# 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.*

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*.

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:

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.

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.

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.

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.

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