

## Introduction: Laboratory & Measurement

### Unit: Laboratory & Measurement

Topics covered in this chapter:

The Scientific Method .....	23
Science Practices .....	29
Designing & Performing Experiments .....	36
Random vs. Systematic Error .....	47
Uncertainty & Error Analysis .....	50
Significant Figures .....	68
Graphical Solutions & Linearization .....	77
Keeping a Laboratory Notebook .....	83
Internal Laboratory Reports .....	89
Formal Laboratory Reports .....	97

The purpose of this chapter is to teach skills necessary for designing and carrying out laboratory experiments, recording data, and writing summaries of the experiment in different formats.

- *The Scientific Method* describes scientific thinking and how it applies to physics and to this course.
- *The AP<sup>®</sup> Physics Science Practices* lists & describes the scientific practices that are required by the College Board for an AP<sup>®</sup> Physics course.
- *Designing & Performing Experiments* discusses strategies for coming up with your own experiments and carrying them out.
- *Random vs. Systematic Error, Uncertainty & Error Analysis, and Significant Figures* discuss techniques for estimating how closely measured data can quantitatively predict an outcome.
- *Graphical Solutions (Linearization)* discusses strategies for turning a relationship into a linear equation and using the slope of a best-fit line to represent the quantity of interest.
- *Keeping a Laboratory Notebook, Internal Laboratory Reports, and Formal Laboratory Reports* discuss ways in which you might record and communicate (write up) your laboratory experiments.

Calculating uncertainty (instead of relying on significant figures) is a new and challenging skill that will be used in lab write-ups throughout the year.

Use this space for summary and/or additional notes:

**Standards addressed in this chapter:****NGSS Standards/MA Curriculum Frameworks (2016):**

This chapter addresses the following MA science and engineering practices:

**Practice 1:** Asking Questions and Defining Problems

**Practice 2:** Developing and Using Models

**Practice 3:** Planning and Carrying Out Investigations

**Practice 4:** Analyzing and Interpreting Data

**Practice 6:** Constructing Explanations and Designing Solutions

**Practice 7:** Engaging in Argument from Evidence

**Practice 8:** Obtaining, Evaluating, and Communicating Information

AP®

**AP® Physics 1 Learning Objectives/Essential Knowledge (2024):**

This chapter addresses the following AP® Physics 1 science practices:

**1.A** Create diagrams, tables, charts, or schematics to represent physical situations.

**1.B** Create quantitative graphs with appropriate scales and units, including plotting data.

**2.A** Derive a symbolic expression from known quantities by selecting and following a logical mathematical pathway.

**2.B** Calculate or estimate an unknown quantity with units from known quantities, by selecting and following a logical computational pathway.

**3.A** Create experimental procedures that are appropriate for a given scientific question.

**3.B** Apply an appropriate law, definition, theoretical relationship, or model to make a claim.

**3.C** Justify or support a claim using evidence from experimental data, physical representations, or physical principles or laws.

**Skills learned & applied in this chapter:**

- Designing laboratory experiments
- Estimating uncertainty in measurements
- Propagating uncertainty through calculations
- Writing up lab experiments

Use this space for summary and/or additional notes: