

WORKSHOP INDEX

NEXT LESSON →

Scientific Investigation, Part I

Objective

In this lesson, you will review what science encompasses and how it works, and cover some of the diversity of its fields. You will also review scientific ethics, reliability, techniques, evaluations, and theories.

What is Science?

The word science comes from a Latin word that means “to know.” However, science is more than just a collection of facts and knowledge. It is a way of observing nature and the universe, and of testing explanations for how and why things are the way they are. Scientists search for the truth. They strive to uncover facts and a better understanding of the natural world and how its parts are interrelated.

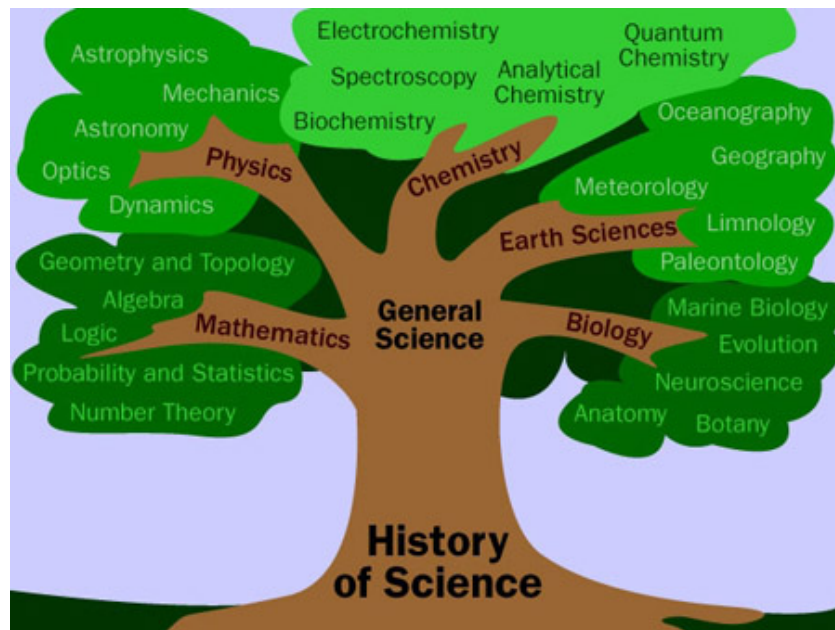
Scientific knowledge and understanding are built on the principle that the universe can be explained in terms of cause and effect. Although there are many definitions of science, only two are useful in our modern understanding: empiricism and realism.

According to **empirical** philosophy, scientific theories are objective, testable, and predictive of results that can be replicated and verified through experimentation. On the other hand, scientific **realism** is more akin to identifying objects and processes; their causes, constituents, or origins; and the manner in which the causes or origins work. In short, empiricism is more about asking questions about reality, and realism is more about identifying structure and cause. It may seem to be a subtle difference and the two are linked closely in a real-world definition of science that encompasses much of both schools of philosophy.

An important philosopher of science, Karl Popper, argued that in true scientific investigation, verification is impossible, and that advancements in scientific knowledge can only be made based on hypotheses that are held to be true, meaning they have not been falsified. Thomas Kuhn also stated that human bias makes all observations tainted with preconceptions based on the current paradigm. Kuhn argued that science involves paradigms and assumptions, and that scientific progress is mainly gained through the falsification or modification of paradigms and the emergence of newer

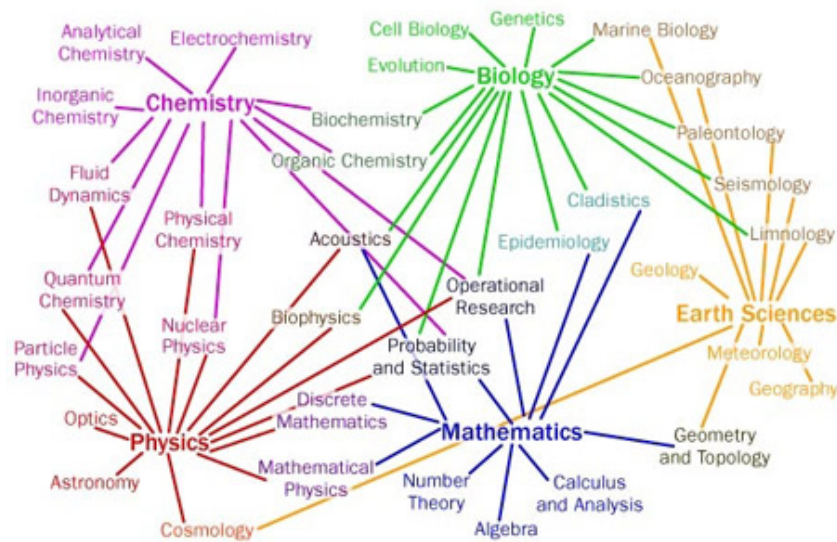
and more powerful paradigms in a cycle that never ends. He also pointed out that science has never historically proceeded as a steady accumulation of facts, but as a series of dramatic (and sometimes cataclysmic) paradigm shifts that precipitate scientific revolution.

The universe works on a consistent set of principles that science attempts to summarize, organize, and interpret for use by man. For instance, storms occur because a certain amount of energy from the sun has heated parts of Earth more than others. Energy flows between these places in a predictable way that follows natural laws. This flow of energy causes the storm and other atmospheric phenomena. Almost every part of our daily lives is based on scientific knowledge and its applications.



Branches of Science

Science covers a lot of conceptual ground; therefore, people separate it into different branches of knowledge. The term “branches” might indicate that the fields of science can be shown in a tree-like diagram. However, as our storehouses of knowledge expand, a web of knowledge may display science more accurately. No matter how you prefer to visualize the complexity of science, please realize that all of scientific progress is inter-related and there are no isolated disciplines within science—everything is connected.



Broad fields of scientific study include:

- Chemistry is the study of the elements and the interactions of their atoms.
- Geology is the study of Earth. Geological sciences are at the juxtaposition of astronomy and Earth Sciences.
- Physics is the study of the physical universe and how its parts interact.
- Biology is the study of life. This is one of the broadest disciplines of science and has become incredibly important as we learn more about ourselves and our place in the natural world.
- Mathematics is the study of number and shape. Although mathematics is a field of science on its own, it is also the glue that holds the other fields together.

Most scientific investigations do not fall strictly within just one of these fields, and there is tremendous overlap and interconnection between them. Within and between these broad fields, there are many other classifications of science. These include biochemistry and geophysics, which combine concepts included in two or more of the broad fields. Others, for example botany and organic chemistry, are specialties within one of the broad fields. In addition, the principles of science are used by sociologists, economists, psychologists, and others who study human behavior. The main idea to remember is that science is a process that encompasses the whole range of causes and effects in the natural world and our systematic attempts to understand it all.

Who Conducts Science?

Science is a process that involves performing many different functions. Although many scientists work in laboratories, certain branches of science work mostly in the field. The settings for scientific research are often as diverse as the careers that utilize them. For instance, engineers, teachers, computer scientists, doctors, farmers, and even chefs do science every day. Furthermore, some scientific fields, such as astronomy, actively encourage amateur observers to contribute