Newton’s Laws

**Objective**

Each student will individually create a slideshow presentation about Newton’s Laws. The students will be able to understand the basic principles of classical mechanics. As a class, they will then use FluidSurveys to compile all the slideshows data together.

**Learning Environment**

The class will use a computer with internet access in the computer lab or at home.

**Types of Students**

College Level.

**Standards**

ISTE/NETS Standards
Facilitate and Inspire Student Learning and Creativity

**Materials**

Computers in computer lab with internet access, FluidSurveys.

**Procedures**

1. The students will learn how to use FluidSurveys with the help of their teacher.
2. Then, each student will be assigned to give the definitions of the physical quantities in classical mechanics and show their relationship that they will research and then create a presentation on the topic.

**The Mass** of an object is a measure of the inertia of the object. Inertia is the tendency of an object at rest to remain at rest, and of an object in motion to continue moving with unchanged vector velocity. The Standard Kilogram is an object whose mass is defined to be one kilogram. The masses of other objects are found by comparison with this mass. A gram mass is equivalent to 0.001 kg.

**A Force** is a push or pull exerted on a body. It is a vector quantity, having magnitude and direction. The Resultant Force on an object causes the object to accelerate in the direction of the force. The acceleration is proportional to the force and universally proportional to the mass of the object. The Newton is the SI unit of force. One Newton (1 N) is that resultant force which will give a 1 kg mass an acceleration of 1 m/s². Newton's First Law: If the resultant external force acting on an object is zero, then the vector velocity of the object will not change. An object at rest will remain at rest; an object in motion will continue in motion with constant velocity. A body accelerates only if an unbalanced force acts on it. This is often called the inertia law.

**Newton’s Second Law:** If the resultant (or net) force \( F \) acting on an object of mass \( m \) is not zero, the object accelerates in the direction of the force. The acceleration \( a \) is proportional to the force and universally proportional to the mass of the object. With \( F \) in newtons, \( m \) in kilograms, and \( a \) in m/s², this proportion can be written as an equation: \( a = \frac{F}{m} \) or \( F = ma \). When this equation and others derived from it are used, \( F \), \( m \), and \( a \) must be in the proper units. The acceleration \( a \) has the same direction as the resultant force \( F \). The vector equation \( \mathbf{F} = \mathbf{ma} \) can be written in terms of components as

\[
\sum F_x = ma_x, \quad \sum F_y = ma_y, \quad \sum F_z = ma_z
\]

where the forces are the components of the external forces acting on the object.

**Newton’s Third Law:** For every force exerted on one body, there is an equal, but oppositely directed, force exerted on some other body. This is often called the law of action and reaction. Notice that the action and reaction forces act on different objects.

**Law of Universal Gravitation:** Two masses \( m \) and \( m' \) attract each other with forces of equal magnitude. For point masses (or spherically symmetric bodies), the attractive force \( F \) is given by

\[
F = G \frac{mm'}{r^2}
\]

where \( r \) is the distance between mass centers, and where \( G = 6.67 \times 10^{-11} \) N·m²/kg² when \( F \) is in newtons, \( m \) and \( m' \) are in kilograms, and \( r \) is in meters.

**The Weight** of an object is the force of gravitation which pulls on the object. On the earth, it is the gravitational force exerted on the object by the earth. Its units are newtons (in the SI) and pounds (in the British system).
Relation between Mass and Weight: An object of mass $m$ falling freely toward the earth is subject to only one force – the pull of gravity, which we call the weight $w$ of the object. The object’s acceleration due to $w$ is the free-fall acceleration $g$. Therefore, $F = ma$ provides us with the relation between $F = w$, $a = g$, and $m$; it is $w = mg$. Because $g = 9.8 \text{ m/s}^2$ on earth, a 1 kg object weighs 9.8 N on earth.

3. After each student has created their own slideshow, all of the data will be combined using FluidSurveys.

4. When the final project is complete, the students will present their project.

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<thead>
<tr>
<th>Application</th>
<th>Using FluidSurveys, the students will compile all data and create a presentation about Newton’s Laws.</th>
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<tr>
<th>Evaluation</th>
<th>The students will present their whole project. Each student will present his or her section of the project. The students will be evaluated based on the following:</th>
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<tbody>
<tr>
<td></td>
<td>• Using FluidSurveys skills – 20 points</td>
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<td></td>
<td>• Creativeness – 10 points</td>
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<td>• Individual participation – 20 points</td>
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<td>50 points</td>
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