

SIR ISAAC NEWTON LEAVES A LEGACY

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Sir Isaac Newton (1642-1727) is known as the first popular hero of modern science. The words "scientist" and "physics" did not exist during his lifetime.

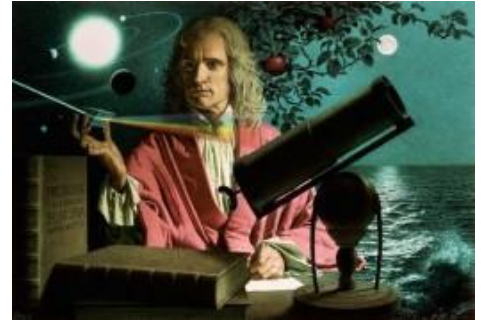
The most enduring legacy of Sir Isaac Newton is his three laws of motion. His most unusual gift was his power of concentration.

SIR ISAAC NEWTON WAS ONCE YOUNG



Sir Isaac Newton was born in 1642. Isaac Newton was unusually small and sickly as a baby. At birth, he could have fit into a quart mug. His father was an illiterate farmer, who died three months before Newton was born.

Newton's mother remarried, but her new husband did not want the boy in their lives, so she abandoned three-year-old Newton. Newton grew up with his grandmother in a lonely farmhouse.



1. *What are some challenges Newton had to overcome as a very young child?*

WOOLSTHORPE MANOR, WHERE ISAAC
NEWTON WAS BORN AND RAISED

In school, Isaac Newton was not an outstanding student early on; nor did he make any close friends. Later, he became the top student after being bullied by a classmate. At home, Isaac drew on the walls of his bedroom until they were covered with his drawings of sundials, circles, triangles, plants, birds, beasts, ships, and people. As a teenager, he could tell the time of day by the shadows he saw.

2. *How would you describe young Newton's personality?*

3. *What technology was Newton using to tell the time of day as a teenager? Why would we consider this a technology?*

THE ECCENTRIC NEWTON

Newton became professor of mathematics at Cambridge University in the United Kingdom at the age of 27. Newton lectured to mostly empty classrooms because most students were not interested in his ideas. Even those who were interested found it difficult to understand his teaching. His secretary said, "*Few went to hear him; fewer understood him.*"

Newton's colleagues viewed him as a solitary, untrusting, glum man. He did not laugh or engage in small talk. He rarely changed his clothes, fastened his shoes, or combed his hair. To dine at an actual table was unheard of; he preferred to snack throughout the day. Sitting down for a meal took far too much time away from his work.

Isaac Newton hardly ever used his bed; he would take naps here and there, around the clock. Newton rarely left his room. He had no hobbies; he never partook in physical activity. His hair turned silver by age 30.

4. *How would you describe Newton's personality as an adult?*

NEWTON UNDERSTOOD THE GRAVITY OF THE SITUATION

In 1687, Newton published *Principia Mathematica*, perhaps the most important science book ever written. In it, Newton explained his three laws of motion. He also helped his fellow scientists understand how gravity worked and what caused the planets to move around the sun. As Newton became famous, he wanted to be left alone—yet he craved attention.

Newton's first law of motion: A ball that stops after rolling along the floor is an example of Newton's first law of motion. This law states that an object's motion will not change until an unbalanced force acts on the object. The law also states that an object will not start to move until an unbalanced force acts on it. A rolling ball stops moving because the force of friction acts on it and slows it down. If there were no friction, the ball would keep rolling.

Another way of stating Newton's first law is that matter resists any change in motion. All objects resist changes in motion. However, not all objects resist changes in motion by the same amount. For example, it does not take very much force to change the motion of a baseball. It takes much more force to change the motion of a bowling ball. The bowling ball resists changes in motion more than the baseball does. The tendency of an object to resist changes in motion is called **inertia**. All objects have inertia. The amount of inertia an object has depends on the object's mass. The greater the mass of an object, the greater its inertia.

5. ***What happens to the motion in a tug-of-war if mass increases (the number of people)? How do you think these observations demonstrate Newton's first law of motion?***

6. **Optimization and Iterations:**

- a. ***What is the optimal design for a baseball knowing that it does not take very much force to change the motion of a baseball?***

- b. ***What is the optimal design for a bowling ball knowing that it takes much more force to change the motion of a bowling ball?***

- c. ***What iterations do you think both may have gone through when engineers were designing them?***

Newton's second law of motion: Newton's first law describes what happens when no unbalanced forces act on an object: the object's motion does not change. What happens when an unbalanced force does act on an object? Newton's second law states that the larger the unbalanced force on an object, the more the object's motion will change. It also states that the larger the object's mass, the smaller its acceleration will be. Acceleration is the change in motion of an object. Think about a baseball. If you throw the baseball gently, it will not move very fast. If you throw it more forcefully, it will move much more quickly. Now, imagine using the same force to throw a bowling ball. What will happen? The bowling ball will move much more slowly than the baseball.

7. ***How do you think increasing the force (the number of people) affects the outcome of a tug-of-war? How do these observations demonstrate Newton's second law of motion?***

Newton's third law of motion: Newton's third law describes that for every force there is a reaction force that is equal in size, but opposite in direction. That is to say that whenever an object pushes another object it gets pushed back in the opposite direction equally hard.



8. ***What observations would you make during a tug-of-war game that would demonstrate Newton's third law of motion?***

Newton's laws of motion were not thought up all on his own. In fact the scientist Galileo had already largely described Newton's law of inertia. Queen Anne knighted Sir Isaac Newton in 1705, which made him the first scientist ever given this honor. Sir Isaac Newton famously said: "*If I have seen further than most men, it is by standing on the shoulders of giants.*"

9. ***What do you think Newton meant when he said the above quote in italics?***

10. ***Why do you think that when we talk about Newton we tend to ignore how he used the work of other scientists like Galileo and Descartes to further his ideas?***

NO ONE GETS OUT ALIVE

Despite being a sickly child and never exercising as an adult, Newton lived a long life in good health. He looked startlingly young at 80 years old. His hair was white, but it was remarkably thick for a man his age. And he did not require glasses. Newton died in his sleep and was buried in Westminster Abbey. His body was found to contain mercury from some experiments he had done.

On his burial monument these words appear: "*Here is buried Isaac Newton, Knight, who by a strength of mind almost divine, and mathematical principles peculiarly his own, explored the course and figures of the planets, the paths of comets, the tides of the sea, the dissimilarities in rays of light, and, what no other scholar has previously imagined, the properties of the colors thus produced. Diligent, wise and faithful in his descriptions of nature, antiquity and the holy Scriptures, he vindicated by his philosophy the majesty of God mighty and good, and expressed the simplicity of the Gospel in his manners. Mortals rejoice that there has existed such and so great an ornament of the human race!*"

11. ***Summarize in your own words a description of the type of person Isaac Newton was and his contributions to understanding nature.***



TOMB OF ISAAC NEWTON IN
WESTMINSTER ABBEY