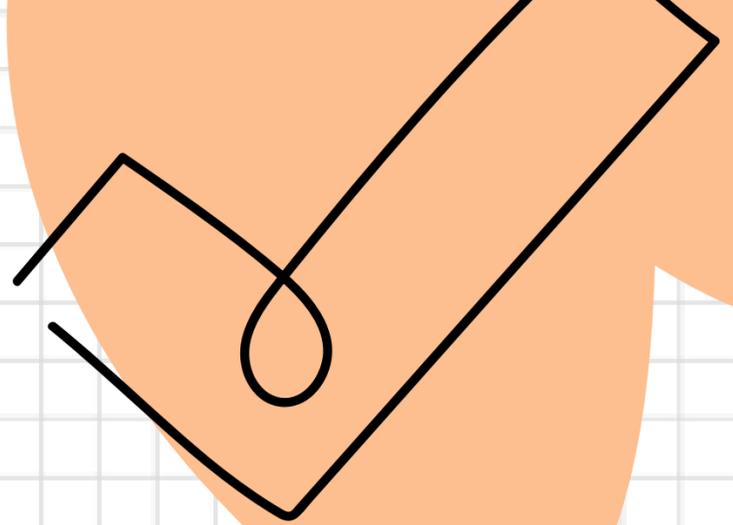
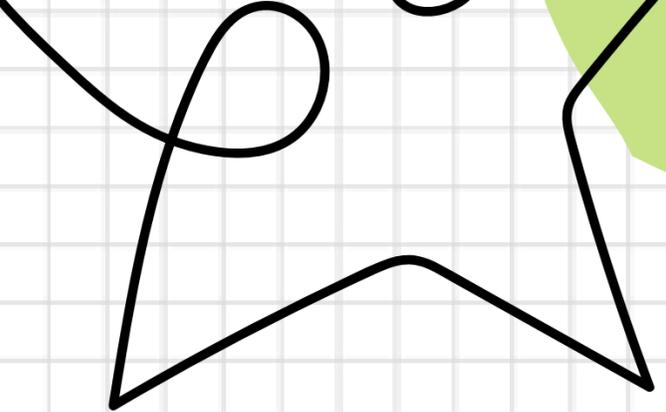
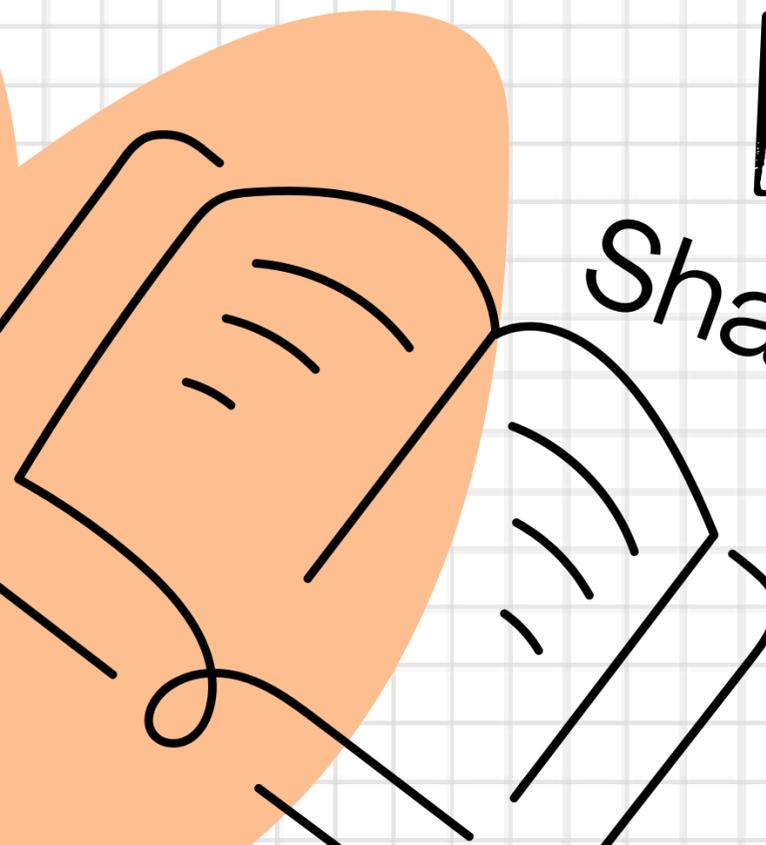


Speaking

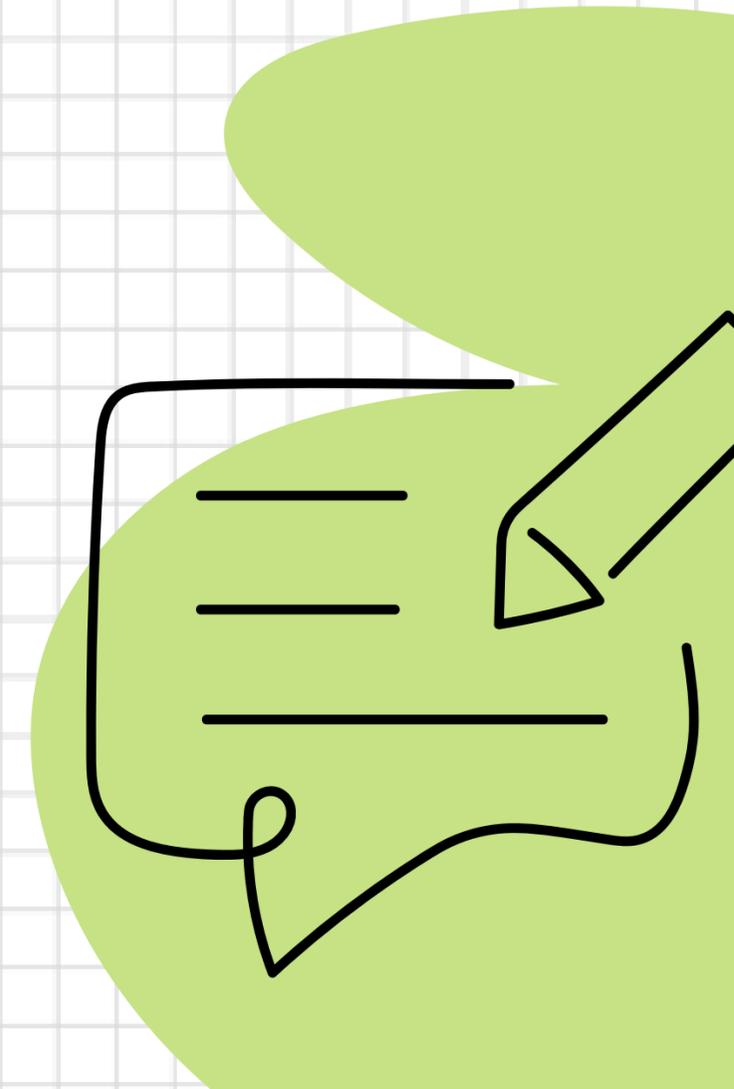


Writing

# **THINKING** through **PHYSICS**



Sharing



Teaching

by Monica Mellini

# HOW STUDENTS DO

## PHYSICS:



Grab numbers  
and equations

STAB IN THE DARK



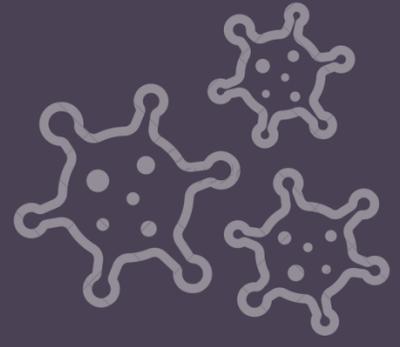
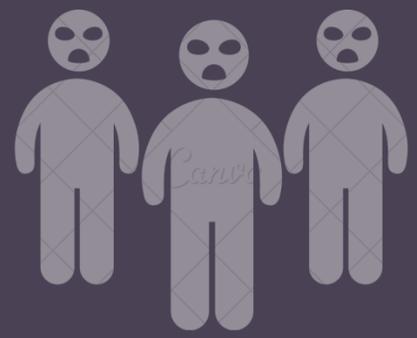
disastrously



SKIP STEPS



No connection to  
lived understanding  
of the world



Ignore units

# GOAL

think through problems

take time

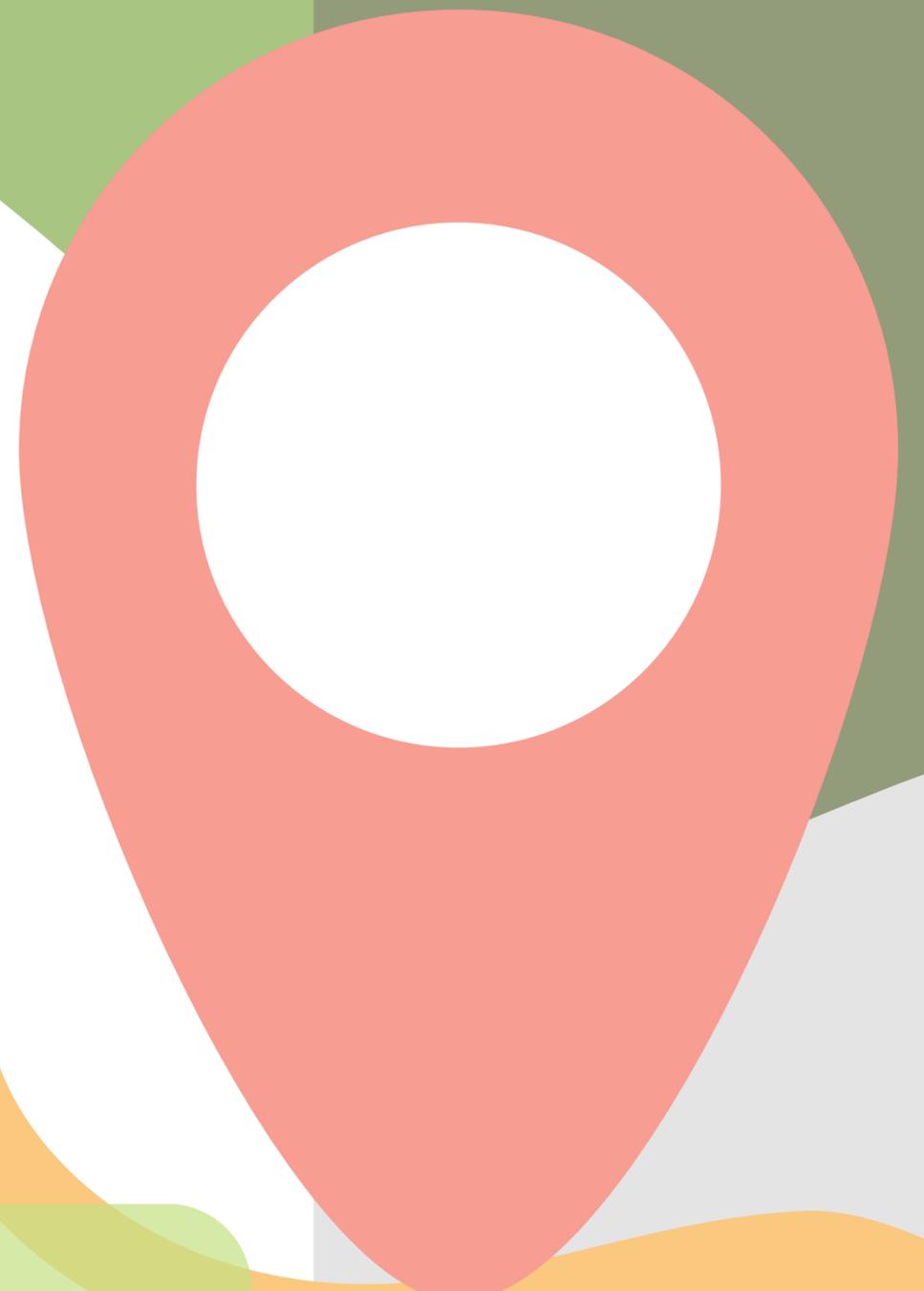
include every step

keep units

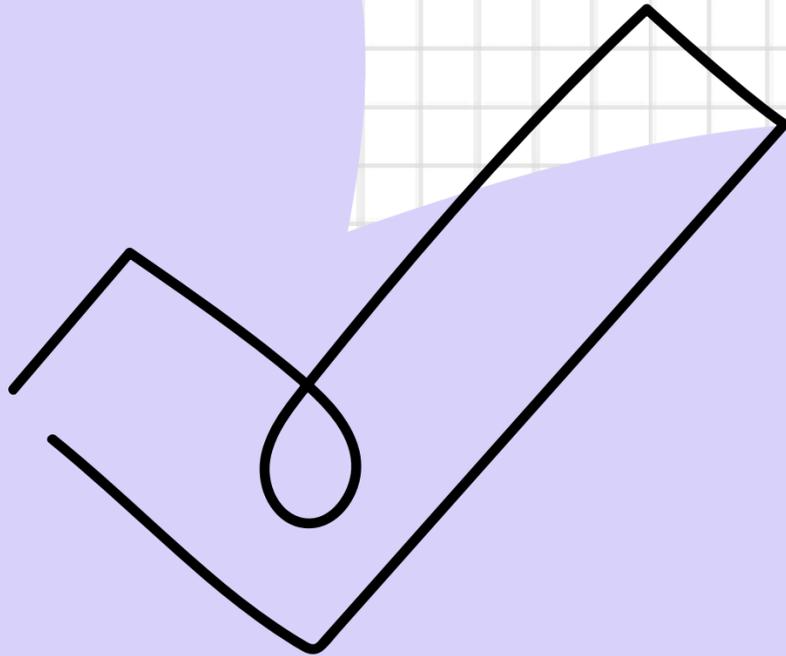
check answers

ask if it makes sense

reuse problems/study deeply



# INTERVENTION: THE CHECKLIST - BEFORE SOLVING



1.

Given information

2.

Vector or Scalar

3.

How many dimensions

4.

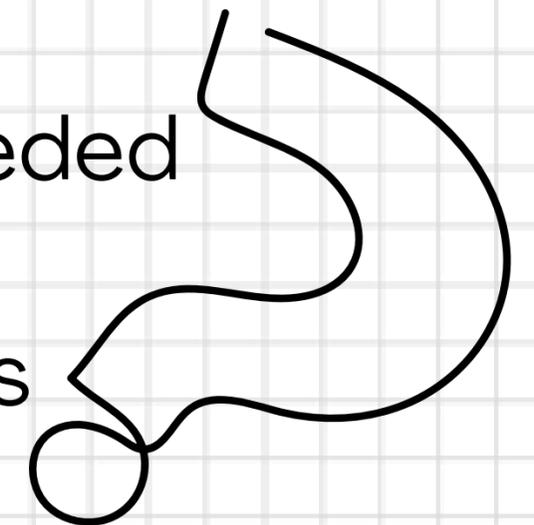
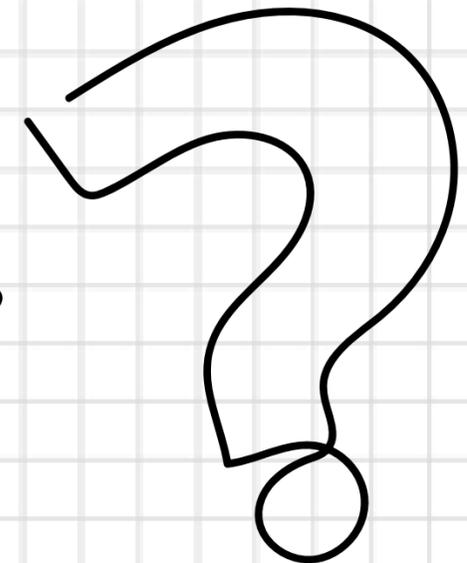
Units

5.

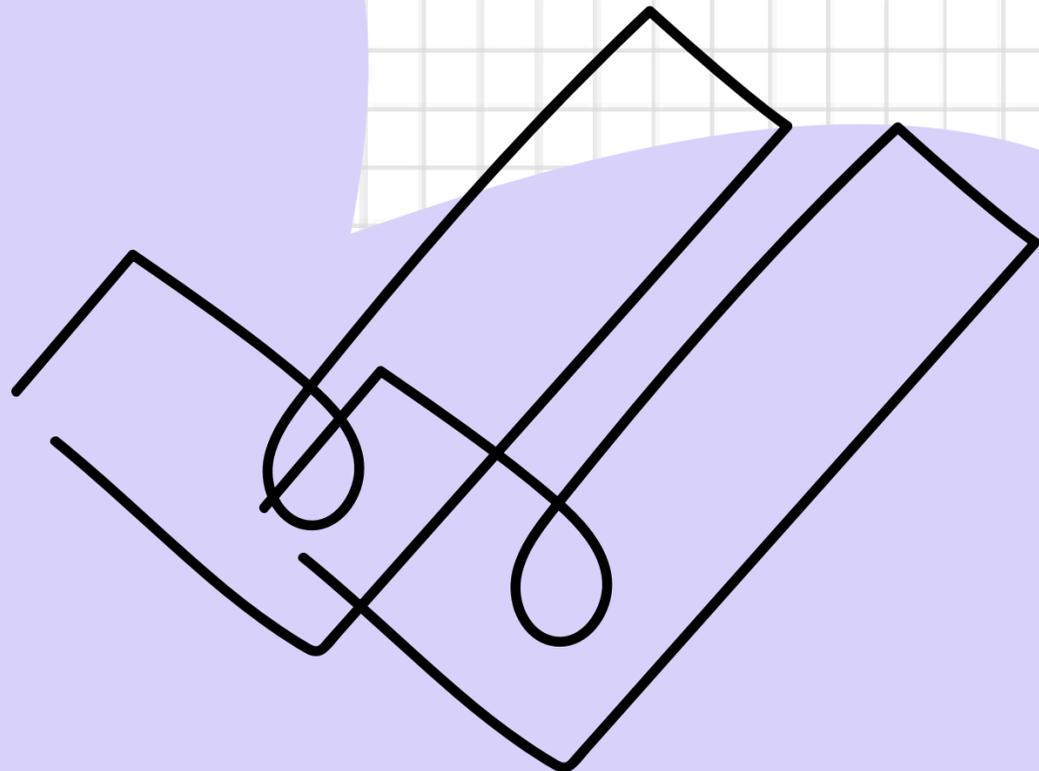
Unit conversions needed

6.

Necessary Equations



# INTERVENTION: THE CHECKLIST - WHILE SOLVING



1.

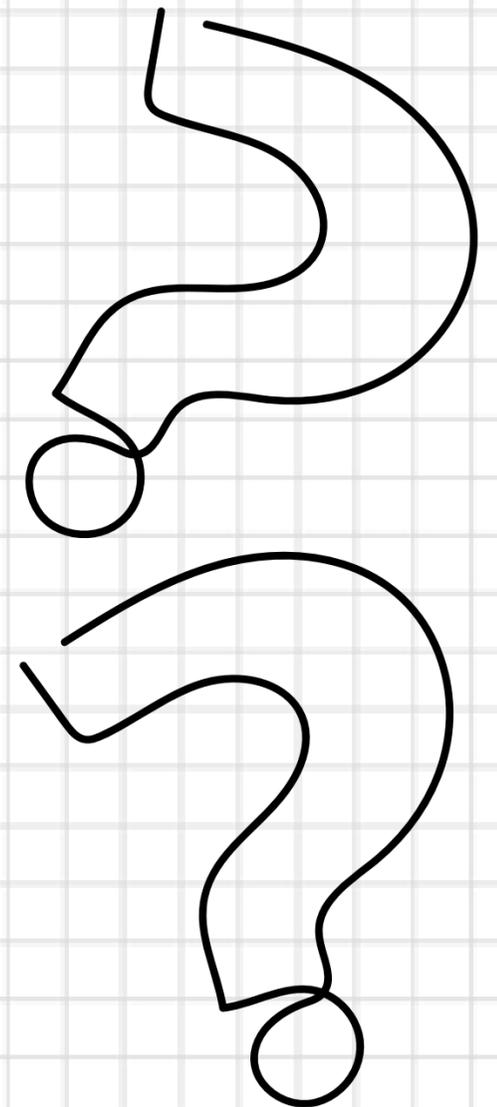
Estimate ROM  
(Rough Order of Magnitude)

2.

+/- Sign relevant?

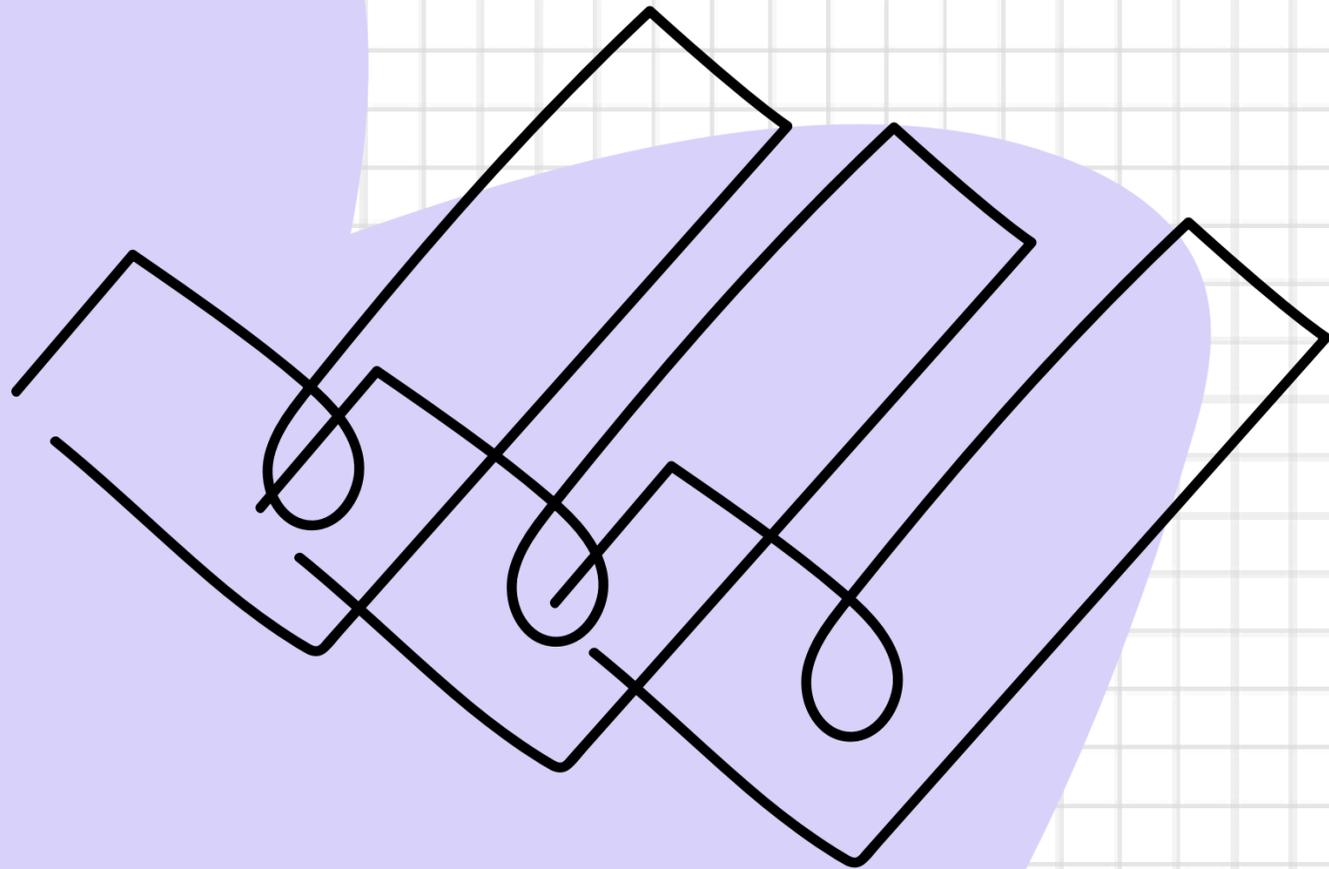
3.

Units consistent?



# INTERVENTION: THE CHECKLIST

## - AFTER SOLVING



1.

Consistent with ROM  
and common sense

2.

Magnitude & Direction

3.

Units make sense

4.

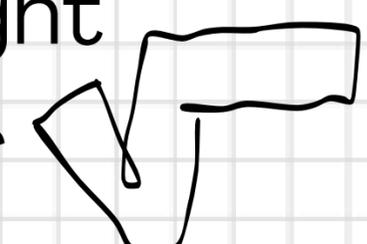
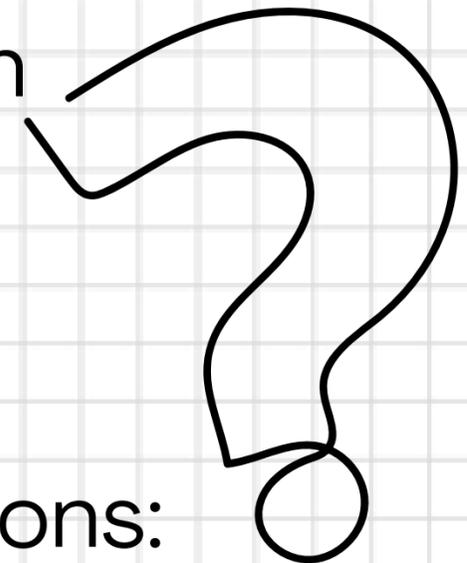
No physical law violations:

no negative time/distance

< age of universe

< speed of light

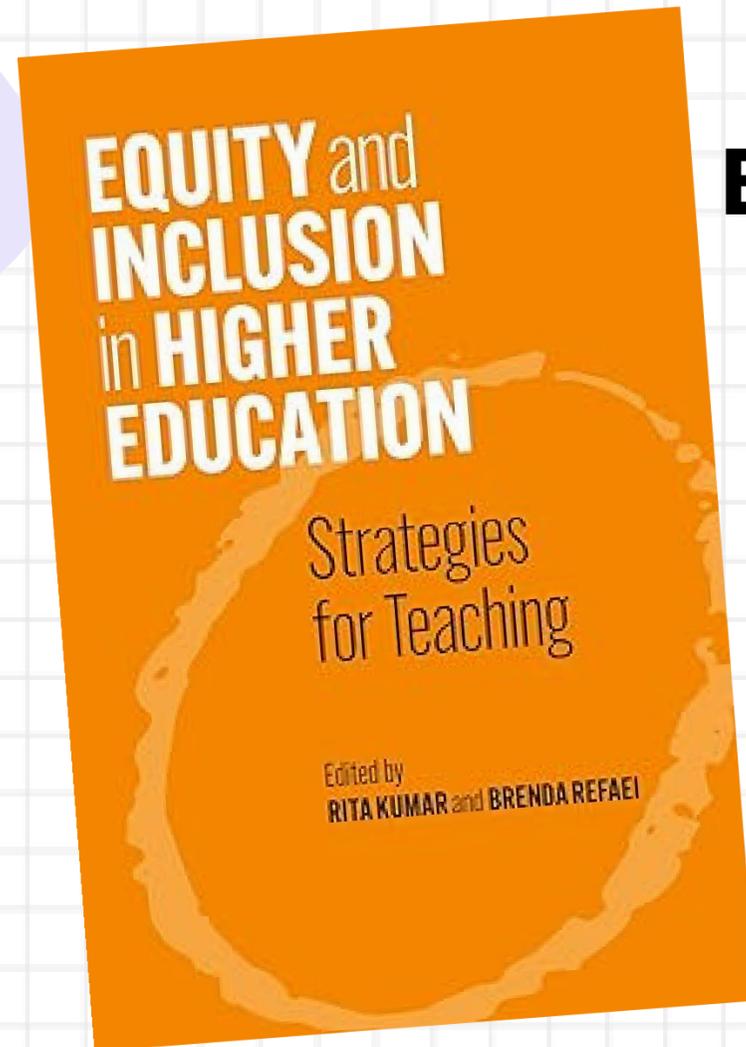
no negatives under



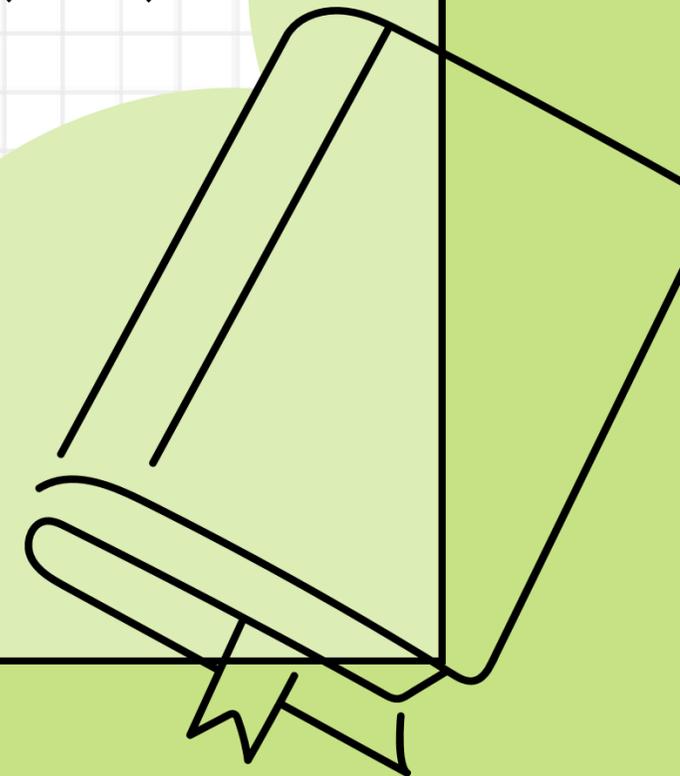
# REFLECTION AND EPIPHANY

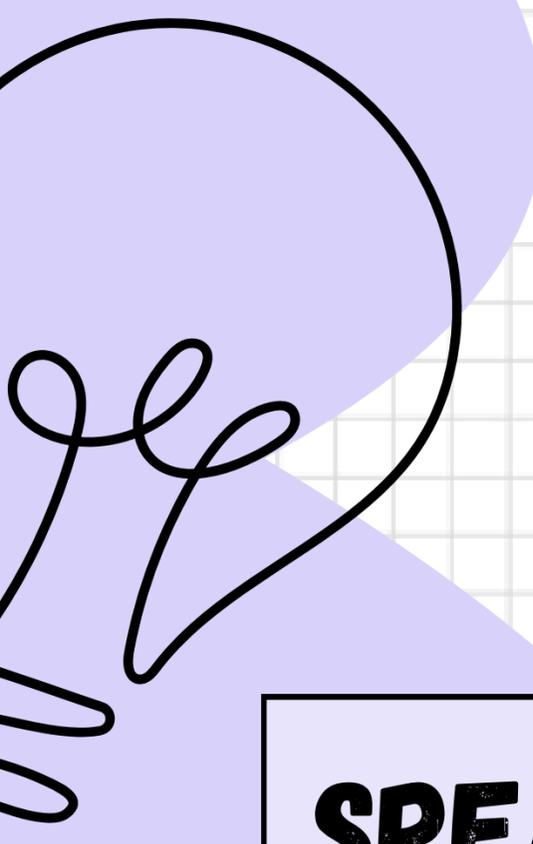
- Craft work, not mass production
- Teaching and learning are multimodal
- Checklists are just the beginning
- Students need a learning praxis
- Assess what you want learned
- Learning is a team activity

# THE BEST RESOURCE



**Equity and Inclusion in Higher Education:**  
Strategies for Teaching  
Rita Kumar and Brenda Refaei (Ed.)  
2021





# HOW TO LEARN PHYSICS

## **SPEAK**

the problem in your own voice. Ask questions aloud. State your approach to finding the solution.

## **WRITE**

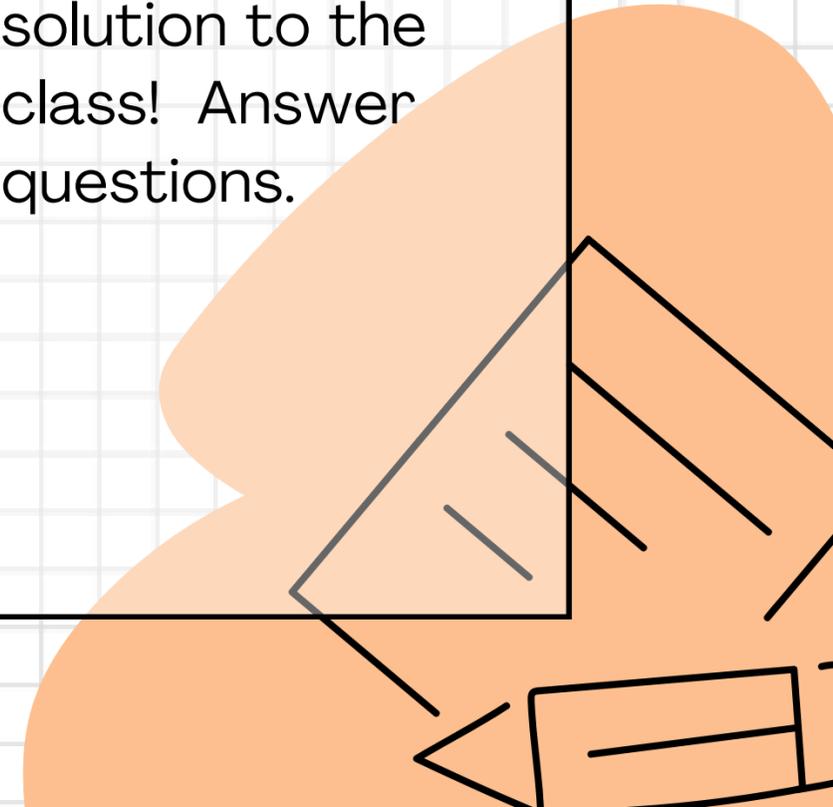
assumptions, sign conventions, and formulas. Write every solution step including unit conversions.

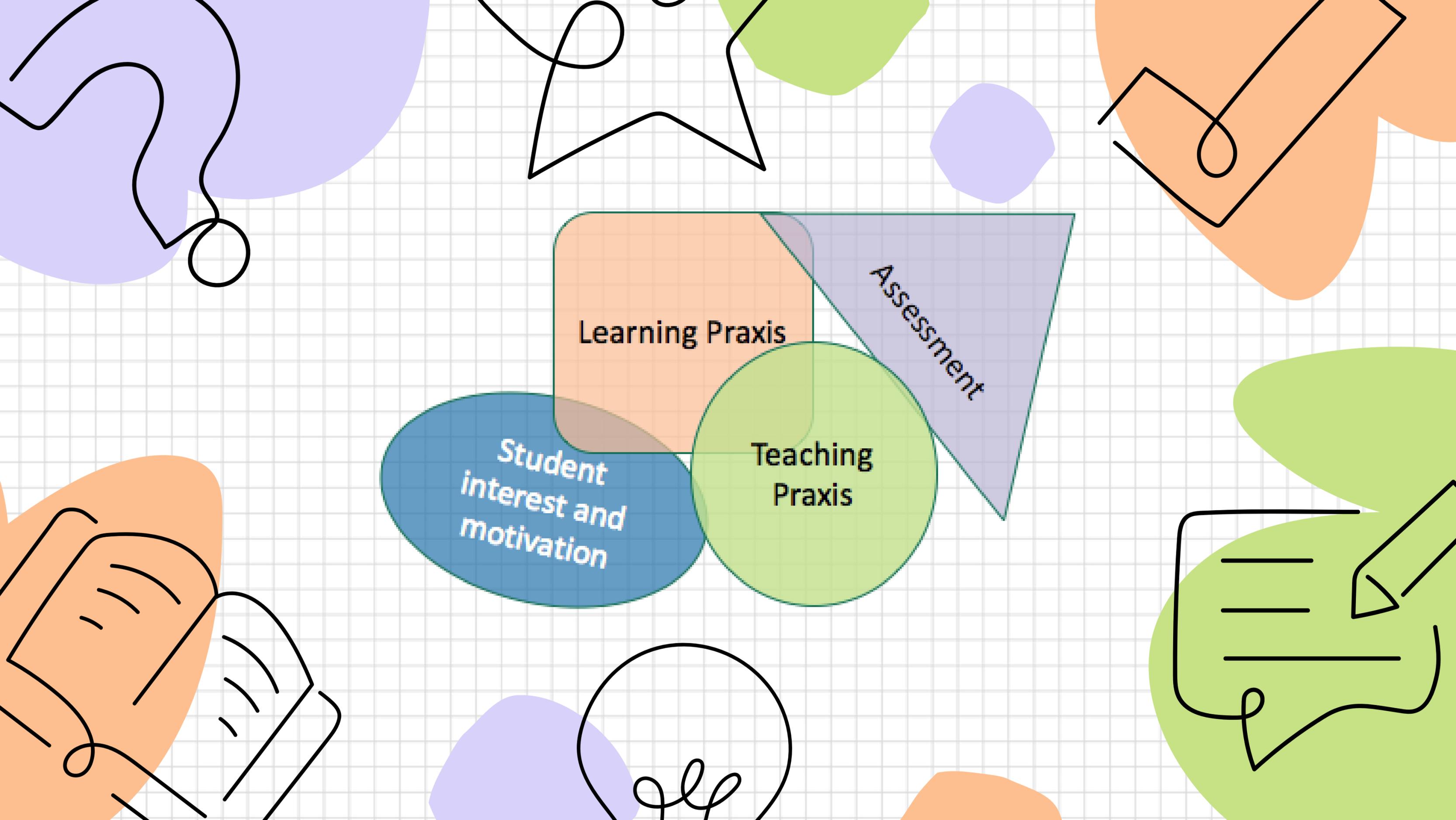
## **SHARE**

Collaborate with team members to solve the problem. Help one another. Check your work.

## **TEACH**

Present your solution to the class! Answer questions.





Learning Praxis

Assessment

Teaching Praxis

Student interest and motivation