Practical work 1 : Drawing and magnification calculation

Measuring cells

Cells and organelles can be measured with a microscope by means of an eyepiece graticule. This is a transparent scale. It usually has 100 divisions (see Figure 1a). The eyepiece graticule is placed in the microscope eyepiece so that it can be seen at the same time as the object to be measured, as shown in Figure 1b. Figure 1b shows the scale over a human cheek epithelial cell. The cell lies between 40 and 60 on the scale. We therefore say it measures 20 eyepiece units in diameter (the difference between 60 and 40). We will not know the actual size of the eyepiece units until the eyepiece graticule scale is calibrated.

To calibrate the eyepiece graticule scale, a miniature transparent ruler called a **stage micrometer scale** is placed on the microscope stage and is brought into focus. This scale may be etched onto a glass slide or printed on a transparent film. It commonly has subdivisions of 0·1 and 0·01mm. The images of the two scales can then be superimposed as shown in Figure 1c.

In the eyepiece graticule shown in the figure, 100 units measure 0·25mm. Hence, the value of each eyepiece unit is:

$$\frac{0{\cdot}25}{100} = 0{\cdot}0025\text{mm}$$

Or, converting mm to μm:

$$\frac{0{\cdot}25 \times 1000}{100} = 2{\cdot}5\,\mu\text{m}$$

The diameter of the cell shown superimposed on the scale in Figure 1b measures 20 eyepiece units and so its actual diameter is:

$$20 \times 2{\cdot}5\mu\text{m} = 50\mu\text{m}$$

This diameter is greater than that of many human cells because the cell is a flattened epithelial cell.

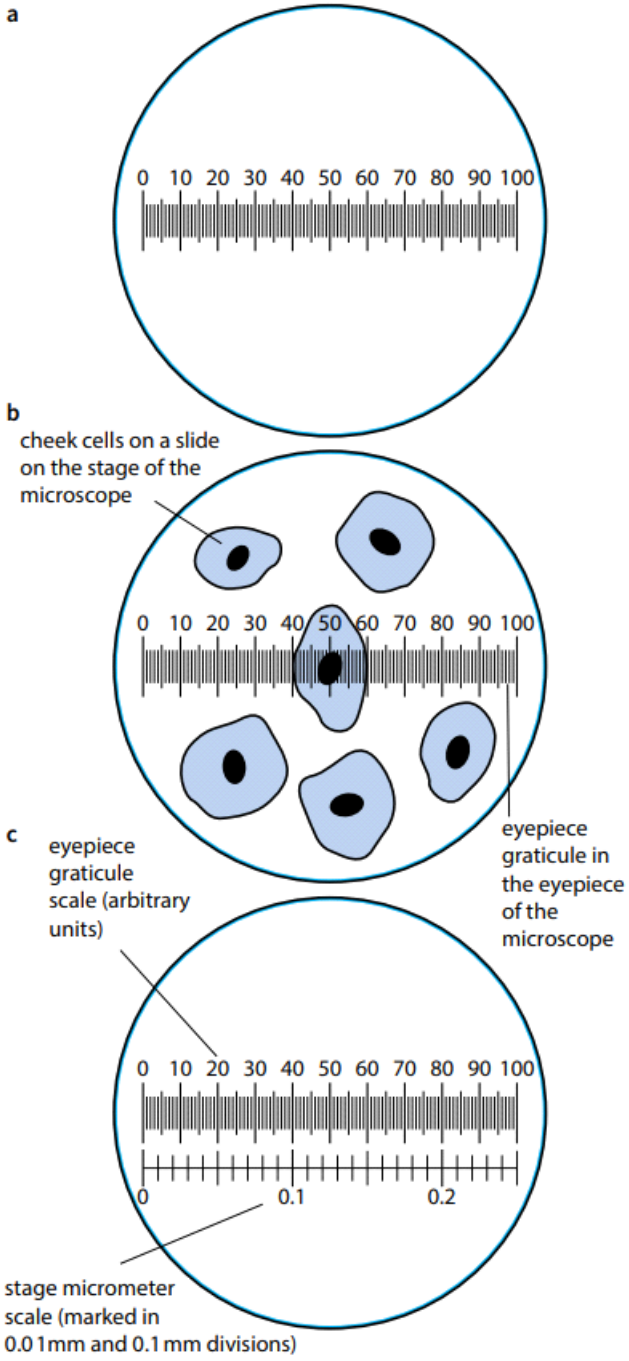

Figure 1

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Calculating the magnification of a photograph or image

To calculate M, the magnification of a photograph or an object, we can use the following method. Suppose we want to know the magnification of the plant cell.

If we know its actual (real) length we can calculate its magnification using the formula

$$M = \frac{I}{A}$$

The real length of the cell is 80µm.

Step 1 Measure the length in mm of the cell in the photograph using a ruler. You find that it is about 60mm.

Step 2 Convert mm to µm. (It is easier if we first convert all measurements to the same units – in this case micrometers, µm.)

1mm = 1000µm

So,

60mm = 60 x 1000µm

= 60000µm

Step 3 Use the equation to calculate the magnification.

$$M = \frac{Image\ Size}{Actual\ Size}$$

$$= \frac{60000\mu m}{80\mu m}$$

= x750

= The multiplication sign in front of the number 750 means 'times'. We say that the magnification is 'times 750'.

You may be asked to carry out a calculation from a set of results – either the results that you have collected, or a set of results that is presented to you.

It is very important to show every single step in any calculation that you make.

For example, you might be given a set of five measurements and asked to find the mean value. You should set out your calculation clearly, like this:

measurements: 12·5 µm, 18·6 µm, 13·2 µm, 10·8 µm, 11·3 µm

$$mean = \frac{(12{\cdot}5 + 18{\cdot}6 + 13{\cdot}2 + 10{\cdot}8 + 11{\cdot}3)}{5}$$

= 66·4

= 13·3µm

The values calculated for the mean are given to the same number of decimal places as the individual readings.

Note: Remember that, even though your calculator will show an answer of 13·28, you must give your answer to only one decimal place because the original measurements are in one decimal place.

Representing data in table

Example:

Rennin concentration /%	Time to reach end-point / s			
	1st reading	2nd reading	3rd reading	Mean
0.0	did not clot	did not clot	did not clot	did not clot
0.2	67.2	68.9	67.8	68.0
0.4	48.1	46.9	47.3	47.4
0.6	30.1	31.9	30.1	30.7
0.8	20.3	19.2	19.9	19.8
1.0	13.1	***18.9***	12.7	12.9

Make sure the boxes are of equal proportion like in this diagram.

■ *The table is drawn with* ***ruled columns****, rows and a border. The purpose of a results table is to record your results clearly, so that you and others can easily see what they are, and so that you can use them easily to draw a graph or to make calculations. Drawing neat, clear lines makes it much easier to see the results at a glance.*

■ *The columns are clearly headed with the quantity and its unit. (Use SI units.) Sometimes, you might want to arrange the table the other way round, so that it is the rows that are headed. Sometimes, both rows and columns might need to include units. The important thing to remember is that the* ***units go in the heading, not with the numerical entries in the table.***

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Drawing

1. Draw with clear, single lines
   -Use sharp pencil.
   -do not have several 'goes' at a line so that it ends up being fuzzy
   - use an HB pencil and a good eraser, so that when you make a mistake (which you almost certainly will) you can rub it out completely
2. Show the overall shape, and the proportions of the different components of the structure you are drawing, accurately -not a textbook version.
3. Do not include shading or coloring
4. Drawing should be large, using most of the space available but not going outside that space (for example, it should not go over any of the words printed on the page).

   Note:
   It is very important to draw what you can see, and not what you think you should see. The microscope slide that you are given might be something that is different from anything you have seen before.

5. Labelling :
   You may be asked to label your drawings.
   -the label lines should be drawn with a ruler and pencil
   -the end of the line should precisely touch the part of the diagram you are labelling and stop exactly at the structure being labelled.
   -Do not use arrowheads.
   -The label lines should not cross over one another.
   -The labels themselves should be written horizontally (no matter what angle the label line is at), and should not be written on the drawing.
6. Include a title stating what the specimen is, E.g: TS Artery.

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Low power plan diagram

1. Do not draw individual as shown in the low power drawing below.

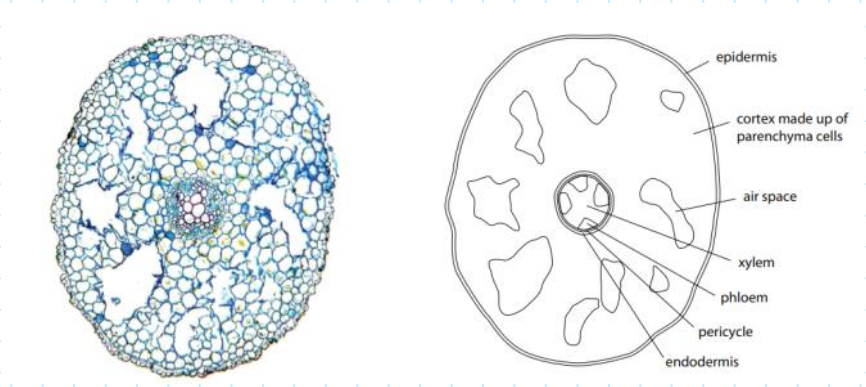
Mistakes of this diagram

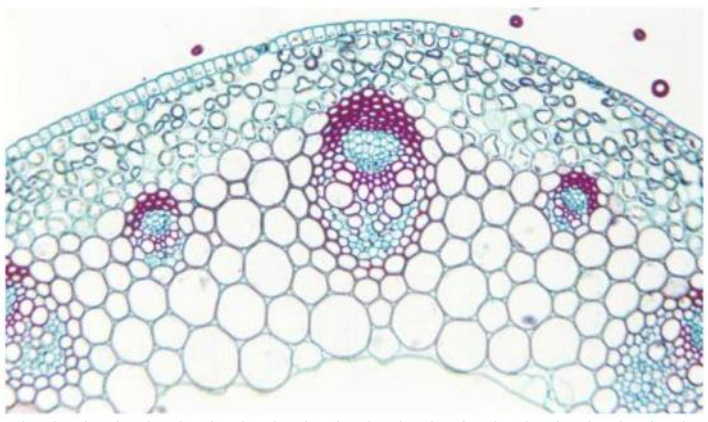
- the labelled lines are not straight.
- a sharp pencil was not used.
- the labelled lines crossed over each other.

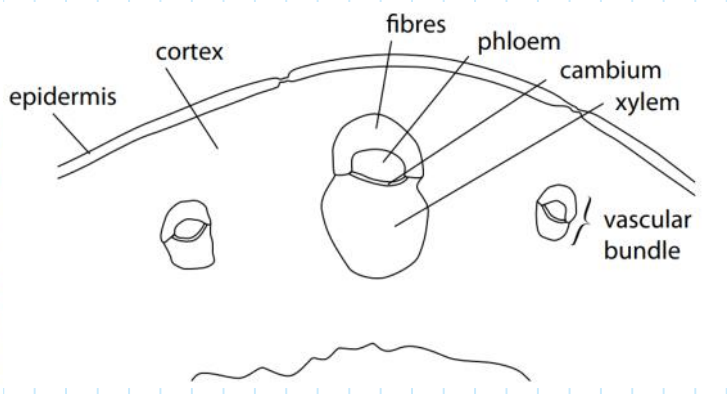
2. Draw all tissues completely, enclosed by lines.

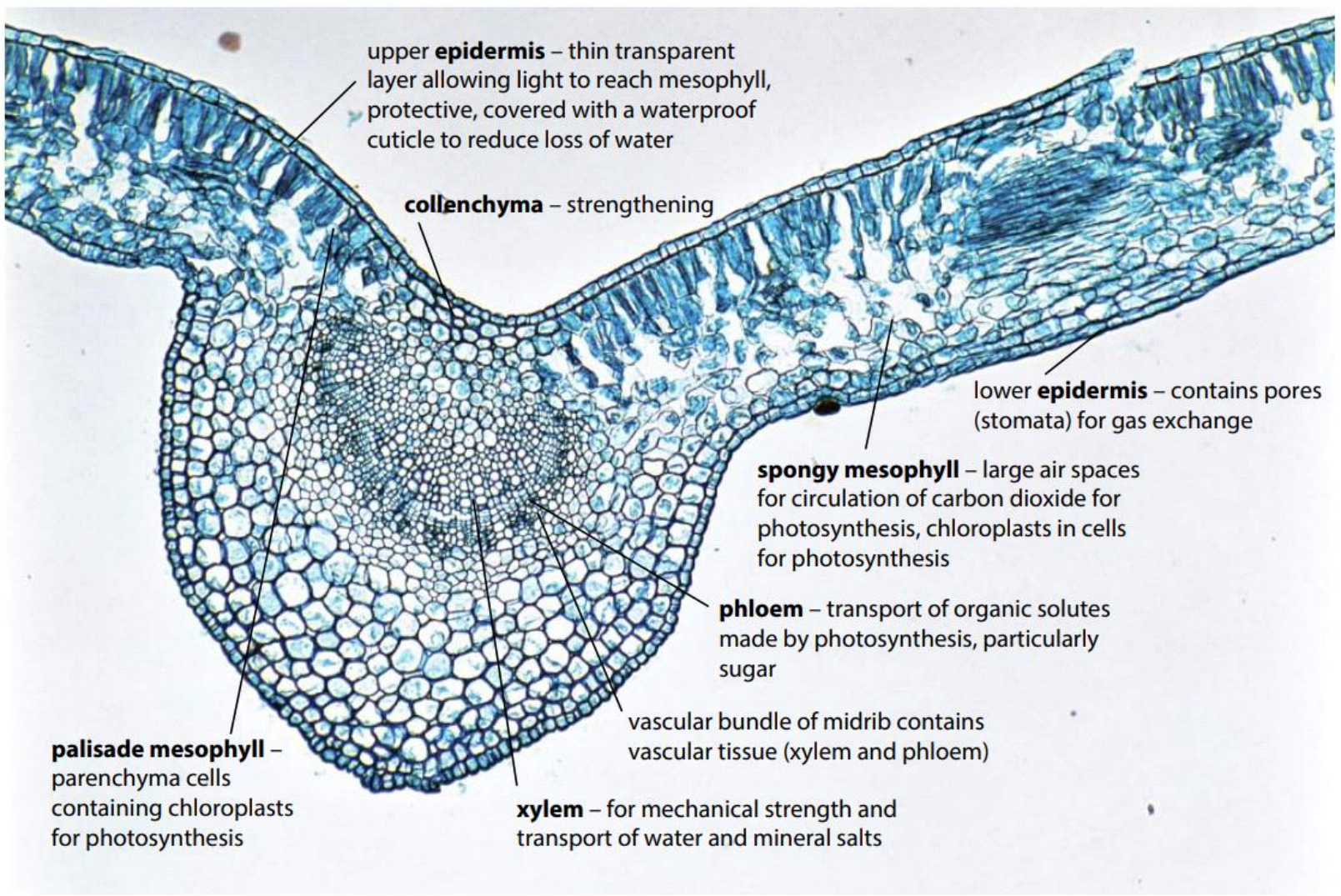
3. Draw correct interpretation of the distribution.

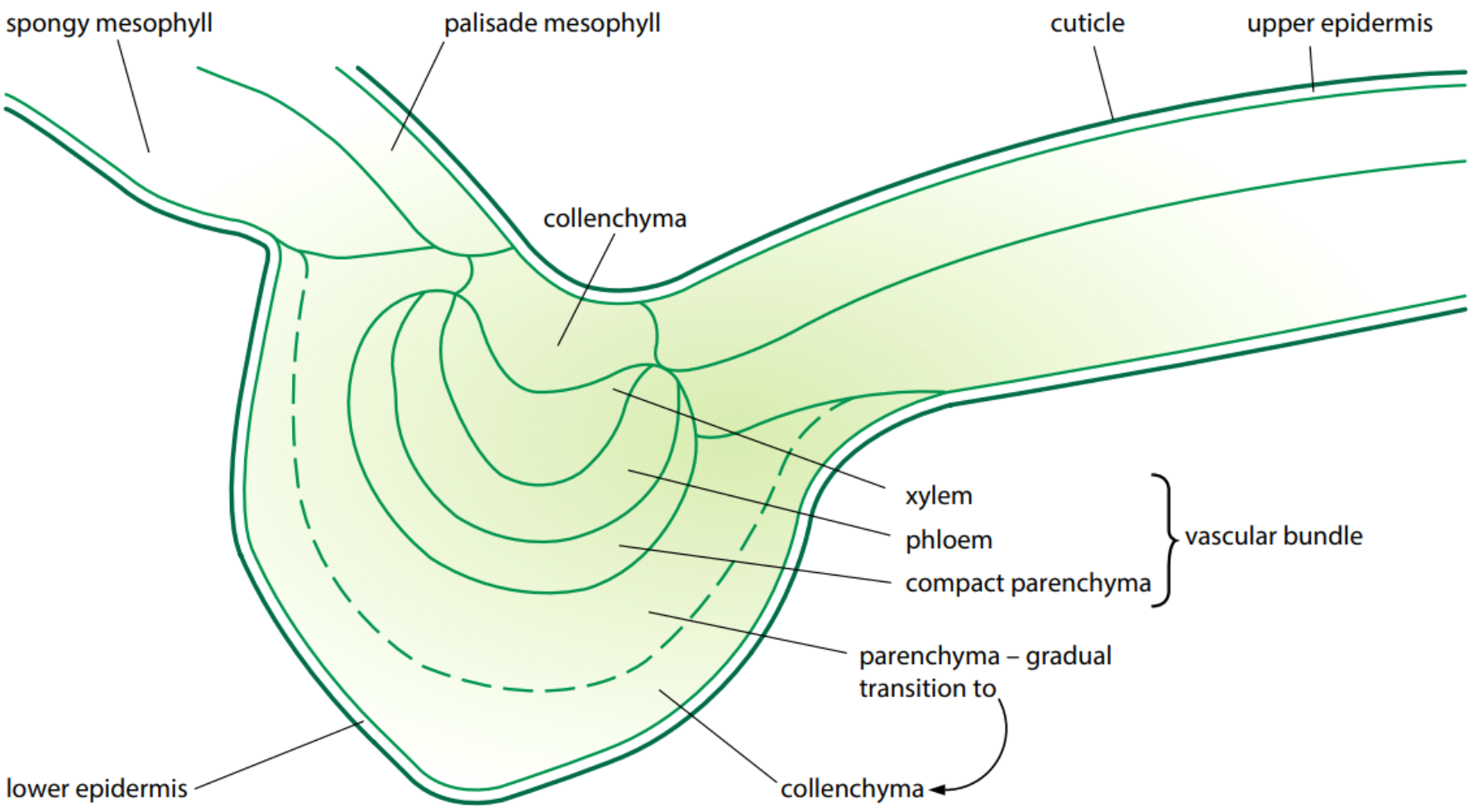
Below are some correct drawings of low power plan diagram











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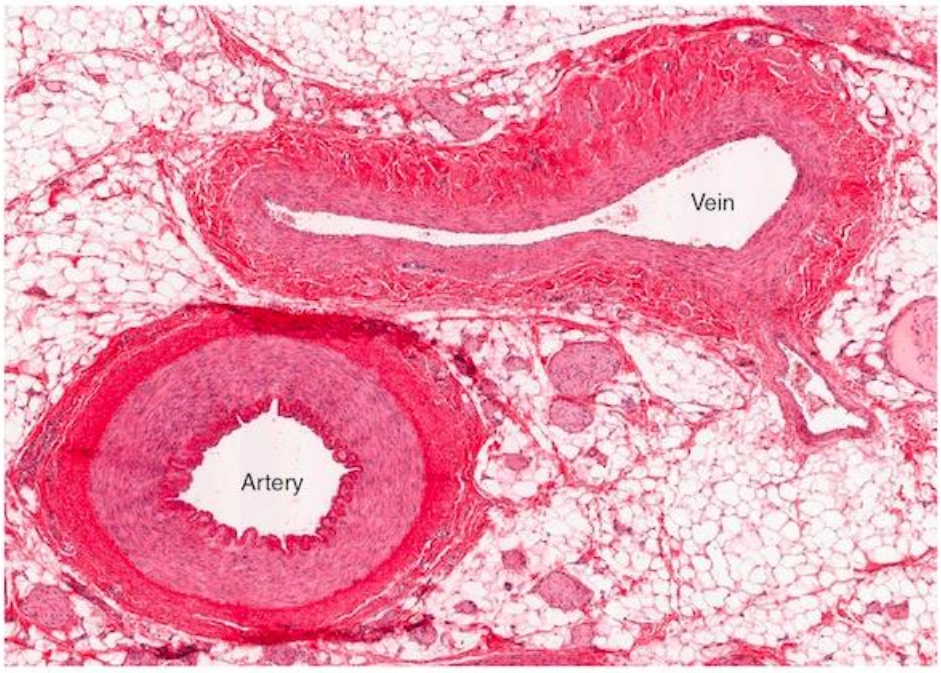
Low power plan diagram of artery and vein



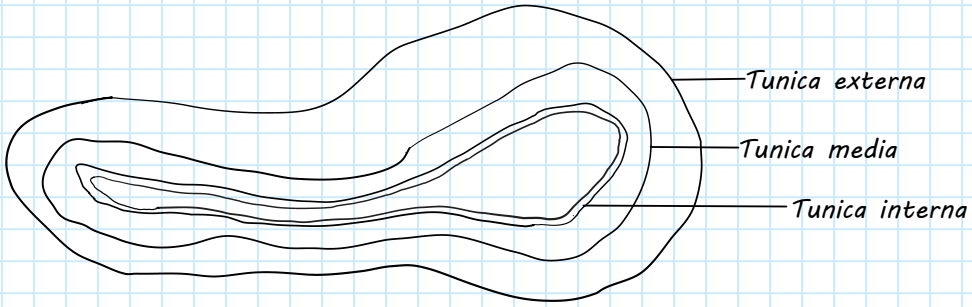


Figure: Vein

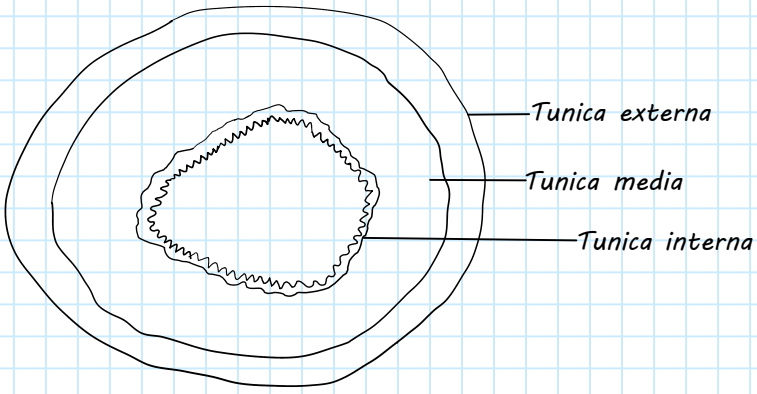


Figure: Artery

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