

PHYS 225

Fundamentals of Physics: Mechanics

Prof. Meng (Stephanie) Shen
Fall 2024 (SGMH1506, Tu Th 5:30 pm - 6:45 pm)
Lecture 1: Introduction | measurement

Agenda

- Class information
- Learning goals
- Break-the-ice
- What do we do in class?
- **Chapter 1: Measurement, units**

Class information: Fundamentals of Physics: Mechanics (PHYS 225)

- **The instructor**

Dr. Meng (Stephanie) Shen

Assistant professor, Dept. of Physics

Email: meshen@fullerton.edu ✓

Meetings: Interactive lectures Tu Th 5:30 pm - 6:45 pm

Office hours: Tu TBA, or right after every class

or by appointment

MH652 or by zoom

- **SI leader:** Jon Priyjanonda

Tu Th 4:00 pm – 5:15 pm MH600

- **The syllabus**

The syllabus is on the “Syllabus” page on Canvas

- **Co-requisite**

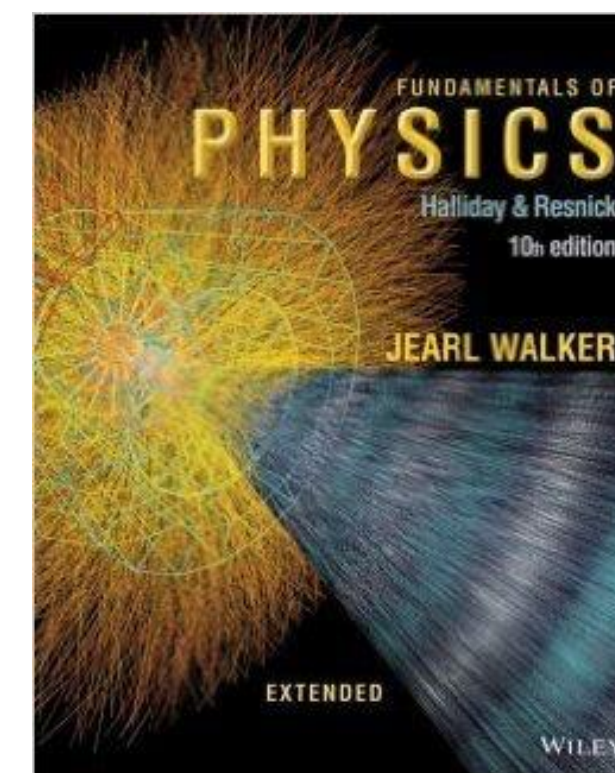
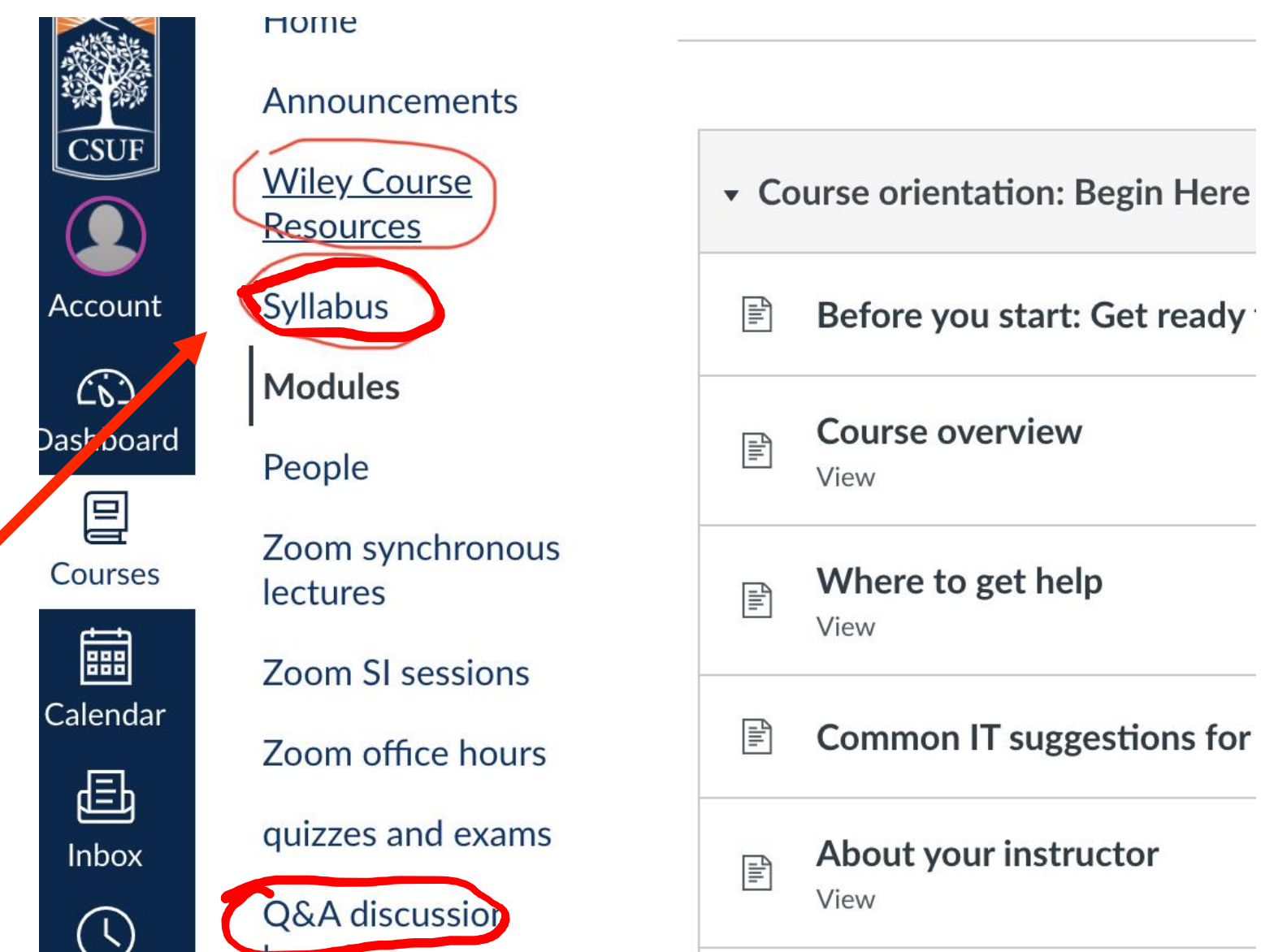
PHYS225L, MATH 150A: Calculus I

- **Textbooks**

Required eTextbook: Wiley Course Resources, complete assignment0 on Canvas course to gain access

Recommended textbooks: Fundamentals of Physics, 11th Edition, Halliday and Resnick

University Physics Volume 1, Samuel J. Ling, Jeff Sanny and William Moebs (free online)



Learning goals and tools to help you succeed in this course

- **Learning goals**

- Learn fundamental concepts of physics: Mechanics
- Apply fundamental concepts to solve problems, such as:
 - ▶ Motion of a car
 - ▶ Rotation of the wheel
 - ▶ Etc.
- Develop communication skills

*** Getting good grades is important for you, but is **not** a learning goal! If you understand the materials well and know how to solve problems, you will earn good grades.

- **Learning tools**

- Pre-lecture surveys — Prepares you for the upcoming chapter
- Classroom activities
- Effective note-taking — take note of important points instead of simply copying everything down
- Homework
- Office hours: **Ask for help!**

About note taking

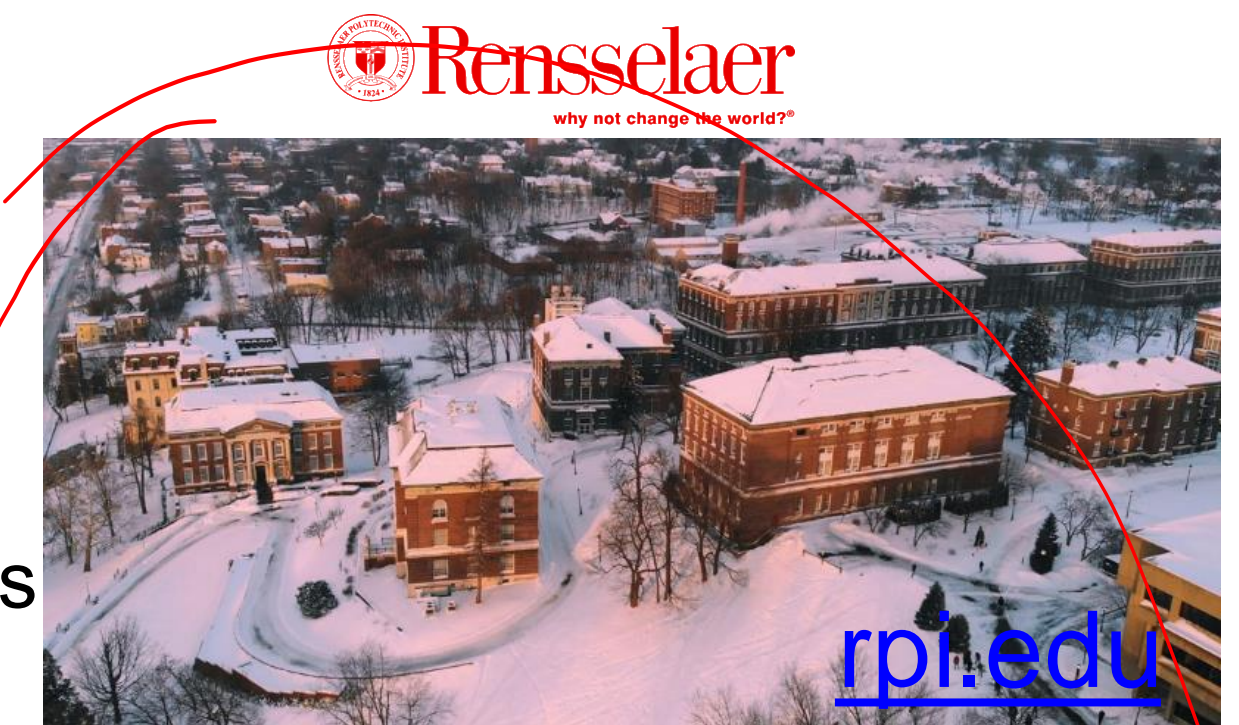
- Effective note-taking is crucial to enhance your understanding and engagement
 - Write down key points and concepts, as what I write in class won't stay
 - However, please don't try to write down everything! That will distract you from learning in this course
 - Identify and take notes of what is important for your understanding

Who am I?

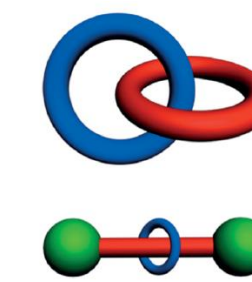
- Dr. Meng Shen,
Assistant Professor of Physics
Email: meshen@fullerton.edu
Office: MH652
- Studied and did research at:
Rensselaer Polytechnic Institute (RPI), Troy, NY
Northwestern University, Evanston, IL
The University of Chicago, Chicago, IL
- Now teaching and doing research at CSUF



RPI: Leadership in Nasa's Manned Lunar Landing ¹



rpi.edu



Dr. Stoddart: Nobel Laureat in molecular motors



Northwestern University



northwestern.edu



uchicago.edu

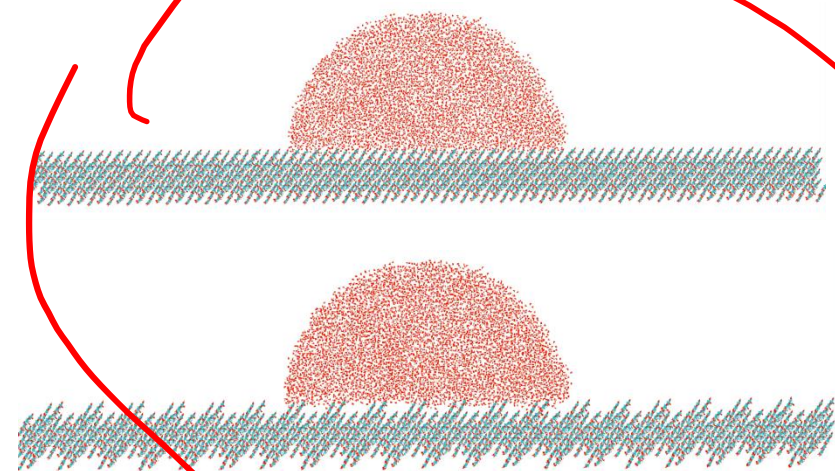


fullerton.edu

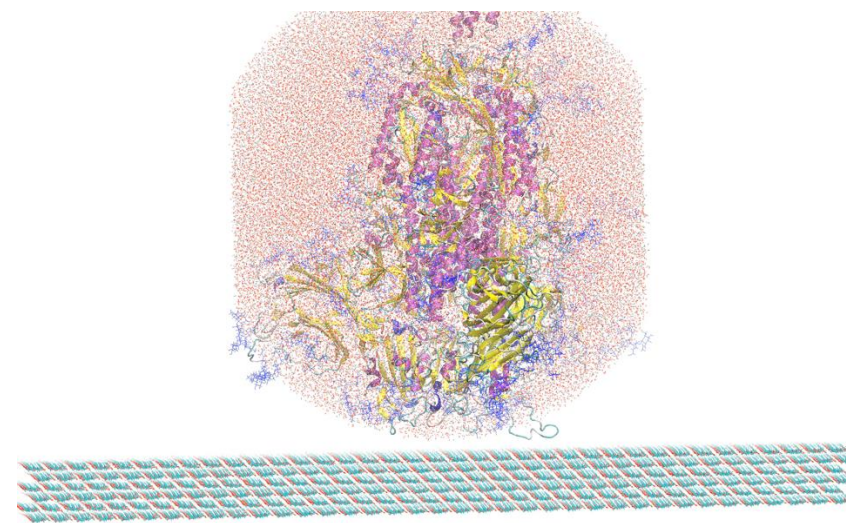
My research at CSUF



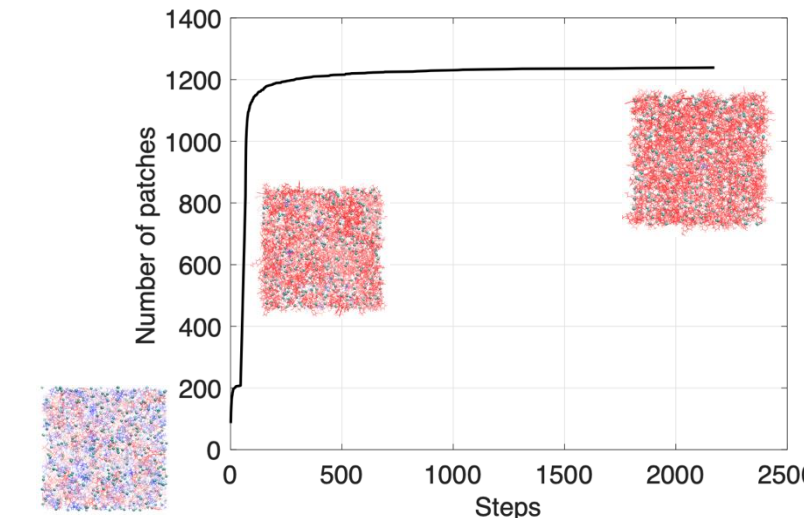
- Computational and theoretical soft matter physics



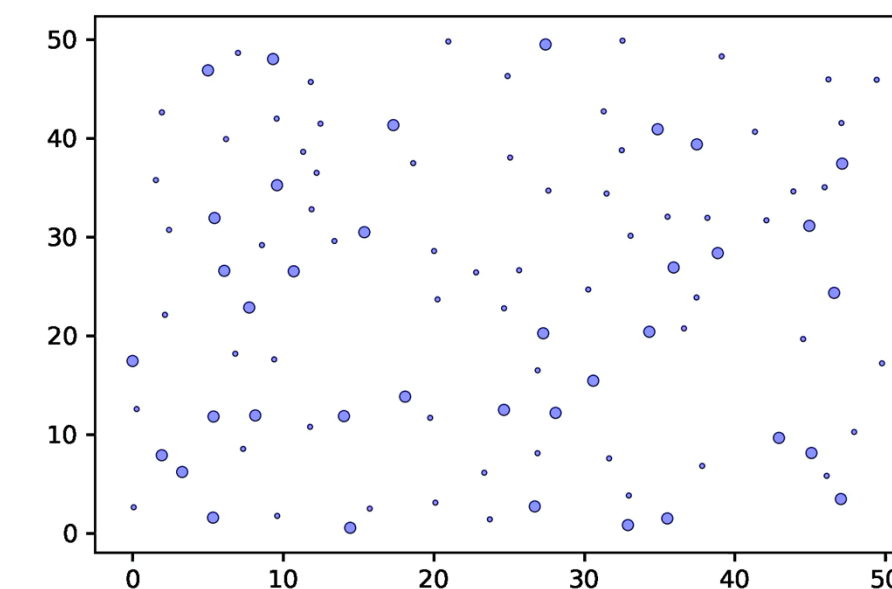
How does the surface pattern affect wetting?



How do virus interact with surfaces at bio-interfaces?



How do clusters grow in polymer cross linking?

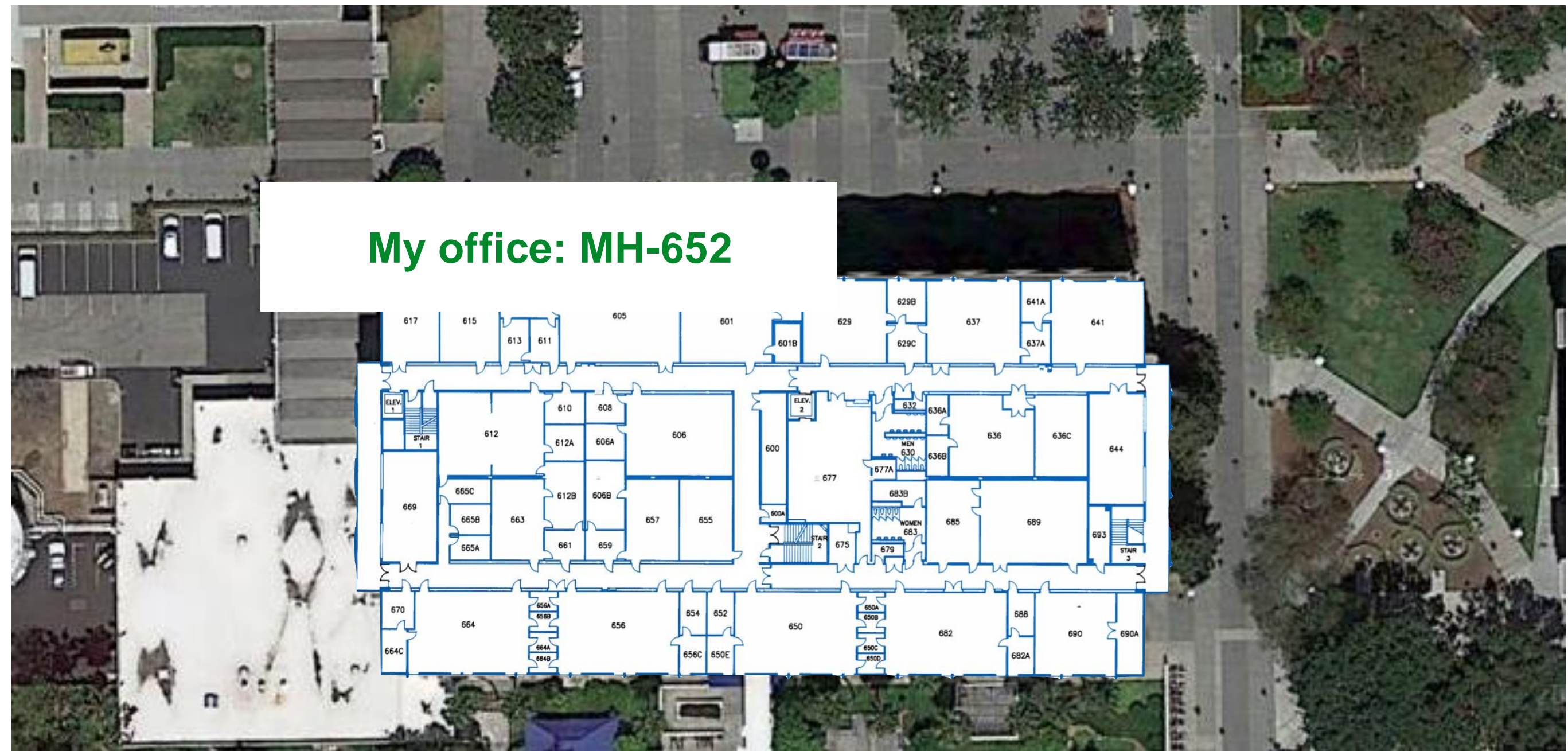


How do particles self assemble?

- Website of my research group: mengshenlab.com
- We have research opportunities for CSUF students!

Where to get help?

- Office hours: Tu (TBA), or right after every class, or by appointment



- SI: Jon Prijanonda
- Canvas: Q & A discussion board
- IT questions: Student HelpDesk

What makes a good first day of classes

- Curiosity

- In this class, you will learn about the physics that governs many phenomena you see in daily life

- **Community**

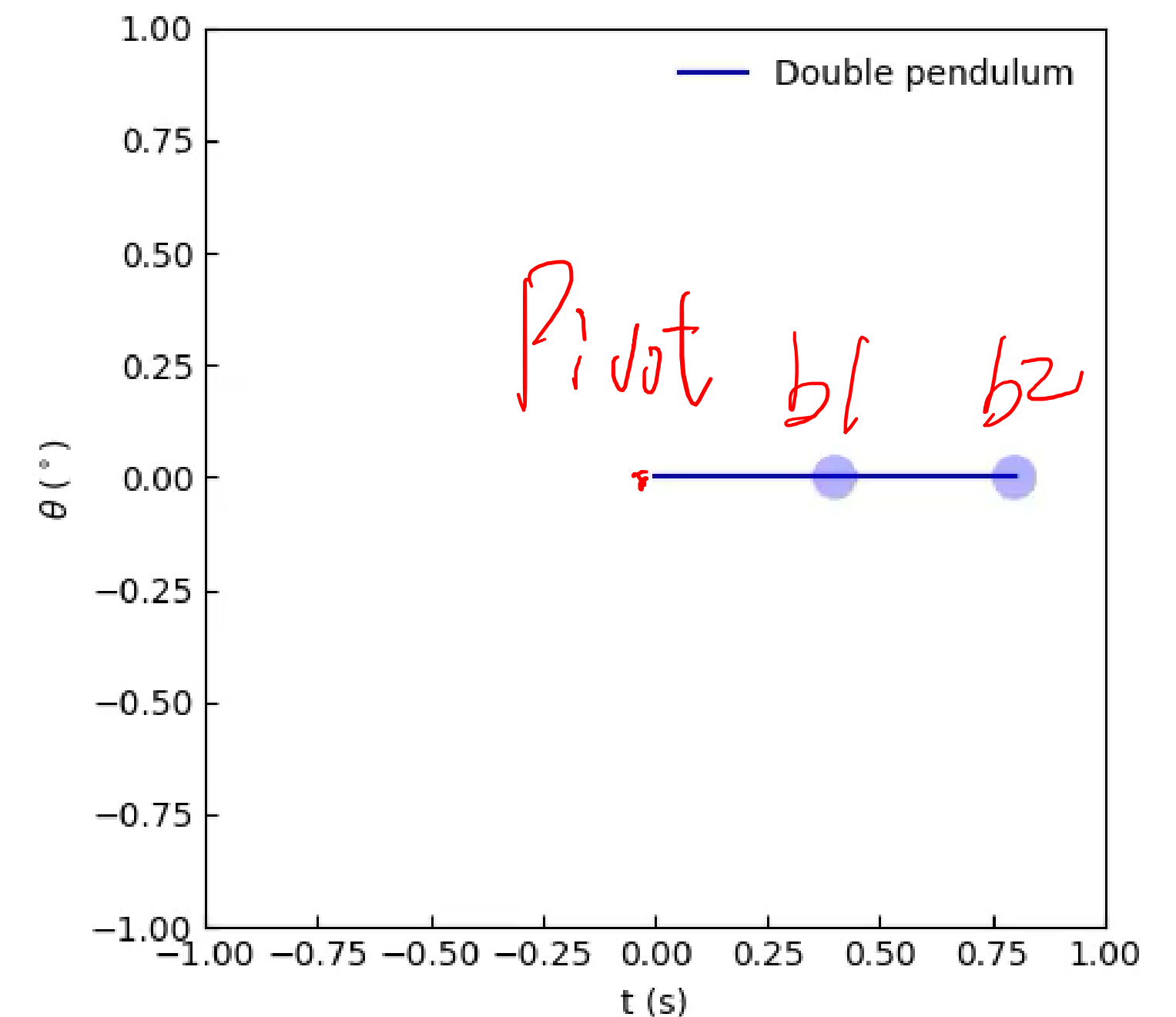
- Meet your neighbors! You will be working together

- **Learning the foundation of physics:**

- We will learn measurement and units in the first week

- **Expectations**

- Be on time and ready to engage
- Don't be afraid of making mistakes
- Questions? Raise your hand to ask
- Be responsible for your own learning. We don't take attendance for regular classes. You make your own decision and take full responsibility of your own decisions.
- Mutual respect. Bottom line: Don't disrupt the other people's learning. Whoever fails to stop disruptive behaviors after a reminder will be asked to leave the classroom.
- Go over the material (book and WileyPlus online materials before lectures)



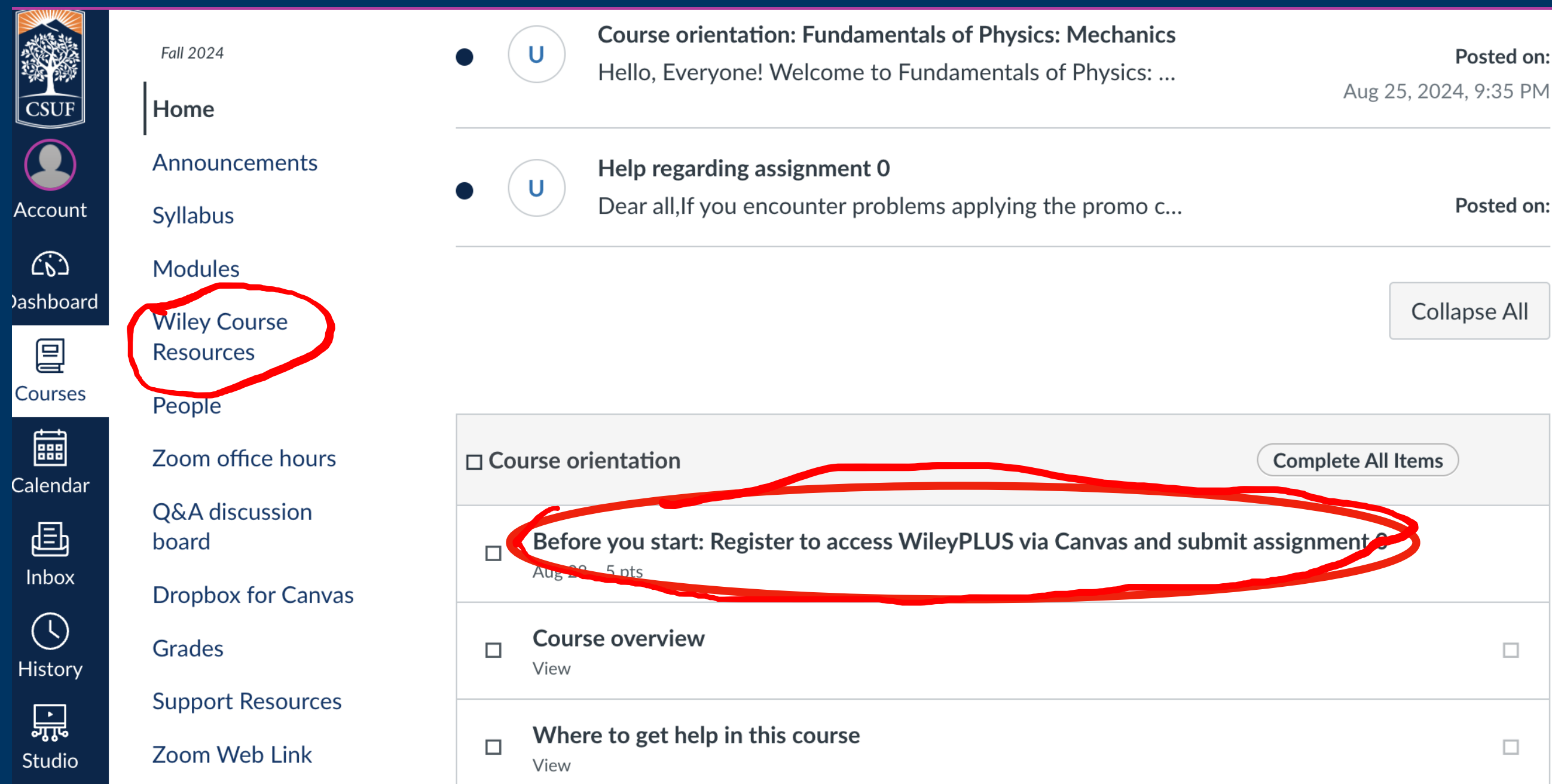
Who are you?

- Introduce yourself to your neighbors (**within 3 min**):
 - Where are you from?
 - What is your major?
 - What do you want to do after graduation?
 - What do you want to learn from this class?
 - Meet your neighbors and tell them something you are interested in
 - Get to know your classmates, you will be working together!

Online resources for the course

- **Canvas (with WileyPLUS integration)**
 - Canvas course: “Fall 2024 PHYS 225-03 19453”
 - Please register to WileyPLUS by submitting assignment 0 on Canvas below
 - eTextbook: Wiley Course Resources

1. Click “Before you start: assignment 0”



2. Select “a single semester” tab



3. Use Promo Code: **CSF42** for a discount price

4. If you successfully registered using the Promo Code, please feel free to share your experience in Q&A discussion board.

WileyPLUS Help

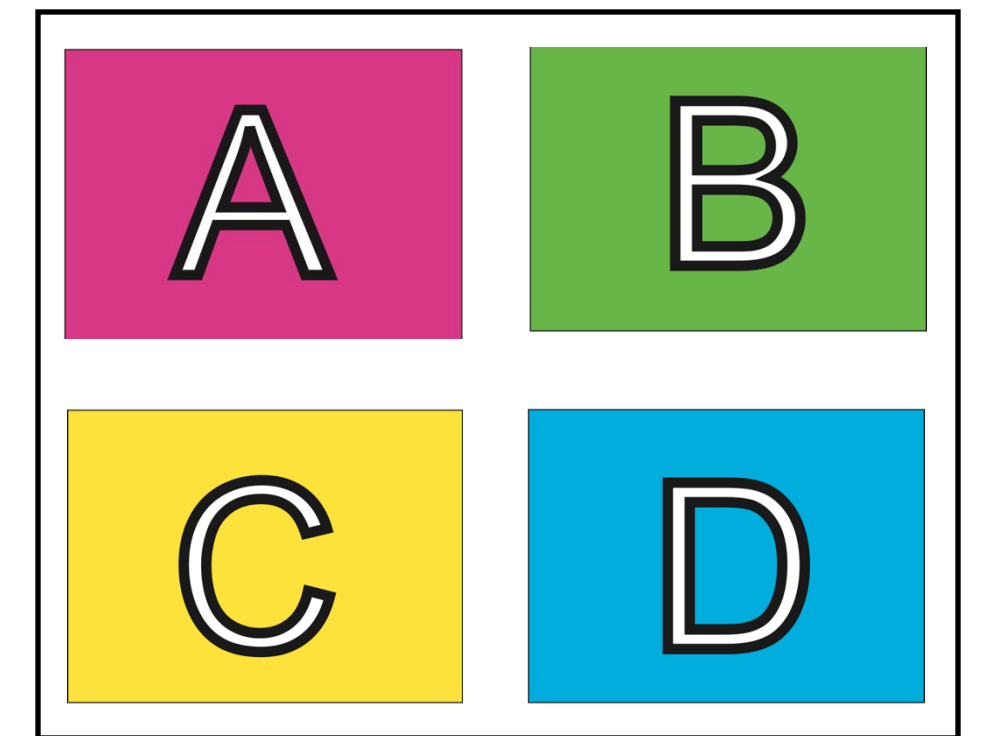
- First, use **Chrome** browser for WileyPLUS contents!
 - Most issues are solved by using the suitable browser!
- Student WileyPLUS Support - <https://www.wileyplus.com/WileyCDA/Section/id-830493.html> or email wileysupport@wiley.com
- Orders only: (877) 762-2974, no technical support

Hardware and software requirement

- Hardware preparation
 - A personal computer with stable internet connection
- Software preparation
 - Browser: Google Chrome (enable cookies)
- Equipment checkout
 - Device request to CSUF IT:
<http://www.fullerton.edu/it/students/equipment/>

What we will do in a typical class

- The first class today is not a typical class where you listen and copy everything I say
- A typical class is **interactive**. I will introduce topics first, and then help you engage in the following “low-stake” ways:
 - Ask you questions that you answer by “clicker cards”:
 - Group activities where you solve problems in groups

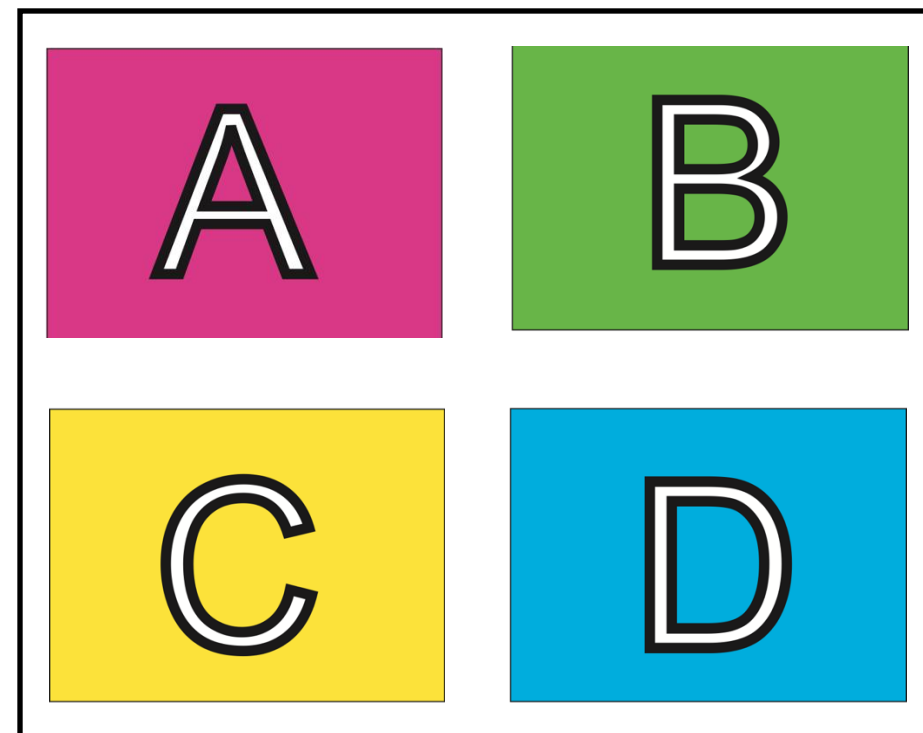


Your participation will be important, because it helps me see where your confusions are and adjust my explanations to help you succeed!

Don't be afraid of making mistakes.

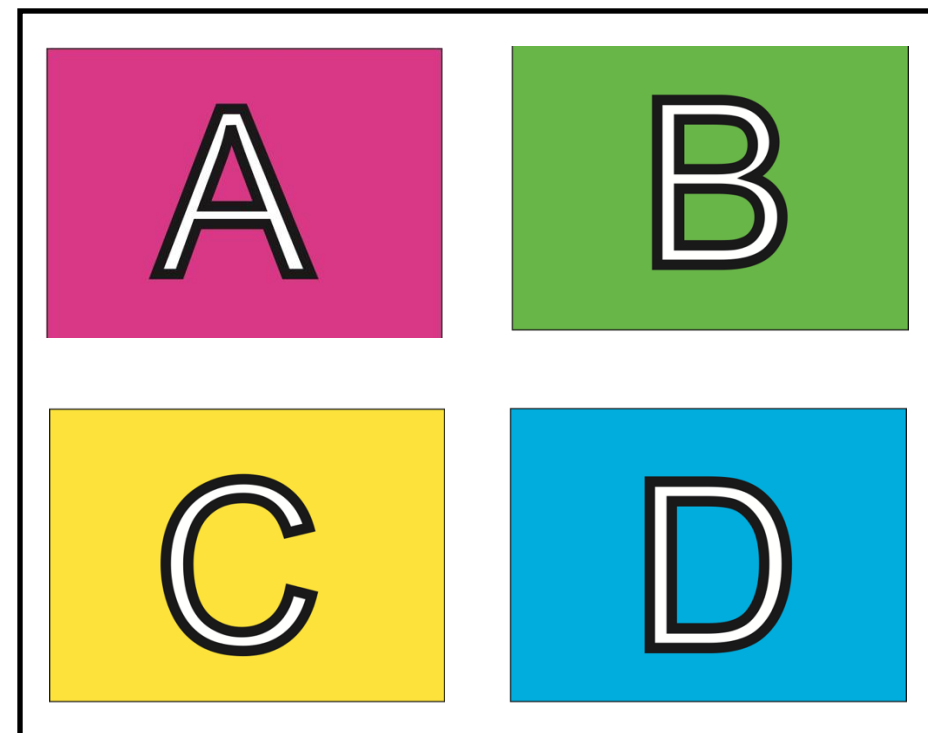
Materials

- Grab an ABCD card and bring it with you for classes:

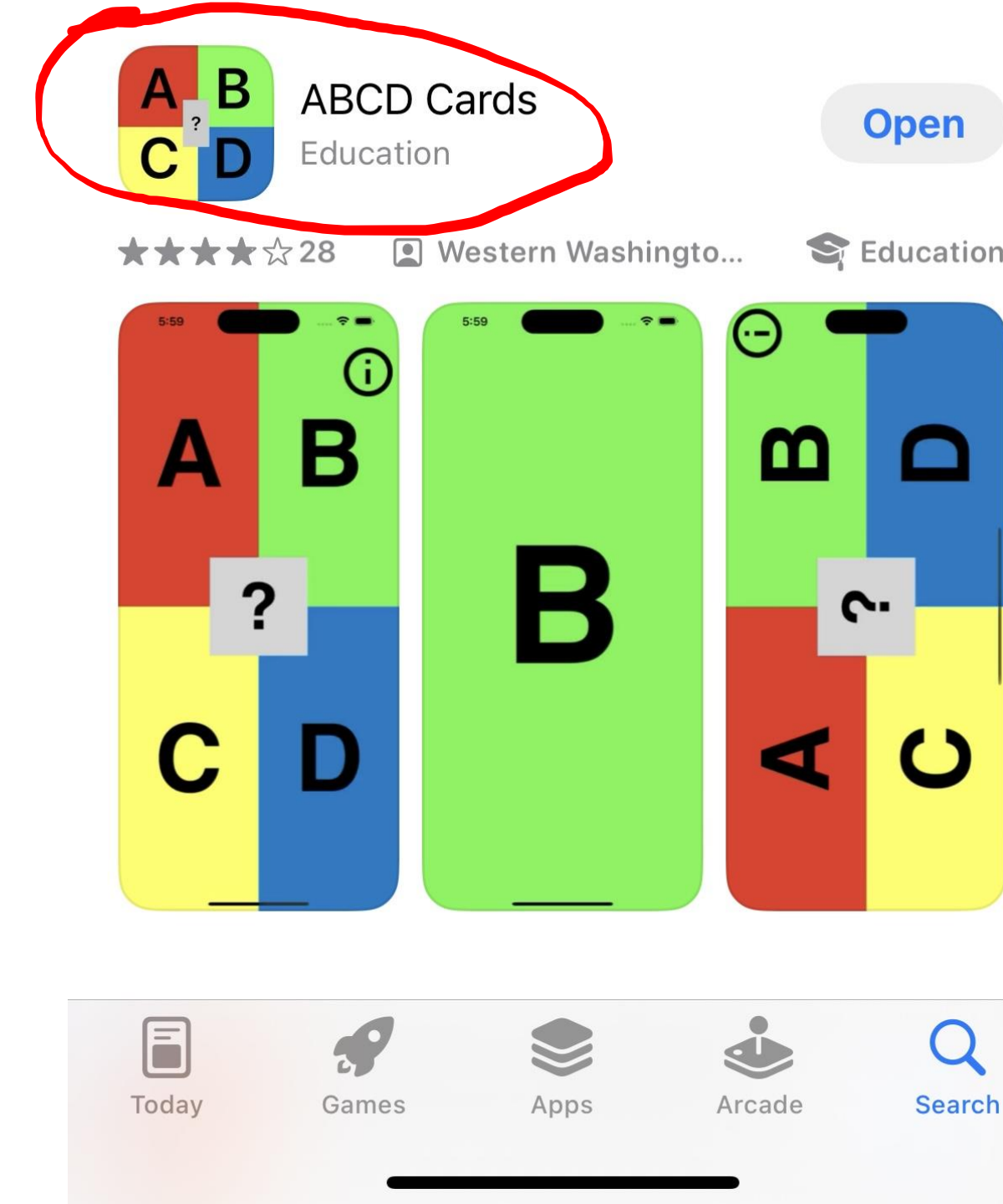


Materials

- Grab an ABCD card and bring it with you for classes:



- Alternatively, free electronic ABCD cards are available in App Store:



Clicker question 0

- What do you find most challenging in a physics class?

A

I find the concepts hard to understand.

B

I find it hard to do the math.

C

I find it hard to relate it to real life.

D

I'm good at physics, I don't need to learn from a physics class.

Grading policies

Grading weights

1	Participation: <u>Pre-lecture surveys (unlimited attempts), other surveys, class activities and and discussions for participation credits (10%)</u>	10%
2	Homework <ul style="list-style-type: none">• Notified and submitted on Canvas• Late homework not accepted, please start ahead of time• Due in a week after assigning the homework	20%
3	Midterm exam 1	15%
4	Midterm exam 2	15%
5	Final exam <i>Cumulative</i>	40%

Emailed submissions are not accepted.

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Final exam	40%

Emailed submissions are not accepted.

Letter grade distribution

Letter grade	GPA
A	90-100
B	80-89
C	70-79
D	60-69
F	0-59

+/- letter grades will apply

Academic integrity and accommodations

- Academic integrity
 - You are accountable for the honesty & integrity of your work: [UPS 300.021](#)
 - Discussion is encouraged except for during closed-book quizzes and exams
 - Bottom line: never take unfair advantages
- Disability statement
 - Please contact Disability Support Services (DSS) & notify me ASAP so arrangements can be made (see Syllabus for details)

Friendly reminder for pre-course assignments to help you start

- Canvas module: **Course orientation**
 - Before you start: Register ... assignment0 (due Aug. 28, 11:59 pm)
- Canvas module: **Pre-course assessment**
 - Survey on the office hour and background (due Aug. 28, 11:59 pm)
 - Survey to help you navigate the course (due Aug. 28, 11:59 pm)
 - Non-graded discussion: Introduce yourself (due Aug. 29, 11:59 pm)
- **Chapter 1: Measurement and units**
 - Module 1.1: Pre-lecture survey (due before the next lecture)
 - Module 1.2.1: Pre-homework questionnaire (due Aug. 29, 11:59 pm)

Walking through the Canvas page

Chapter 1: Measurement

- Learning objectives
 - Measurements
 - Base quantities and units
 - ❖ SI units
 - ❖ Order of magnitude and prefixes
 - ❖ Significant figures
 - ❖ Unit conversion

Measurement



In the past ¹



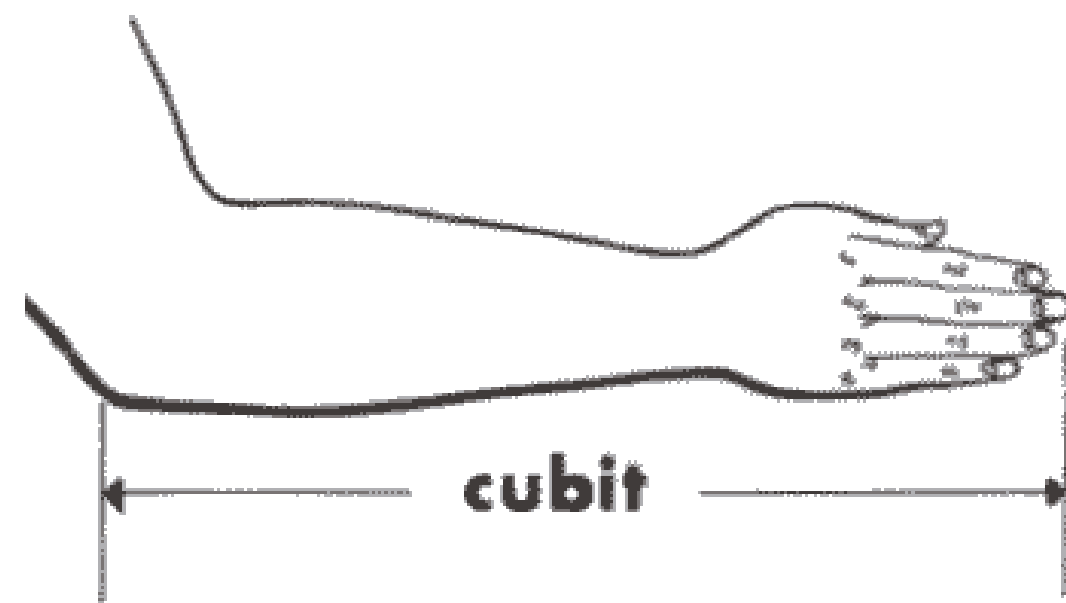
Today ²

¹ <https://www.youregypttours.com/egypt-tours-blog/weights-in-ancient-egypt>

² wikipedia

A little history about measurements

- How was length measured in the past?



Ancient Egypt ¹: 1 cubit \approx 52.4 cm

Ancient Babylon ²: 1 cubit \approx 53.0 cm

Ancient Rome ³: 1 cubit \approx 120 cm

*How do they
communicate about
the length in the past?*



¹ Clagett, Marshall. *Ancient Egyptian science: a source book*. Vol. 2. American Philosophical Society, 1989.

² Conder, Claude Reignier. *The rise of man*. EP Dutton, 1908.

³ Stone, Mark H. "The cubit: a history and measurement commentary." *Journal of Anthropology* 2014 (2014): 1-11.

What are needed for precise measurement?

- Base quantities = What to measure.
- Units : By what standard?

Three base quantities for mechanics

- **Base quantities:** A small number of physical quantities - by international agreement - to be used to define *all* other physical quantities.
- Three base quantities for mechanics:
 - Length
 - Time
 - Mass

Clicker question 1

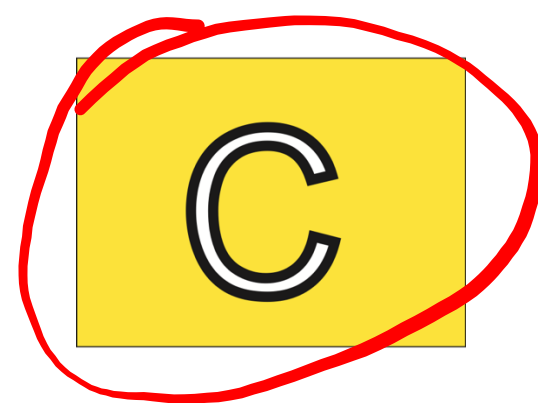
- What is **NOT** one of the base quantities in this course?



Length



Time



Speed

$$\frac{\text{length}}{\text{time}}$$



Mass

SI units

- **SI units:** The international system of units, also called the “metric system”.
- **SI base units:** The SI units for **base quantities**
 - Meters or m (length)
 - Seconds or s (time)
 - Kilograms or kg (mass)

Clicker question 2

- What are prerequisites for precise measurement?

A

Base quantities (for example, **Length, time and mass**)

B

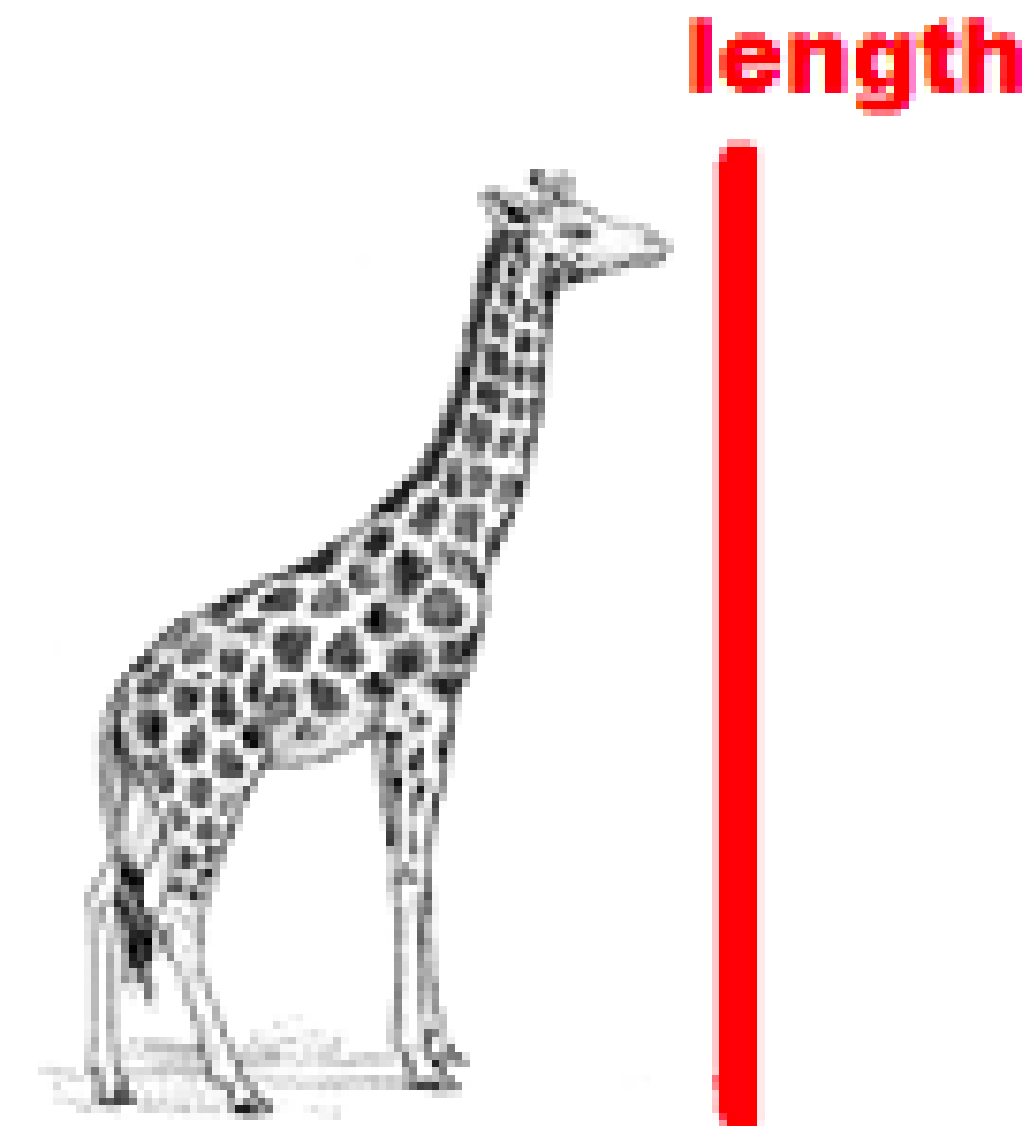
Units: Commonly acknowledged standards to compare the quantities

C

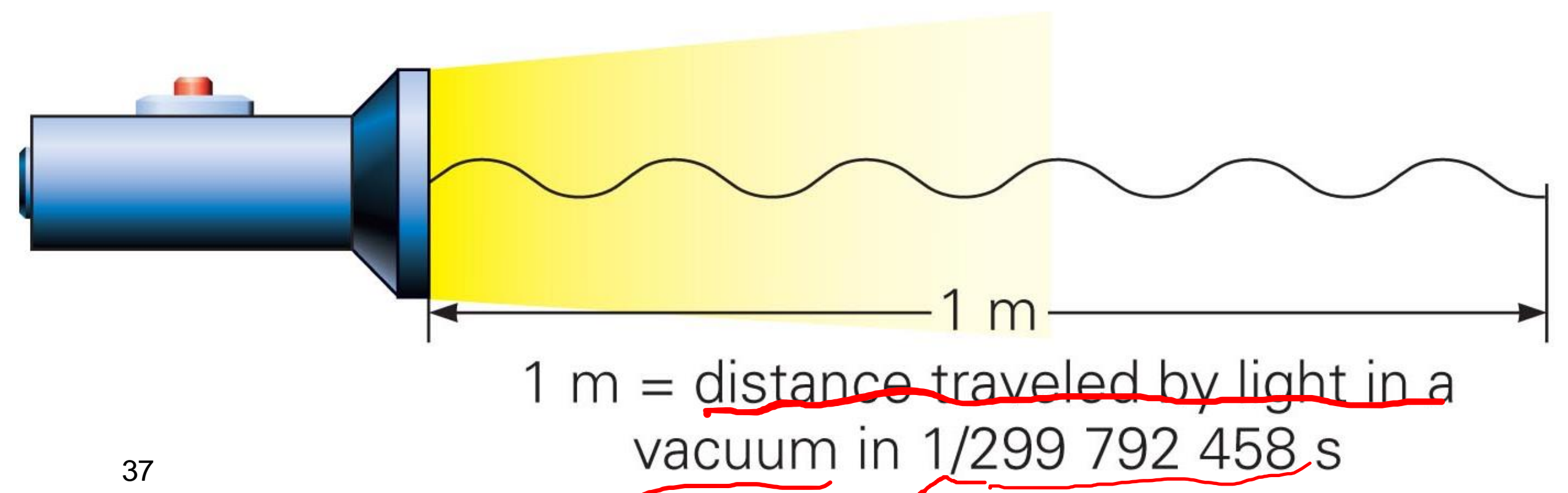
Both above

Length

- What is length?
 - Sizes in space
- SI unit for length:
 - Meters (m)



LENGTH: METER



Length scales

Size =
 $10^?$ m

Approx. size of observable universe	27
Voids & filaments	24
Diameter of our galaxy	21
Average thickness of our galaxy	19
Distance to nearest star	17
Distance of Voyager 1 from sun	13
Diameter of sun	9
Diameter of earth	7
Mount everest height	4
Average human height	0
Large mosquito	-2
Red blood cell diameter	-5
Cell membrane thickness	-8
Hydrogen atom radius	-11
Proton size	-15

10^7

10^{-5}

Prefixes

For convenience, the powers of 10 (order of magnitude) can be replaced by **prefixes**.

km
/
kilo 10³

TABLE 1.2 Some Multiples and Prefixes for Metric Units*

Multiple [†]	Prefix (and Abbreviation)	Pronunciation
10 ¹²	tera- (T)	ter'a (as in <i>terrace</i>)
10 ⁹	giga- (G)	jig'a (<i>jig</i> as in <i>jiggle</i> , <i>a</i> as in <i>about</i>)
10 ⁶	mega- (M)	meg'a (as in <i>megaphone</i>)
10 ³	kilo- (k)	kil'o (as in <i>kilowatt</i>)
10 ²	hecto- (h)	hek'to (<i>heck-toe</i>)
10	deka- (da)	dek'a (<i>deck</i> plus <i>a</i> as in <i>about</i>)
10 ⁻¹	deci- (d)	des'i (as in <i>decimal</i>)
10 ⁻²	centi- (c)	sen'ti (as in <i>sentimental</i>)
10 ⁻³	milli- (m)	mil'li (as in <i>military</i>)
10 ⁻⁶	micro- (μ)	mi'kro (as in <i>microphone</i>)
10 ⁻⁹	nano- (n)	nan'o (<i>an</i> as in <i>annual</i>)
10 ⁻¹²	pico- (p)	pe'ko (<i>peek-oh</i>)
10 ⁻¹⁵	femto- (f)	fem'to (<i>fem</i> as in <i>feminine</i>)
10 ⁻¹⁸	atto- (a)	at'toe (as in <i>anatomy</i>)

*For example, 1 gram (g) multiplied by 1000, or 10³, is 1 kilogram (kg); 1 gram multiplied by 1/1000, or 10⁻³, is 1 milligram (mg).

[†]The most commonly used prefixes are printed in blue. Note that the abbreviations for the multiples 10⁶ and greater are capitalized, whereas the abbreviations for the smaller multiples are lowercased.

Clicker question 3

Red $\rightarrow 10^{-5} \text{ m} = 10 \times 10^{-6} \text{ m} = 10 \mu\text{m}$
 $1 \mu\text{m} \sim 10^{-6} \text{ m}$

- To the nearest power of 10, what is the size of a human white blood cell?

A

1 nm

B

10^{-7} m

C

$10 \mu\text{m}$

D

10 mm

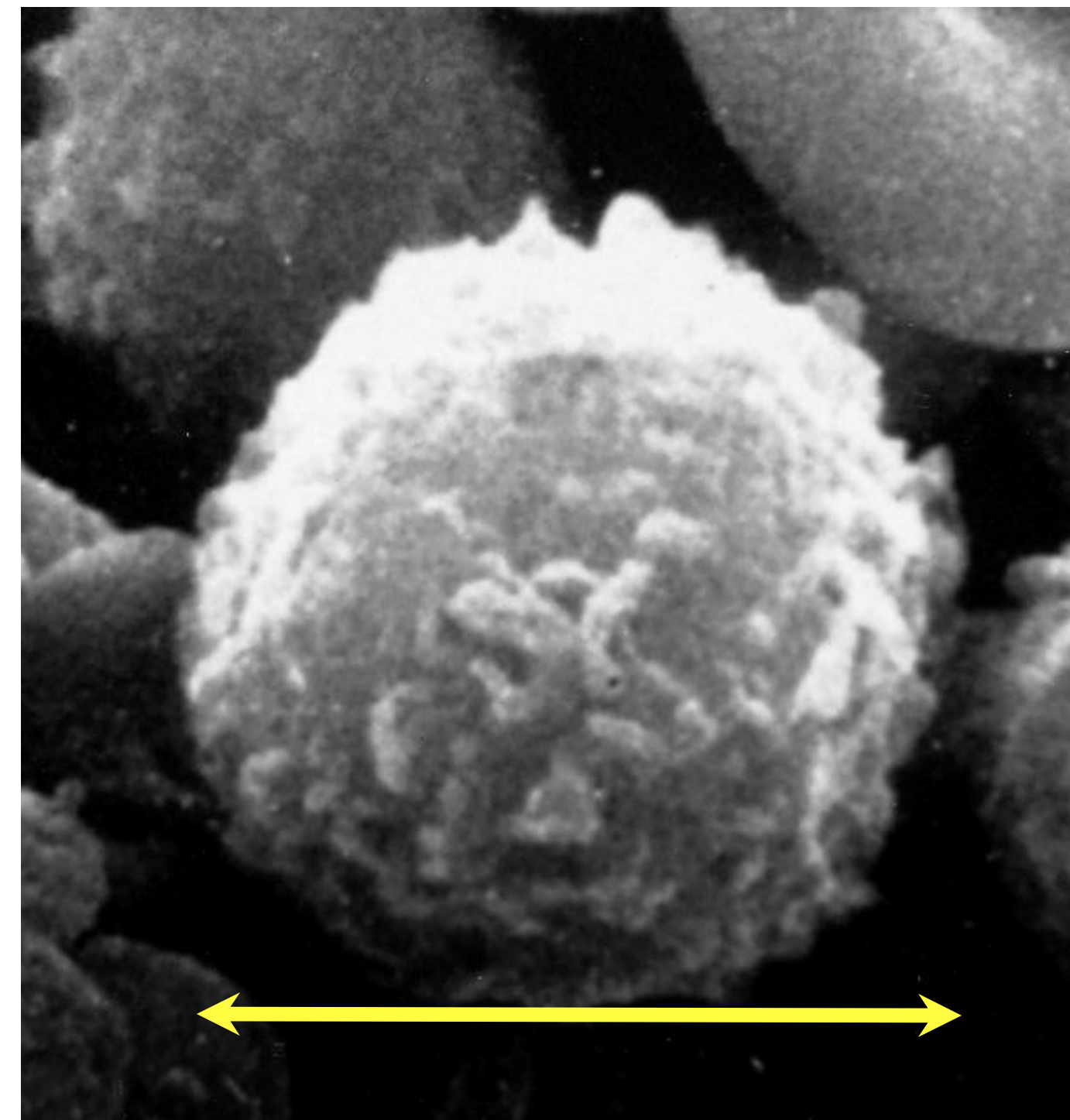
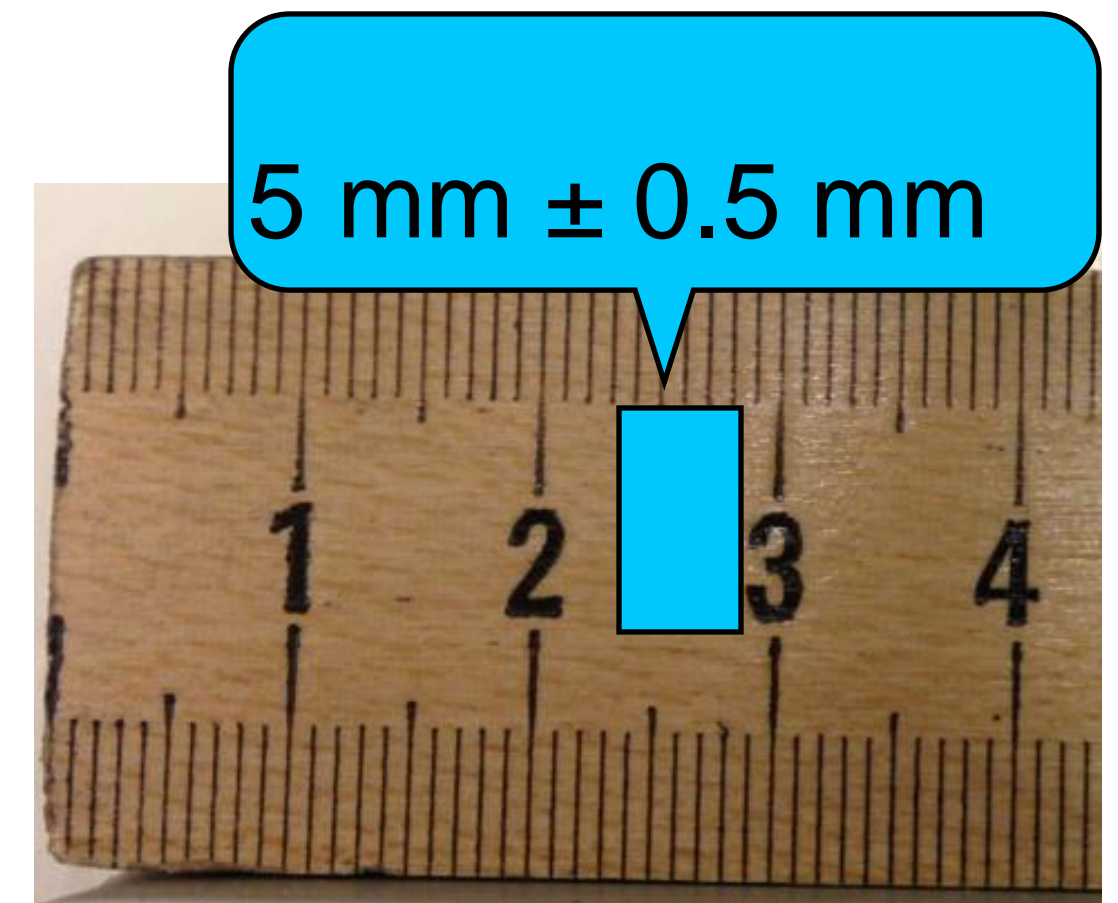


Image courtesy Wikipedia

Significant figures

Precision

- **Significant figures:**
 - The effective number of digits in a value.



Significant figures

Notation for Number

Scientific notation
preceding
Ordinary
121 000

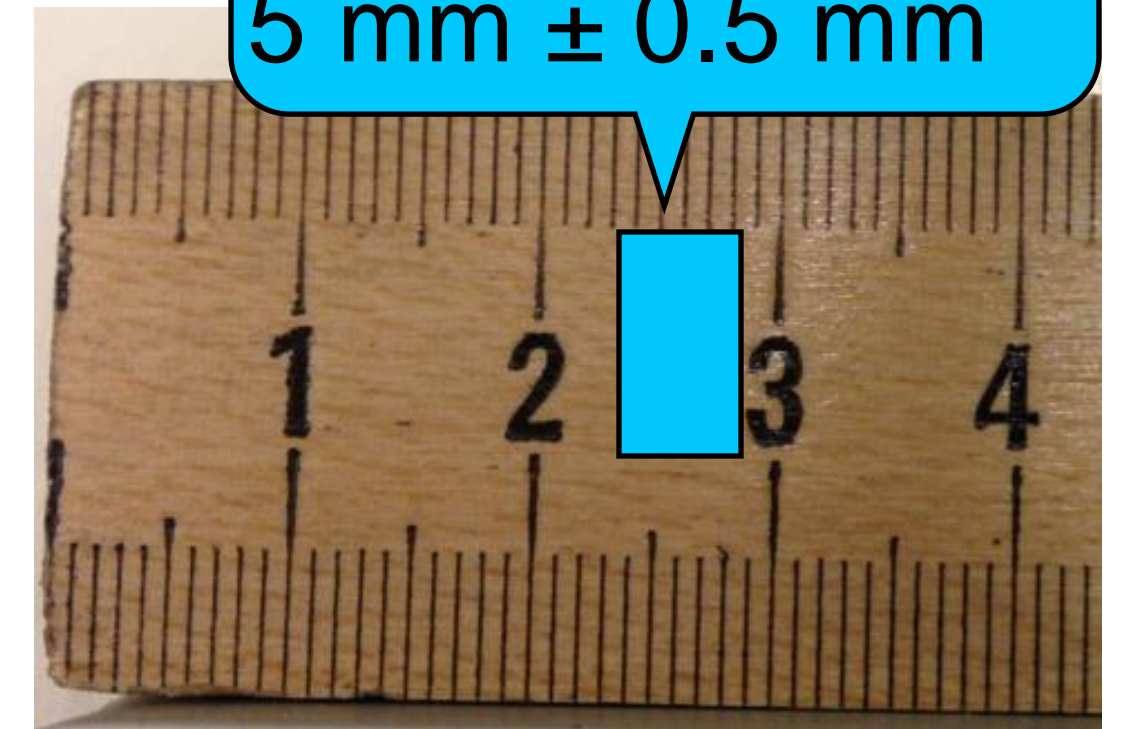
1.21×10^5

- **Significant figures:**

- the effective number of digits in a value.
- **Scientific notation:** digits shown in the preceding coefficient

$7.8 \times 10^{-5} \text{ m}$

has 2 significant figures



Significant figures

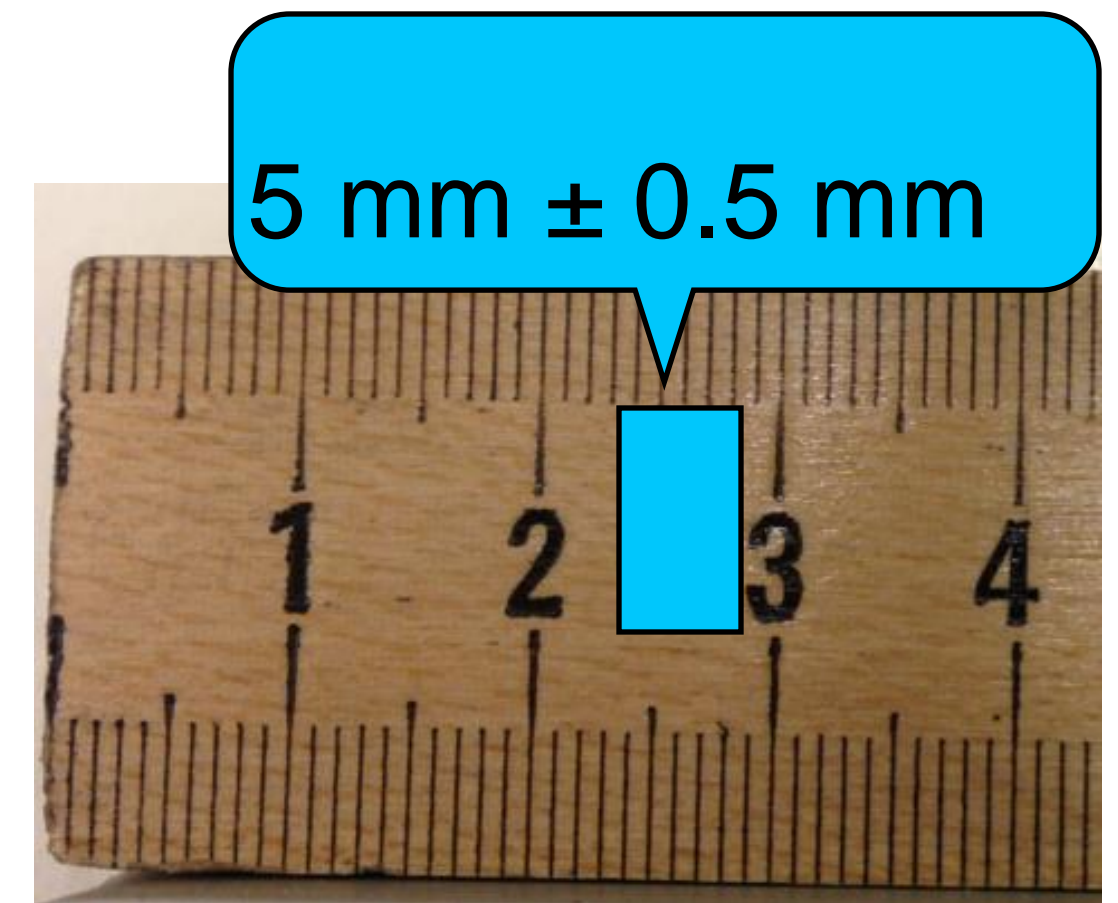
- **Significant figures:**

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$7.8 \times 10^{-5} \text{ m}$ has 2 significant figures

- **Ordinary notation:** all digits except zeros at the beginning of a number

0.000 780 has 3 significant figures



Significant figures

- **Significant figures:**

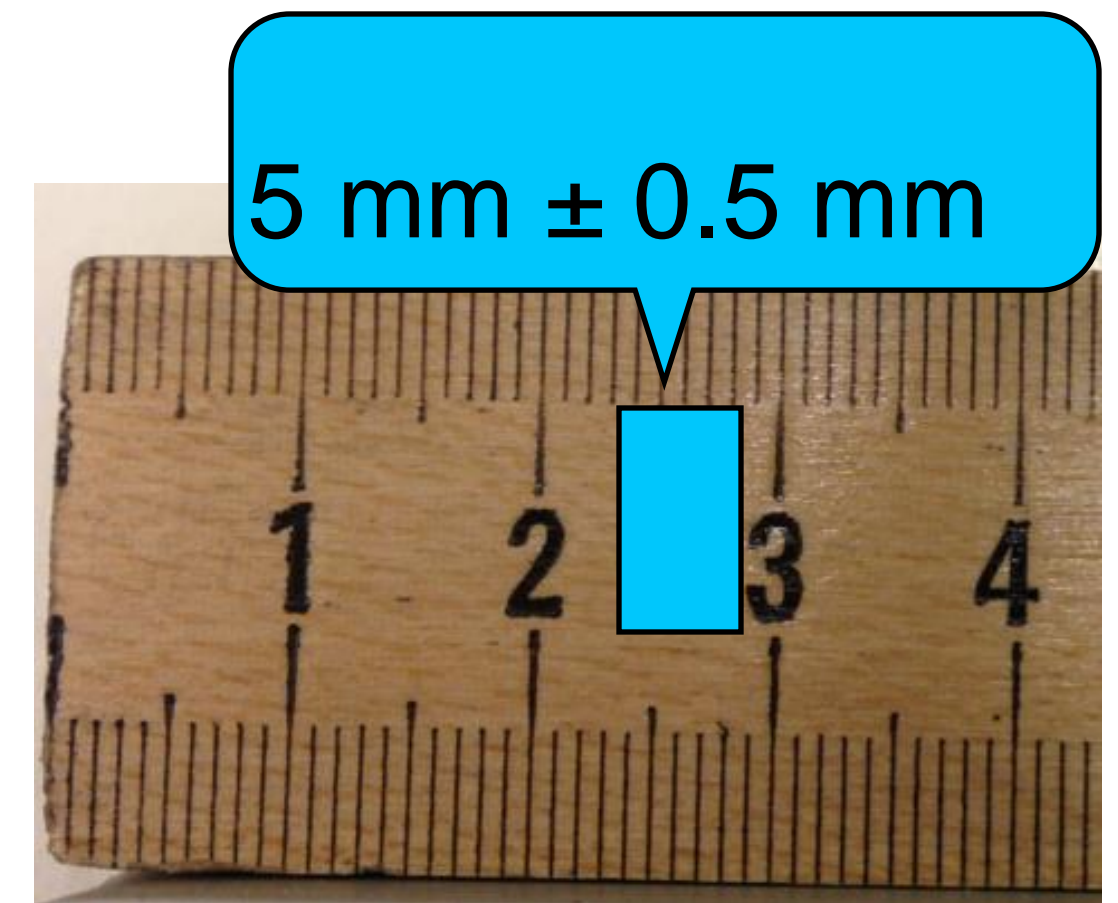
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- **Scientific notation:** digits shown in the preceding coefficient

$7.8 \times 10^{-5} \text{ m}$ has 2 significant figures

- **Ordinary notation:** all digits except zeros at the beginning of a number

0.000 780 has 3 significant figures

- **Note:** In this class, trailing zeros are included to count significant numbers
- **Note:** For online submissions, please use ordinary notations to avoid technical problems.



Clicker question 4

0.0034200
X

- How do we write the scientific number 3.42×10^{-3} as an ordinary number with 5 significant numbers?

A

0.00342

3 sig. fig.

B

0.0034200

C

3.4200

Not the same value

Next class: Unit conversion