

# Elmhurst College

## Galileo and the Methods of Science

In concluding, let us summarize **Galileo's contribution to the style of science**. Much of his life was a struggle to define a proper scientific method. He was concerned with how scientific statements should be defined and proven, with the criteria of scientific truth. For Galileo, a proper physical statement can be tested according to *only two criteria*. *A theory must be logically consistent internally*. Mathematics is the means by which the elements of theory are defined, clarified, and logically ordered. The language of science should be unambiguous, in contrast with the rich but imprecise language of everyday life. Secondly, *agreement with experiment is the ultimate arbiter among theoretical possibilities*. Galileo admitted no intellectual authority in science other than these: logical consistency and experimental agreement. He ridiculed the criterion of "perfection" imposed upon science by scholastic, and ultimately Greek, philosophy. "Perfection for what specific purpose?" he asked. The imposition of philosophical, theological, or political values upon the methods or conclusions of science could only interfere with the direct and simple thought necessary for the accurate formulation of scientific ideas. Galileo divorced mechanics from all considerations of the nature of moving bodies. Their color, shape, texture, composition, and surprisingly, even their weight, were all irrelevant to the **description of their motion: all that mattered was their position and the way their position changed with time**.

Galileo's austere criteria implied a necessary limitation of his objectives. Kepler's search for cosmic harmony, however pleasing personally, was nevertheless meaningless in Galileo's terms. It was a quest for an imprecisely defined goal. It is no accident that in Galileo we find the first appearance of truly abstract theoretical reasoning in physics. However unattainable in reality and however they violate common sense and experience, *Galileo's idealized dynamical principles can be used simply and efficiently*. This gave them extraordinary power as instruments of thought. What Galileo sacrificed of Aristotle's demand for direct perception of the multiplicity of nature, he gained in clarity, accuracy, and efficiency of thought. Similarly, *experimental science was for him not a passive monitoring of the rich complexity of nature, but a direct intervention into nature to construct an idealized, experimental environment, one which best approximates the abstractions embodied in theory*. He preferred to think with complete mathematical accuracy about simple dynamical processes – uniform motion parallel to the surface of the earth or uniform gravitational acceleration – rather than lose clarity with more realistic problems. His program for mechanics was *a new beginning; others would carry on*.