



## The Scientific Method

### Overview

We see a laboratory researcher looking through a microscope. There is dispute over who actually invented the microscope, which occurred sometime around 1600 in Holland. But there is no dispute over who made the most of its invention. In 1674, Antony van Leeuwenhoek, the grammar school-educated clerk and untrained amateur optician, made one of the greatest discoveries of human history: microbes. As a result of his great patience, careful observation, and attention to detail, Leeuwenhoek found the “very tiny animalcules” that many other, better educated and trained researchers had overlooked. He is regarded as the father of microbiology, and his discovery paved the way for the work of Louis Pasteur and others who formulated the microbial theory of human disease. His work made possible the eventual conquest of disease and its attendant human misery, as well as the early death that had plagued (and limited) humanity since the beginning of life on Earth.

As interesting and inspirational as Leeuwenhoek’s story is, there is another context at work here. The Dutch, building upon the brilliant work of Christiaan Huygens, who formulated the first complete wave theory of light, became remarkably adept at making, grinding, and polishing glass to an extraordinary consistency and clarity. The first telescope (a reversed microscope) was not invented by Galileo, as is often thought, but by a Dutchman.

Leeuwenhoek, through diligence, patience, and attention to minute detail, was able to build lenses that produced magnification over 200 times greater than previously attained. And, in the process, he also rejected the “conventional wisdom” of the day on how to build such devices, and formed an entirely new method that took full advantage of his extraordinary lenses. The rich traditions of “glass working” that Leeuwenhoek helped establish caused scientists who needed precision optics to go to Holland.

It’s one of the great ironies of history that the Dutch also settled South Africa. During this time, they found shiny pieces of very hard glass and figured out how to cut, grind, shape, and polish this new gem to an extraordinary degree. So even today, when you mention the word diamond, you think of DeBeers, and Antwerp is still the place to go to get precision optics. Talk about making use of “core capabilities!”

Our image also conveys a much larger set of forces at work. It represents the invention of the so-called Scientific Method, a way of looking at reality that is distinctively European in its genesis and exposition. Although Rene Descartes is

generally credited with its articulation, it really traces its origins to a much earlier time—300 B.C.—and to the Greek philosopher Euclid.

Euclid, the “father of geometry,” established a method of inquiry that was truly unique and has no parallel in any other culture. The Chinese, for instance, whose culture was technologically much more advanced than that of Western Europe, had no corresponding insight: namely, the idea that you could develop a relatively few general statements (called axioms, postulates, and definitions) and from these construct an incredibly broad and generalized fabric of reality. This was the basis of the scientific revolution that the Greeks started, and which lay essentially dormant for almost 2,000 years, until it returned during the Renaissance. This was the tradition of thought that Descartes, Bacon, Newton, and others built upon to establish the modern era.

## **Professions and Trades**

The list of professions and trades associated with science is long indeed. For this exercise, we'll limit our list to that associated with Leeuwenhoek's story:

- Artist
- Glass Blower
- Glass Cutter
- Laboratory Technician
- Machinist
- Metalworker
- Process Engineer
- Optician
- Physicist