1.1D: Basic and Applied Science

Basic science increases the knowledge base of a field of research while applied science uses that knowledge to solve specific problems.

LEARNING OBJECTIVES

Differentiate between basic and applied science

KEY TAKEAWAYS

Key Points

- The only goal of basic science research is to increase the knowledge base of a particular field of study.
- Applied science uses the knowledge base supplied by basic science to devise solutions, often technological, to specific problems.
- The basic science involved in mapping the human genome is leading to applied science techniques that will diagnose and treat genetic diseases.

Key Terms

- **basic science**: research done solely to expand the knowledge base
- **applied science**: The discipline dealing with the art or science of applying scientific knowledge to practical problems.
Two Types of Science: Basic Science and Applied Science

The scientific community has been debating for the last few decades about the value of different types of science. Is it valuable to pursue science for the sake of simply gaining knowledge, or does scientific knowledge only have worth if we can apply it to solving a specific problem or to bettering our lives? This question focuses on the differences between two types of science: basic science and applied science.

Basic science or “pure” science seeks to expand knowledge regardless of the short-term application of that knowledge. It is not focused on developing a product or a service of immediate public or commercial value. The goal of basic science is knowledge for knowledge’s sake; though this does not mean that, in the end, it may not result in a practical application.

In contrast, applied science or “technology” aims to use science to solve real-world problems such as improving crop yields, finding a cure for a particular disease, or saving animals threatened by a natural disaster. In applied science, the problem is usually defined for the researcher.

Example of Applied Science: After Hurricane Ike struck the Gulf Coast in 2008, the U.S. Fish and Wildlife Service rescued this brown pelican. Thanks to applied science, scientists knew how to rehabilitate the bird.

Some individuals may perceive applied science as “useful” and basic science as “useless.” A question these people might pose to a scientist advocating knowledge acquisition would be, “What for?” A careful look at the history of science, however, reveals that basic knowledge has resulted in many remarkable applications of great value. Many scientists think that a basic understanding of science is necessary before an application is developed; therefore, applied science relies on the results generated through basic science. Other scientists think that it is time to move on from basic science and instead to find solutions to actual problems. Both approaches are valid. It is true that there are problems that demand immediate attention; however, few solutions would be found without the help of the wide knowledge foundation generated through basic science.
A Link Between Basic and Applied Science: The Human Genome Project was a 13-year collaborative effort among researchers working in several different fields of science. The project, which sequenced the entire human genome, was completed in 2003.

One example of how basic and applied science can work together to solve practical problems occurred after the discovery of DNA structure led to an understanding of the molecular mechanisms governing DNA replication. Strands of DNA, unique in every human, are found in our cells where they provide the instructions necessary for life. During DNA replication, DNA makes new copies of itself shortly before a cell divides. Understanding the mechanisms of DNA replication enabled scientists to develop laboratory techniques that are now used to identify genetic diseases, pinpoint individuals who were at a crime scene, and determine paternity. Without basic science, it is unlikely that applied science would exist.

Another example of the link between basic and applied research is the Human Genome Project, a study in which each human chromosome was analyzed and mapped to determine the precise sequence of DNA subunits and the exact location of each gene. (The gene is the basic unit of heredity; an individual’s complete collection of genes is his or her genome. ) Other less complex organisms have also been studied as part of this project in order to gain a better understanding of human chromosomes. The Human Genome Project relied on basic research carried out with simple organisms and, later, with the human genome. An important end goal eventually became using the data for applied research to seek cures and early diagnoses for genetically-related diseases.

While research efforts in both basic science and applied science are usually carefully planned, it is important to note that some discoveries are made by serendipity; that is, by means of a fortunate accident or a lucky surprise. Penicillin was discovered when biologist Alexander Fleming accidentally left a petri dish of Staphylococcus bacteria open. An unwanted mold grew on the dish, killing the bacteria. The mold turned out to be Penicillium and a new antibiotic was discovered. Even in the highly organized world of science, luck, when combined with an observant, curious mind, can lead to unexpected breakthroughs.