



Syllabus reference:

Candidates should be able to:

(d) calculate the linear magnification of an image (HSW3);





• This symbol in the corner of a slide indicates a picture, diagram or table taken from your text book



To accurately measure the size of cellular structures we need a suitable scale:





Ideally, we need a scale we can see directly alongside the cells we are observing:





Start by putting a ruler under the microscope:





Appearance of ruler at medium magnification





Appearance of tissue at medium magnification





Estimating cell size at medium magnification





Diameter of field of view/mm	No. of cells lengthways	No. of cells widthways	Mean length (mm)	Mean width (mm)
1.00				





$1 \text{mm} = 1000 \mu \text{m}$

Diameter of field of view/mm	No. of cells lengthways	No. of cells widthways	Mean length (mm)	Mean width (mm)
1.00	5	12	0.2	0.083

Mean length of cells = 0.2 x $1000 = 200 \mu m$

Mean width of cells = 0.083 x $1000 = 83 \mu m$



Mean length (µm)	Mean width (µm)	
200	83.3	
125	67	
167	90	
100	67	
125	100	
111	47	
111	43.5	
100	50	
330	100	
220	105	
166	111	
100	91	
133	85	
52	38	
100	30	



Mean length (µm)	Mean width (µm)
200	60
170	40
91	48
250	63
250	55
142	48
250	56
200	90
500	59
330	125
200	59
140	50
90	77
100	45
77	42





















<u>The graticule</u> a more suitable 'ruler' for measuring cells

• The slide graticule:



• The eyepiece graticule:







The eyepiece graticule has regular divisions. These need to be calibrated for each magnification





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The eyepiece graticule remains constant no matter what magnification the cells are viewed at.





are viewed at.



Nucleus



The eyepiece graticule remains constant no matter what magnification the cells are viewed at.

9

8





Eyepiece & stage graticules







Figure 4.3 Stage micrometer viewed at x100 magnification. The total length of the micrometer is 1mm









Figure 4.2

Cells of onion epidermis as viewed at x400 magnification with the same graticule in the eyepiece

We know that at this magnification, each division of the eyepiece graticule represents 2.67µm

The length of the cell covered by the graticule is 98 divisions, therefore the length of this cell is 2.67 x 98 = $262\mu m$





We now have two measurements for the length of an onion cell; 212 μ m and 262 μ m.

Which of these is the more accurate estimate of the length of onion epidermal cells?





Estimating cell width. Figure 4.5. Cells of the onion epidermis as viewed at x100 magnification with a graticule in the eyepiece of the microscope

Remember the total length of the eyepiece graticule represents 1060µm at this magnification

There are approximately thirteen cells in the length of the graticule

Therefore the average width of **one cell** is 1060 ÷ 13 = **81.5µm**





Figure 4.6.

Cells of the onion epidermis as viewed at x400 magnification with the same graticule in the eyepiece of the microscope

Remember, we know that at this magnification, each division of the eyepiece graticule represents 2.67µm

Here, two cells span 62 divisions on the eyepiece graticule. This represents 2.67 x 62 = 165.5 μ m

Therefore the average width of one cell is 165.5 ÷ 2 = 82.8µm





Comparison of estimates from Ws1 with those from Ws3

- The answers on Ws1 are means of several samples
- Whilst the answers on Ws3 are based on a single sample
- The variety of onion used may be different
- The samples may have come from onions at different stages of growth









Calculating magnification & actual size:











Actual size









Magnification





Calculating magnification & actual size:



Actual size	=	Image size
notual 5120		Magnification
Magnification	_	Image size
aginnoation		Actual size

