

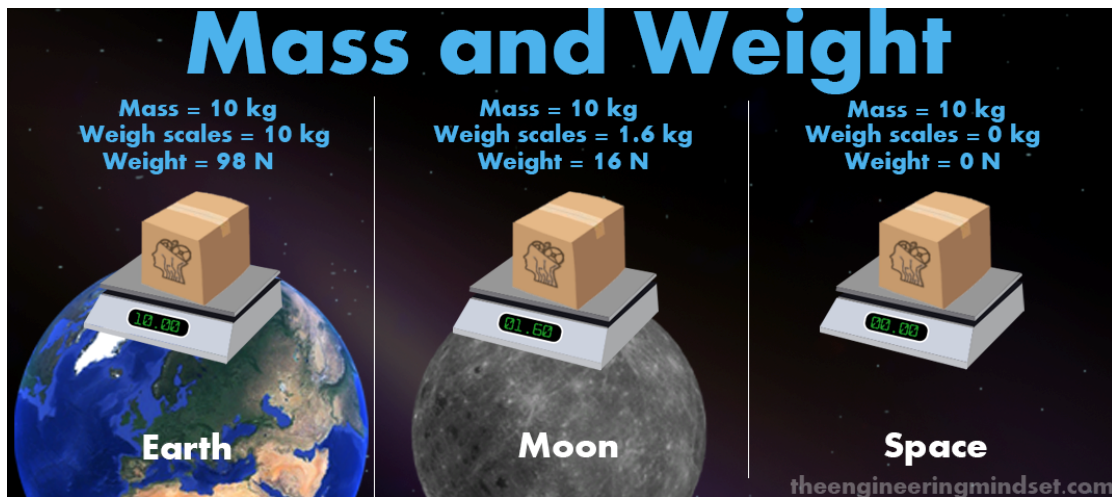
Grade 8 Science

Systems in Action

Class 7

Mass vs. Weight

- Are mass and weight the same?
- Mass – the measure of the amount of matter or material in an object
- Weight – the measure of how strong the force of gravity is between two objects
- Earth exerts a force of 9.8N for every kilogram of an object's mass so the force of gravity is 9.8N/kg



- Moon has less mass than Earth so its gravitational pull is less; one-sixth of Earth's gravitational pull
- Parcel with the same mass would weigh differently on Earth, Moon and Space

Measuring Force

- **Spring Scale** – consists of a spring with a hook on the end
 - As more force is applied, the spring stretches farther
 - Can find force of friction by sliding an object at a constant speed



$$F_g = mg$$

- F_g = Force of Gravity (N)
- m = mass of object (kg)
- g = strength of Earth's gravitational field
9.8 N/kg

$$F = ma$$



Checkpoint



Find the weight of a 50kg student in Newtons on Earth.

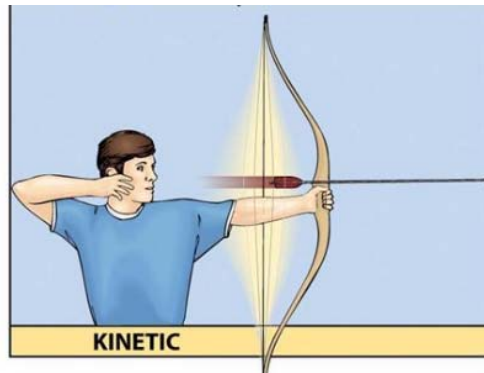
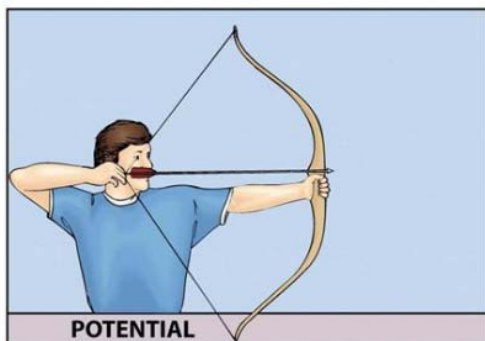
Energy

- Energy – the ability to apply a force to move an object a distance; the ability to do work
- Unit: joules (J)

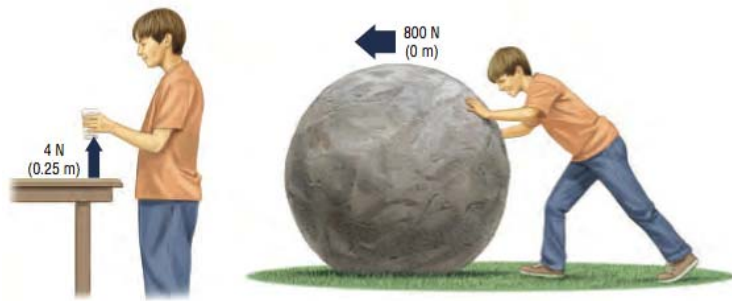


Law of Conservation of Energy

- Energy cannot be created or destroyed; energy can only be transformed from one form to another
- Types of energy:



Work



- Work – the result when a force moves an object a certain distance

work = force applied (in newtons) \times distance moved (in metres),
or $W = F \times d$

- Unit = N•m or joule (J)



Checkpoint



How much work is done on a computer mouse if 0.3N of force is used to slide the mouse a distance of 2.5cm?

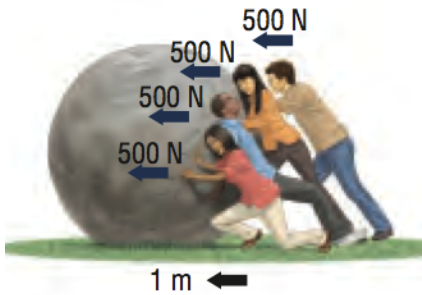




Checkpoint



You have asked three friends to help you move a rock. Each of you applies 500N of force to the rock and the rock moves 1m. How much work was done on the rock?



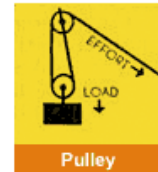
Machines



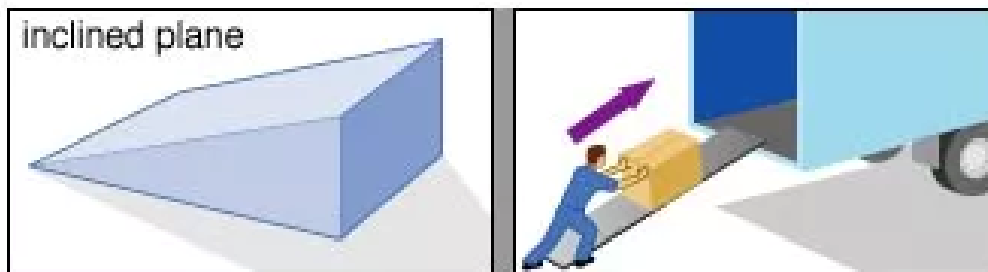
- Machine – any mechanical system that reduces the force required to accomplish work
- Machines make work easier by:
 1. Increasing the force that can be applied to an object
 2. Increasing the distance over which the force is applied
 3. Changing the direction of a force

Simple Machines

- Simple machine – a device that requires a single force to work; made of only one or two parts
- Six simple machines:
 - Inclined Plane
 - Wedge
 - Screw
 - Lever
 - Wheel & Axle
 - Pulley



Inclined Plane

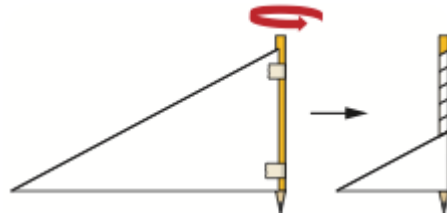


- Inclined plane – a flat supporting surface tilted at an angle with one end higher than the other to aid in raising or lowering a load
- Ex: Ramps, spiral staircase

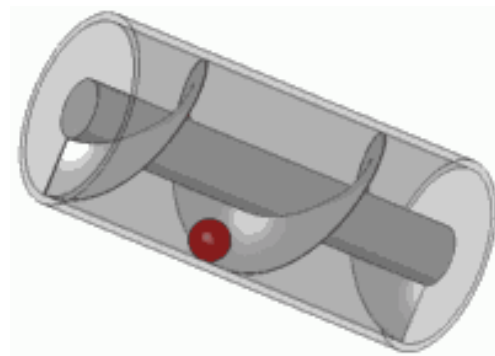
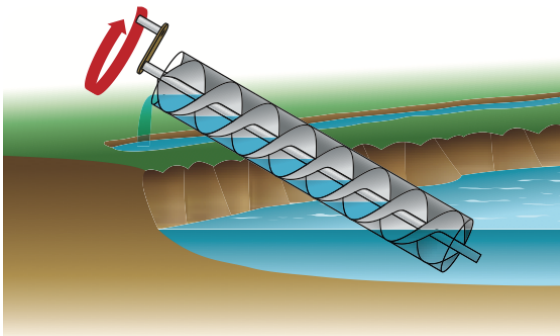
Screw



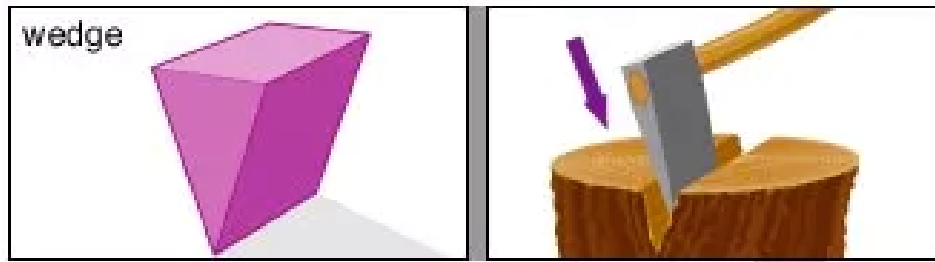
- An inclined plane that has been cut into a central core or wrapped around a central cylinder



- Archimedes' screw is a device used historically to lift water
- Modern versions of the Archimedes' screw are used to move sludge in sewage treatment plants or to move fish

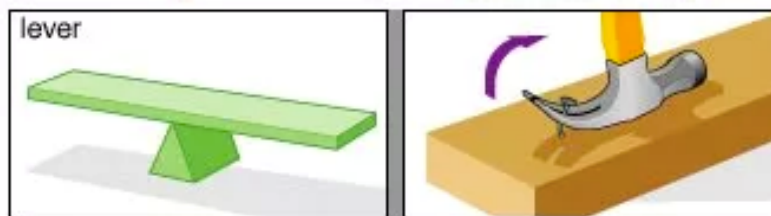


Wedge



- A wedge is made of two inclined planes to push two objects apart, cut objects into pieces or hold objects in place
- Ex: Axe, knife, door stop

Lever

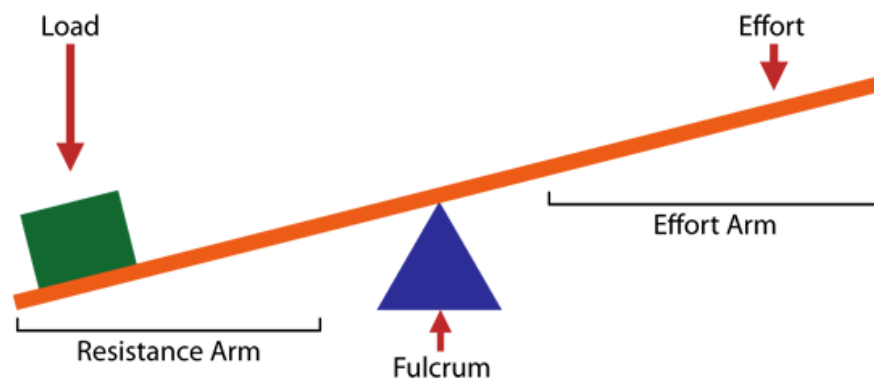


- Lever – a rigid bar that pivots at a point called the fulcrum
- Load arm – the part of the bar between the fulcrum and the load
- Effort arm – the part of the bar between the fulcrum and where the effort is applied

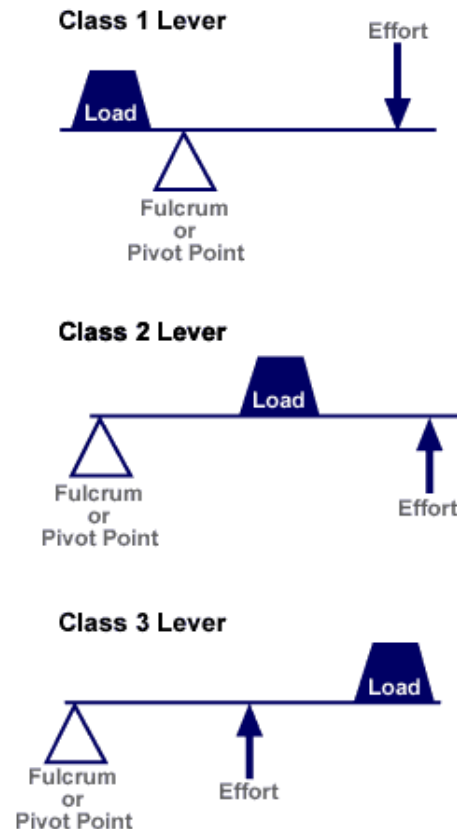
- Ex: Scissors, door handles, seesaws
- Designed so that the force applied to one part of the lever can be change or redirected to move a load



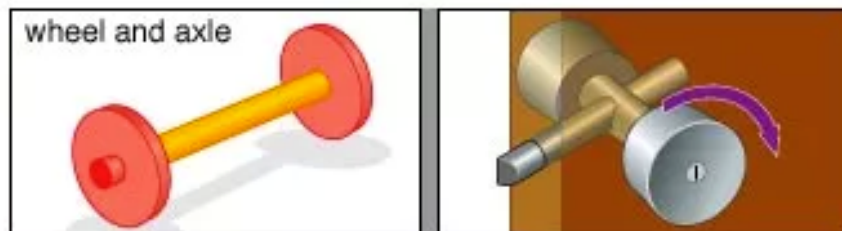
- Input Force – the force applied by the user
- Output Force – the redirected push that the lever applies to the load
- Load force (resistance) – the force that the user's input force has to overcome



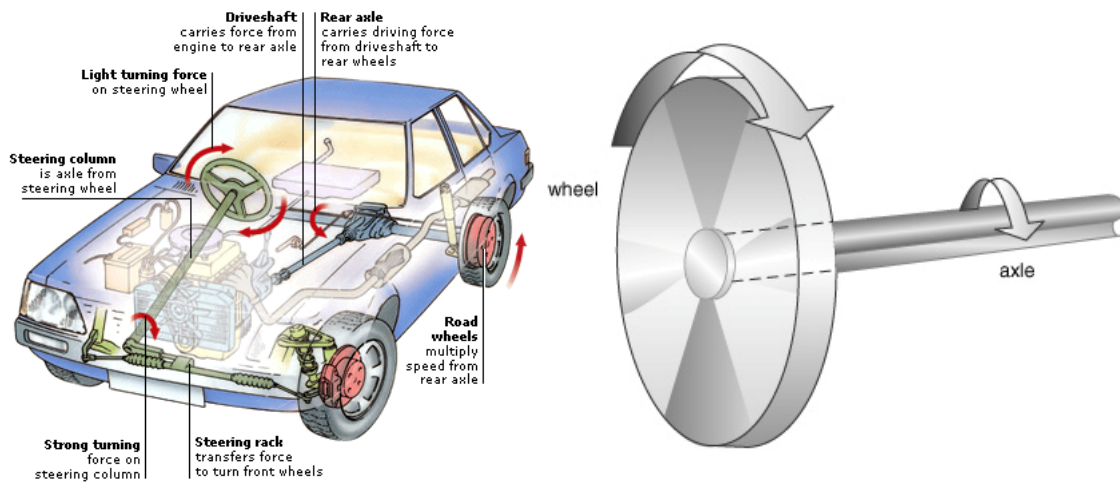
- Three classes of levers:
 - **Class 1 Lever** – the fulcrum is between the load force and the input force (ex: seesaw)
 - **Class 2 Lever** – the load force is between the fulcrum and the input force (ex: wheelbarrow)
 - **Class 3 Lever** – the input force is between the fulcrum and the load force (ex: fishing rod)



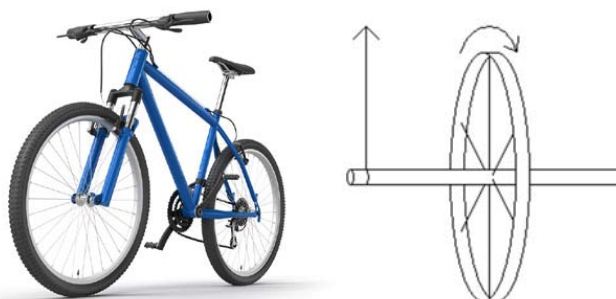
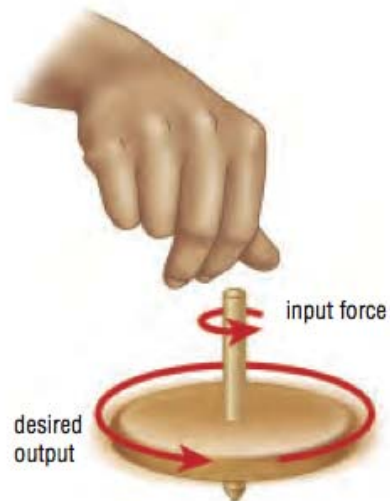
Wheel & Axle



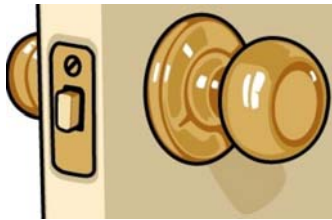
- Wheel & Axle – a large diameter disk (wheel) attached to a small diameter shaft (axle)
- Ex: Steering wheel
- Using the wheel to turn the axle converts a small input force into a large output force



- Another version of wheel and axle is to turn a large input force on the axle to gain an advantage in distance on the wheel
- Ex: Spinning top, wheels on a bike

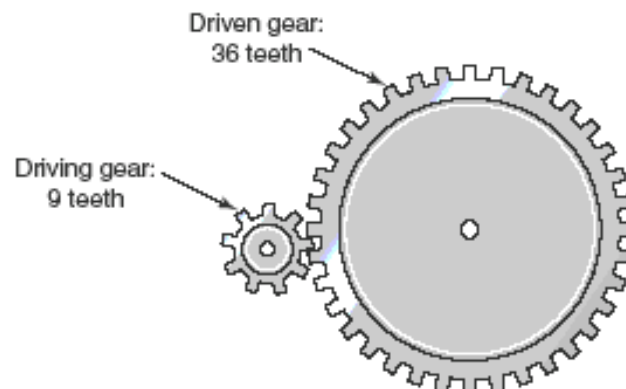


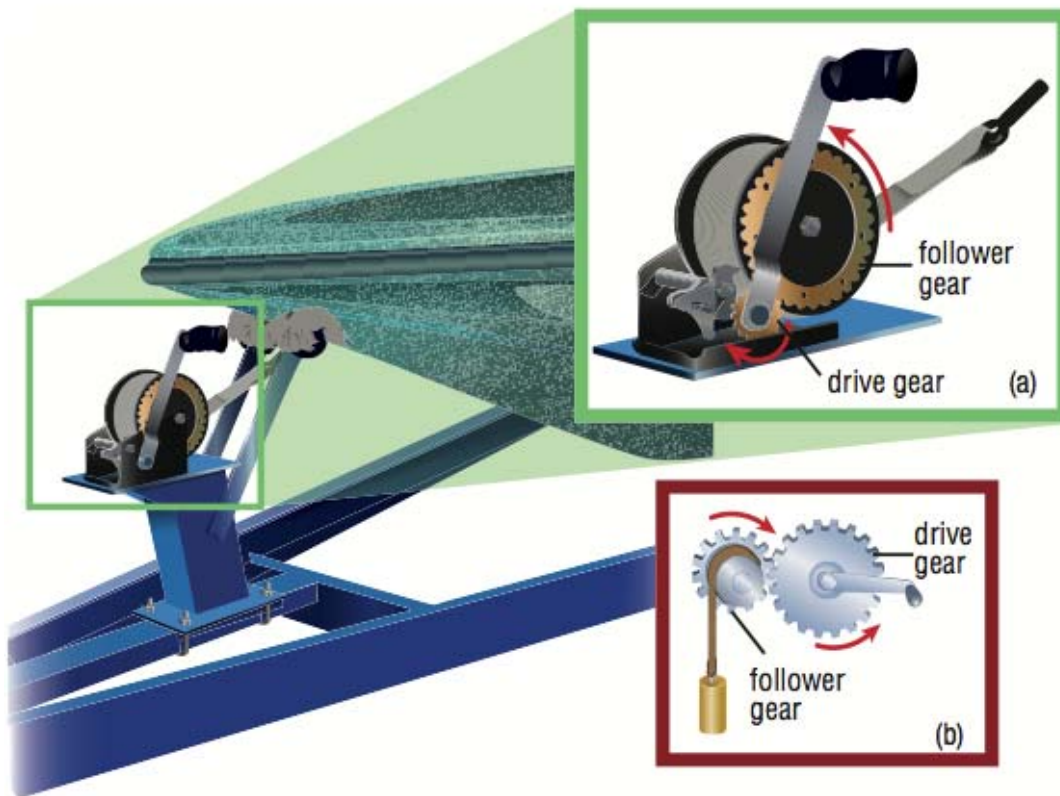
- Rotary motion to rotary motion (turning a bicycle's pedals to turn a wheel)
- Rotary motion to linear motion (turning a doorknob moves the latch in or out)
- Linear motion to rotary motion (pushing a rolling pin causes it to turn)



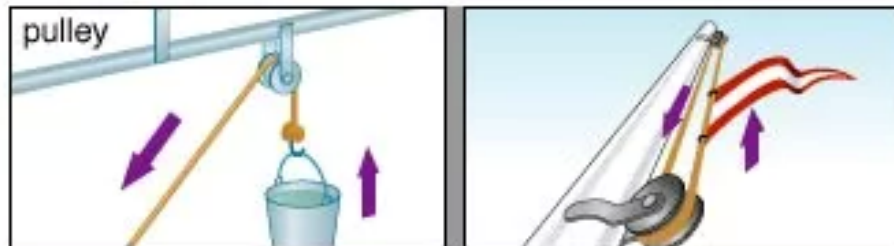
Gears

- Modified wheel and axle with toothed wheels
- Used to speed up or slow down motion or to change the direction of motion





Pulleys



- Pulleys use wheel and axles to make pulling objects easier
- Used to lift heavy loads or to change the direction of a force
- Can be used as a single pulley or a pulley system

- A fixed pulley is attached to a rigid, non-moveable structure at some point
- A moveable pulley is not attached to a fixed structure

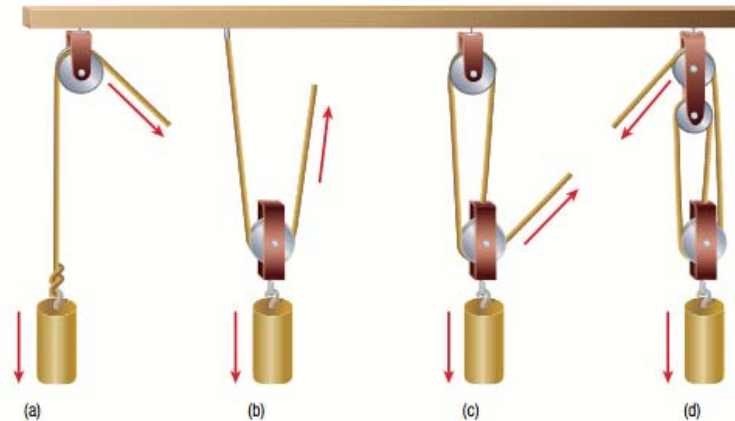


Figure 13 (a) Single, fixed pulley (b) Single, moveable pulley (c) Double pulley system (d) Multiple pulley system

Mechanism

- Mechanism – two or more simple machines working together; mechanical systems
- Example:
 - Bicycles – wheel and axle, screw
 - Scissors – lever, wedge

