NEWTON'S LAWS

BASICS

- 3 laws to describe the motion of an object
- The 1st law summarized Galileo's work about inertia
- 1st law: when the net force is equal to 0, the object moves at a constant speed in a straight line (constant velocity) or stays at rest
- 2nd law: when the net force is not equal to 0, it will change the speed and/or the direction of the motion. The effect of the force will depend on the inertia of the object (its mass): it's difficult to change the motion of an object with a big inertia.
- 3rd law: it's the law of interaction. When one object exerts a force on a second object, the second object exerts an equal but opposite force on the first object.
- Examples of the 3rd law:
  - When you push a wall, it will push you back
  - When you hit something, it can be painful because the object applied the same force on your fist
  - When a small rock is falling, it is attracted by the Earth but at the same time it will attract the Earth (the Earth doesn't move because of its big inertia) …
- Experiments and examples on inertia:
  - The coin and the card (the coin will fall on the glass: it doesn't move because it will resist the change in motion thanks to its inertia)
  - The amazing karate chop
  - You are stopped by the seat belt when the car stops abruptly …

ADVANCED

- The 2nd law : the net force is equal to the mass multiplied by the acceleration

$$\vec{F} = m\vec{a}$$

- The acceleration is the change of velocity during an interval of time:

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

- Other law of Newton: gravity

$$F = G\frac{m_1 \times m_2}{d^2}$$

- This force controls the motion of the planets, the stars, the satellites, …

LINKS

- Evolution of science: mechanic
  - Aristotle thought that a force was necessary to have a motion
  - Galileo thought that a force was necessary to change a motion and proposed the law of inertia
  - Kepler observed the motions of planets and satellites and proposed 3 empirical laws
  - Newton developed Galileo's ideas and explained the Kepler's laws
  - Einstein and his theory of special relativity (twin paradox)
- Evolution of science: structure of the matter
  - The Greeks with a philosophical approach: there must be an elementary component of the matter that **you can't divide** (literally "atomos")
  - Thomson with the model of the plum pudding: negatively charged particles i.e. electrons embedded or suspended in a sphere of positive charge (electrons presented as plums inside the bowl of pudding)
  - Rutherford's experiment: alpha particles sent through a gold foil showed that a big part of the atoms was void. There should be a positive nucleus at the center and electrons turning around (just like a planet with satellites)
  - New models with electrons represented as a kind of cloud around the nucleus
- Evolution of science: link with the global warming controversy