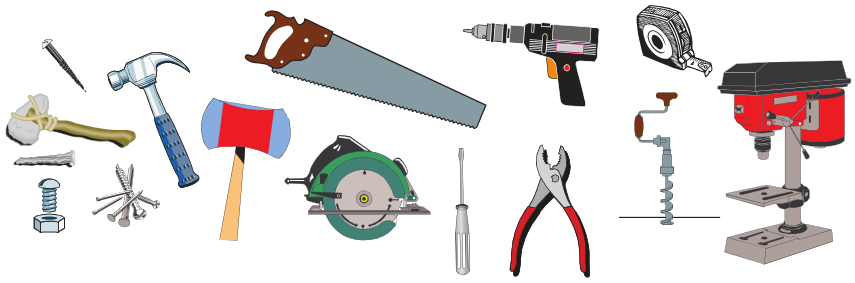
Introduction

We began our study of integrated science with the scientific method. To understand how science developed, you needed to know how it worked. Scientists are people who live and work like everyone else. What they do has an impact on the world. Of course, the world affects them, too. We will conclude our study by examining the ways in which science and scientists interact with the world.

Technology in Society

In a **society**, people use many tools as they interact and rely on one another. Think of the many tools it takes to build a house. Each of these tools and the ways they are used was created by humans. The development of these tools is one form of **technology**, or way to perform tasks of increasing complexity. When humans first began building houses, houses were not very complex. The house might have been made of mud, sticks, and some stones. Compare building a house like that to building a modern home. The change in levels of *technology* is great. Where only a few materials were used before, hundreds of materials are now used. Building a modern house is a complex job which has been made easier by technology. It requires many people with highly developed skills. All of these skills and the tools that are used were created by people. This technology is a part of our *society*.



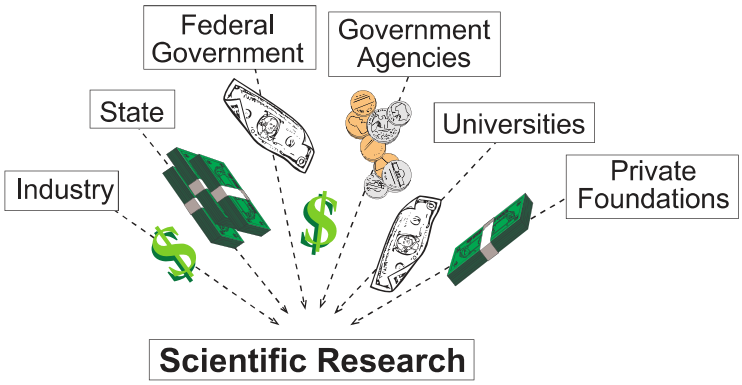
All of these tools were created by people and are a form of technology.

Changes in Technology

There is not a sharp boundary between science and technology. Scientific discoveries lead to technological innovations, and those innovations may lead to further discoveries. Recently, our society has required some changes in house-building technology. Concerns about diminishing

resources are among the greatest causes. As we have discussed, energy is a resource. It allows us to do things and change things. People began to view losing energy as a problem. In a home, we lose energy through windows and walls and in many other areas. People began to demand new ways to prevent energy from being lost.

The people and machines that build homes are part of the housing **industry**. The *industry* recognized the demand of people. Because industries are larger than a single company, the resources of an industry are greater than that of a single business. The industry began to fund research. The research focused on ways to conserve energy in the home. Scientists performed this research. The research was geared specifically to energy conservation in homes. One aspect of knowledge, however, is that it can be used in many ways. The result is that technological problems often provide us with new knowledge.



Scientific research can be paid for by many sources.

This new knowledge can be paid for by many sources. Industry, state and federal government agencies, universities, and private foundations all fund scientific research in our society. One way that research is funded is through **grants**. These *grants* are sums of money awarded to groups and individuals for scientific research. Imagine our example about energy conservation. Can you think of a government agency that might offer a grant for energy conservation? Agencies that deal with housing, energy, or the environment might top your list. Now, think about bubble gum. Can you think of any government agency that is highly concerned with bubble gum? Because there probably is none, there are probably no grants for bubble gum research.

The result is that scientists do not usually pay for the research they conduct. Instead, others provide the money needed to do the research. Sometimes, no source can be found to fund a particular area of research. In these cases no research will be done. The **economy** of the world controls when and how much money is available for certain activities. If the bubble gum industry became powerful, the *economy* would reflect this. If there were then a problem with bubble gum technology, money would probably be available for research.

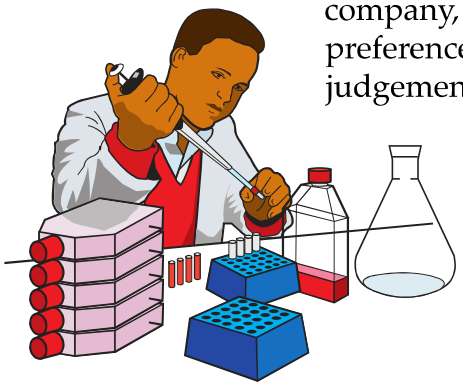
Scientists do not usually pay for the research they do.

When an area of public and social concern arises, research is often conducted. Scientists apply their analytical skills, their knowledge, and their insights to these problems. When the process is effective, scientists can then help the public understand both the causes and likely outcomes. Consider **acid rain**. Acid rain carries dissolved acids, which can cause problems such as water pollution and corrosion of various substances. Because the problem of *acid rain* became a public priority, scientists have studied it. We now know many of its sources and many of its effects. We also have many predictions about what acid rain may yet do.

Much acid rain is a **by-product** of many of our forms of technology. When you turn on an electrical appliance, you don't intend to create acid rain. The electricity you use, however, may be generated from coal. When coal is burned, acid rain is a *by-product*. The acid rain may cause fish to die. You don't intend for this to happen, but it may happen. Technology has impacts on areas of our lives that we often don't foresee. Sometimes the impacts of technology are beneficial, but sometimes they are not beneficial.

Technology is based on scientific knowledge. We now have a certain amount of knowledge about acid rain. Scientists and others who work with technology are using their knowledge. They are trying to solve this problem. One solution might be to stop burning the fuels that result in acid rain. Would this be practical? Most people would not want to part with their appliances and cars. When solving problems, scientists have to consider such things. They must take human values and abilities into account. If they do not, their solutions will not be successful nor publicly accepted.

For many people, the ability to have numerous electrically powered appliances is of great value. They like this aspect of technology. Sometimes though, they may feel differently. Other people may not value numerous electric appliances. They may feel them to be a nuisance. Although the technology is the same, the responses of different people are not the same.



Scientists must consider how the new technology they create will change the world.

If you worked as an engineer for an electrical company, you might have a certain **bias**, or preference that could hinder impartial judgement. That is, you would probably not like the idea of doing away with electricity. As a scientist, you would be expected to know your own *bias*. You would be expected to design your research and investigation to compensate for your bias.

At the end of your research, you would submit your ideas to your **peers**, or others with similar knowledge, background, and goals. One of the most important aspects of science is that it is open for all to review. Other scientists would review your work. If they found it was done well and was accurate, they would say so. It is important to allow others to review all aspects of the scientific process. This allows the methods to be approved and the outcomes verified. The public could then be notified of your findings. The result may be a new technology.

Summary

Many problems encountered in the world are the result of technology. The search for the solution to problems like acid rain involves many engineers, designers, scientists, and others. The search for solutions advances scientific knowledge. Scientists bring this knowledge to the public and inform them. Scientists must be aware of their own biases. They must make their findings available for review by *peers*. Scientists must consider how the new technology they create will change the world. Funds for such research come from many government and private sources. The value of such technology and research, however, varies for different people and at different times.