Chapter 1 — A WORLD VIEW

This is a new chapter; it combines material formerly found in *To the Student*, the Prologue—*On Building a World View*, a section of Chapter 1—*Measuring Space and Time*, Appendix A—*The Metric System*, and Appendix B—*Numbers Large and Small* with new material on the very wide range of distances found in the universe.

1-1 FIRST GRADE

Goal

Set the mood for the course.

Content Compares learning physics with learning to read in first grade.

Teaching Tips We hope that the students have fun with this short essay.

1-2 ON BUILDING A WORLD VIEW

Goals

Describe what we mean by a physics world view.
Present the physics world view as a dynamic one.
Describe the process of science.

Content As the title of the text indicates, the major theme of the text is presenting physics as a world view. This section develops some ideas in the philosophy of science.

Teaching Tips We leave this section as a reading assignment at this time and return to the material again and again as we develop the ideas of physics.

1-3 BODE'S LAW

Goal

Present the criteria for accepting a hypothesis as a law of physics.

Content Use Bode's law for the mean radii of the planetary orbits to present and discuss the criteria for the acceptance of a hypothesis as a law of physics; (1) agree with the existing data, (2) make predictions that can be tested, and (3) have a scientific basis.

Teaching Tips We use this section as an interesting way of discussing the criteria.

1-4 MEASUREMENTS

Goals

Present the need for a common measurement system.
Introduce the SI system of units and contrast it with the U. S. customary system.
Introduce the prefixes, *kilo*, *centi*, and *milli*.
Introduce the basic units of length, mass, and time.

Content We discuss the need for having a measurement system that it well defined and universally adopted. We then discuss the metric system and its advantages. We state that we will primarily use the metric system in this text but will give approximate English equivalents in parentheses when it is useful.

Teaching Tips We return to the material again and again as we solve problems. If you plan to include problem solving as part of your course, we highly recommend that you assign Chapter 1 of *Problem Solving to Accompany PHYSICS: A World View.*

Problem Solving 1.1 We chose not to cover significant figures in any detail but felt that students should be encouraged not to just copy a stream of numbers from a calculator. With very few exceptions in the text and in *Problem Solving*, we chose to keep just three significant figures.

Problem Solving 1.2 This is a short introduction to the use of units. The students are shown that units can be an additional check on their calculations.

Problem Solving 1.3 Many problems involve changing units. This section shows the students how to change from one set of units to another.

Video Encyclopedia 1 #1 *Basic Units*

1-5 SIZES: LARGE AND SMALL

Goals

Describe the vast range of lengths found in the universe.
Introduce the powers-of-ten notation.
Introduce the idea of order of magnitude.
(Computing) Show how to calculate with numbers in powers-of-ten notation.

Content We begin by imagining taking a photograph of children that is 1 m on a side. In the spirit of the film *Powers of Ten*, we imagine expanding our view by factors of 10 until we reach the edge of the visible universe at a scale of 10^{26} m. We then decrease the scale by factors of 10 until we reach the size of a proton at a scale of 10^{-15} m. We also describe how to calculate in powers-of-ten notation.

Teaching Tips This is a very useful section if you are going to be studying the chapters on atomic and nuclear physics.

Computing *Powers of Ten* We expand on the ideas of the powers-of-ten notation and show how to multiply and divide numbers in this format.

Problem Solving 1.4 As an introduction to problem solving we calculate how long it takes to "pass a squeeze around the world."

Film *Powers of Ten* by Philip Morrison, Phylis Morrison, and the Office of Charles and Ray Eames.

Computer Animations *Active Figure* Animations are available on the Multimedia Manager Instructor's Resource CD. They are organized by textbook chapter, and each animation comes within a shell that provides information on how to use the animation, exploration activities, and a short quiz.

Answers to the Conceptual Questions

1. Both world views are based on a large experimental base, but a physics world view incorporates data from outside the range of human sensations.
2. The physics world view is a shared set of ideas that represent the current explanations of how the material world operates.
3. It does not have any scientific basis.
4. A theory should make specific predictions that are testable. The material world is far too complex for a single theory to predict every observable outcome.
5. It must: 1) account for the known data, 2) make predictions that can be tested, and 3) have a scientific basis.
6. Bode's law is just a recognized mathematical pattern. It does not have any scientific basis.
7. A theory is only accepted as physical law after the scientific community tests its predictions against observations. The more prestigious the scientist who proposes the theory, the more likely the scientific community will commit resources to test the theory.
8. We are more likely to accept a theory proposed by a respected scientist with the proper credentials, but if the theory from the handyman is able to make predictions that are testable, the source of the theory should not matter.
9. The United States is the only major country that has not adopted the metric system.
10. The metric system has only one standard unit for each basic measurement, eliminating the need for many different conversion factors. It is costly to convert machinery and signposts.
11. About 170 cm
12. About 50 cm
13. About 2.5 m
14. About 1.9 m
15. About 85 kg
16. About 70 kg
17. 10^3 miles (3000 miles) or 10^3 kilometers (4800 km) or 10^6 m
18. 10^{10} people (6.5 billion)

Answers to the Exercises

19. $$(1\text{ day})\left[\frac{24\text{ h}}{1\text{ day}}\right]\left[\frac{60\text{ min}}{1\text{ h}}\right]\left[\frac{60\text{ s}}{1\text{ min}}\right] = 86{,}400\text{ s}$$

20. $$(1\text{ yr})\left[\frac{365.25\text{ days}}{1\text{ yr}}\right]\left[\frac{24\text{ h}}{1\text{ day}}\right]\left[\frac{60\text{ min}}{1\text{ h}}\right]\left[\frac{60\text{ s}}{1\text{ min}}\right] = 3.16 \times 10^7\text{ s}$$