

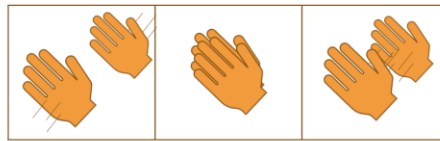
Fundamentals in physics



Forces and their interactions

Interaction:

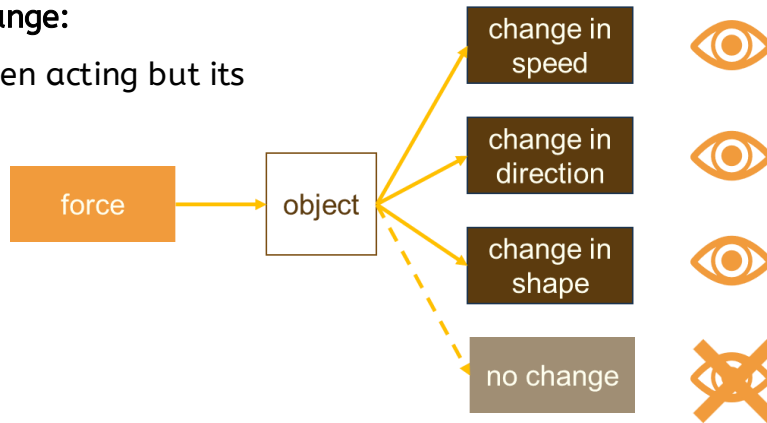
When two objects influence each other and cause a pair of forces to arise.



one force on each object equal in size opposite in direction

Forces can cause change:

A force cannot be seen acting but its effects often can.



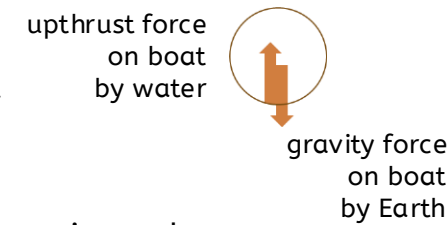
Forces can be contact or non-contact:

Contact forces arise between two touching objects.

Non-contact forces can act between two objects at a distance.

contact	thrust, friction, air resistance, water resistance, normal contact, upthrust
non-contact	gravity force, magnetic force

Free-body force diagrams



One object

Arrows to show size and direction of forces

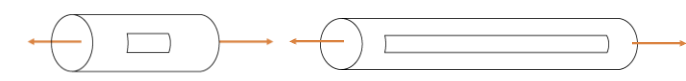
Labelled forces:

- What kind of force is acting?
- What is the force acting on?
- What exerts the force?

Deforming forces



Two pushing forces cause compression: the object contracts.



Two pulling forces cause tension: the object extends.



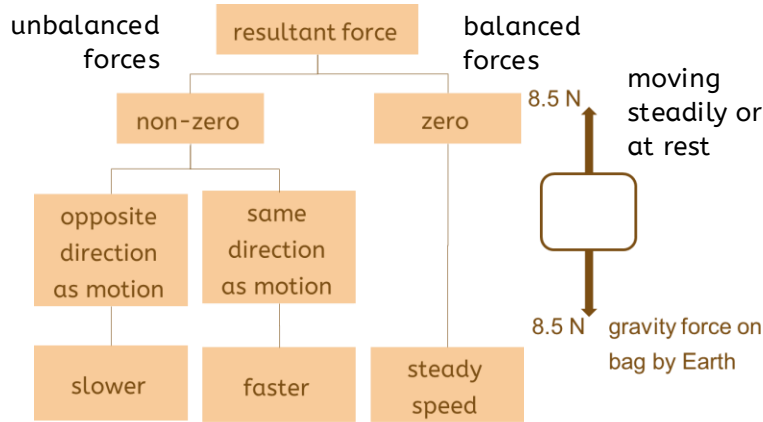
Fundamentals in physics



Combining forces

More than one force acting:

- Their effects are combined
- As if a single force is acting: the resultant force



Friction force

- **What?** One of three frictional forces. They act to resist motion.
- **Where?** Acts between solid surfaces, along the surfaces.
- **When?** An object is sliding or trying to. When starting to slide, the applied force must be larger than the limiting friction: so, an unbalanced force acts.
- **How?** Opposite direction to the motion, or the applied force.
- **Why?** Surfaces are uneven, so the 'catching' between them must be overcome.

	Useful	Nuisance
Walking	✓	
Machines		✓
Driving	✓	
Wear and tear		✓



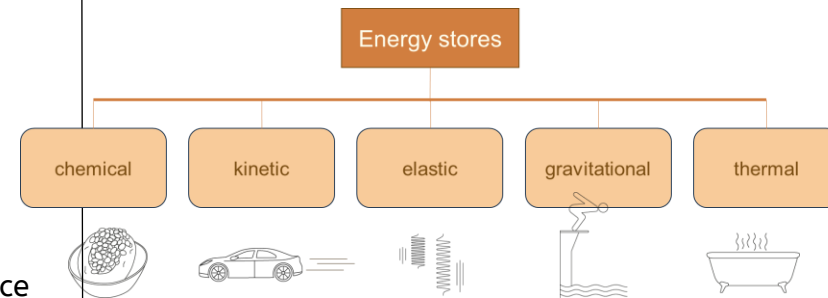
lubricant

Energy stores and pathways

What energy does:

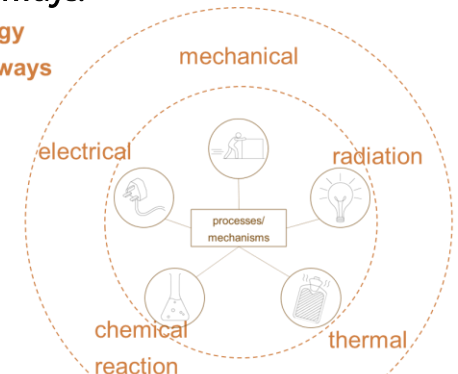
- Flows between objects in a system
- Stays the same when it transfers
- Cannot be used up

Energy is transferred between stores:



Energy is transferred because of processes, by pathways:

Energy pathways



Fundamentals in physics



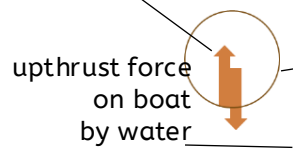
Modelling forces

Forces are modelled because:

- forces cannot be seen acting
- there are many forces acting at a time
- their size and direction have important effects on situations, so need to be shown.

Arrows (length represents size, direction of forces)

Dot or rectangle shows simplified object



Labels describe type of force, object acted on and objects exerting force on it.

Investigating forces

Scientific methods:

- With or without hypothesis
- Manipulating variables or not

Statement to answer an enquiry question.

comparative term

Smoother surfaces cause less friction to act on objects sliding over them.

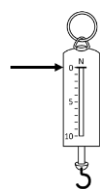
present tense

the effect which can be tested

'group' being tested (IV)

Planning to collect high-quality data:

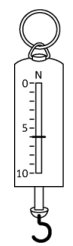
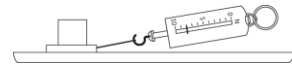
- Measuring with skill
- Preparing the data table
- Repeatable data



Check force-meter is on zero with no force.

headings describe variable

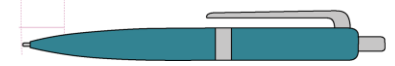
IV	Surface	Force to start sliding (N)			DV in columns
		1	2	3	
↓	Glass	1.4	1.5	1.7	repeated
	Metal	1.5	1.6	1.7	
	Polished wood	2.0	2.3	2.2	
	Plastic	2.9	3.0	2.9	
	Paper	4.5	3.8	4.0	



Observing by measurement

Using a scale

- set of lines at equal increments
- Labelled with numbers and units



Measuring instruments

- Include rulers, balances, clocks and thermometers.
- Force is measured using a force-meter.

Peer review: ★★★

Peers (people of a similar level of knowledge) test the results for quality.

Repeatability: Same group, same results

Reproducibility: Different group, same results

Quantities: and their units

Base quantities: length (m), mass (kg), time (s) and temperature (K).

Derived quantities include force (N).

