Mechanics and Motion

Motion is one of the key topics in physics. Everything in the universe moves. It might only be a small amount of movement and very very slow, but movement does happen. Don't forget that even if you appear to be standing still, the Earth is moving around the Sun, and the Sun is moving around our galaxy. The movement never stops.

Motion is one part of what physicists call **mechanics**.

Basic Terminology

The physics of **motion** is all about forces.

- Forces need to act upon an object to get it moving, or to change its motion. Changes in motion won't just happen on their own. So how is all of this motion measured?

- Velocity. Physicists use some basic terms when they look at motion. How fast an object moves, its speed or **Velocity**, can be influenced by forces.

- Acceleration is a twist on the idea of velocity. Acceleration is a measure of how much the velocity of an object changes in a certain time (usually in one second). Velocities could either increase or decrease over time.

- Mass is another big idea in motion. Mass is the amount of something there is, and is measured in grams (or kilograms). A car has a greater mass than a baseball.

Simple and Complex Movement

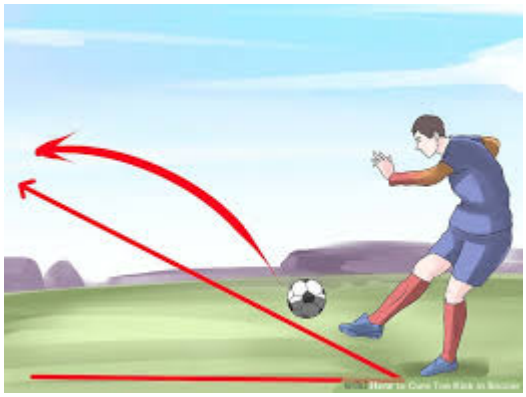
There are two main ideas when you study mechanics. The first idea is that there are **simple movements**, such as if you're moving in a straight line, or if two objects are moving towards each other in a straight line. The simplest movement would be objects moving at constant velocity. Slightly more complicated studies would look at objects that speed up or slow down, where forces have to be acting.

There are also more **complex movements** when an object's direction is changing. These would involve curved movements such as circular motion, or the motion of a ball being thrown through the air. For such complex motions to occur, forces must also be acting, but at angles to the movement.

Forces of Nature

Forces are a big part of physics. Physicists devote a lot of time to the study of **forces** that are found everywhere in the universe. The forces could be big, such as the pull of a star on a planet. The forces could also be very small, such as the pull of a nucleus on an electron. Forces are acting everywhere in the universe at all times.

Examples of Force



Let's look at the forces acting on that soccer ball before you kicked it. As it sat there,

1) the force of gravity was keeping it on the ground, while

2) the ground pushed upward, supporting the ball.

On a molecular level,

3) the surface of the ball was holding itself together as the gas inside of the ball tried to escape.

There may have also been small forces trying to push it as

4) the wind blew. Those forces were too small to get it rolling, but they were there.

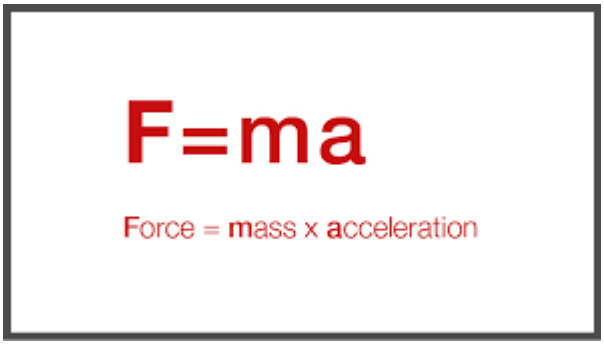
And you never know what was under the ball. Maybe an

5) insect was stuck under the ball trying to push it up. That's another force to consider.

If there is more than one force acting on an object, the forces can be added up if they act in the same direction, or subtracted if they act in opposition. Scientists measure forces in units called **Newtons**. For example, the force applied to the soccer ball (from the kick) could be equal to 12 Newtons.

A Formula of Force

There is one totally important formula when it comes to forces, **F = ma**. That's all there is, but everything revolves around that formula. "F" is the total (net) **force**, "m" is the object's **mass**, and "a" is the **acceleration** that occurs. As a sentence,



"The net force applied to the object equals the mass of the object multiplied by the amount of its acceleration."

The net force acting on the soccer ball is equal to the mass of the soccer ball multiplied by its change in velocity each second (its **<u>acceleration</u>**).

Do you remember the wind gently blowing on the soccer ball? The force acting on the ball was very small because the mass of air was very small. Small masses generally exert small forces, which generally result in small accelerations (changes in motion).