Newton's Rules of Reasoning

In 1687, Isaac Newton published his masterpiece, the *Mathematical Principles of Natural Philosophy*, or *Principia*. In this work, Newton demonstrated the mathematical proofs for his universal law of gravitation and completed the new cosmology begun by Copernicus, Kepler, and Galileo. He also described the rules of reasoning by which he arrived at his universal law.

Isaac Newton, *Rules of Reasoning in Philosophy*

Rule 1

We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances.

To this purpose the philosophers say that Nature does nothing in vain, and more is in vain when less will serve; for Nature is pleased with simplicity, and affects not the pomp of superfluous causes.

Rule 2

Therefore to the same natural effects we must, as far as possible, assign the same causes.

As to respiration in a man and in a beast; the descent of stones in Europe and in America; the light of our culinary fire and of the sun; the reflection of light in the earth and in the planets.

Rule 3

The qualities of bodies, which admit neither intensification nor remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever.

For since qualities of bodies are only known to us by experiments, we are to hold for universal all such as universally agree with experiments; and such as are not liable to diminution can never be quite taken away.

Rule 4

In experimental philosophy we are to look upon propositions inferred by general induction from phenomena as accurately or very nearly true, notwithstanding any contrary hypotheses that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions.

This rule we must follow, that the argument of induction may not be evaded by hypotheses.

Historical Thinking Skill: Contextualization

- How might following Newton's rules of reasoning have changed future scientific inquiry?

The Father of Modern Rationalism: RENÉ DESCARTES HAS LONG BEEN VIEWED as the **founder of modern rationalism and modern** philosophy because he believed that human beings could **understand the world—itself** a mechanical system—by the same rational principles inherent in **mathematical thinking. In his *Discourse on Method*, he elaborated on his approach to discovering truth.**

René Descartes, *Discourse on Method*

In place of the numerous precepts which have gone to constitute logic, I came to believe that the four following rules would be found sufficient, always provided I took the firm and unswerving resolve never in a single instance to fail in observing them.

The first was to accept nothing as true which I did not evidently know to be such, that is to say, scrupulously to avoid precipitance and prejudice, and in the judgments I passed to include nothing additional to what had presented itself to my mind so clearly and so distinctly that I could have no occasion for doubting it.

The second, to divide each of the difficulties I examined into as many parts as may be required for its adequate solution.

The third, to arrange my thoughts in order, beginning with things the simplest and easiest to know, so that I may then ascend little by little, as it were step by step, to the knowledge of the more complex, and in doing so, to assign an order of thought even to those objects which are not of themselves in any such order of precedence.

And the last, in all cases to make enumerations so complete, and reviews so general, that I should be assured of omitting nothing.

Those long chains of reasonings, each step simple and easy, which geometers are wont to employ in arriving even at the most difficult of their demonstrations, have led me to surmise that all the things we human beings are competent to know are interconnected in the same manner, and that none are so remote as to be beyond our reach or so hidden that we cannot discover them—that is, provided we abstain from accepting as true what is not thus related, i.e., keep always to the order required for their deduction one from another. And I had no great difficulty in determining what the objects are with which I should begin, for that I already knew, namely, that it was with the simplest and easiest. Bearing in mind, too, that of all those who in time past have sought for truth in the sciences, the mathematicians alone have been able to find any demonstrations, that is to say, any reasons which are certain and evident, I had no doubt that it must have been by a procedure of this kind that they had obtained them.

Historical Thinking Skill: Comparison

- What was the main difference between Descartes's and Newton's methods of reaching scientific truth?