Newton's 2nd Law

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Introduction

Sir Isaac Newton, 1643-1727, was born in UK. He was a mathematician and physicist and one of the foremost scientific intellects of all times. His contributions to science included modern laws of optics, the development of calculus, the Newtonian telescope and his law of cooling. However, the most important discoveries were his three laws of motion and the universal law of gravitation which sufficed to regulate the cosmos, but only, as Newton believed, with the help of God.

The major objective of this article is to describe Newton's 2nd Law as well as to demonstrate it by artworks. This will make it more perceptible and understandable to the readers. There is a popular story about this law. Probably the more correct version of the story is that Newton, upon observing an apple fall from a tree, began to think along the following lines: The apple is accelerated, since its velocity changes from zero as it is hanging on the tree and moves toward the ground. Thus, by Newton's 2nd Law there must be a force that acts on the apple to cause this acceleration. Let's call this force "gravity", and the associated acceleration the "acceleration due to gravity". The law is generally formulated by $F = ma$ where F is force, m is mass and a is the acceleration, where for a free fall in air $a = g = 9.8$ m/sec^2. The equation looks simple and aesthetic where Einstein said once that beauty is the first test about an equation to be correct.

Figure 1 is an artistic demonstration of the law. Sisyphus pushing a heavy boulder demonstrates force F, a push or pulls exerted on an object. The mythological figure of Sisyphus is one of the best well-known penitents of the underworld. The Gods' punished him for his hubris to push a heavy boulder up a mountain that always rolls back after reaching the summit. Mass m is the amount of matter in a body and a measure of the inertial property of it. It is demonstrated by the sculpture entitled Male Torso of Fernando Botero (b.1932), a Colombian painter and sculptor. g is described by the right artwork of Botero in which two images seem to be falling at acceleration g where the one on the right seems to make efforts in preventing him of falling down due to gravity force attraction. Additional demonstrations of the law in its form $F = mg$ are demonstrated in Figures 2-7. Figure 2 shows a falling drop. Anatoli Fomenko (b.1945), a Russian mathematician painted it. Figure 3 is entitled Castle in the Pyrenees. Rene Magritte, a Belgian surrealist artist, painted it where he painted also Figure 4 entitled Clear Ideas and Figure 5 entitled The Battle of the Argonneî that demonstrates the situation of absence of gravity. And finally, Figure 6 demonstrates $F = mg > 0$ where in Figure 7 entitled anti-gravity $F = mg = 0$.
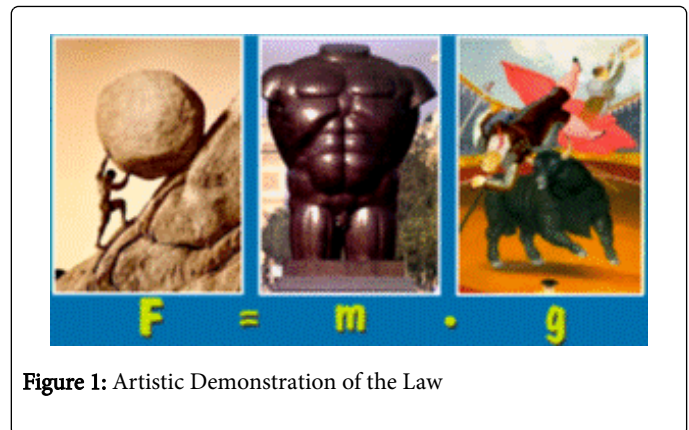

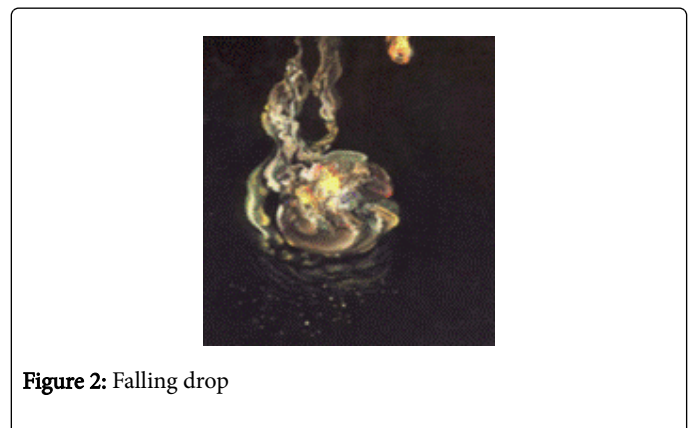**Figure 1:** Artistic Demonstration of the Law
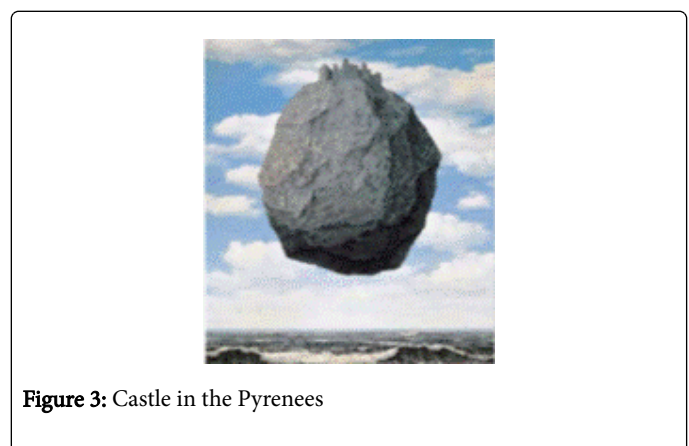

Figure 2: Falling drop

Figure 3: Castle in the Pyrenees

Figure 4: Clear Ideas

Figure 6: F = mg>0

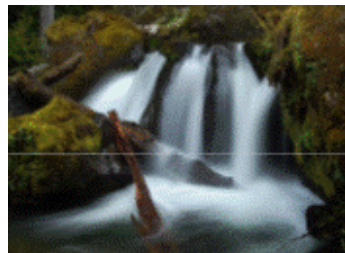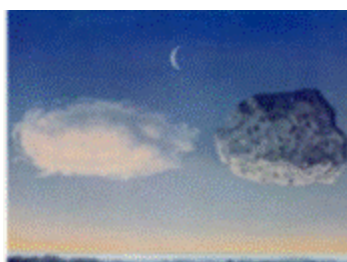**Figure 5:** The Battle of the Argonneî

Figure 7: Anti-gravity F = mg = 0