# Maths skills – M2.2 Change the subject of an equation

### Tutorials

Learners may be tested on their ability to:

* use and manipulate equations, e.g. magnification

### Changing the subject of an equation

There are many important equations or formulae that are used in many biological contexts. It is essential that you are able to rearrange these formulae to make the “unknown” part of the equation the subject.

The golden rule with equations is to make sure that one side always equals the other. The equals sign is the crucial part, so if you do something to one side of the equation, you must do the same to the other side.

The part of the equation that you are trying to find, the ‘unknown’, always goes on the left hand side, but the equation can be written either way round, so a=bc is exactly the same as bc=a, but if it is a that is the subject of the equation, it goes on the left hand side.

For example three quantities *a*, *b* and *c* are linked by the simple relationship *a* equals *b* times *c.*

$$a=bc$$

To make *b* the subject of the equation you need to get it on its own. So we need to divide both sides of the equation by *c. c* then cancels out on the right hand side, and leavesthe formula *a* divided by *c* equals *b*.

$$\frac{a}{c}=b$$

The new subject of the equation is *b*, so it must go on the left hand side, so the equation is written the other way around:

$$b=\frac{a}{c}$$

For example, as explained in section M1.8, a common equation used in biological drawing links magnification, image size and object size. The equation for this is magnification = the size of the image divided by the actual size of the object.

$$magnification= \frac{size of image}{size of real object}$$

If you know the magnification, and the size of the image, you can work out the actual size of the object. So you need to rearrange the equation to make the actual size of the object the subject. Your first problem is that what you want as the subject is a denominator in a fraction. So you would start by multiplying both sides by the actual size of the object. This allows you to cancel this term from the right hand side of the equation. So you now have magnification times the actual size of the object equals the size of the image.

$$magnification x size of real object=size of image$$

You now divide both sides of the equation by the magnification, which lets you cancel magnification from the left hand side, leaving the actual size on its own, and has size of image divided by magnification on the right hand side.

$$size of real object= \frac{size of image}{magnification}$$

Many equations can be represented as a formula triangle. For example, the magnification formula in a triangle looks like this, where ‘I’ represents the size of image, ‘m’ is the magnification and ‘o’ is the size of the real object.

I

M

O

Although these are very useful, it is essential that you understand how to rearrange formulae yourself, and fully understand the equals sign. If you rely on the triangle, when you come to rearrange, for example, the equation for a straight line:

y = mx + c

or Pythagoras’s equation:

a2 + b2 = c2

you will not be able to do it.

This resource has been produced as part of our free A Level teaching and learning support package. All the A Level teaching and learning resources, including delivery guides, topic exploration packs, lesson elements and more are available on the qualification webpages.

 If you are looking for examination practice materials, you can find the Sample Assessment Materials (SAMs) on the qualification webpages: [Biology A](http://www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/) / [Biology B](http://www.ocr.org.uk/qualifications/as-a-level-gce-biology-b-advancing-biology-h022-h422-from-2015/)

**OCR Resources**: *the small print*OCR’s resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by the Board, and the decision to use them lies with the individual teacher. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources.
© OCR 2017 - This resource may be freely copied and distributed, as long as the OCR logo and this message remain intact and OCR is acknowledged as the originator of this work.

OCR acknowledges the use of the following content: n/a

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

### Produced in collaboration with the University of East Anglia

We’d like to know your view on the resources we produce. By clicking on ‘Like’ or ‘Dislike’ you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click ‘Send’. Thank you.

If you do not currently offer this OCR qualification but would like to do so, please complete the Expression of Interest Form which can be found here: [www.ocr.org.uk/expression-of-interest](http://www.ocr.org.uk/expression-of-interest)

Looking for a resource? There is now a quick and easy search tool to help find free resources for your qualification:
[www.ocr.org.uk/i-want-to/find-resources/](http://www.ocr.org.uk/i-want-to/find-resources/)