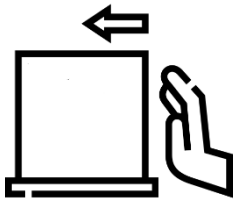
Motion, forces and energy

P1.5 Forces

Effects of Forces

- Forces can change the size, shape, or motion of an object.
  E.g. Stretching a spring changes its shape, pushing a box changes its motion, kicking a ball changes its speed and direction.



Motion and force

- If there's no resultant force, an object will:
  - Stay at rest (stay still, not move) if it was not moving. E.g. a book on a table stays still
  - Move at a constant speed in a straight line if it was already moving.
  - If there is a resultant force, the object accelerates in the same direction as the force. E.g. car accelerates when the engine pushes it forward.
  - **Motion only changes if there is a resultant force.**

Calculating force

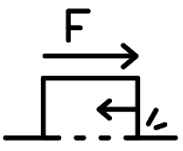
- Equation: $F = ma$, *w*here ***F*** = force in newtons (N), ***m*** = mass in kilograms (kg) and ***a*** = acceleration in m/s^2
  - A 2 kg ball accelerates at 3 m/s^2. Find the force. $F = ma$ $F = 2 \times 3 = 6$ N
  - A 5 N force accelerates a box at 2 m/s^2. Find the mass. $m = F/a$ $= 5 / 2 = 2.5$ kg

Resultant force

- When two or more forces act along the same straight line:
  - Same direction: add them. 5N⇨ + 4N⇨ = 9N⇨
  - Opposite directions: subtract the smaller from the larger. 5N⇨ + 4N⇦ = 1N⇨

Friction and drag

- **Friction** always opposes motion. Friction is the force that *resists* motion when two surfaces touch. It produces heat. E.g. Brakes on a bike slow it down, rubbing hands together produces warmth.



- **Drag** is friction in fluids (liquids or gases).
  - Liquid: water resistance slows boats.
  - Gas: air resistance slows falling objects or moving cars.