Physics
COMPARISON CHART

Updates

This edition reflects numerous changes from the previous edition to better support educators in meeting national and state standards for teaching physics. Additional changes have been made to address customer concerns regarding a disconnect between the difficulty of example problems and the text itself, and to better improve the scaffolding of section and chapter review questions including updated images, errata corrections, reordered chapters, and new lab activities. A new teaching strategy has been implemented in both the student edition and the teacher edition. Multiple chapters were removed either because their content was covered in other courses or because their content was omitted from competitor texts. Components of this edition may not be compatible with its predecessor.

NEW

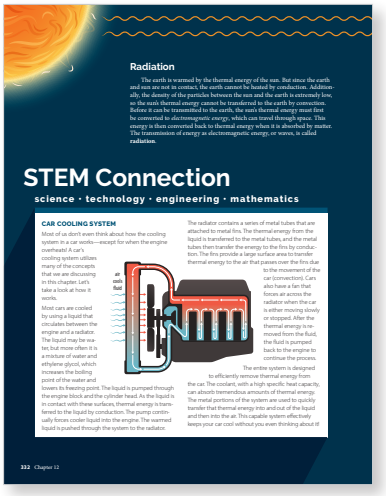
4th Edition

3rd Edition

Content Updates

- This edition condenses the total number of chapters from 29 to 25.
  - The mathematical concepts covered in Chapter 2 were absorbed into Chapter 1.
  - Chapters discussing Newton's Laws were arranged consecutively.
  - Chapters 9 and 10 were combined into Chapter 8 for a singular chapter on energy.
  - Section 26A on intensity and color was incorporated into Chapter 20 on light and reflection.
- A four-step teaching cycle (engage, instruct, apply, and assess) has been added to both the student and teacher editions.
- Objectives for the course, each chapter, and each lab activity have been added. Section-level objectives were updated to reflect the chapter content.
- Inquiry activities and STEM activities have been added to the lab manual.
- Preassessments, formative assessments, and summative assessments were also added throughout the text.
- Worldview investigations have been added throughout the student edition to provide opportunities for students to do additional research.
- Changes have been made to the structure, organization, and example problems to better prepare students for advanced concepts.

Textbook Snapshot


Radiation

The earth is warmed by the thermal energy of the sun. But since the earth and sun are not in contact, the earth cannot be heated by conduction. Additionally, the density of the particles between the sun and the earth is extremely low, so the sun's thermal energy cannot be transferred to the earth by convection. Before it can be transmitted to the earth, the sun's thermal energy must first be converted to electromagnetic energy, which can travel through space. This energy is then converted back to thermal energy when it is absorbed by matter. The transmission of energy as electromagnetic energy, or waves, is called **radiation**.

STEM Connection

science · technology · engineering · mathematics

CAR COOLING SYSTEM

Most of us don't even think about how the cooling system in a car works—except for when the engine overheats! A car's cooling system utilizes many of the concepts that we are discussing in this chapter. Let's take a look at how it works.

Most cars are cooled by using a liquid that circulates between the engine and a radiator. The liquid may be water, but more often it is a mixture of water and ethylene glycol, which increases the boiling point of the water and lowers its freezing point. The liquid is pumped through the engine block and the cylinder head. As the liquid is in contact with these surfaces, thermal energy is transferred to the liquid by conduction. The pump continually forces cooler liquid into the engine. The warmed liquid is pushed through the system to the radiator.

The radiator contains a series of metal tubes that are attached to metal fins. The thermal energy from the liquid is transferred to the metal tubes, and the metal tubes then transfer the energy to the fins by conduction. The fins provide a large surface area to transfer thermal energy to the air that passes over the fins due to the movement of the car (convection). Cars also have a fan that forces air across the radiator when the car is either moving slowly or stopped. After the thermal energy is removed from the fluid, the fluid is pumped back to the engine to continue the process.

The entire system is designed to efficiently remove thermal energy from the car. The coolant, with a high specific heat capacity, can absorb tremendous amounts of thermal energy. The metal portions of the system are used to quickly transfer that thermal energy into and out of the liquid and then into the air. This capable system effectively keeps your car cool without you even thinking about it!

332 Chapter 12

Special Features

- More infographics were added to visually explain physical concepts.
- Boxes addressing ethical issues related to the realm of physics have been added.
- STEM Connection boxes have been added throughout the textbook.
- Multiple mini labs, short hands-on activities, have been added to each chapter.