



Chapter 7

Work, Energy, and Simple Machines



Understanding how work is done and energy is used helps us make life easier every day.



Observe



Think



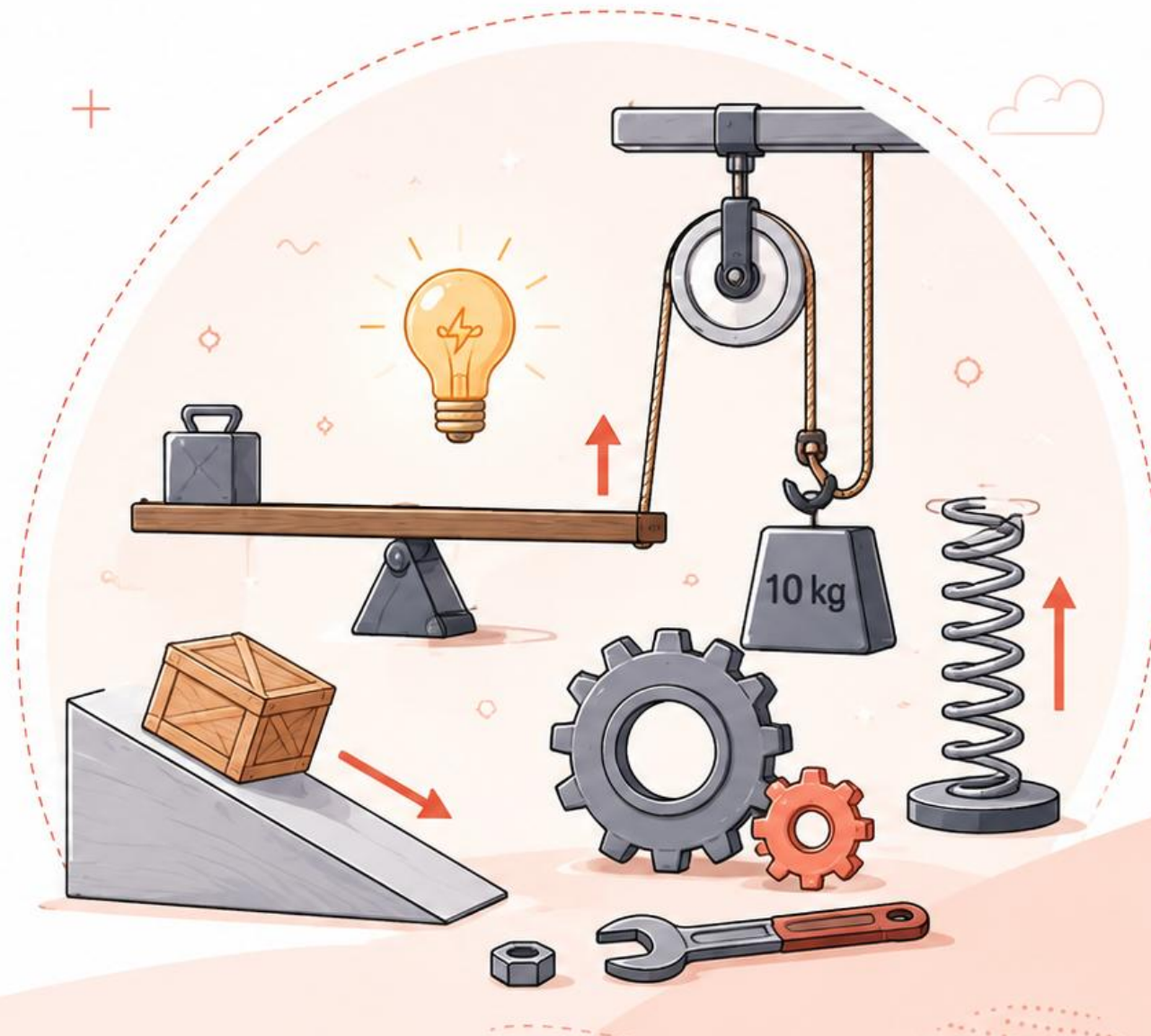
Experiment



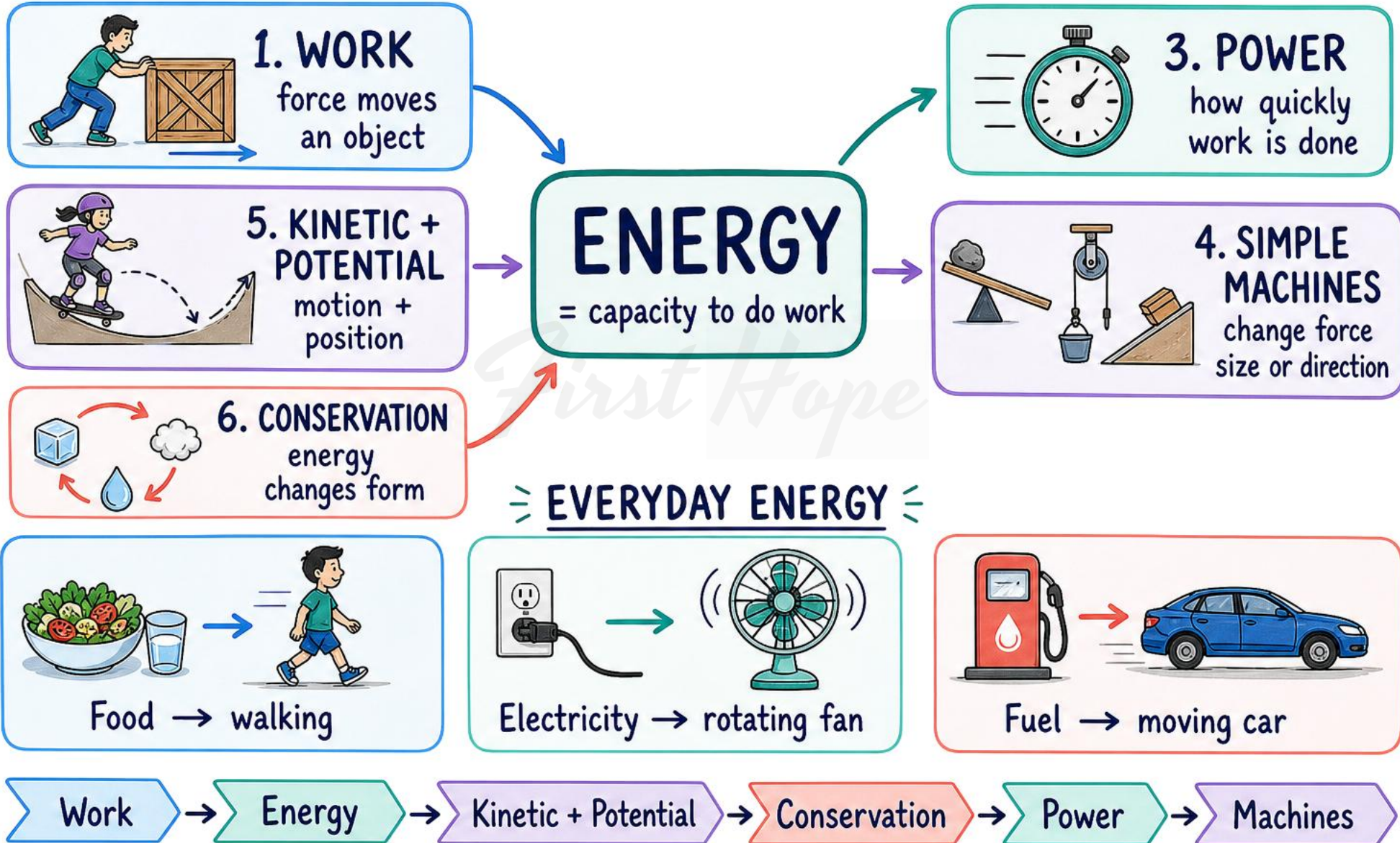
Explore



Discover



WORK, ENERGY & SIMPLE MACHINES



WHEN IS SCIENTIFIC WORK DONE?

Scientific work is done when a force causes displacement in the direction of the force.

Work depends on:

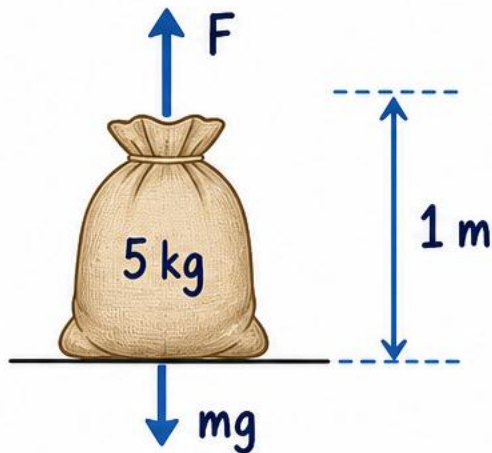
1. force
2. displacement along the force

★ Larger force, same distance → more work

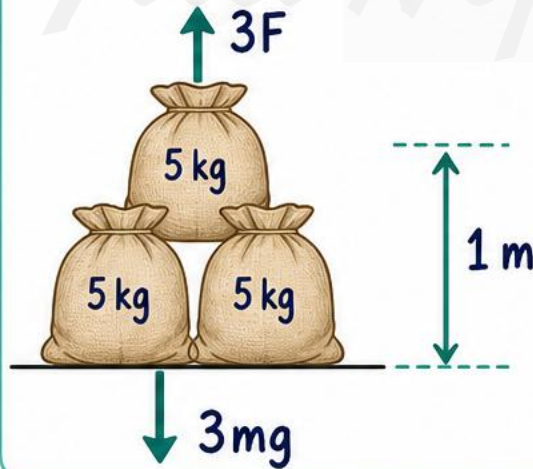
★ Same force, larger distance → more work

✓ Always name who does the work and the object on which work is done.

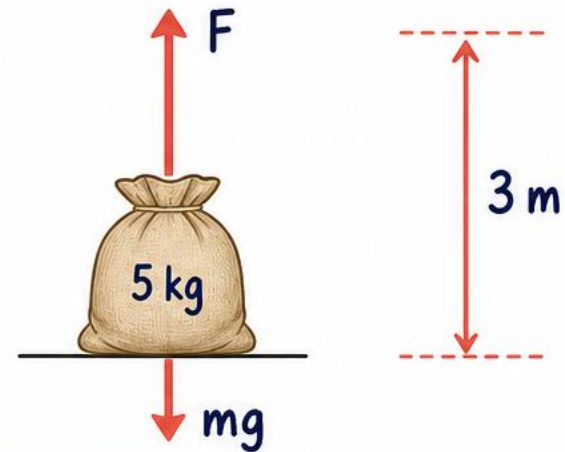
A. 1 bag raised 1 m → work = W



B. 3 bags raised 1 m → work = $3W$



C. 1 bag raised 3 m → work = $3W$



★ More force or more displacement means more work.

CALCULATING WORK

$$W = F \times s$$

W = work done

F = constant force

s = displacement in the direction of force

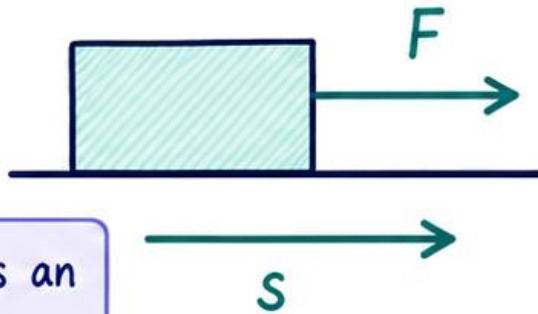
★ Use this form when force and displacement are parallel.

SI unit: joule (J)

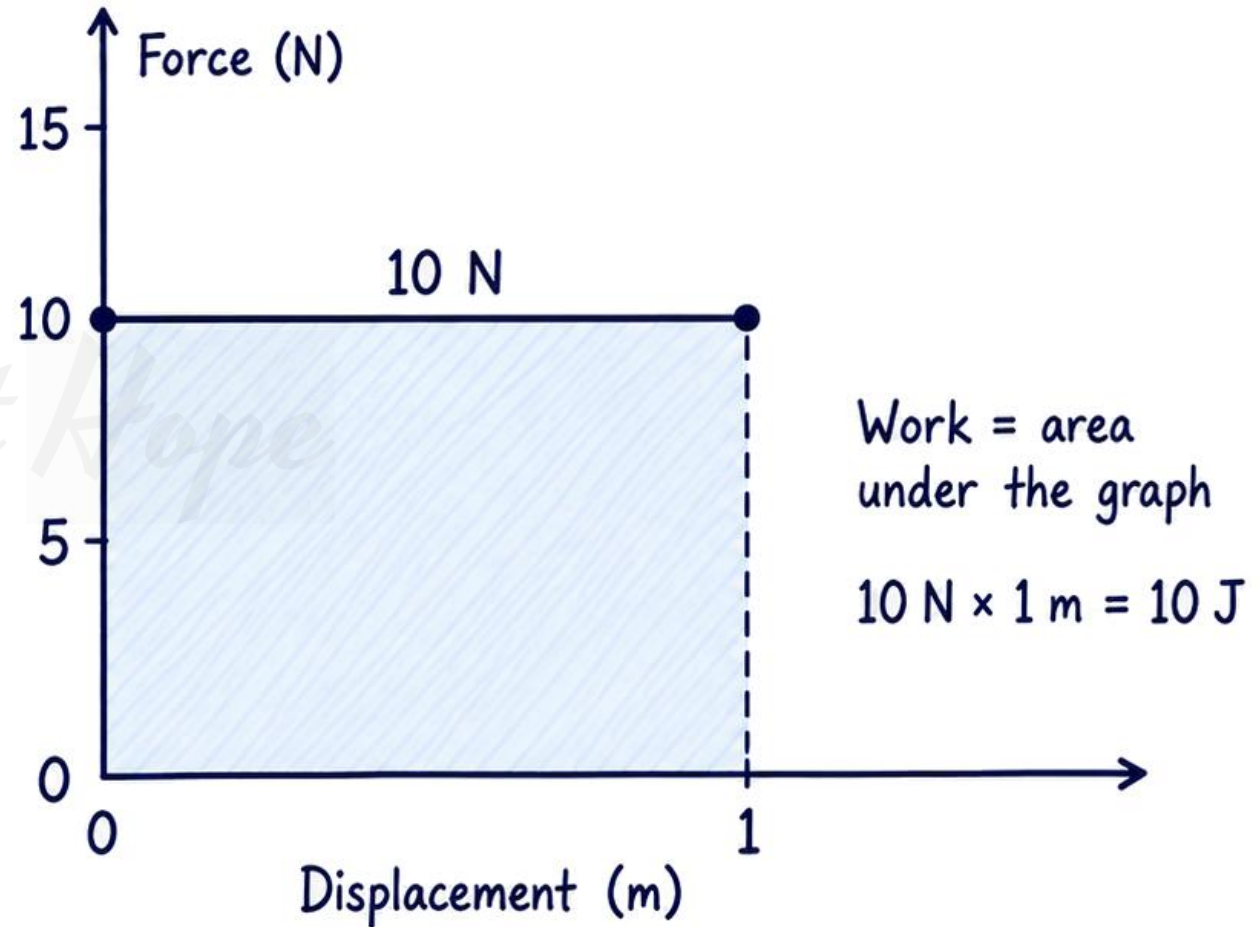
$$1 \text{ J} = 1 \text{ N} \times 1 \text{ m}$$

$$1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$$

1 joule: a 1 N force moves an object 1 m along the force.



FORCE-DISPLACEMENT GRAPH



★ For a changing force, work is the signed area under the F - s graph.

ZERO WORK

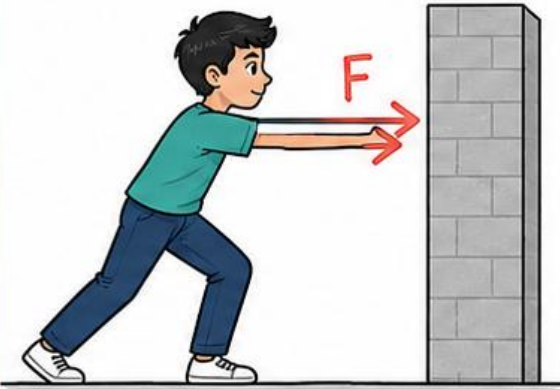
Work by a particular force is zero when:

1. Force is zero
 $F = 0$

2. There is no displacement
 $s = 0$

3. Force is perpendicular to displacement
 $F \perp s$

PUSHING A RIGID WALL



Force is applied,
but the wall
does not move.

Work on the wall = 0

CARRYING A BOX HORIZONTALLY



Upward force $\perp$ horizontal displacement

Work by her upward force on the box = 0



Feeling tired does not mean mechanical work was done on the object.
Muscles still use chemical energy.

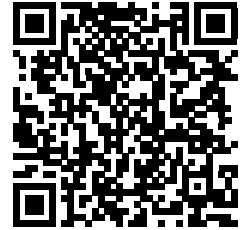


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