<u>Galileo's Law of Acceleration/Falling Bodies</u>

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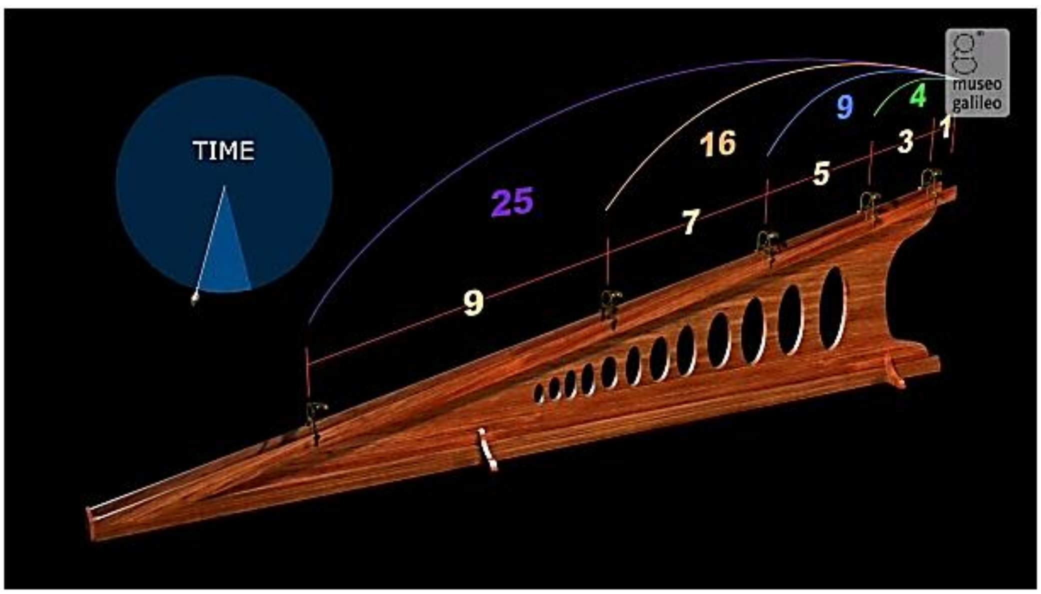
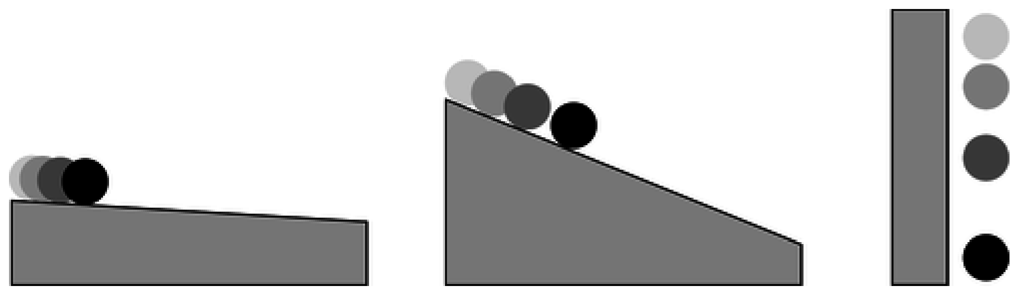
Galileo set out to prove that all objects, regardless of their mass, would fall at the same rate..that is, they would have the same free-fall acceleration. The motion of a freely falling object was too fast for Galileo to measure directly. His ingenious method to analyze the motion was to use an inclined plane at a very small angle so as to reduce the effect of gravity enough to slow a rolling ball to a speed that would allow its measurement.

Galileo's use of the inclined plane to study the motion of objects is one of his most important contributions to science. The inclined plane allowed Galileo to accurately measure the effect of gravity on falling objects and develop a universal law describing this effect.

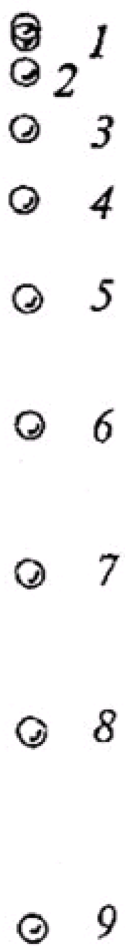


This experimental apparatus provided a demonstration of the Galilean law of the natural fall of bodies, which stated that the spaces traversed from an initial position of rest are proportional to the squares of the times of fall.
The pendulum attached to the inclined plane was swung at the same time as the small ball was released. In each successive oscillation of the pendulum, the sphere traversed spaces that increased in accordance with the sequence of odd numbers.
In the first oscillation period, the sphere traversed a given interval from its rest position. In the second period, it traveled three spaces; in the third period, five spaces, in the fourth period, seven spaces, and so on.
It follows that the sphere traverses four spaces in two periods from a rest position, nine spaces in three periods, sixteen spaces in four periods, and so on.

Galileo used the results from his inclined plane experiments and extrapolated them for a vertical inclined plane. He imagined increasing the angle of the incline until it was vertical. In essence, rolling the ball down the vertical inclined plane would be like dropping the object vertically in free-fall.



Although having an increased acceleration, Galileo reasoned that the same pattern of motion he found along the inclined plane would extend to falling objects.



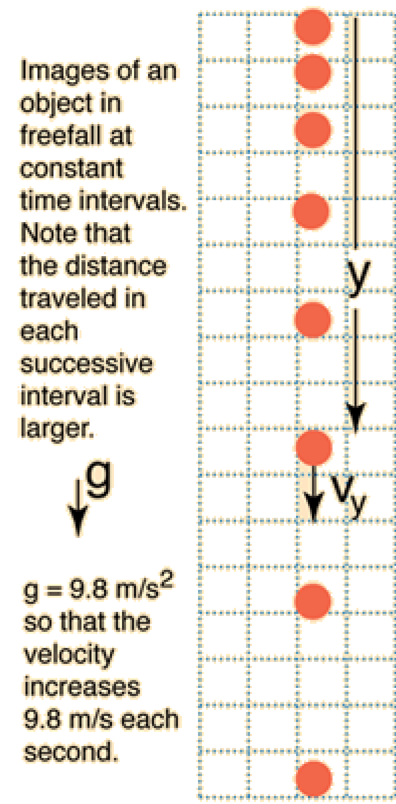
Summary of Galileo's Law of Acceleration/Falling Bodies

Law of Odd Numbers: the distance covered during each equal interval of time goes by the odd numbers.

Law of Squares: the total distance covered after equal time intervals goes by the square of time. In other words, the total distance covered is proportional to t^2.

Law of Velocity: the velocity of an object in free fall is proportional to t.

Law of Acceleration: neglecting the effects of air, all bodies in free-fall accelerate at the constant rate. $\boldsymbol{g}$ **= 9.80 m/s²**



← *The numbers in this diagram indicate time units passed.*

Kinematic (Galilean) Equations of Motion
Galileo summarized these laws in a set of equations that represent a precise description of the behavior for any object that is uniformly accelerating in a linear path. We can also interpret and describe uniformly accelerated motion by plotting and analyzing position-time and velocity-time data from graphical representations.