2.0: Introduction

Model building in physics

Physicists build models.

Physicists then explore these models in the hopes of gaining insight into how the actual physical world operates.

Therefore, what *you* will do throughout this course is build models, of increasing complexity, of the real world and by closely examining these models *you* may gain insight into how the world operates. Some of the early models you will examine will be obviously limited, but keep in mind that even the most advanced physicists are merely model-builders, and the models they typically study are as superficial to them as the models we will study are to us.

Model building is necessary because of the overwhelming complexity of the real world. To attempt to study a real phenomenon, with all of its many details intact, is extremely difficult. Moreover, models often allow you to focus on the important aspects of a phenomenon without the distracting details.

For example, a model of reality that everyone is familiar with is a map. Imagine if Google Maps showed every driveway and alleyway regardless of your level of zoom! Although these details exist, a model that tried to encompass all of these details at all times would be *less* useful than one in which everyone's driveway was omitted. In fact it would be an unreadable mess. *Thus, it is possible to omit detail, to be a poorer reflection of reality, yet to be a better, more effective, and more useful model*. The correct "zoom" level for driving across town ignores driveways but includes most, if not all, streets. However if your task was to drive across the state, not only are the driveways be omitted but so are the vast majority of side streets; probably only state and federal highways are included on the map. Thus, a good model is closely tied to the task at hand. What can be a very useful model for one task can be useless for another.

Thus, when we build models where the effects of friction are neglected, or the shape of an object is ignored, it is not the case that this is a deficient model of the situation. It may well be the case that if these details were included some important features of the scenario would be masked by the complexity. Simplifications made in constructing models of reality are not always limitations to the usefulness of the model, often they are the key to building a useful and productive model.

Units

In this course we will exclusively use the *International System of Units*. In this system, all times are measured in seconds (s), all positions in meters (m), and all masses in kilograms (kg). For the sake of clarity, I will not include units during every step of a calculation, but it can safely be assumed that these standard units are in use throughout all calculations.

Active reading

If you do not currently have a pen or pencil in your hand, pick one up.

As you read this text, you should be writing down explanatory notes to yourself, questions to be asked in class, and any flashes of insight you may have. Don't be afraid to write in the text. I promise that actively wrestling with the ideas on the page rather than passively reading the words on the page will make a huge difference in your understanding. If you find yourself reading page after page of the text without spontaneously thinking of questions, either you are not really digesting the material or you should be in a more advanced class.

In addition, the concepts and principles of physics are complex, even the ones that appear to be simple. (If the principles really were simple, it would not have taken humankind thousands of years to understand the motion of a simple falling object!) They will become clear to you only after careful study. With this in mind, the text is not meant to be read (and written in) once. It should be re-read (and re-written in!) as you work through the various activities included. Hopefully, as you complete the activities the concepts will come into better focus.