



Chapter 1

About Science

THE MAIN IDEA



Science is the study of nature's rules

- 1.1 [Understanding the Natural World](#)
- 1.2 [Investigating the Sea Butterfly](#)
- 1.3 [Technology Is Applied Science](#)
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1.5 Chemistry is Integral to Our Lives

When you wonder what the land, air, or ocean is made of, you are thinking about chemistry. When you wonder how a rain puddle dries up, how a car utilizes the energy of gasoline, how photovoltaics work, or how your body acquires energy from the food you eat, you are again thinking about chemistry. **By definition, chemistry is the study of matter and the transformations it can undergo.** **Matter** is anything that has mass and occupies space. It is the stuff that makes up all material things—anything you can touch, taste, smell, see, or hear is matter. The scope of chemistry, therefore, is very broad.

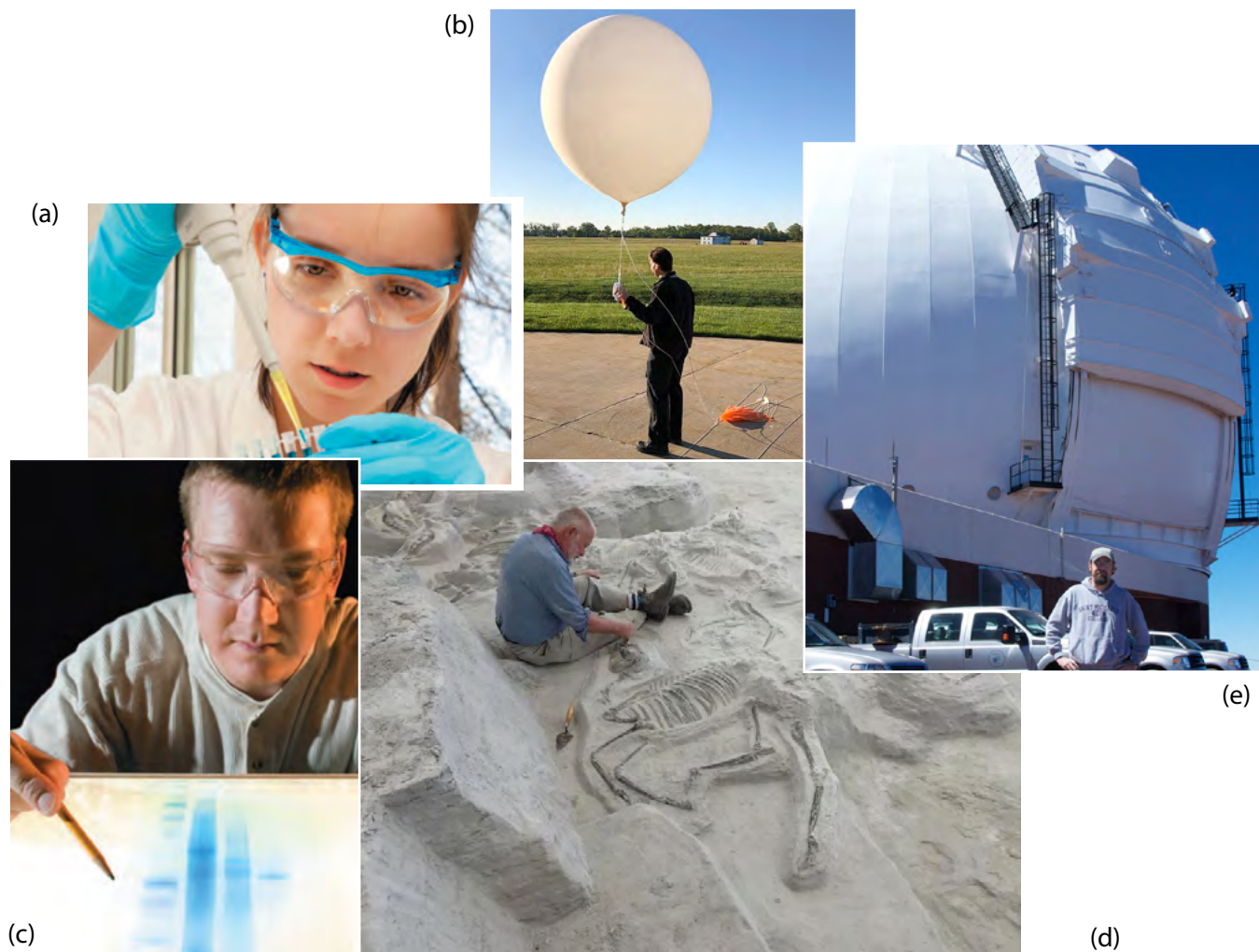
Chemistry is often described as a central science, because it touches all the other sciences (**Figure 1.11**). It springs from the principles of physics, and it serves as the foundation for the most complex science of all—biology. Indeed, many of the great advances in the life sciences today, such as genetic engineering, are applications of some very exotic chemistry. Chemistry is also the foundation for earth science. It is also an important component of space science. Just as we learned about the origin of the Moon from the chemical analysis of moon rocks in the early 1970s, we are now learning about the history of Mars and other planets from the chemical information gathered by space probes.

Progress in science is made as scientists conduct research. Research is any activity whose purpose is the discovery of new knowledge. Many scientists focus on **basic research**, which leads us to a greater understanding of how the natural world operates. Basic research in chemistry tells us how atoms combine to form molecules or how the structures of molecules can be determined. **Applied research** focuses on the development of useful applications of the knowledge laid down by basic research. The majority of chemists choose applied research as their major focus. Applied research in chemistry has provided us with medicine, food, water, shelter, and so many of the material goods that characterize modern life.



READING CHECK

What is the definition of chemistry?



^ Figure 1.11

Chemistry is a foundation for many other disciplines. (a) Biochemists analyzing DNA profiles. (b) Meteorologist releasing a weather balloon to study the chemistry of the upper atmosphere. (c) Technicians conducting DNA research. (d) Paleontologists preserving uncovered ancient fossils. (e) Astronomer in front of observatory, which can be used to study the chemical nature of stars.



^ Figure 1.12

The Responsible Care symbol of the American Chemistry Council.

Over the course of the past century, we became very good at manipulating atoms and molecules to create materials to match our needs. At the same time, however, mistakes were made when it came to caring for the environment. Waste products were dumped into rivers, buried in the ground, or vented into the air without regard for possible long-term consequences. Many people believed that Earth was so large that its resources were virtually unlimited and that it could absorb wastes without being significantly harmed.

Most nations now recognize this as a dangerous attitude. As a result, government agencies, industries, and concerned citizens are involved in extensive efforts to take care of the environment. For example, members of the American Chemistry Council, who, as a group, produce 90 percent of the chemicals manufactured in the United States, have adopted a program called Responsible Care. Through this program, members of this organization have pledged to manufacture their products without causing environmental damage. The Responsible Care program emblem is shown in **Figure 1.12**. Through the wise use of chemistry, waste products can be minimized, recycled, engineered into useful products, or rendered environmentally safe. This is an area of research known as *Green Chemistry*, which we explore in detail in the Contextual Chemistry essay at the end of the next chapter.

Chemistry has influenced our lives in many important ways, and it will continue to do so in the future (**Figure 1.13**). For this reason, it is in everyone's interest to become familiar with the basic concepts of chemistry.



^ Figure 1.13

Most of the material items in any modern house are shaped by some human-devised chemical process.

CONCEPT CHECK

Chemists have learned how to produce aspirin using petroleum as a starting material. Is this an example of basic or applied research?

CHECK YOUR ANSWER

This is an example of applied research, because the primary goal was to develop a useful commodity. However, the ability to produce aspirin from petroleum depended on an understanding of atoms and molecules developed from many years of basic research.