The Science Scribe

Designed by Lian Soh

Instructions:
This document has been arranged on an A3 native sheet. However, extensive design efforts have been put in place to ensure all content scales in high fidelity regardless of what size you print to.

We have tested this document on at home black and white printers up to heavy duty commercial colour printers with impressive results.

Print yourself a copy and glue it in your book, paste it on your wall during study time or convince your teacher to tear down an old poster and put up this study map instead! It just looks cooler...

SPECIAL:
Students, tell your teachers!
Teachers, listen up!

Every term The Science Scribe has excess resources to clear out of its inventory. We don't do "sales" like greedy
resource companies because that's not our philosophy: instead, we do **freebies!**

Teachers need to send an email to info@sciencescribe.co.nz

The email must:
• Come from a school email address
• Contain information about the year level and science subject name (e.g: Level 2 Biology).
• State how many students will need resources (E.g: Lv2 Bio - 27 students, 2 teachers)
• Contain some form of annual calendar that shows

when assessments for certain topics are taking place (including practice tests) or when topics are starting/ ending. Ballpark date estimates are okay!
We only use this information so we can send resources to
places that need them the most! It does not guarantee your class resources.

L1 SCIENCE

The Science Scribe™

Designed by Lian Soh in New Zealand for NCEA

Version 1

Mechanics Study Map

Motion - Forces - Energy

Motion

Motion refers to *how* an object is moving.
Is it stationary, accelerating or moving at constant speed?

Velocity & Speed

$$v = \frac{d}{t}$$

symbol	name	units
v	velocity	ms^{-1}
d	distance	m
t	time	s

If something is stationary then it has zero speed. If something is in motion then it is:

- **Moving at constant speed:**
  If something moves at constant speed then it means it isn't getting faster or slower; therefore it is **not accelerating.** Any object which is not accelerating will have **no net force** (which means that *all forces* acting on the object are balanced; the forces cancel out to zero).

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OR

- **Moving at non-constant speed:**
  This means the speed is changing. If there is a change in speed then there **is an acceleration**. Any object that is accelerating will **have a net force** (all forces acting on the object are unbalanced; the forces do not cancel out to zero)

$$a = \frac{\Delta v}{\Delta t}$$

symbol	name	units
a	acceleration	ms^{-2}
v	velocity	ms^{-1}
t	time	s

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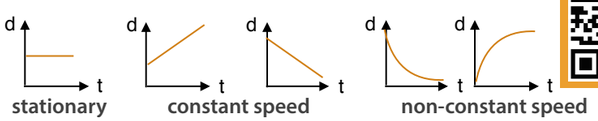
LINK: Forces can cause things to accelerate.

LEADS ONTO

Graphs of Motion

There are two types of graphs we can use to track an objects motion. They are:

Distance vs Time Graphs



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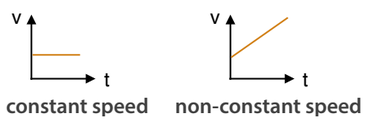
Velocity vs Time Graphs



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In a velocity vs time graph, the total area under the line will be equal to the total distance travelled.

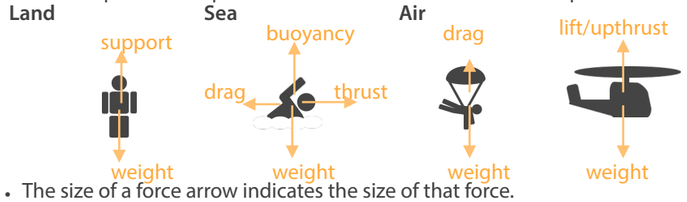
Area of a rectangle: *length x width*
Area of a triangle: *½ x base x height*

Forces

What types of forces are acting on the object? How big are these forces, and do they cancel each other out?

Types of Forces

Forces are pushes and pulls. Common names in different examples are:



- The size of a force arrow indicates the size of that force.
- Weight is a force in *N* caused by the downward acceleration due to gravity (approx. 10 N kg^{-1}). Mass is a quantity in *kg*.

Net Force

$$F = m\,a$$

symbol	name	units
F	force	N
m	mass	kg
a	acceleration	ms^{-2}

For all of the forces acting on an object, if the forces in either of the horizontal or vertical directions:

Do not cancel, then there is a net force

- This means the forces are described as unbalanced and the object **will be accelerating or decelerating** in the same direction as the net force.

OR

Do cancel, then there is no net force

- This means the forces are described as balanced and the object will **not be accelerating.** Objects that are not accelerating will have a constant speed or will be stationary.

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LINK: There are two major categories of energy: kinetic and potential. A system is said to have energy if it has the ability to do work. Work is done whenever energy is converted.

LEADS ONTO

Pressure

This is the application of force over an area.

$$P = \frac{F}{A}$$

symbol	name	units
P	pressure	Pa
F	force	N
A	area	m^2

Applying a force over a large area will result in a lower pressure compared to over a smaller area.

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LEADS ONTO

Work

If a force is able to cause something to move a certain distance, then we say that work has been done.

Work is also done whenever energy has been converted from one form to another.

$$W = F\,d$$

symbol	name	units
W	work done	J
F	force	N
d	distance	m

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LINK: Power is work done per second

Energy (kinetic)

Kinetic energy is the energy possessed by ANY object that is currently in motion (has a speed).

Sizes of mass and velocity

$$E = \tfrac{1}{2}\,m\,v^2$$

symbol	name	units
E	energy	J
m	mass	kg
v	velocity	ms^{-1}

- **Doubling the mass and keeping velocity constant** will cause the kinetic energy to double as well.
- **Doubling the velocity while keeping the mass constant** will cause the kinetic energy to quadruple (an increase by 4x).

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Energy (potential)

Potential energy is *stored energy*. It has the *potential to* do work by *converting* that stored energy into kinetic energy.

Gravitational Potential Energy

$$E = m\,g\,h$$

symbol	name	units
E	energy	J
m	mass	kg
g	acceleration by gravity	ms^{-2}
h	height	m

Gravitational potential energy is the type of potential energy we focus on in NCEA L1.

- **E = mgh** is the same as work done (W = Fd, see video).
- Work is done when lifting an object (kinetic energy is converted to gravitational potential energy) and also when dropping an object (gravitational potential energy is converted to kinetic energy)
- If an object is dropped; a tiny amount of energy converts to heat/sound due to friction with air. Most of it will still be converted to kinetic energy.

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LEADS ONTO

Power

Power is the rate of energy used per second. It is the rate of work being done (the rate of energy being converted)

$$P = \frac{W}{t}$$

symbol	name	units
P	power	W
W	work done	J
t	time	s

- **High power** means that something is able to do a lot of work (convert a lot of energy or use a lot of energy) in a short period of time.
- **The unit for power is watt** (W) or joules per second (Js^{-1})

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