

## Newton's law of gravitation (2.07 Force, Weight and gravity)



The spring balance reads a downward pull/ attraction/ gravitational force from the Earth.

direction of the force: downwards

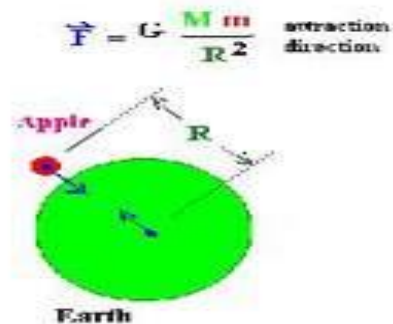
size:  $\vec{F} = -G \frac{Mm}{R^2}$  G – gravitational constant; M – mass of the Earth, m – mass

of the body on/ near the Earth's surface, R – radius of the Earth, the sign – means that F is attractive

### Newton's Gravitation Law

Any two objects in the Universe attract each other with a force that is

- 1 Proportional to the product of their masses;
  - 2 Inversely proportional to the square of their distance apart;
  - 3 Parallel to the line between their centers.
- This gravity force is the weight!



Determine the force of gravitational attraction between a 74.0 kg boy sitting 1.45 m away from a 67.5 kg girl.

$$F_g = G \frac{m_1 m_2}{r^2}$$

$$F_g = (6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2) \frac{(74.0 \text{ kg})(67.5 \text{ kg})}{(1.45 \text{ m})^2}$$

$$F_g = 1.58 \times 10^{-7} \text{ N}$$

Gravitational force acts in field of the acting body.

Property of the field is gravitational field strength g – a force acting on each kilogram of mass

For the Earth: g=10N/kg. Weight of a body with mass m: W=mg

A person has mass 50kg and weight of 500N. *Everyday language: weight =mass/ balances*

Comparing weight and mass: On a lighter space object (the Moon)/ in increasing distance from the Earth weight is decreasing and mass is the same.

All bodies near the Earth's surface move with acceleration g. g = 10m/s<sup>2</sup>

Key words: attract v/ attractive *adj*/ attraction *n*; weight; mass; gravitational field strength