# Topic Page: Mechanics

Definition: **mechanics** from *Dictionary of Energy*

*Physics*. the branch of physics that deals with motion and with the reaction of physical systems to internal and external forces.

Summary Article: **mechanics**
from *The Columbia Encyclopedia*

branch of physics concerned with motion and the forces that tend to cause it; it includes study of the mechanical properties of matter, such as density, elasticity, and viscosity. Mechanics may be roughly divided into statics and dynamics; statics deals with bodies at rest and is concerned with such topics as buoyancy, equilibrium, and the principles of simple machines, while dynamics deals with bodies in motion and is sometimes further divided into kinematics (description of motion without regard to its cause) and kinetics (explanation of changes in motion as a result of forces). A recent subdiscipline of dynamics is nonlinear dynamics, the study of systems in which small changes in a variable may have large effects. The science of mechanics may also be broken down, according to the state of matter being studied, into solid mechanics and fluid mechanics. The latter, the mechanics of liquids and gases, includes hydrostatics, hydrodynamics, pneumatics, aerodynamics, and other fields.

## Early Mechanics

Mechanics was studied by a number of ancient Greek scientists, most notably Aristotle, whose ideas dominated the subject until the late Middle Ages, and Archimedes, who made several contributions and whose approach was quite modern compared to other ancient scientists. In the Aristotelian view, ordinary motion required a material medium; a body was kept in motion by the medium rushing in behind it in order to prevent a vacuum, which, according to this philosophy, could not occur in nature. Celestial bodies, on the other hand, were kept in motion through the vacuum of space by various agents that, in the Christianized version of Aquinas and others, acquired an angelic character.

This explanation was rejected in the 14th cent. by several philosophers, who revived the impetus theory proposed by John Philoponos in the 6th cent. A.D.; according to this theory a body acquired a quantity called impetus when it was set in motion, and it eventually came to rest as the impetus died out. The impetus school flourished in Paris and elsewhere during the 14th and 15th cent. and included William of Occam (Ockham), Jean Buridan, Albert of Saxony, Nicolas Oresme, and Nicolas of Cusa, although it was never successful in replacing the dominant Aristotelian mechanics.

## Modern Mechanics

Modern mechanics dates from the work of Galileo, Simon Stevin, and others in the late 16th and early 17th cent. By means of experiment and mathematical analysis, Galileo made a number of important studies, particularly of falling bodies and projectiles. He enunciated the principle of inertia and used it to explain not only the mechanics of bodies on the earth but also that of celestial bodies (which, however, he believed moved in uniform circular orbits). The philosopher René Descartes advocated the application of the mathematical-mechanical approach to all fields and founded the mechanistic philosophy that was so important in science for the next two centuries or more.

The first system of modern mechanics to explain successfully all mechanical phenomena, both terrestrial and celestial, was that of Isaac Newton, who in his *Principia (Mathematical Principles of Natural Philosophy*, 1687) derived three laws of motion and showed how the principle of universal gravitation can be used to explain both the behavior of falling bodies on the earth and the orbits of the planets in the heavens. Newton's system of mechanics was developed extensively over the next two centuries by many scientists, including Johann and Daniel Bernoulli, Leonhard Euler, J. le Rond d'Alembert, J. L. Lagrange, P. S. Laplace, S. D. Poisson, and W. R. Hamilton. It found application to the explanation of the behavior of gases and thermodynamics in the statistical mechanics of J. C. Maxwell, Ludwig Boltzmann, and J. W. Gibbs.

In 1905, Albert Einstein showed that Newton's mechanics was an approximation, valid for cases involving speeds much less than the speed of light; for very great speeds the relativistic mechanics of his theory of relativity was required. Einstein showed further in his general theory of relativity (1916) that gravitation could be explained in terms of the effect of a massive body on the framework of space and time around it, this effect applying not only to the motions of other bodies possessing mass but also to light. In the quantum mechanics developed during the 1920s as part of the quantum theory, the motions of very tiny particles, such as the electrons in an atom, were explained using the fact that both matter and energy have a dual nature—sometimes behaving like particles and other times behaving like waves. Two different but mathematically equivalent forms of quantum mechanics were elaborated, the wave mechanics of Erwin Schrödinger and the matrix mechanics of Werner Heisenberg.

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