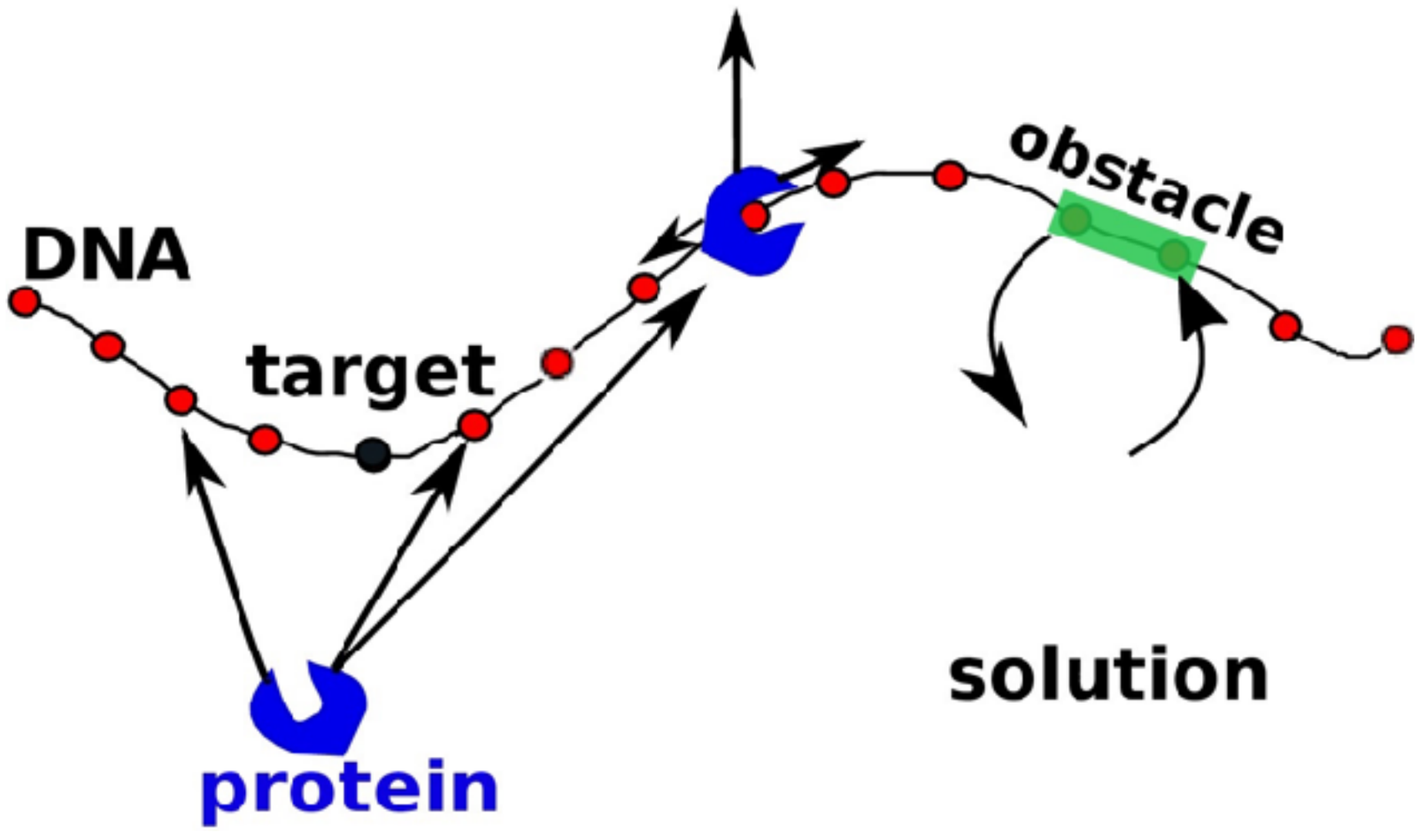
e.g. Blue particle = protein inside a cell

Red particle = water molecules inside a cell

Contents of this course

Thermodynamics: Order from heat and molecular chaos

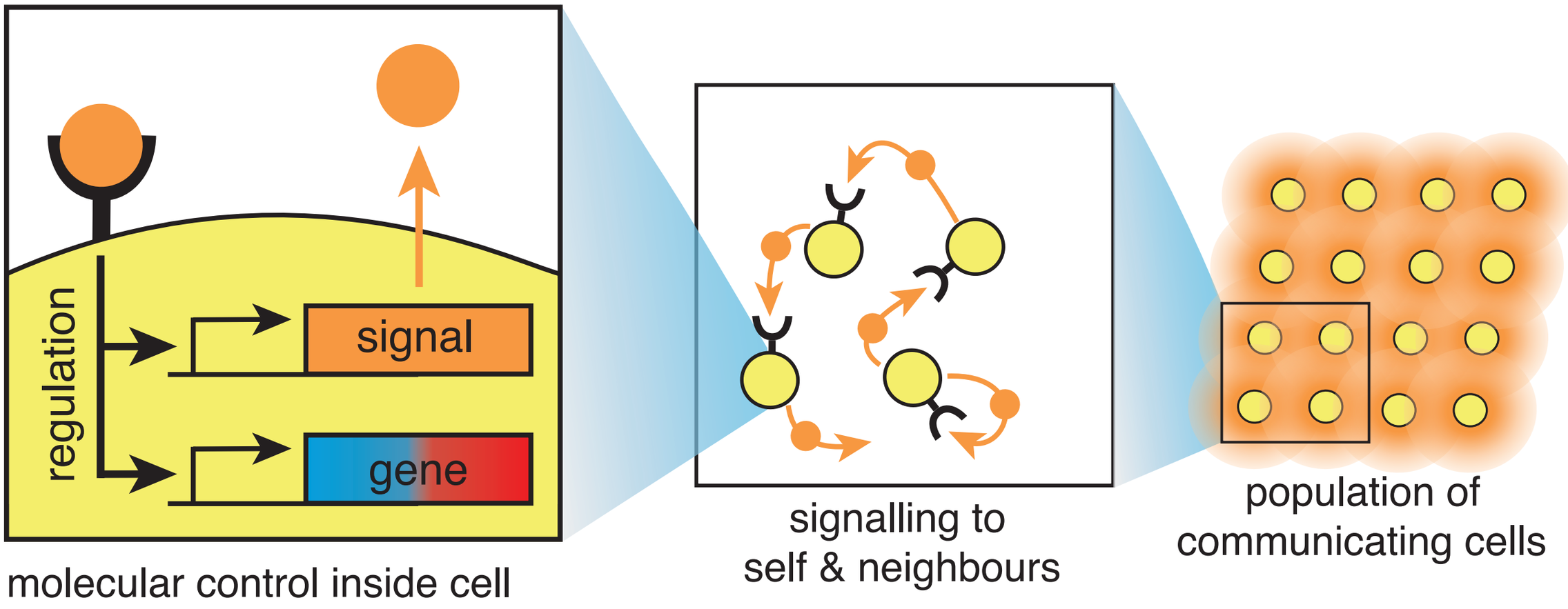
Diffusion: Protein (transcription factor) finding target site on DNA



http://news.rice.edu/2015/12/10/obstacles-not-always-a-hindrance-to-proteins/

- Challenge 1: Mind boggling # of parameters
- Challenge 2: What are the right metrics for living systems?

Example: Hundreds of cells talking to each other
to turn ON/ OFF each others' genes



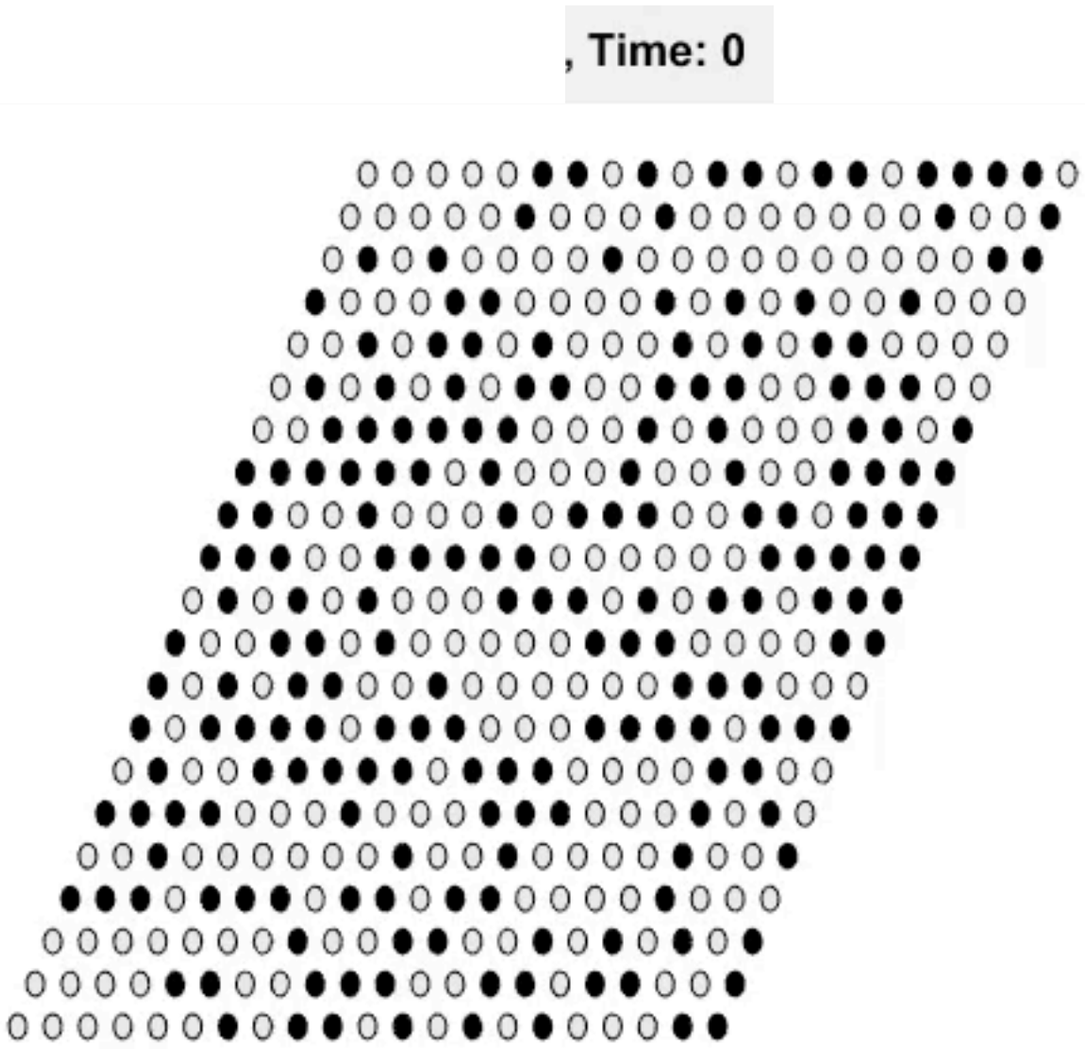
molecular control inside cell

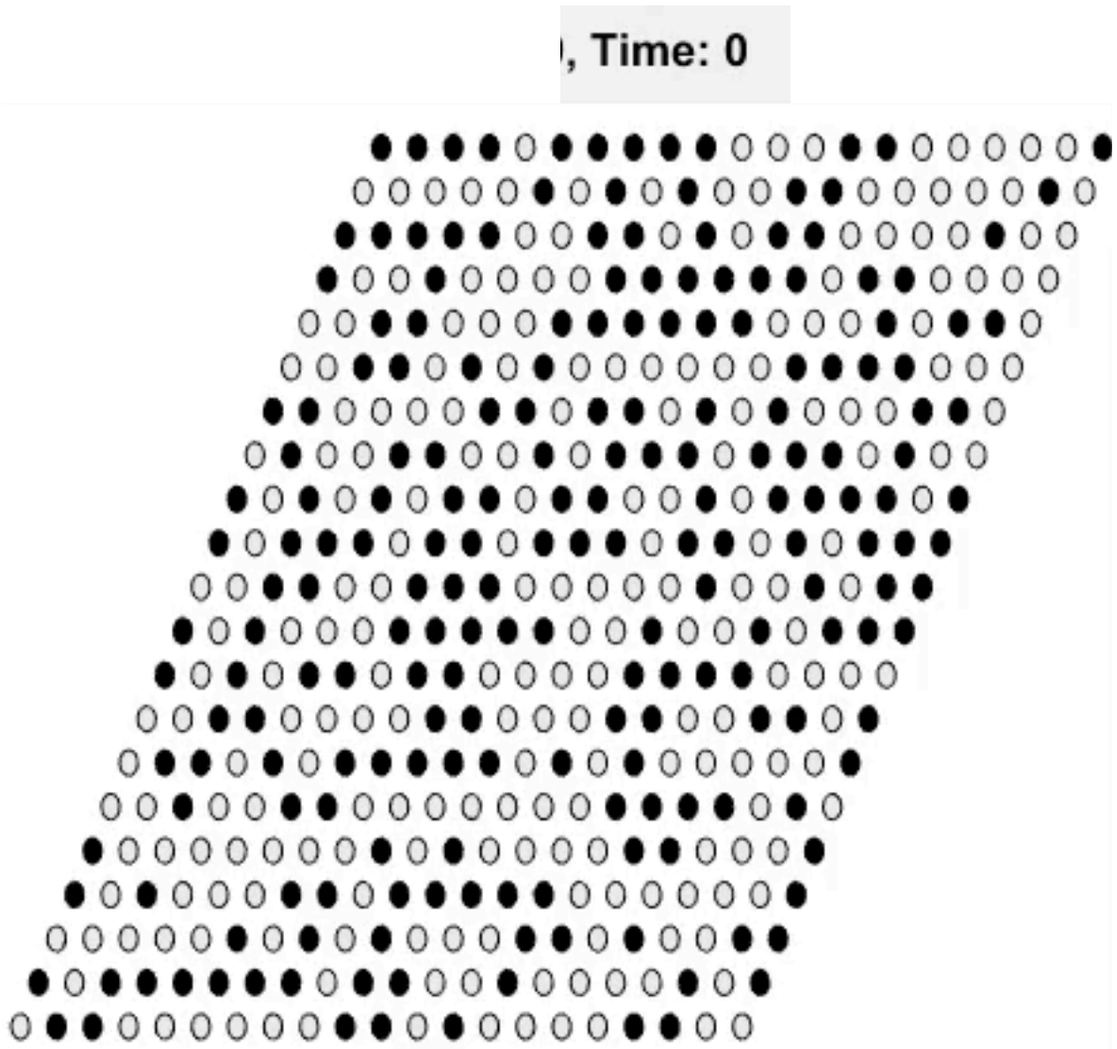
signalling to
self & neighbours

population of
communicating cells

- Challenge 1: Mind boggling # of parameters
- Challenge 2: What are the right metrics for living systems?

Can you predict what pattern will form
without knowing what each cell does?



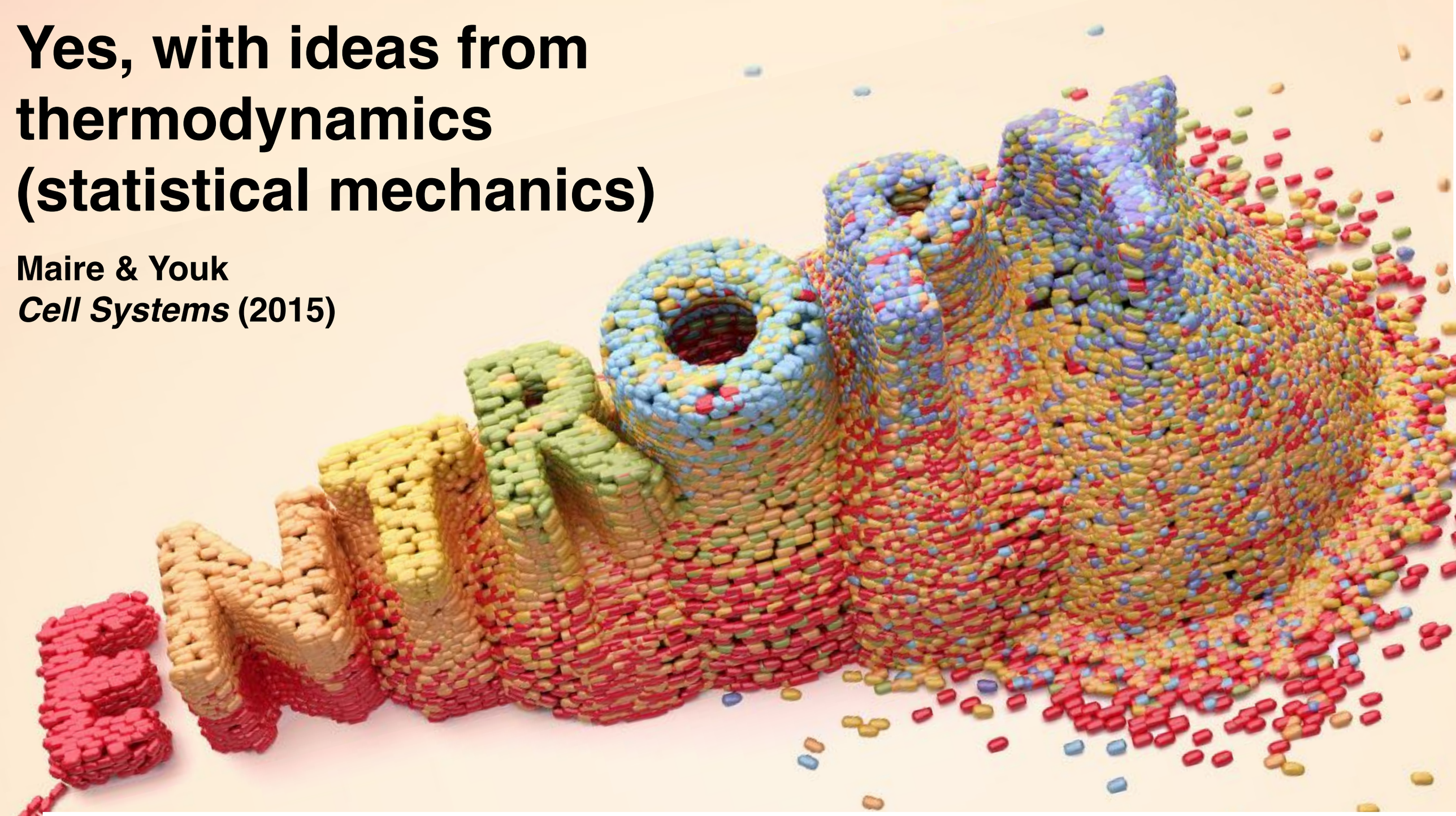


cell with gene OFF

cell with gene ON

Yes, with ideas from thermodynamics (statistical mechanics)

Maire & Youk
Cell Systems **(2015)**



Ludwig Boltzmann, who spent much of his life studying statistical mechanics, died in 1906, by his own hand. Paul Ehrenfest, carrying on the work, died similarly in 1933. Now it is our turn to study statistical mechanics.

Perhaps it will be wise to approach the subject cautiously. We will begin

Excerpt from “States of Matter” by D. Goodstein