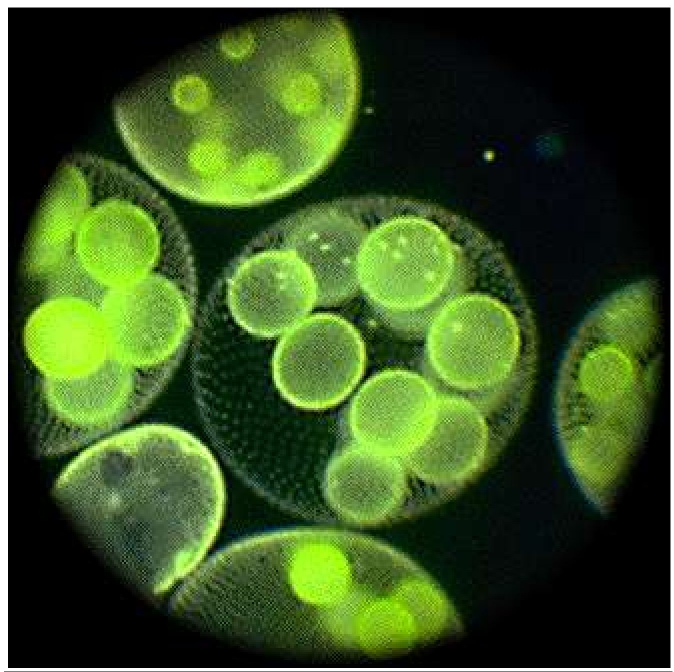
Year 12

Springwood High School.

A level Biology
Summer task reading



[BRIDGING UNIT GCSE TO AS]

Units, measurements and standard form

Units are very important part of biology. The common units you should know are:

unit	name	Measurement of
m	metres	Distance or length
kg	kilograms	mass
A	amps	current
s	Seconds*	time
^oC	Degrees celsius[1]	temperature
M	Molar	concentration
J	Joule	energy

*Notice ‘s’ is the abbreviation for seconds, not ‘sec’.

[1]You may come across the unit K (Kelvin). To convert a K temperature to ^oC, take away 273. E.g. 373K = 100^oC

However, there are several units derived from these basic units that you will come across commonly in biology. These are:

unit	name	Measurement of
cm^3	centimetres cubed	Volume, usually solids and gases*
ml	millilitres	Volume, liquids*
mm	millimetres	length
µm	micrometres or microns	length
nm	nanometres	length
mV	millivolts	voltage

Notice that cm^3 and ml are an equal measure i.e. $1cm^3$ = 1ml

What happened to litres?

Instead of using litres (l), at A level you will be expected to use dm^3 (decimetres cubed). This avoids confusing l for litres with a number 1. Millilitres are still represented as ml.

‘Per’

At GCSE, you would have written metres per second like this: m/s

A levels use a different notation: ms^{-1}

There is a mathematical reason for this, but you don’t need to know it (unless you are desperate to find out!).

The minus sign when present in units tells you that it should be read as ‘per’, e.g.

kg per second	kgs^{-1}
bubbles per minute	bubbles min^{-1}
per litre	dm^{-3}

Prefixes

These go before a unit to alter its magnitude. You are familiar with some of them already.

symbol	prefix	meaning	Example
M	Mega	x 1,000,000 (million)	MJ
k	kilo	x 1,000	kg
m	milli	÷ 1000	mV
µ	micro	÷ 1,000,000 (millionth)	µm
n	nano	+ 1,000,000,000 (billionth)	nm

Millivolts are often used in measuring voltage in cells.

µm are commonly used in measurements of cells and organelles.

nm are used in measuring wavelengths of light.

Standard form

Biology often uses numbers that are too large to be written down conveniently. Standard form is a short hand way for writing large or small values.

Instead of 1400 m standard form would be 1.4×10^3 m

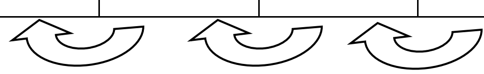
This is the same as saying 1.4 x 10 x 10 x 10. If you work this out, it is the same as 1400 m. You can use 1.4km which is the same thing, but as you will see below, it is good practice to get used to using standard form. Notice that the first value will be a number between 1 and 9, so that:

1450 m is $1.49\text{x}10^3$ m

Another way to think about it is by moving the digits along, so:

$1.49\text{x}10^3$m move the digits 3 places to the left of the decimal point:

			1	.	4	9
1	4	9	0	.	0	0

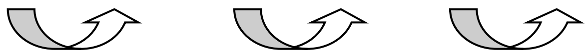


However, you will be much more likely to come across small values is biology. In standard form, a minus sign is used, so that:

0.003m is $3 x 10^{-3}$ m

This time, you move the digits 3 places to the right of the decimal point:

3	.				
0	.	0	0	3	



It gets easier when you start to recognise the relationship between standard form and the prefixes:

Standard form	**Same as**	
$x10^{3}$	kilo	x1000
$x10^{-3}$	milli	÷10000
$x10^{-6}$	micro	÷1,000,000
$x10^{-9}$	nano	÷1,000,000,000

<u>Notes.</u>

Gramme is the English variant of gram, but you will commonly see gram used.

There is a space between the number and the unit e.g. 3 m, not 3m. This also applies to % sign. The exception is degrees ^{o} which does not require a space.

Spaces can be used instead of commas for large numbers e.g. 10 000 000 rather than 10,000,000

Important equations

Aerobic respiration of glucose

Glucose + oxygen → carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

Formation of ATP

$ATP \rightleftharpoons ADP + P_i$

Note the reversible reaction arrow.

Moles.

In the equation for respiration, each symbol could represent a single atom or molecule, e.g. there are 6 oxygen molecules, or 1 glucose molecule. Scientists would read this equation as the symbols representing a mole (mol) of the substance, e.g. 1 mol of glucose reacts with 6 mol of oxygen to make 6 mol of carbon dioxide and 6 mol of water.

1 mol of a substance contains exactly the same number of atoms/molecules (6.02×10^{23}).

The relative atomic mass of an element (R.A.M.) can be used to determine the mass of 1 mol of an element, e.g.

12 g carbon = 1 mol of C

16 g oxygen = 1 mol of O

40 g calcium = 1 mol of Ca

For molecules, add the R.A.M. of all the atoms present. This is known as the Relative Molecular Mass (R.M.M) e.g.

32 g oxygen = 1 mol of O_2

17 g of ammonia = 1 mol NH_3

44 g of carbon dioxide = 1 mol CO_2

Useful formulae

Mean average = (Σ x) / n

Add the values together, and then divide by the number of different values. Given the symbol $\bar{x}$.

% change mass

$$\left(\frac{\text{Final mass} - \text{original mass}}{\text{original mass}} \right) \times 100$$

% error

$$\left(\frac{\text{Experimental result} - \text{actual result}}{\text{Actual result}} \right) \times 100$$

Some Useful Definitions

Limitations
Factors that have not been controlled or taken into account in the design of an experiment or procedure can be referred to as limitations. These can be described as design faults and will affect each run and replicate equally throughout the investigation as they are inherent in the apparatus and procedure used.

Errors
An error is not a design fault of the procedure but a single or 'one-off' incident or event (caused by the person carrying out the experiment or by faulty apparatus) that makes the data inaccurate.

Accuracy
Accuracy is an assessment of how close an observed value is to the true value. This can be achieved either by: the calculation of (or commenting on) the percentage error; commenting on the accuracy of the apparatus; or commenting on how the trend line compares to the theoretical trend line/predicted line/line of best fit.

Reliability
Reliability considers the spread of the data from the mean. This can be assessed by considering the standard deviation of the data or by the concurrence of the replicates. One way to improve reliability is by performing more repeats, as this will reduce the effect of any anomalous results on the mean. A reliable procedure is one that produces concurrent replicate results (close to the true value).

Precision
Precision refers to how small the units of measurements are, i.e. the number of decimal places to which any measurement can be recorded, as determined by the apparatus used.
(For example, a 1 cm^3 graduated pipette has the smallest measuring unit of 0.01 cm^3, so the precision is limited to 0.005 cm^3, half the smallest unit.)

Validity
Validity is the confidence that can be placed in the conclusion, given the level of accuracy and reliability and sources of error and limitations within the strategy. Confidence limits/calculated values of a statistical test can be used to assess the confidence that can be placed in a conclusion.

Range bars
Range bars plot the highest and lowest results in each data set. Range bars typically extend *different* distances away from the mean.

Error bars
Error bars may be plotted using the standard deviation, standard error or other statistical method. Error bars typically extend *the same* distance either side of a mean.

Ideal table

• All raw data in a single table with ruled lines and border.
• Independent variable (IV) in the first column; dependent variable (DV) in columns to the right (for quantitative observations) OR descriptive comments in columns to the right (for qualitative observations).
• Processed data (e.g. means, rates, standard deviations) in columns to the far right.
• No calculations in the table, only calculated values.
• Each column headed with informative description (for qualitative data) or physical quantity and correct SI units (for quantitative data); units separated from physical quantity using either brackets or a solidus (slash).
• No units in the body of the table, only in the column headings.
• Raw data recorded to a number of decimal places and significant figures appropriate to the least accurate piece of equipment used to measure it.
• All raw data recorded to the same number of decimal places and significant figures.
• Processed data recorded to up to one decimal place more than the raw data.
• Clear and informative title.

Ideal line graph

• Independant variable (IV) on the *x*-axis and dependent variable (DV) on the *y*-axis.
• Correct scaling (equidistant increments on both axes and graph makes good use of the paper).
• Both axes labelled correctly with SI units for numerical data.
• Points plotted with a saltire cross (x) or a dot surrounded by a circle; if more than two data sets are plotted, other symbols such as vertical crosses (+) may be used in addition provided these are distinguishable clearly from the grid lines.
• Plots joined by a straight line between them, or by a curve if there is confidence in the intermediate values implied by the curve.
• Line of best fit/trend line, if drawn, takes into account uncertainty in the data points (i.e. discounts effect of anomalous data points).
• Clear and informative title.

Bar charts

Bar charts are used when the independent variable is non-numerical, e.g. the number of different insect species found on trees. These data are discontinuous.
• They can be made up of lines, or blocks of equal width, which do not touch.
• The lines or blocks can be arranged in any order, but it can aid comparison if they are arranged in descending order of size.
• Each axis should be labelled clearly with an appropriate scale.

Annotations
• Whilst a label might be the name of a tissue, an annotation adds a descriptive quality such as shape, size or colour.

Drawings from a microscope
• Single, clear lines drawn with a sharp pencil.
• No shading or colour on the diagram.
• Informative title to be included.
• Scale included (e.g. high power, low power, x80, x10) to show approximate magnification.
• Low power tissue plans may not include cells.
• High power diagrams show a few adjacent cells only; adjacent cells must have complete lines.
• Cells or tissues should be in correct proportions.
• Label lines drawn in pencil using a ruler.

Command words

Analyse Separate information into components and identify their characteristics.
Annotate To provide notes of explanation.
Apply Put into effect in a recognised way.
Assess Make an informed judgement.
Calculate Generate a numerical answer, with working shown.
Comment Present an informed opinion or infer points of interest relevant to the context of the question.
Compare Identify similarities.
Complete Write the information required.
Consider Review and respond to information provided.
Contrast Identify differences.
Deduce Draw conclusions from information provided.
Define Specify meaning of the word or term.
Demonstrate Provide clear evidence.
Describe Provide a detailed account (using diagrams/data from figures or tables where appropriate). The depth of the answer should be judged from the marks allocated for the question.
Determine The quantity cannot be measured directly but can be obtained by calculation. A value can be obtained by following a specific procedure or substituting values into a formula.
Discuss Give a detailed account that addresses a range of ideas and arguments.
Distinguish Recognise and identify difference(s).
Draw Produce a diagram or to infer.
Estimate Assign an approximate value.
Evaluate Judge from available evidence.
Examine Investigate closely.
Explain Set out reasons or purposes using biological background. The depth of treatment should be judged from the marks allocated for the question.
Identify Recognise or select relevant characteristics.

Illustrate Make clear by using examples or provide diagrams.
Interpret Translate information provided.
Justify Present a reasoned case.
Label To indicate (by using a straight line).
List Provide a number of points with no elaboration. If you are asked for two points then give only two!
Measure Establish a value using a suitable measuring instrument.
Name To provide appropriate word(s) or term(s).
Outline Restrict the outline to essential detail only.
Plot Mark out points on a graph or illustrate by use of a suitable graph.
Predict Suggest possible outcome(s).
Recall Repeat knowledge from prior learning.
Recognise To identify.
Record Report or note.
Relate Make interconnections.
Sketch Produce a simple, freehand drawing. A single clear sharp line should be used.
In the context of a graph, the general shape of the curve would be sufficient.
State Produce a concise answer with no supporting argument.
Suggest Apply your biological knowledge and understanding to a situation which you may not have covered in the specification.
Summarise Present main points in outline only.
Use Apply the information provided or apply prior learning.

Additional Clarification:

How: Describe in what way or by what means……
What: Provide specific information……
Why: Explain the reason or purpose……
Accuracy: The accuracy of an observation, reading or measurement is the degree to which it approaches a notional 'true' value or outcome. For example: closeness to a line of best fit; accuracy of apparatus on percentage error.
Precision: The ability to be exact (degree of precision).
Reliability: The measure of confidence that can be placed in a set of observations or measurements. For example: confidence limits of statistical tests or concordance of repeats or standard deviation.
Validity: The implication that the outcome of an activity is not being distorted by extraneous factors.

Biological words – prefixes and suffixes

Biology requires you to use precise, technical language, some of which can be confusing. Many of the words are derived from Greek and Latin; learning to recognize common prefixes, suffixes and roots will help you to identify unusual terms.

SIZE/AMOUNT

a/an	without
bi	two
demi	half
deut	second
eu	well
haplo	single
hetero	different
homo	same
iso	equal
magni	large
micro	small
mono	one
multi	many
myrio	countless
oligo	few
pan	all
poly	many
prim	first
prot	first
quarter	four
semi	half

NUMBER

un	1
di	2
tri	3
tetr	4
pent	5
hex	6
hept	7
oct	8
non	9
dec	10
dodeca	12

WHERE/WHEN

ab	away from
ad	towards
apo	separate
ante	before
anti	against
cata	down
circum	around
com	with
contra	opposite
dextro	right
dia	through
ecto	outside
endo	within
epi	upon
ex	out of
exo	outside
extra	beyond
hyper	above
hypo	beneath
in	in
infra	under
inter	between
intra	within
laevo	left
meso	middle
meta	after
para	near
per	through
peri	around
post	after

pre	before
pro	in front of
retro	behind
sub	below
super	beyond
supra	above
sym	with
syn	with
sys	sith
trans	across
ultra	above

BODY PARTS

anthro	joint
angi	vessel
aur	ear
cap	head
capill	hair
cardi	heart
ceph	head
cerebr	brain
cheir	hand
cili	eyelash
cord	heart
corp	body
cost	rib
crani	skull
dactyl	finger
dent	tooth
derm	skin
digit	finger
don't	tooth
dors	back
gastr	stomach
genu	knee
gloss	tongue
gnath	jaw
manu	hand
myo	muscle
nas	nose
meur	nerve
odont	tooth
opt	eye
oss	bone
ot	ear
ped	foot
pil	hair
pod	foot
pulmo	lung
rhin	nose
sarc	flesh
som	body
stom	mouth
trich	hair
vas	vessel
ventr	belly

COLOURS

alb	white
argyr	silver
chrom	colour
chrys	golden
chlor	green
cyan	blue
erythro	red
flav	yellow
iod	violet
irid	rainbow
leuc	white
melan	black
nigr	black
polio	grey
porphyry	purple
rhodo	red
rubr	red
verd	green
xanth	yellow

CHEMICAL STORES

adip	fat
amyl	starch
aqua	water
calc	stone
glucos	glucose
glyc	sweet
hydr	water
ket	ketone
lact	milk
lecith	egg yolk
lign	wood
lip	fat
lith	stone
sacchar	sugar
sal	salt
stear	fat
steat	fat
sucr	sugar
xyl	wood

GENERAL ROOTS

acanth	prickle
acro	summit
actin	ray
ala	wing
amphi	both
andr	male
anthro	man
asc	sac
aster	star
auto	self
aux	grow
avi	bird
basi	at the bottom
bio	life
blast	germ
bov	ox
brachy	short
brady	slow
branch	gill
bursa	pouch
caec	blind
calor	heat
cani	dog
carp	speed
cauda	tail
cera	horn
clad	branch
clast	broken
conch	shell
copro	dung
corn	horn
cotyl	cup
crypt	hidden
cten	comb
cyst	capsule
cyt	cell
dendr	tree
dino	terrible
echin	spiny
eco	house
equi	horse
feli	cat
fer	carry
fil	thread
gemin	twin
glia	glue
gono	seed
gymn	naked
gyb	woman
haem	blood
hippo	horse
hom	man
hyal	glassy

lacuna	space
lepto	slender
lumen	cavity
lysis	loosen
macula	spot
mito	thread
morph	form
motor	mover
muri	mouse
neo	new
oecious	house of
onto	existing
oo	egg
ornith	bird
ovi	sheep
pachy	thick
palae	old
petr	rock
phag	eat
pher	carry
phil	love
phloe	tree bark
phor	carry
phot	light
phragm	fence
phyll	leaf
phyto	plant
pisc	fish
platy	flat
pleur	side
plica	fold
pneu	air
porc	pig
pseudo	false
pter	wing
radi	root
rect	straight
rhiz	root
schizo	split
sect	cut
simi	monkey
sperm	seed
stell	star
sten	narrow
stroph	turning
therm	heat
thero	beast
tom	cut
troch	wheel
trop	turning
troph	feed
unc	hook
uro	tail
vitr	glass
xer	dry
zo	animal
zyg	yoke

THE END…

-ase	indicates substance is an enzyme
-ose	indicates substance is a sugar