

1.0 Introduction

There are four main concepts, or lenses, through which we can look at a physical event:

- Momentum: which can be thought of as how hard it is to stop an object;
- Energy: the ability to do work;
- Dynamics: how forces change the momentum (or velocity) of an object; and
- Kinematics: the study of motion over time without considering what causes the motion.

How we're different: Traditional mechanics texts introduce and fully develop one concept at a time in depth before moving onto the next, usually starting with kinematics, then dynamics, energy, and momentum. Instead, we introduce all the concepts at the beginning, using simplified examples, developing depth and complexity as we practice over time. Our method is supported by studies indicating that people learn iteratively: by revisiting concepts that become increasingly familiar. The way we will be learning physics is a little more like we all learned our first language – you just dive in and start doing it. Happily, we have already started many years ago, because you come to your first class with some familiarity of momentum, forces, energy, and motion. Now, we will deepen your familiarity and practice working on problems.

From previous science experiences, many of us have a “formulas and answers” approach:

- you give me a problem;
- I find a formula;
- I put in the numbers and get an answer;
- I find out if I'm right!

Instead, I encourage you to try a number of different strategies:

- **I don't know the answer, but I am curious about what's going on;**
- **I look at the event through each of the four lenses and consider which is the most helpful;**
- **I draw a picture;**
- I consider what would happen if things were different... if the problem was upside down, or if one of the masses were way, way larger than the other.
- I simplify the problem so the behavior will be obvious.
- I imagine a scenario where I observed something similar.
- **I consider whether my answer makes sense.**

Inside of the second method, there may be a “formula and answer” process, but there may be others as well, such as using a drawing or a simplification. You may also have other strategies that you would like to try. However, in this course, the boldface strategies should be utilized with most every undertaking.

Change is often difficult, and many of us will find ourselves defaulting into the “formulas and answers” way of looking at physics. We may also find ourselves using an approach that we all agree is a bad idea, like, “this mass *wants* to speed up when it is hit...” when none of us really think that a steel block has volition, or that its volition would result in a change of velocity! One of the key differences in this course is that we will practice awareness of how we are looking at a

problem as well as the reflective capacity to ask ourselves if this is a good way to look at a problem.

Exercise 1:

Likely you've used many methods to answer questions. Please describe what it was like for you:

- When you solved a difficult problem with successful formula hunting.
- When you solved a difficult problem through consideration of concepts.
- How were these experiences different in how you felt during and after the process?