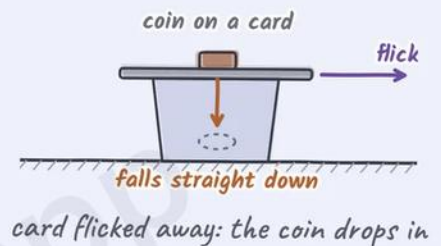
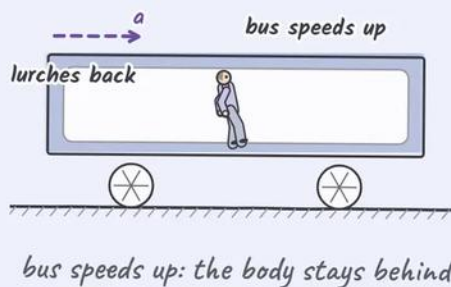
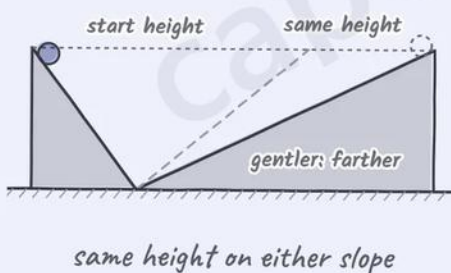




from Aristotle's mistake to Newton's three laws, and everything a force can do to a body

Aristotle's fallacy, Newton's first law

- Aristotle: a force is needed to keep a body moving
- Galileo: the ball stops from opposing forces, friction and air drag
- motion itself needs no force to continue
- first law: a body keeps its state unless a net external force acts
- that stubbornness is inertia; mass is its measure
- first law defines an inertial frame, where no net force means constant velocity
- bus starts, you lurch back; it brakes, you lurch forward



Newton's second law, impulse

net force, the rate of change of momentum

$$F = \frac{dp}{dt}$$

for constant mass

$$F = ma$$

momentum, defined

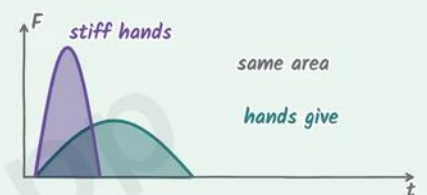
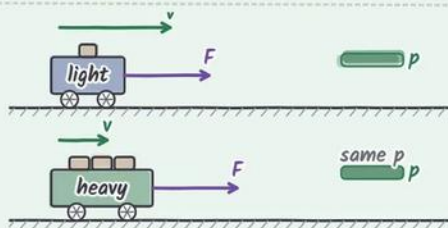
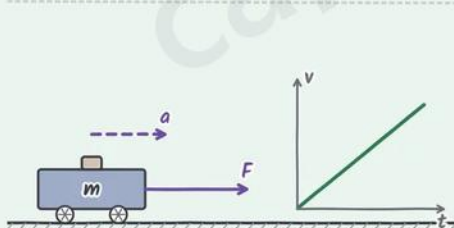
$$p = mv$$

impulse, constant force

$$J = F\Delta t = \Delta p$$

impulse, varying force

$$J = \int F dt$$



pull a cart: a follows F , v climbs

same push, same time: same p gained

stiff or giving hands: same area

$F = ma$ is a special case. A rocket loses mass: apply $F = dp/dt$ to rocket and exhaust together. The area under an F - t curve is the impulse

