

1.1 A Brief History of Advances in Science

When a sore throat keeps you home from school, you probably ask yourself, “How did I catch this cold?” You then speculate about how you could have been exposed to germs, and how you might avoid exposure next time. When a light goes out in your room, you ask, “How did that happen?” You might check to see if the lamp is plugged in, check the bulb, or even look at your neighbors’ houses to see if there has been a power outage. When you think like this, you are searching for *cause and effect* relationships – trying to find out what events cause what results. This type of thinking is *rational thinking*. Rational thinking is basic to science.

Today we use rational thinking so much that it’s hard to imagine other ways of interpreting our experiences. But it wasn’t always this way. At times, people have relied more on superstition and magic to interpret the world around them – or have simply failed to ask, “Why?”

Rational thought became very popular in Greece in the 3rd and 4th centuries BC. From there it spread throughout Rome and other parts of the Mediterranean world. When the Roman Empire fell in the 5th century AD, advancements in science came to a halt in Europe. Barbarians destroyed much in their paths as they conquered Europe and brought in the Dark Ages. But during this time science continued to advance in other parts of the world. The Chinese and Polynesians were charting the stars and planets. Arab nations developed mathematics and learned to make glass, paper, metals, and certain chemicals. Finally the Greek philosophy of rational thinking was brought back into Europe by Islamic people who entered Spain during the 10th, 11th, and 12th centuries. Then universities emerged. When the printing press was invented in the 15th century, science made a great leap forward. This invention did much to advance scientific thought (just as computers and the Internet are doing today.)

Up into the 16th century most people thought the Earth was the center of the universe. They thought the sun circled the stationary Earth. This thinking was challenged when the Polish astronomer Nicolaus Copernicus quietly published a book proposing that the sun is stationary and that the Earth revolves around it. These ideas conflicted with Church teachings and were banned for 200 years.

Modern science began in the 16th century when the Italian physicist Galileo Galilei revived the Copernican view. Galileo used experiments, rather than speculation, to study nature’s behavior. Galileo was arrested for popularizing the Copernican theory and for his other contributions to scientific thought. Yet a century later his ideas and those of Copernicus were accepted by most thinking people.

1.2 Mathematics and Conceptual Physical Science

Pure mathematics is different from science. Math is a study of relationships among numbers. When used as a tool of science, the results are fantastic. Measurements and calculations are essential parts of the powerful science we practice today. For example, it would not be possible to send missions to Mars if we couldn’t measure the positions of spacecraft or calculate their trajectories.

1.3 The Scientific Method – A Classic Tool

In the 16th century the Italian physicist Galileo and the English philosopher Francis Bacon developed a formal method for doing science – **the scientific method**. Based on rational thinking and experimentation, this method works as follows:

1. Recognize a question or a problem
2. Make an educated guess – a **hypothesis** – to answer the question
3. Predict consequences that can be observed if the hypothesis is correct. The consequences should be *absent* if the hypothesis is not correct.
4. Do experiments to see if predicted consequences are present.
5. Formulate the simplest general rule that organizes the three ingredients – hypothesis, predicted effects, and experimental findings.

1.6 Science Has Limitations

Science deals only with the hypotheses that are testable. Its domain is therefore restricted to the observable natural world. While scientific methods can be used to debunk various paranormal claims, they have no way of accounting for testimonies involving the supernatural. The term supernatural literally means “above nature.” Science works within nature, not above it. Likewise, science is unable to answer philosophical questions such as “What is the purpose of life?” Though these questions are valid and important ones, they lie outside the realm of science.

1.8 Technology – Practical Use of the Findings of Science

Science and technology are also different from each other. Science is concerned with gathering knowledge and organizing it. Technology lets humans use the knowledge for practical purposes, and it provides the instruments scientists need to conduct their investigations.