

Introductory Classical Mechanics: An Alternate Order of Concepts

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The Course

- Scientific Inquiries – Physics (SI Phys)
- Single semester long
- Introductory physics
- Classical mechanics, but no circular motion or rotation
- Algebra based – almost all 1-dimensional, no trigonometry

The Students

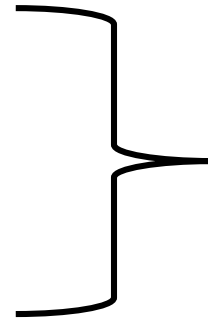
- All sophomores take the course (about 220 – 240 students every year)
- Only about 10-15% have had HS physics prior
- Every year only about 3-10 students test out
- Wide range of math ability – some struggle with basic algebra, some are in second semester calculus or higher
- Most have little or no knowledge of trigonometry

The Problem

1. In most units there are some concepts that most students easily understand, while there are some concepts that most students struggle with.
2. Students often don't see the bigger picture
 - a) Students don't consider concepts from previous units
 - b) Student's only consider concepts from previous units

Typical Classical Mechanics order of topics

1. Kinematics
2. Newton's Laws
3. Momentum
4. Gravity
5. Energy



The order of these
three often switch
around

Typical SI Physics order of topics

1. Intro to Kinematics
2. Newton's Laws
3. Kinematics
4. Gravity
5. Momentum
6. Energy

The idea behind a complexity based topic order

In general, break up the larger units into smaller concepts and then order those concepts throughout the semester in the order of increasing complexity or difficulty.

However, to do this some sort of method or framework is needed to define complexity.

The idea behind a motion based topic order

I use motion to define what I mean by complexity.

1. Physics of an object at rest
2. Physics of an object moving at a constant velocity
3. Physics of an object with a changing velocity
4. Physics of gravity

The physics of an object at rest

Topics covered

- Vectors
- Position
- Force and net force
- Mass
- Free body diagrams

The physics of an object moving at constant velocity

Topics covered

- Velocity, position and velocity vs time plots
- Momentum
- Kinetic energy
- Newton's first law
- The concept of a conserved quantity

The physics of an object with a changing velocity – part 1

Topics covered

- Acceleration, acceleration vs time plot
- Newton's second law
- Impulse
- Work

The physics of an object with a changing velocity – part 2

Topics covered

- More advanced kinematics equations
- More advanced kinematic plots

The physics of an object with a changing velocity – part 3

Topics covered

- Collisions
- Conservation of momentum
- Newton's third law

The physics of an object with a changing velocity – part 4

Topics covered

- Free fall concepts
- Free fall kinematics
- Equivalence principle

The physics of gravity

Topics covered

- Gravitational field strength
- Newton's Law of gravity
- Gravitational potential energy and conservation of energy

Odds and ends

Integrative assessments

Proficiency based assessment

Remote labs and homework

Thoughts or Questions?

How would you rearrange the topics in your classes?