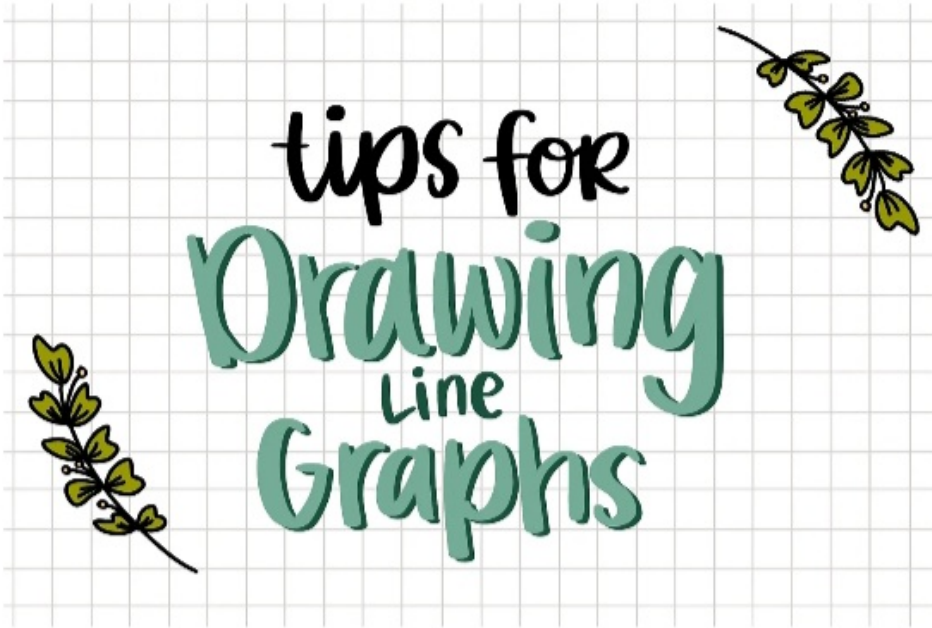
Tips for Drawing Graphs in Biology

There are two types of graphs that students often have to draw in Biology exams - the line graph and the bar chart. The line graph is frequently tested, in both the theory paper (Data-based question in Paper 2 for Pure Biology/Paper 4 for Science Biology) and the practical paper. In this post, my focus is on the line graph.



The graph question is usually worth about 4 marks because of the 4 areas we look out for:
S: Scale
P: Plots
A: Axes
L: Line

It may sound like it's *only* 4 marks and some of you may be tempted to just give that up... but really, it's easy to score the full 4 marks. Follow the tips below, practise drawing all the 10 graphs in the data-based questions in your TYS and these 4 marks will seem like a give-away.

I'll elaborate more on S,P,A,L below, especially on the things to look out for based on common mistakes that students make.

Scale

The scale you choose should have all plotted points occupying ***at least 50% of the grid*** provided, in both the *x* and *y* direction. To check for this, just make sure the lowest value and highest value fill at least half of each axis. (See Figure 1 below for illustration of this).

Be mindful about the scale you use, ***choose one that is easy to work with***.
Examples include:

- "0, 2, 4, 6...." or
- "0, 5, 10, 15...."

for each 2cm square on a standard graph paper (or simply put, each "big square").

I'm sure you've heard your teacher mention not to use "awkward scales". These scales are named as such because the scales cannot be read properly and plotting may become inaccurate. An example would be

- "0, 3, 6, 9...." for each "big square". It's difficult to accurately plot a value of 4 in this case.

Next, be careful while labelling your scale on each axis. Make sure there are ***no gaps in the scale***. By gaps, I mean this: "0, 5, 10, 20, 25, 30" where *15* is missing from the scale.

If the values provided are huge, there is ***no need to start from zero***. To maximise the grid provided, start with a comfortable value just below the provided value or use the actual value if it's suitable for your scale. (See Figure 1 below for example of this).

Always remember to label the origin with the starting value of each axis. Many students tend to only label the scale on the axes but would forget the point of origin, especially if it doesn't start with "0".

Plots

This component is quite easy to score. Just make sure the coordinates are correct when plotting and you'll be fine. If you're nervous or tired, and all the squares seem to merge and... you *just* can't seem to see exactly which corner of the "small square" your plot should be, use a ruler to guide you so it's harder to make that misalignment mistake.

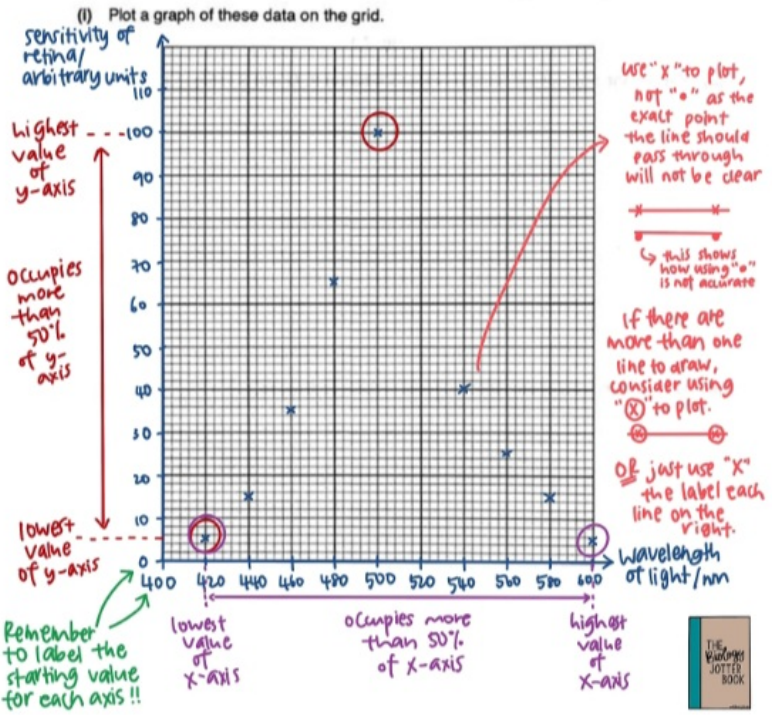
I've written (in bright red) another tip you should follow, in Figure 1 below. Remember to ***use "x" when marking your plots***.

Photo credit: The picture used below is taken from the 2018 GCE O Level Biology Paper 6093/02/O/N/18 Question 8.

Figure 1

Tips for the "scale" and "plots" components when drawing line graphs. The annotations I've made are colour-coded you may wish to use them as guides for reading the various points.

wavelength of light/nm	420	440	460	480	500	520	540	560	580	600
sensitivity of retina/arbitrary units	5	15	35	65	100		40	25	15	5



Axes

There are a number of things to note to score the 1 mark for this component.

The question provides you with a table of values and wants you to "*Plot a graph of these data on the grid.*" Which set of data is for the x-axis and which is for the y-axis? Remember that ***independent variable is the one on the x-axis***, and the ***dependent variable is on the y-axis***.

Sometimes, the question could be (for example) "*Plot the sensitivity of the retina against the wavelength of light*". In this case, remember it's always "*Plot y against x*". So the sensitivity of the retina is on the y-axis, while the wavelength of light is on the x-axis.

Next, do not forget to ***label both axes***. Write the title and the unit (just follow the phrasing given in table) for each axis. Either one of the below 2 ways are acceptable:

- wavelength of light/nm
- wavelength of light (nm)

One more thing for this axes component... ***Label the scale on the axes***. Use small dashes as markings and make sure the "big squares" are labelled with a value. (See the annotations in green in Figure 2 below).

Line

A line does not mean it must be straight. A curve is also a line... so the most frequently asked question by students is "***When do we draw a curve?***"

Here are the scenarios you should draw a smooth curve:

- the plots show an obvious curve (See Figure 2 below)
- based on theory, you know it should be a curve (e.g. rate of enzymatic reaction against pH graph)

Similarly, draw a straight line with a ruler, if the plots are all aligned into a straight line.

If they don't show a curve or straight line, and you don't see any obvious relationship between the two variables, you can use your ruler to join the plots. (See annotation in red in Figure 2 below).

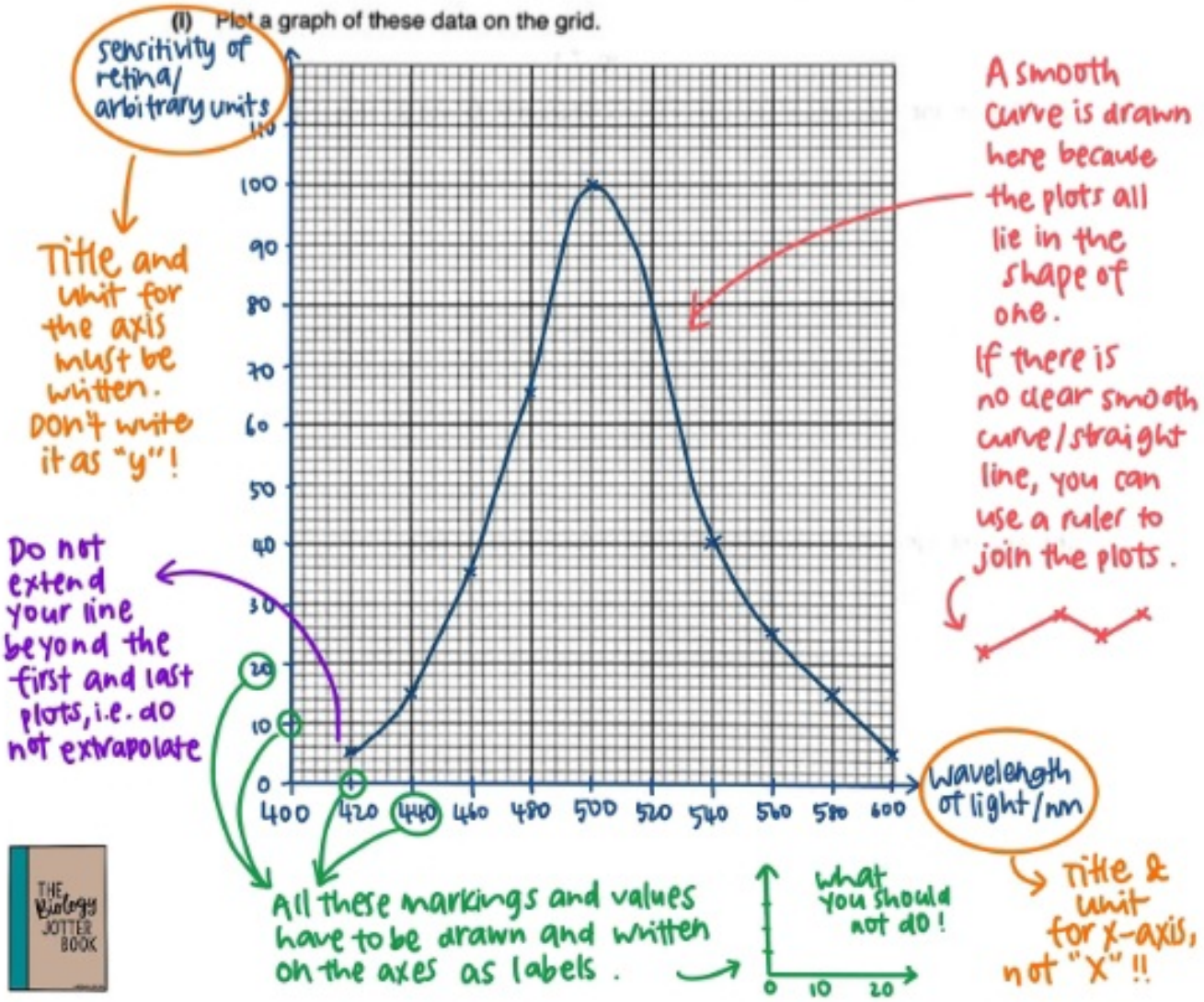
Sometimes, the question demands that you draw a "Line (or curve) of best fit" then you do just that. Do take care to balance the points about the line you draw - not too many points above or below the line drawn. There is no need to force the line to pass the origin as well.

One last thing about the line, strictly ***no extrapolation*** unless told to do so. That means, you do not extend the line before or beyond the first and last plots respectively.

Figure 2

Tips for the "axes" and "line" components when drawing line graphs

wavelength of light/nm	420	440	460	480	500	520	540	560	580	600
sensitivity of retina/arbitrary units	5	15	35	65	100		40	25	15	5



I hope the tips in this post help! Practice makes perfect so try to work on more data-based questions.

Let me know if you have any questions or feedback. Till the next post, take care and stay safe!

P.S. One last thing I forgot to mention earlier: The *entire graph should be done in pencil*, including all the labels and markings.