

Physical Principles in Biology
Biology 3550
Spring 2025

Lecture 1: Introduction to Class

Monday, 6 January 2025

©David P. Goldenberg
University of Utah
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Course topics:

- Measurement, units and dimensions
- Probability
- Random walks and diffusion
- Energy and Thermodynamics
- Molecular motors

A general theme: The conversion of random thermal motion into directed chemical change and motion that makes life possible.

Course Mechanics

Instructor

David P. Goldenberg
306 Aline Skaggs Biology Building
goldenberg@biology.utah.edu

Office hours:

- Thursdays: 1:00 - 2:00 PM
In person, ASB 306
- Other times by appointment.
(Send me an e-mail message!)

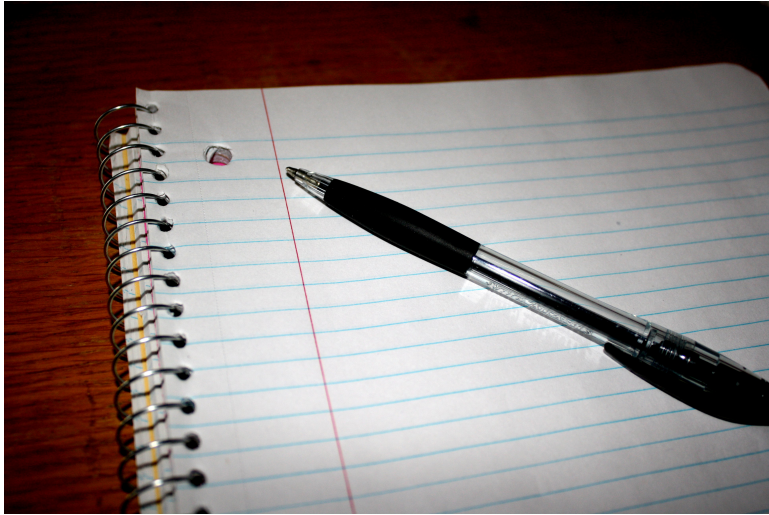
Teaching Assistant

Ian James
u0398270@utah.edu

Electronic Etiquette Policy

- The use of cell phones, tablets or laptop computers will not be allowed during lectures.
- Exceptions will be made for special accommodations.
- Cell phones may be used in cases of emergency.
- Please feel free to talk with me about any special problems this policy may create for you.

A Recommended Alternative to Electronic Screens



An Occasional Response to the Electronic-device Policy

- Who is Goldenberg to tell me what is the best way to take notes?
- It's not all about you!
The policy is meant to improve everyone's experience in class.
The absence of electronic devices helps keep everyone engaged.
Electronic devices are distracting to those around you!

Course Mechanics

Lectures

- Monday, Wednesday, Friday: 9:40 - 10:30 AM
- Room 2010 Henry Eyring Building (HEB)
- Slides will be posted on Canvas after class.
- Clickers
 - iClicker+ and iClicker 2 devices are supported.
 - iClicker app for mobile devices will not be supported for this class!
 - iClicker+ is available at the Bookstore for \$44.95.
 - License cost is covered by School of Biological Sciences.
 - Responses (and other activities) will count for 5% of total class grade.
 - Have a calculator handy!
 - Lowest five scores will be dropped.

Other Ways to Earn “Clicker” Points

- **Group problem solving sessions.**

Periodically, part of the class time will be devoted to problem solving, with students working in groups of two or three.

- **Special homework assignments**

One or a few short homework assignments, in addition to the bigger ones described below.

- **Catch out the prof!**

Points will be given for finding errors in the lecture notes or the slides used in class.

To count for points, errors on the lecture slide have to be caught before the instructor catches them in class!

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Textbook

- Lecture notes/text available on Canvas and at:
http://goldenberg.biology.utah.edu/courses/biol3550/courseMaterial_3550.shtml
- Provided as pdf files.
- Please let me know if you need the notes in another format.

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Problem Sets

- Total of about six assignments.
- Graded (30% of course grade).
- Submitted as pdf files through Gradescope (must be typed).

Quizzes

- Five quizzes, on: 24 Jan., 7 Feb., 21 Feb., 28 March., 11 April.
(All Fridays, dates subject to change.)
- 25 minutes, in second half of class session.
- Each will cover material since last quiz or mid-term exam.
- 30% of course grade.
- Lowest quiz score will be dropped.

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Mid-term Exam

- Friday, 17 March (date subject to change).
- 50 minute exam.
- Will cover all prior material.
- 15% of course grade.

Final Exam

- 8:00 - 10:00 AM, Friday, 25 April.
- Cumulative, covering the entire course.
- 20% of course grade

Academic Integrity and Honor Code

■ For homework assignments:

- You may: Work with other students; ask questions of the instructor; use internet or other resources, with proper attribution.
- You may not: Turn in work that is identical to that of other students; use Chegg, ChatGPT or other sources that provide answers to the specific problems.

■ For quizzes and exams:

- You may: Communicate with the instructor.
- You may not: Communicate with anyone else (except in dire emergencies); use notes, books or any other resource, including the internet.

■ You must complete the Canvas module on Academic Integrity and the Honor Code:

- Read the Honor Code statement.
- Complete the quiz with a perfect score!

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Grade Breakdown

- Clicker responses: 5%
- Homework: 30%
- Quizzes: 30%
- Mid-term exam: 15%
- Final exam: 20%

Maximum Grade Cutoffs

- A: 92-100% (including A-)
- B: 82-91% (including B- and B+)
- C: 70-81% (including C- and C+)
- D: 60-69%
- E: < 60%
- Cutoffs **may** be adjusted **downwards**.

How to Succeed in this Class

- Stay healthy!
- Come to class *prepared to participate*.
 - Read the online notes/text.
 - Review the slides from the previous lecture.
 - Bring questions about what you don't understand.
- Do the problem sets to learn.
 - Start early.
 - Work with a group.
 - Work with a group the smart way.
Don't rely on the "smart" person!
- Use the quizzes and exams from previous years to learn.
 - Answers will not be provided.
 - Work on your own to solve the problems.
 - Then ask other students, the TA or me.
- If you have problems, come talk to me!

Course Mechanics

Other Administrative Stuff

- Faculty and Student Responsibilities
- Special Accommodations
- Academic Conduct
- Title IX: Addressing Sexual Misconduct
- University Safety Statement

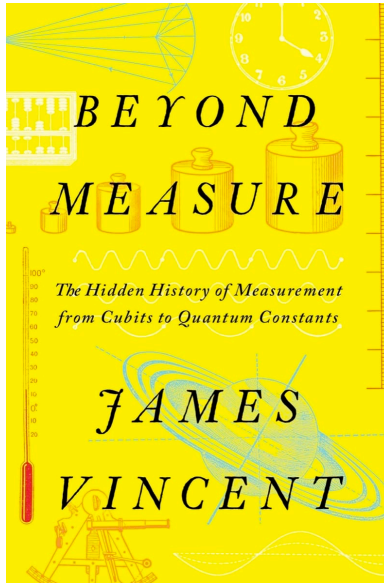
See the class web page and syllabus:

<http://goldenberg.biology.utah.edu/courses/biol3550/>

Warning!



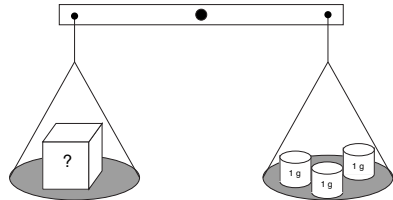
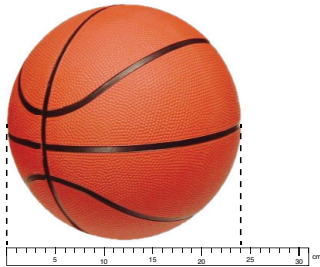
Direction Change



Vincent, J. (2022). *Beyond Measure: The Hidden History of Measurement from Cubits to Quantum Constants*.
W. H. Norton. <https://wnorton.com/books/9781324035855>

The Scale of Things: Units and Dimensions

- Nearly all measurements are comparisons.



- Are there measurements that don't involve comparisons?
- What are some obvious things to use for comparison to measure length?

A Famous Prank at MIT (1958)

Measurement of the Harvard Bridge (Boston to Cambridge, MA)
in Smoot Units (the height of Oliver Smoot, class of 1962)

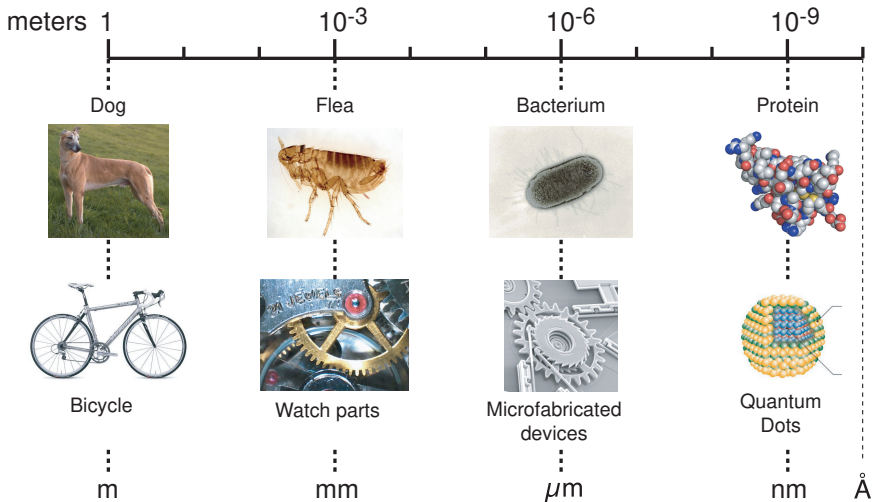


- 1 smoot = 1.7 m (5 ft 7 in)
- Length of the Harvard Bridge: 364.4 smoots \pm one ear

Official Recognition of the Smoot



Length Scales for Biological and Human-manufactured Objects



Dimensions versus Units

- Dimension: A quantity like length, mass, volume, *etc.* that can be expressed in different but interchangeable units.
- Unit: A specific reference for expressing a dimension, *e.g.*, m, mm or smoot.
- Different units for the same dimension can be directly compared with one another, but units for different dimensions cannot be.

We can compare 1 m and 1 smoot, but not 1 m and 1 gram.
- There is a whole discipline, called metrology, that deals with measurement and the standardization of units.