

Think Like a Physicist: The Physics Problem Solver's Toolkit

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Course Description (Summer Course)

Unlock the power of physics problem solving with a hands-on course designed to level up your skills and prepare you for advanced study. This course equips you with mathematical tools and systematic strategies to approach challenges across various subfields of physics, including mechanics, electromagnetism, astrophysics and quantum mechanics. You'll master essential techniques like visual diagrams to represent interactions, dimensional analysis to quickly validate relationships between quantities, symmetry arguments to simplify complex systems, and coordinate systems to streamline computations. Learn to create and interpret graphical representations to visualize physical systems, uncover patterns, and approach problems with the analytical mindset of a physicist.

Engaging practice sessions, collaborative problem-solving, and interactive activities will build your confidence in breaking down even the most complex scenarios, so you can start problems effectively and approach them with creativity and precision. To inspire your journey, physicists at the University of Chicago and MIT will share their unique perspectives on how they apply problem solving skills to solve real-world challenges and push the boundaries of science.

By the end of the course, you'll have a powerful toolkit to systematically approach physics problems, preparing you for advanced studies and STEM careers.

Course Criteria

This course is only open to pre-college students. Experience with mathematics through pre-calculus is required.

Course Logistics

Duration: 3 Weeks

Daily Schedule: 3 hours lecture + 2 hours recitation

Weekly Schedule:

- Every Tuesday: Problem Set Due
- Every Friday: Weekly Quiz

Grade Distribution

- Weekly Quizzes (2 total): 30%
- Problem Sets (2 total): 30%
- Participation and Recitation Engagement: 20%
- Final Exam/Project: 20%

Week-by-Week Syllabus

Week 1

- Day 1: Introduction – What It Means to Think Like a Physicist
- Day 2: Dimensional Analysis and Estimation
- Day 3: Representing Problems Visually
- Day 4: Coordinate Systems and Problem Setup
- Day 5: Symmetry and Conservation Laws (+Quiz 1)

Week 2

- Day 6: Mechanics I – Force, Motion, and Constraints
- Day 7: Mechanics II – Energy and Momentum Transfer (Pset 1 Due)
- Day 8: Electromagnetism – Fields and Forces
- Day 9: Astrophysics and Gravity
- Day 10: Quantum Thinking and Wave-Particle Duality (+Quiz 2)

Week 3

- Day 11: Graphical and Computational Approaches
- Day 12: Multiple Representations and Strategic Thinking (Pset 2 Due)
- Day 13: Open-Ended and Real-World Problems
- Day 14: Guest Physicist Panels and Challenge Problems
- Day 15: Final exam