



6.1 Isaac Newton

Isaac Newton is one of the most brilliant figures in scientific history. His three laws of motion are probably the most important natural laws in all of science. He also made vital contributions to the fields of optics, calculus, and astronomy.

Plague provides opportunity for genius



Isaac Newton was born in 1642 in Lincolnshire, England. His childhood years were difficult. His father died just before he was born. When he was three, his mother remarried and left her son to live with his grandparents. Newton bitterly resented his stepfather throughout his life.

An uncle helped Newton remain in school and in 1661, he entered Trinity College at Cambridge University. He earned his bachelor's degree in 1665.

Ironically, it was the closing of the university due to the bubonic plague in 1665 that helped develop Newton's genius. He returned to Lincolnshire and spent the next two years in solitary academic pursuit.

During this period, he made significant advances in calculus, worked on a revolutionary theory of the nature of light and color, developed early versions of his three laws of motion, and gained new insights into the nature of planetary motion.

Fear of criticism stifles scientist

When Cambridge reopened in 1667, Newton was given a minor position at Trinity and began his academic career. His studies in optics led to his invention of the reflecting telescope in the early 1670s. In 1672, his first public paper was presented, on the nature of light and color.

Newton longed for public recognition of his work but dreaded criticism. When another bright young scientist, Robert Hooke, challenged some of his points, Newton was furious. An angry exchange of words left Newton reluctant to make public more of his work.

Revolutionary law of universal gravitation

In the 1680s, Newton turned his attention to forces and motion. He worked on applying his three laws of motion to orbiting bodies, projectiles, pendulums, and free-fall situations. This work led him to formulate his famous law of universal gravitation.

According to legend, Newton thought of the idea while sitting in his Lincolnshire garden. He watched an apple fall from a tree. He wondered if the same force that caused the apple to fall toward the center of Earth (gravity) might be responsible for keeping the moon in orbit around Earth, and the planets in orbit around the sun.

This concept was truly revolutionary. Less than 50 years earlier, it was commonly believed that some sort of invisible shield held the planets in orbit.

Important contributor in spite of conflict

In 1687, Newton published his ideas in a famous work known as the *Principia*. He jealously guarded the work as entirely his. He bitterly resented the suggestion that he should acknowledge the exchange of ideas with other scientists (especially Hooke) as he worked on his treatise.

Newton left Cambridge to take a government position in London in 1696. His years of active scientific research were over. However, almost three centuries after his death in 1727, Newton remains one of the most important contributors to our understanding of how the universe works.



Reading reflection

1. Important phases of Newton's education and scientific work occurred in isolation. Why might this have been helpful to him? On the other hand, why is working in isolation problematic for developing scientific ideas?
2. Newton began his academic career in 1667. For how long was he a working scientist? Was he a very productive scientist? Justify your answer.
3. Briefly state one of Newton's three laws of motion in your own words. Give an explanation of how this law works.
4. Define the law of universal gravitation in your own words.
5. The orbit of a space shuttle is surprisingly like an apple falling from a tree to Earth. The space shuttle is simply moving so fast that the path of its fall is an orbit around our planet. Which of Newton's laws helps explain the orbit of a space shuttle around Earth and the orbit of Earth around the sun?
6. **Research:** Newton was outraged when, in 1684, German mathematician Wilhelm Leibniz published a calculus book. Find out why, and describe how the issue is generally resolved today.