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 x 2·5μm = 50μm

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

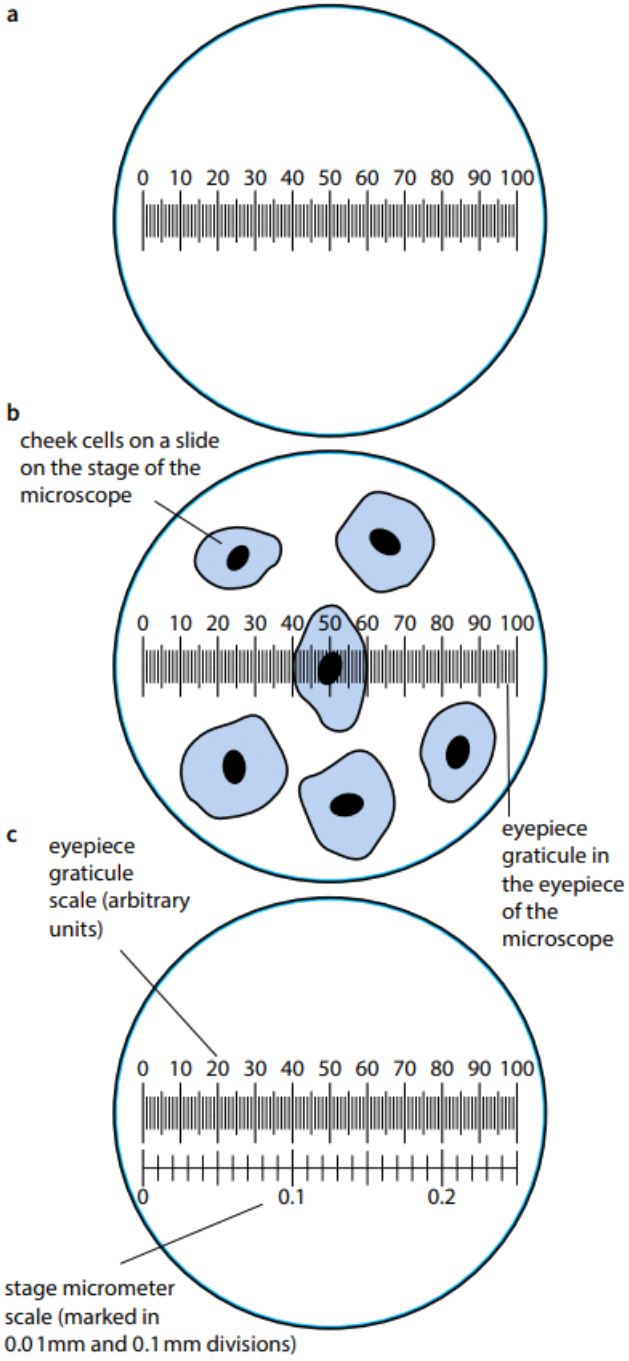


Figure 1

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.

1. *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.*
2. *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.***
3. *If they ask you to write about both compare and contrast or just differences between two specimens, make sure to include a "feature column" along with two columns for two specimens.*

e.g.

feature	L1	Fig. 2.1
shape of section	oval	wavy
number of tissue layers	more	fewer
position of vascular bundles	arranged in a circle	scattered
size of vascular bundles	all the same size	some large and some small

How to plot a line graph

1. Independent variable is plotted on the x-axis.
2. Dependent variable is plotted on the y-axis.

} 1-Mark for correct axis.

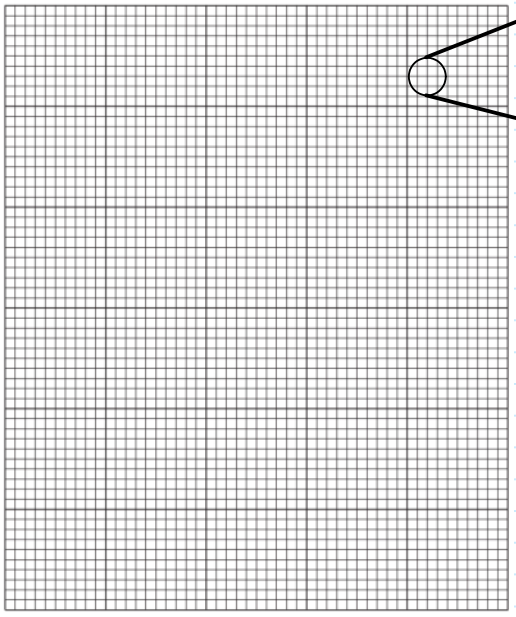
3. Scale must be even and not awkward and must be written every 10 small boxes.

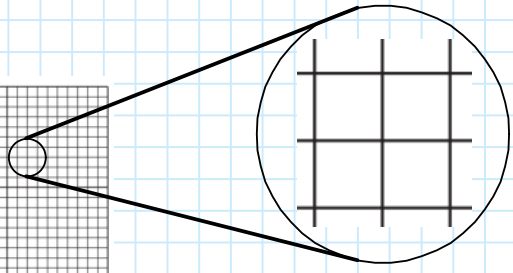
} 1-Mark for correct scale.

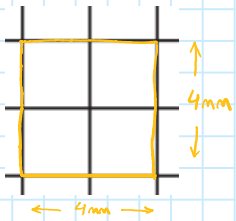
4. For plotting,

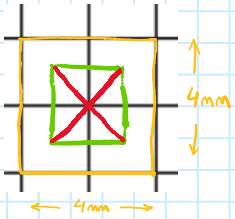
} 1 - Mark for correct plot.

Only	NOT
⊙	•
×	o
	⊙
	⊗

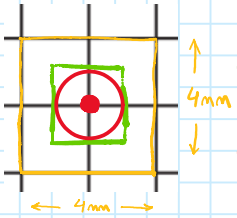








- Shows how big plot needs to be
- Plot



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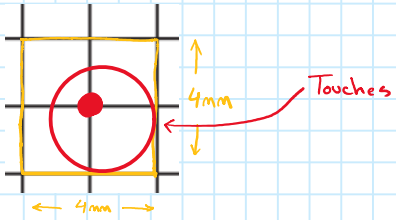
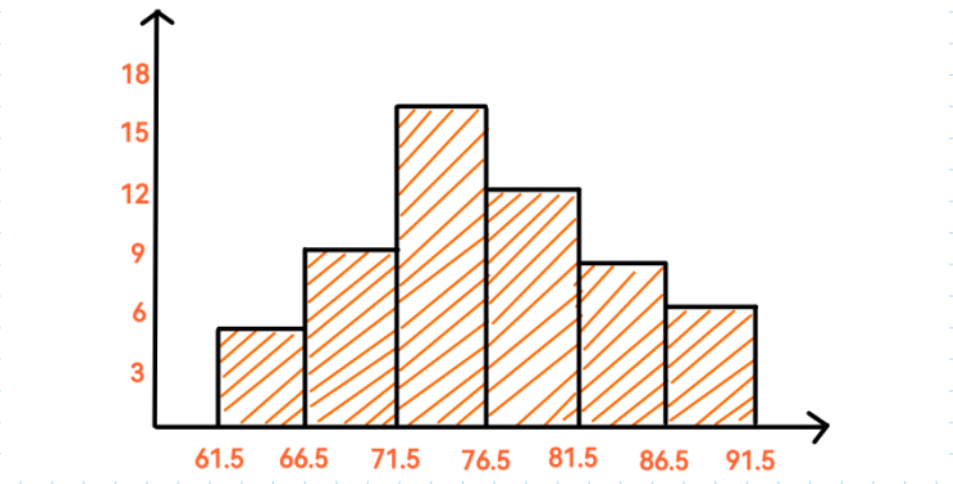


No marks for plot as plot touched 4mm x 4mm region.
Loses 1-mark for correct plot.

5. Join plot to plot with ruled lines; unless guided in the question to draw a smooth curve.
   The line must be ruled, clear and sharp.
   Loses mark if the line is :
   a. feathery
   b. Irregular thickness
   c. Incorrect plot
   d. Extrapolated when point to point line(not line of best fit).
   e. Line of best fit may have extrapolation to edges of grid.
   f. Not drawn with sharp pencil.

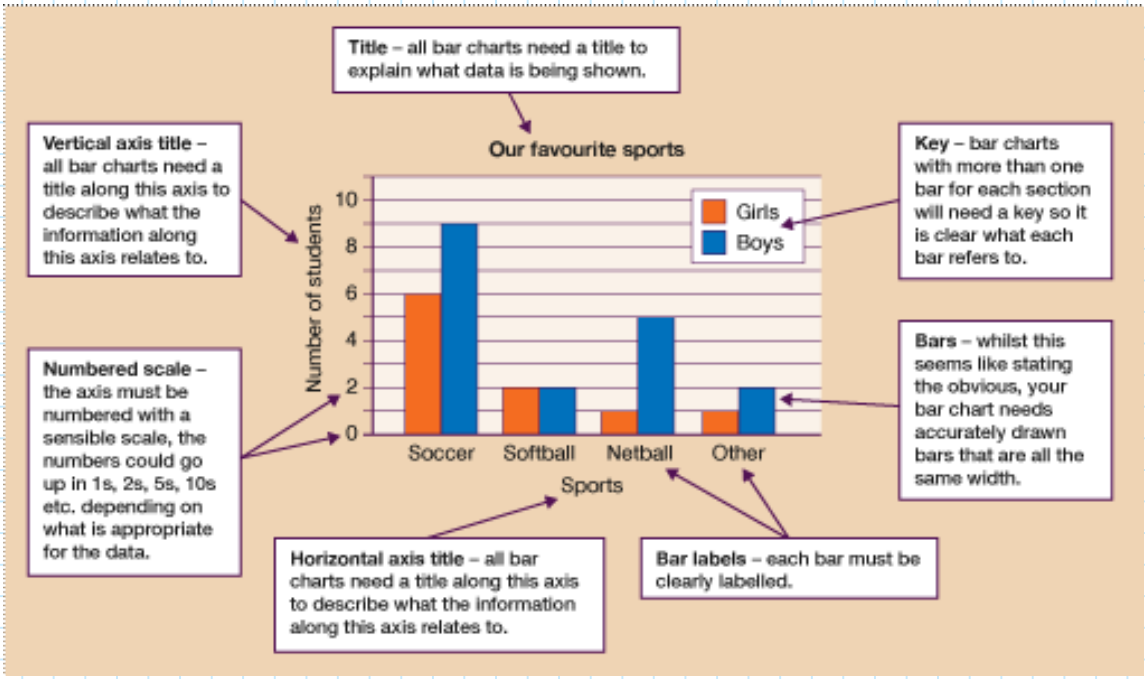
How to plot Bar Charts and Histograms

Histogram



- Make sure that there are no spaces between the bars in Histograms.
- Frequency goes in the y-axis and categories and class goes in the x-axis.

Bar-chart



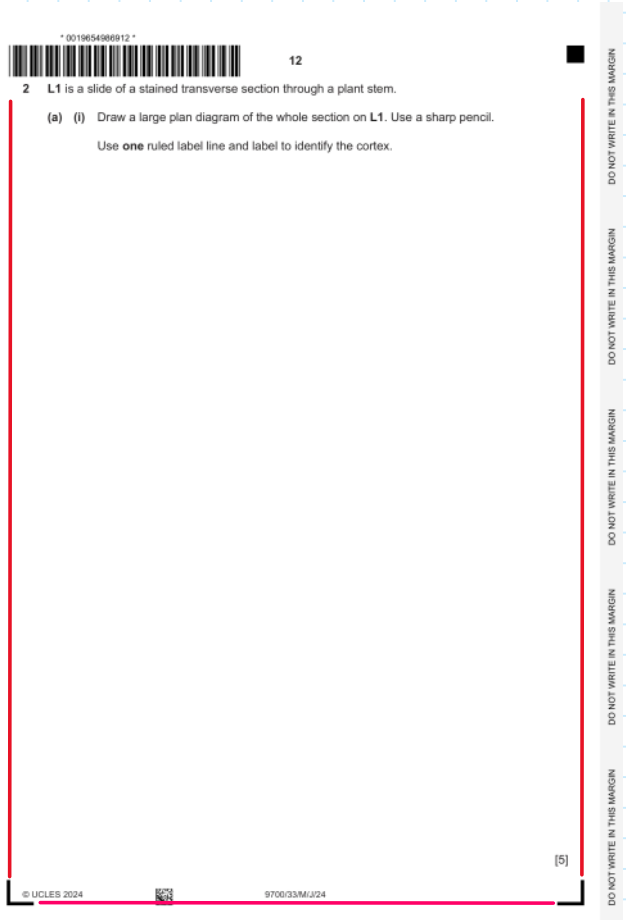
Make sure the spaces between the bars or groups of bars are equal.

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.

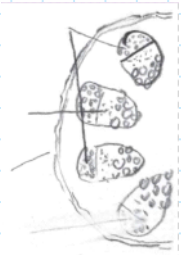
5. Labelling :
   You may be asked to label your drawings.
   1. The label lines should be drawn with a ruler and pencil
   2. The end of the line should precisely touch the part of the diagram you are labelling and stop exactly at the structure being labelled.
   3. Do not use arrowheads.
   4. The label lines should not cross over one another.
   5. 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.



Ensure that your drawings and annotations are within the red region.

Low power plan diagram

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



Mistakes of this diagram

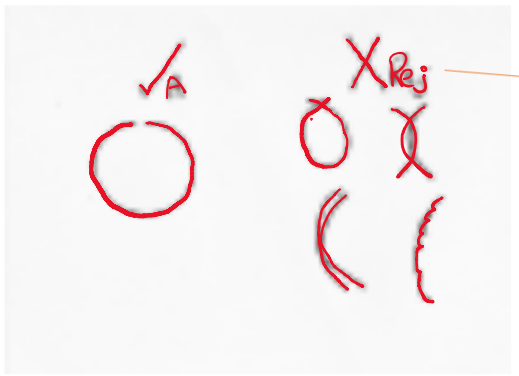
- the labelled lines are not straight.
- a sharp pencil was not used.
- the labelled lines crossed over each other.

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

Directions for drawing



Under "X"

Reject all, loses 1 mark from "*clear, sharp unbroken* line" part

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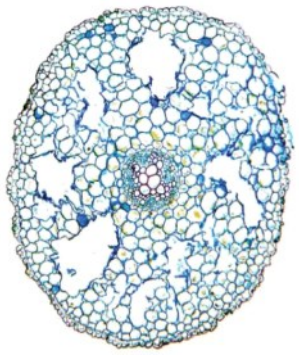
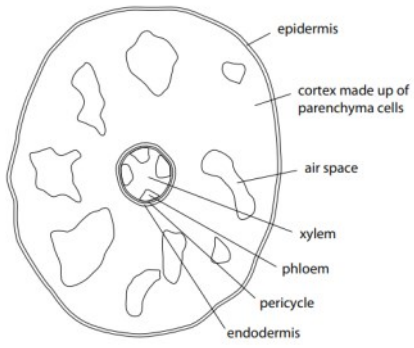
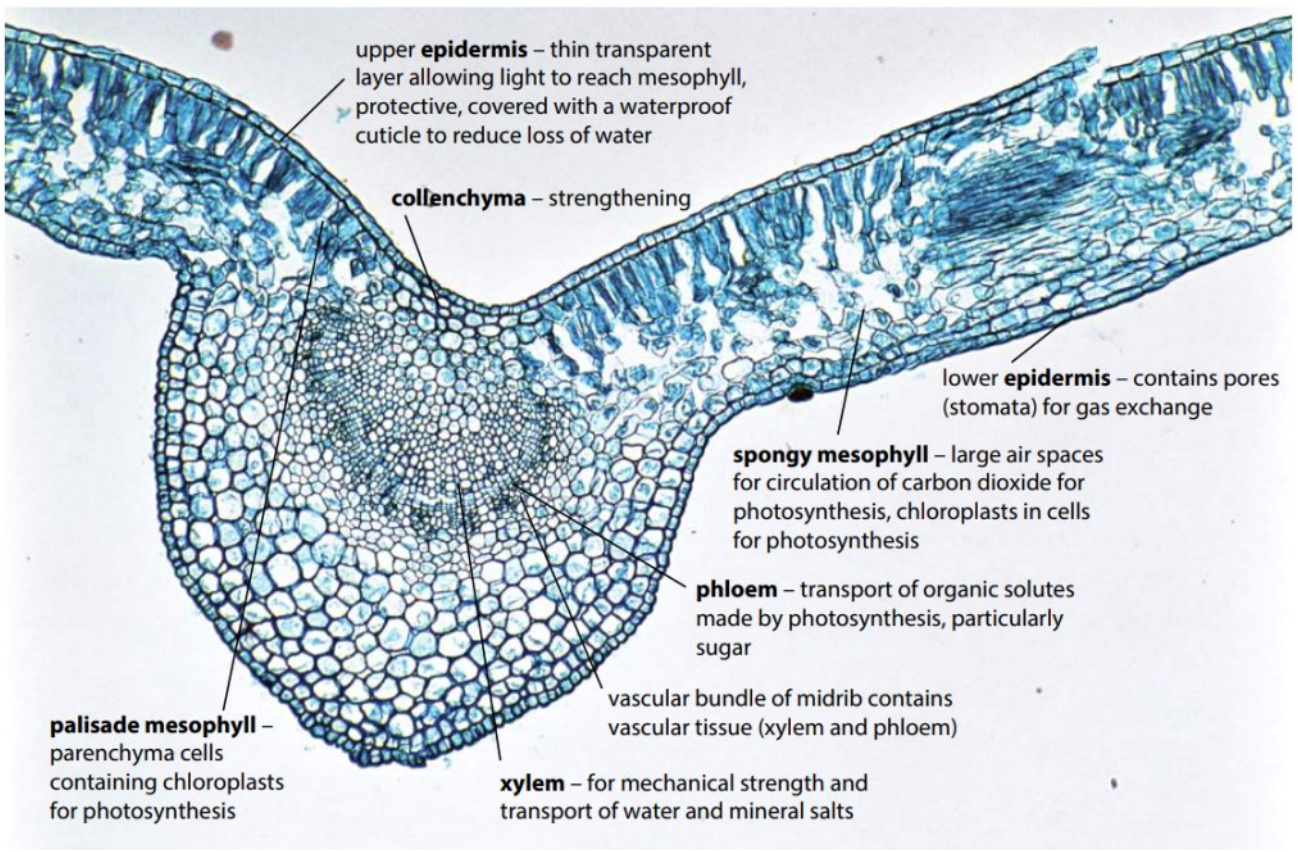
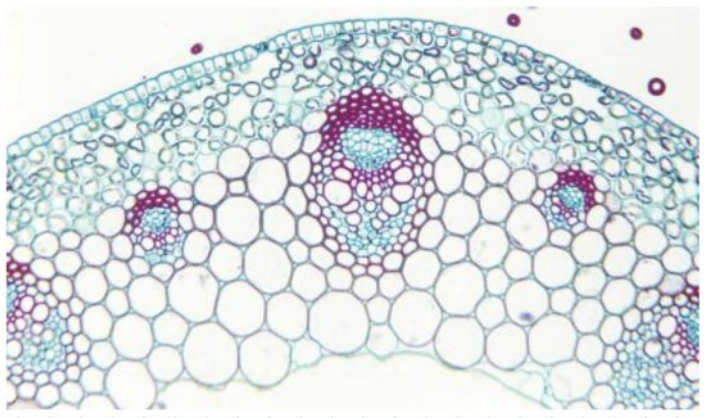
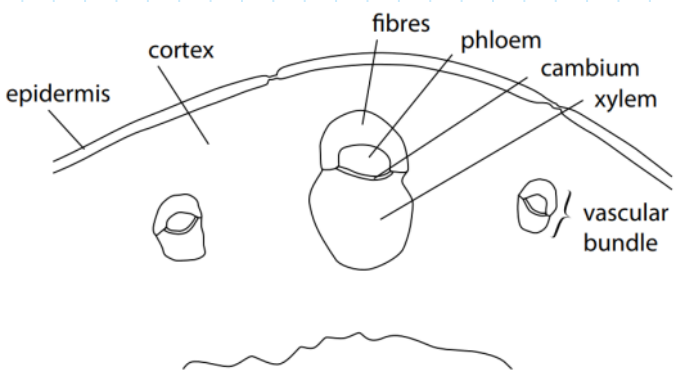
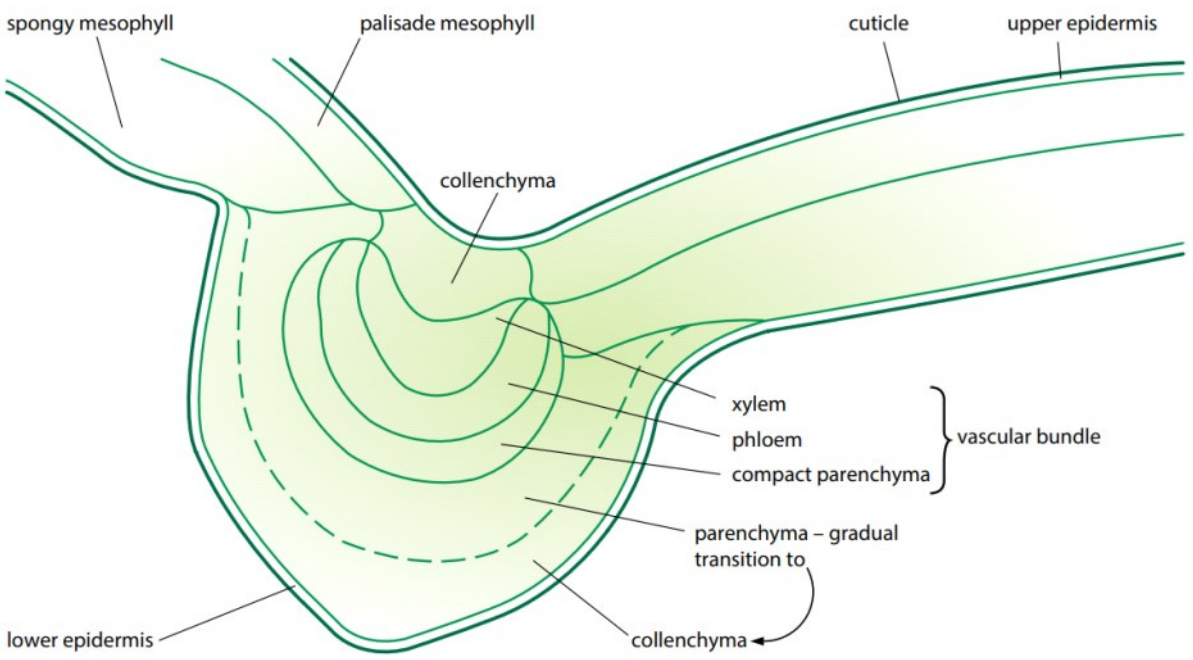




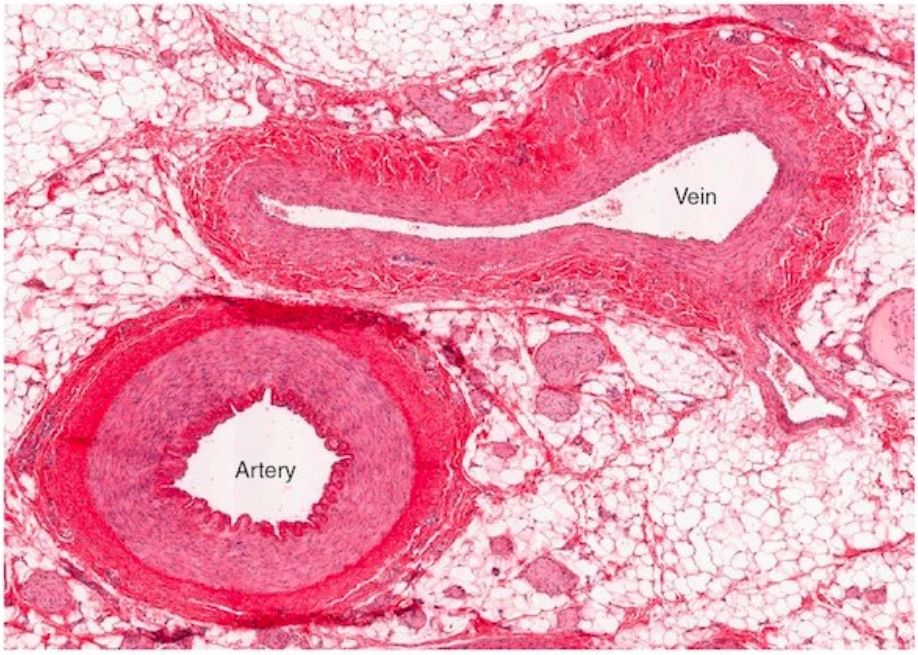








Low power plan diagram of artery and vein



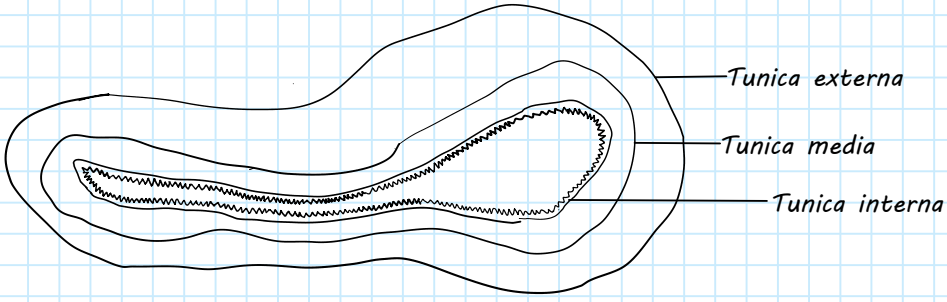


Figure: Vein

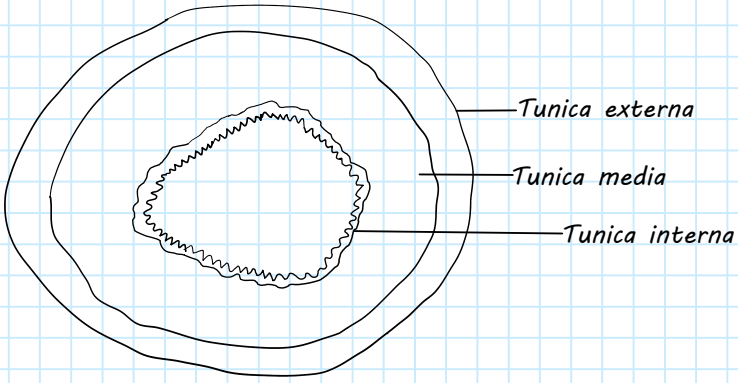


Figure: Artery

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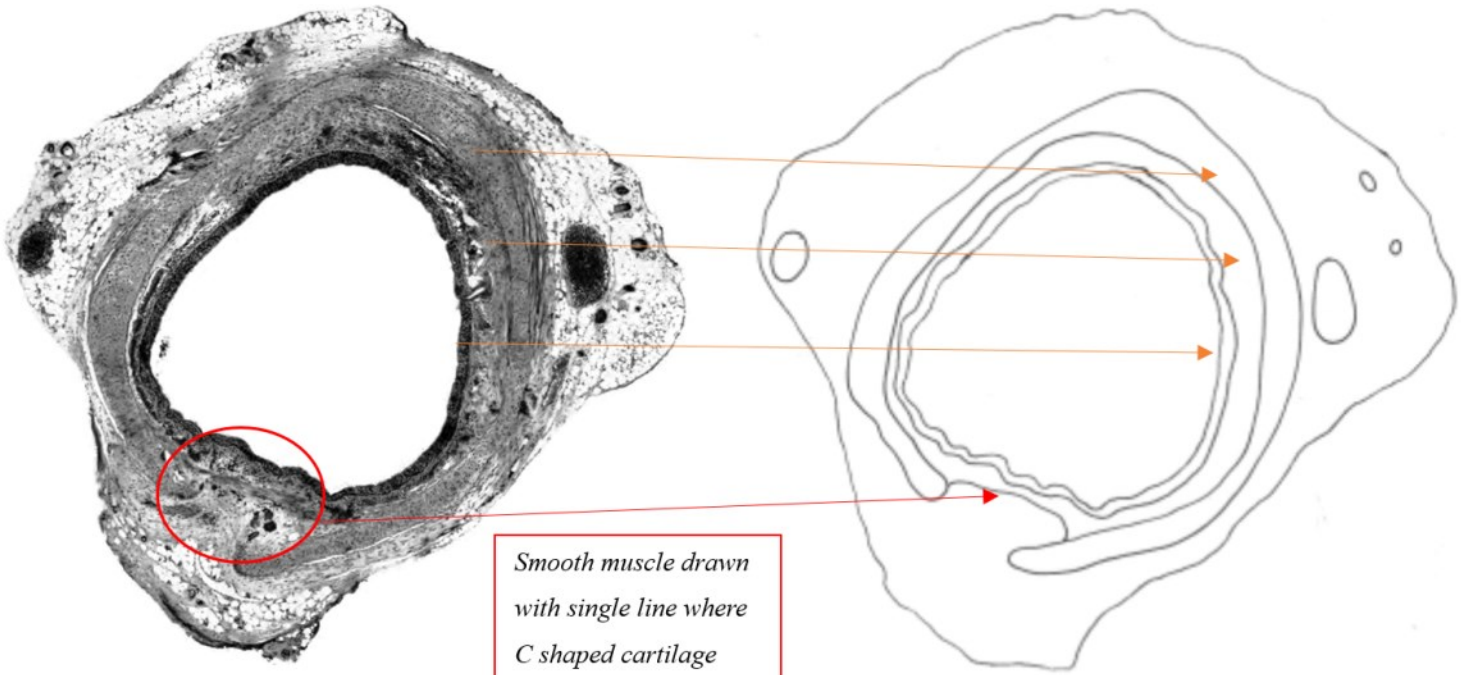
Trachea with C shaped cartilage.



Smooth muscle drawn with single line where C shaped cartilage discontinues.

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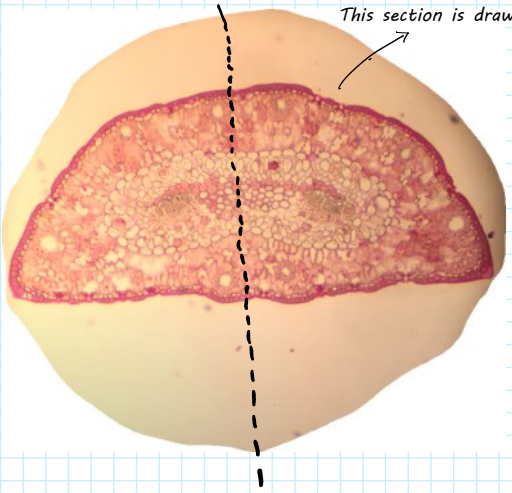
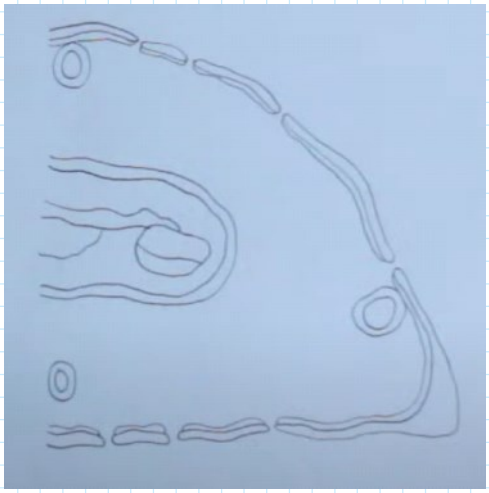
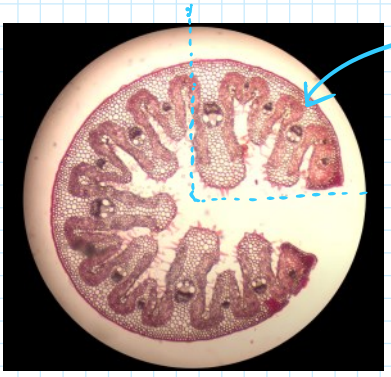


Specimen seen through microscope



Low powered plan diagram of the section



Specimen viewed under microscope

Low power plan diagram of the section

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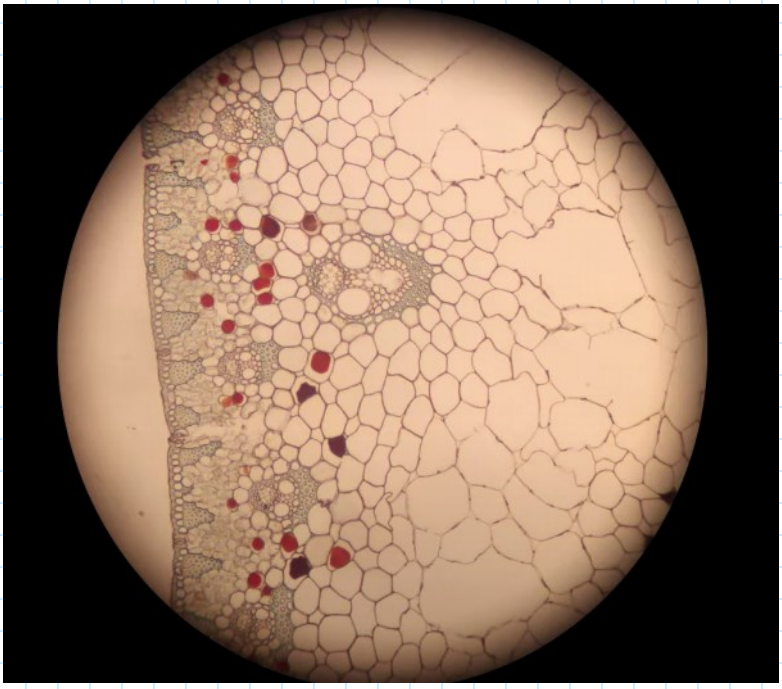
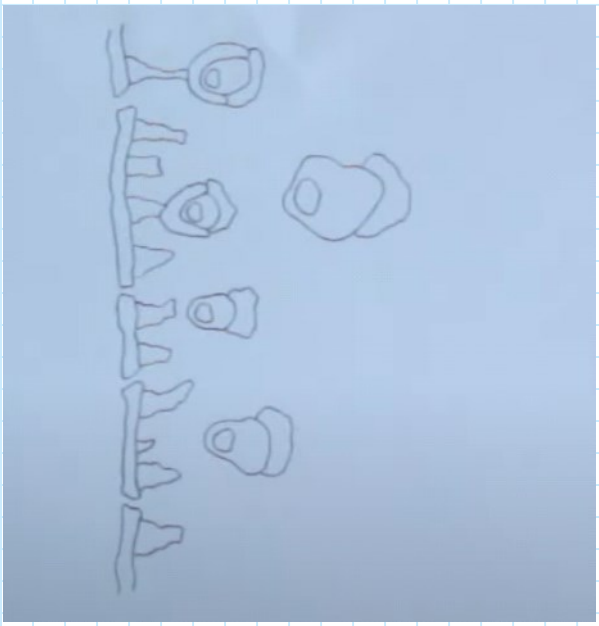
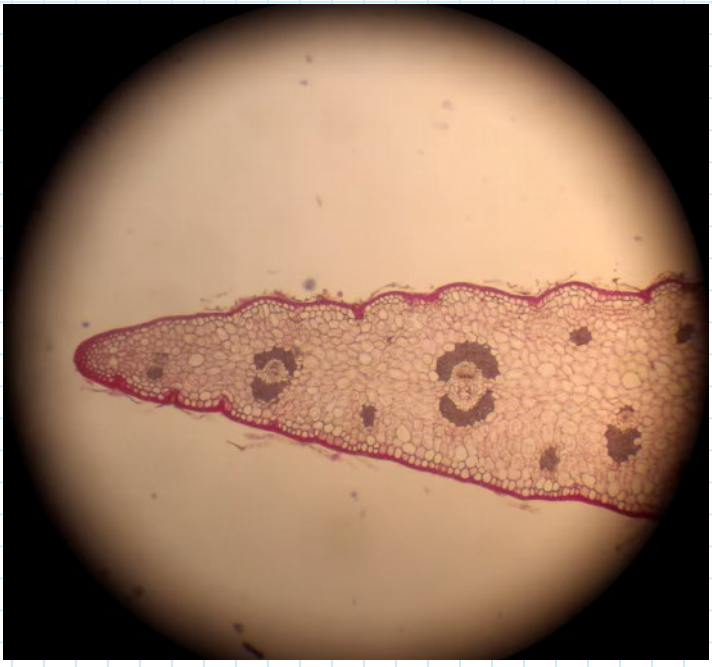


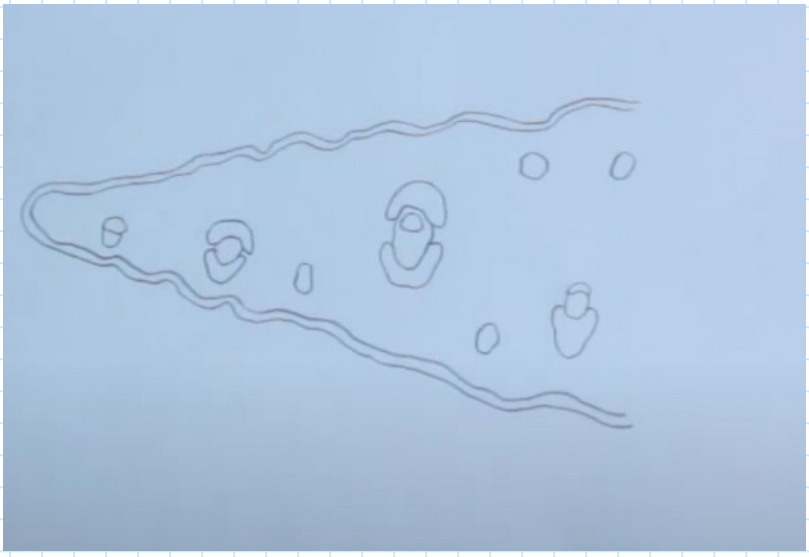
Specimen seen through microscope



Low power plan diagram



Specimen seen through microscope



Low power plan diagram

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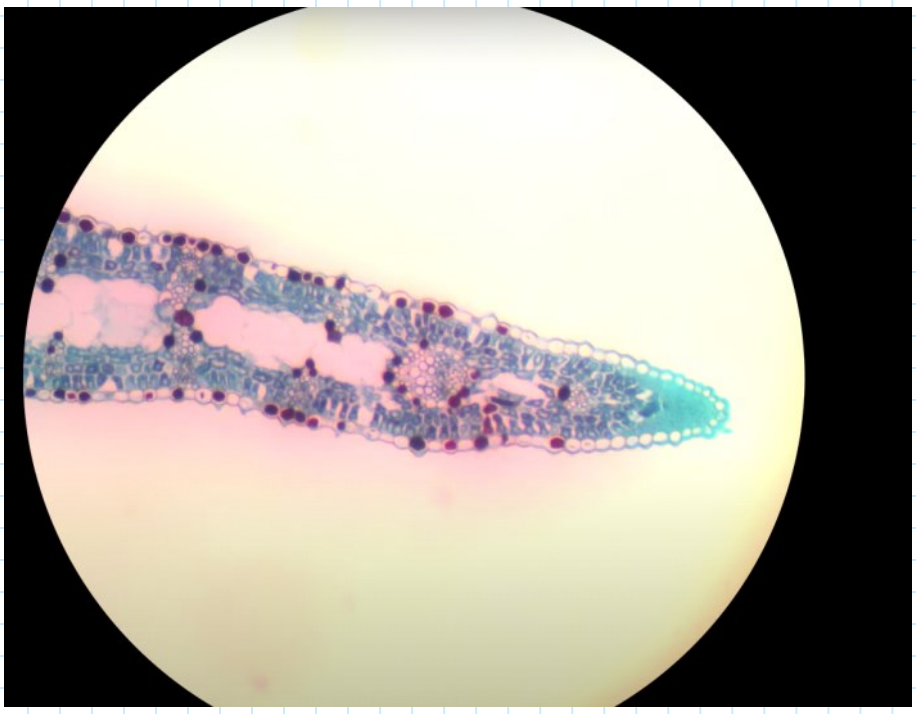

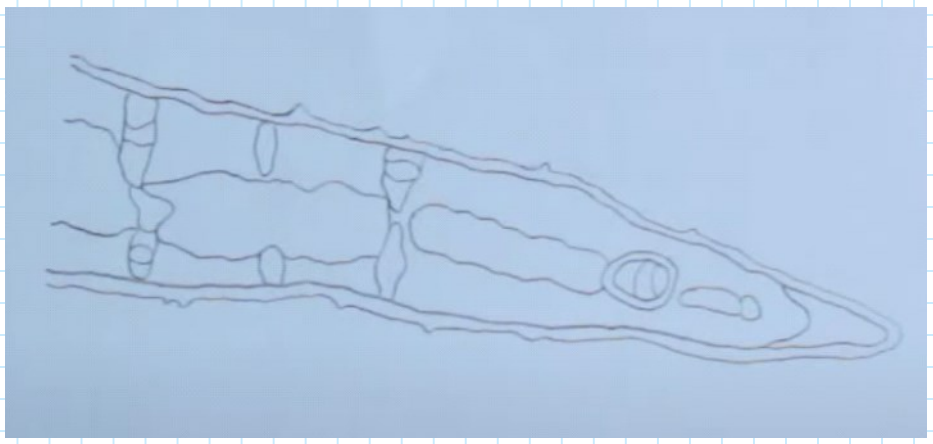

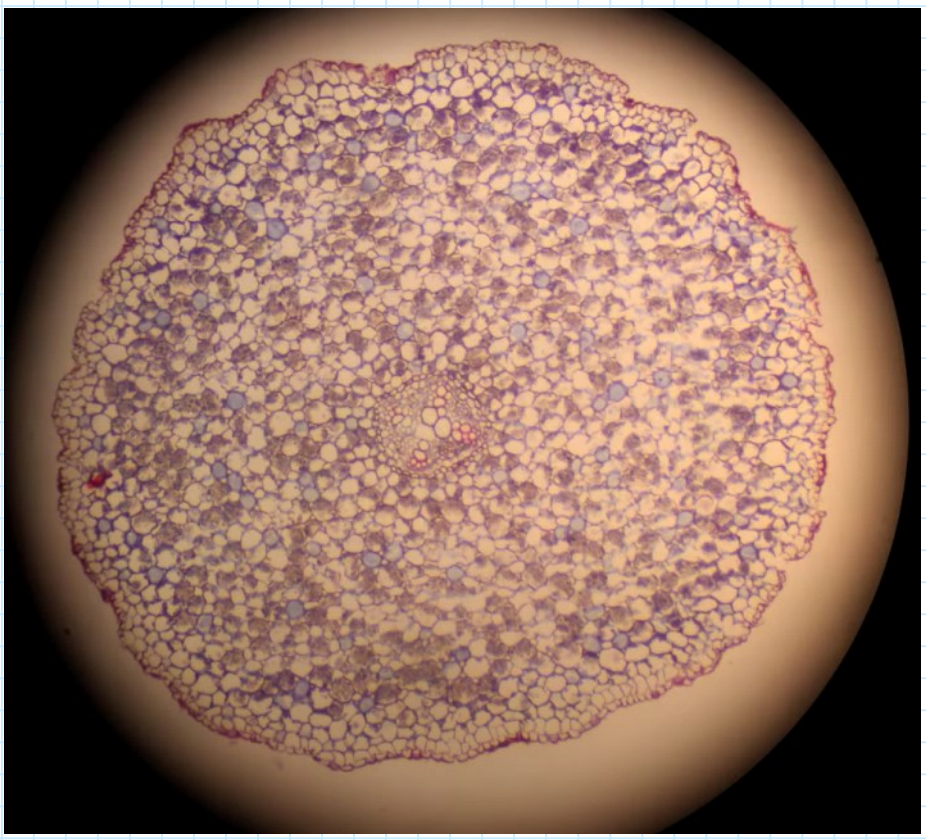

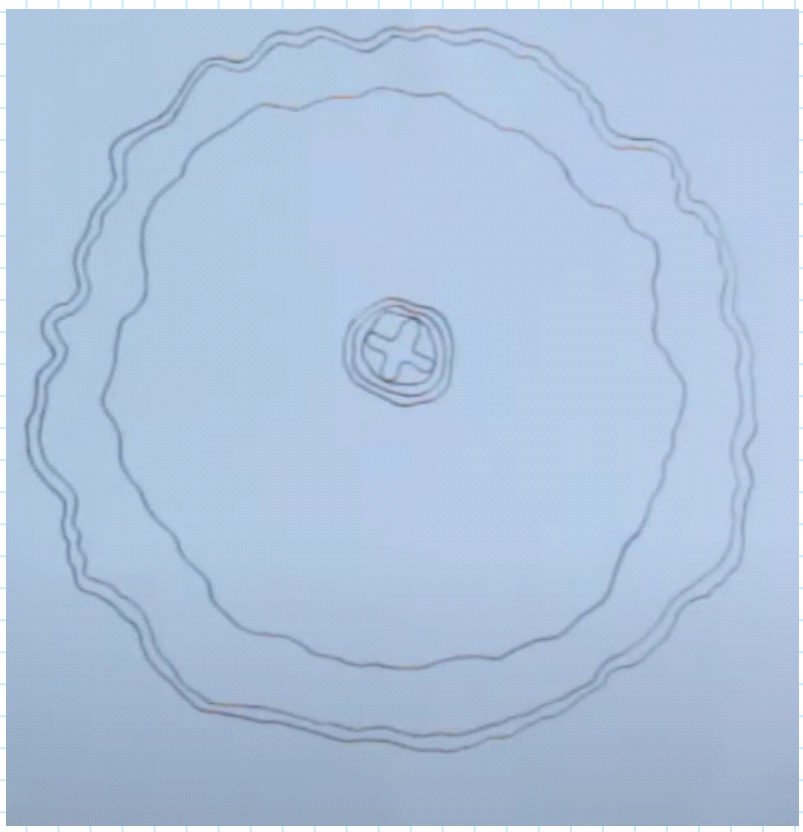

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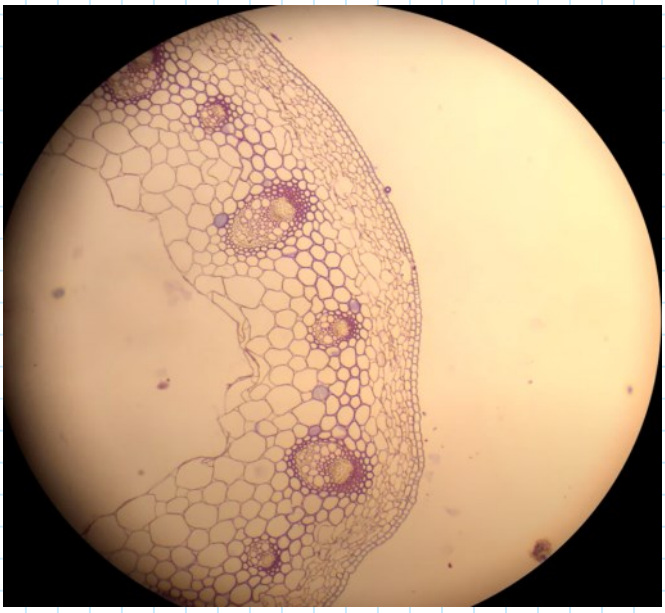

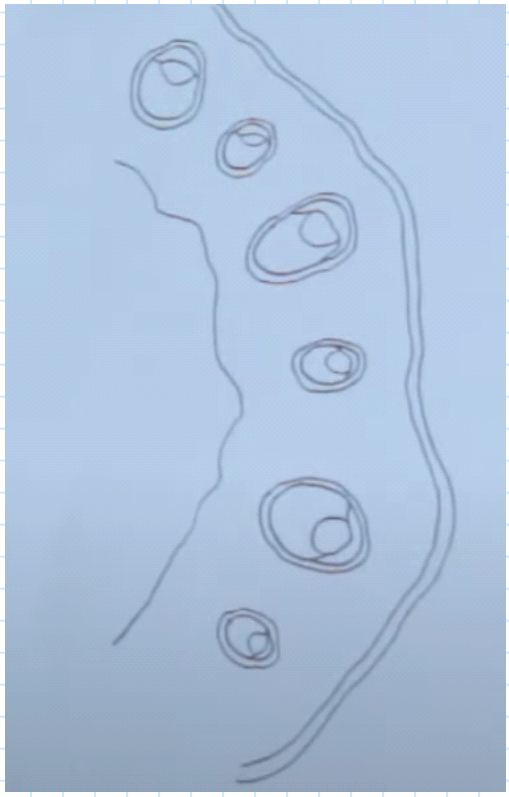

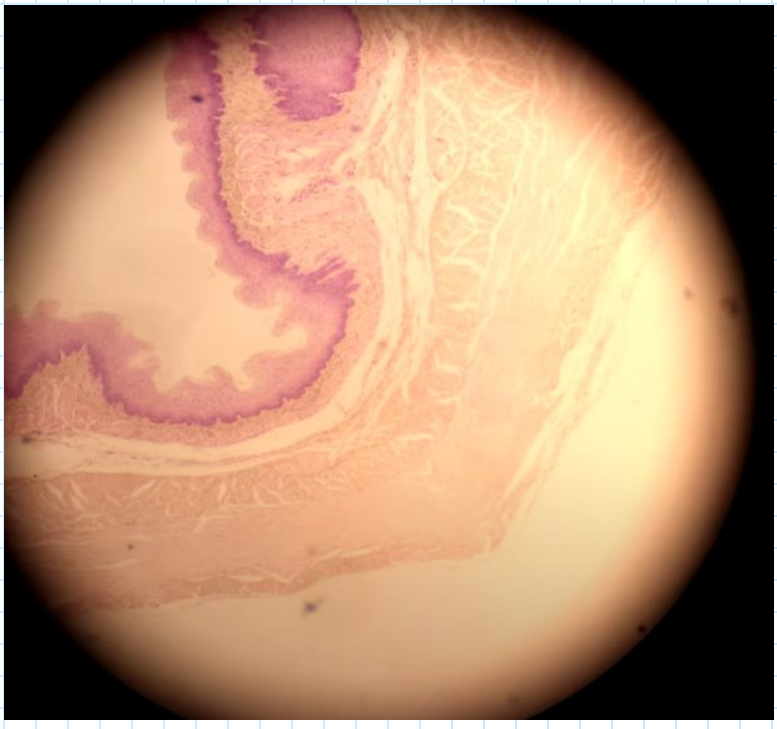

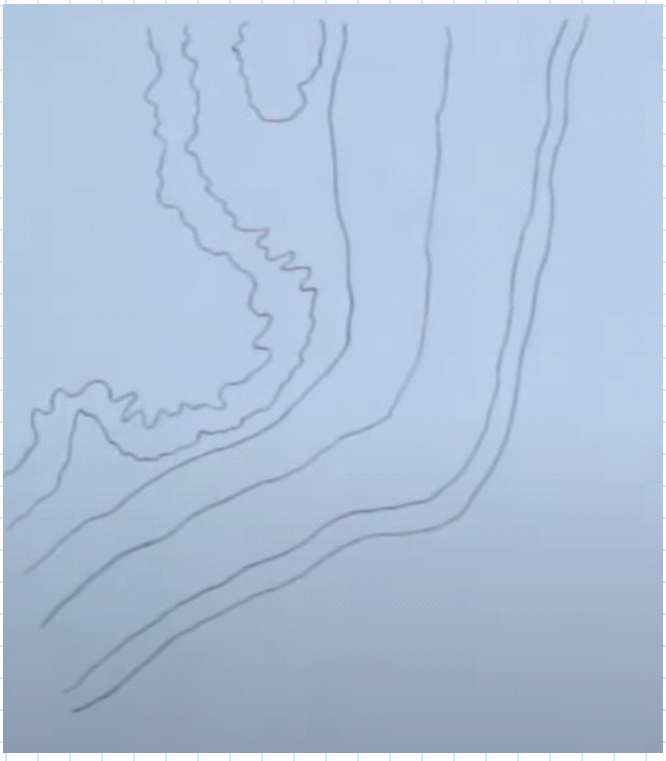

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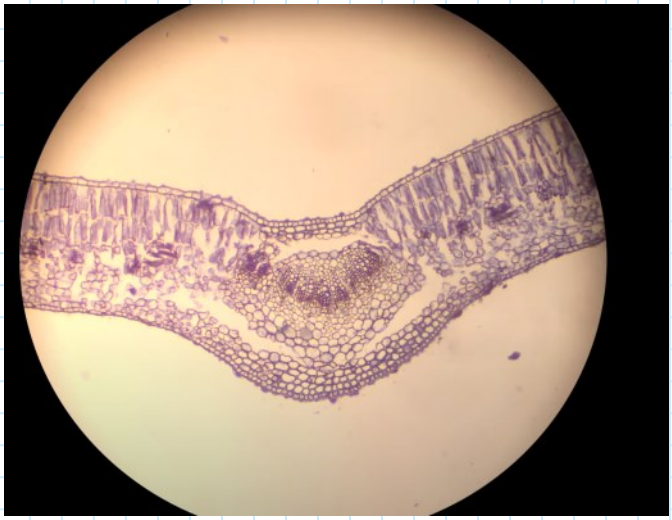

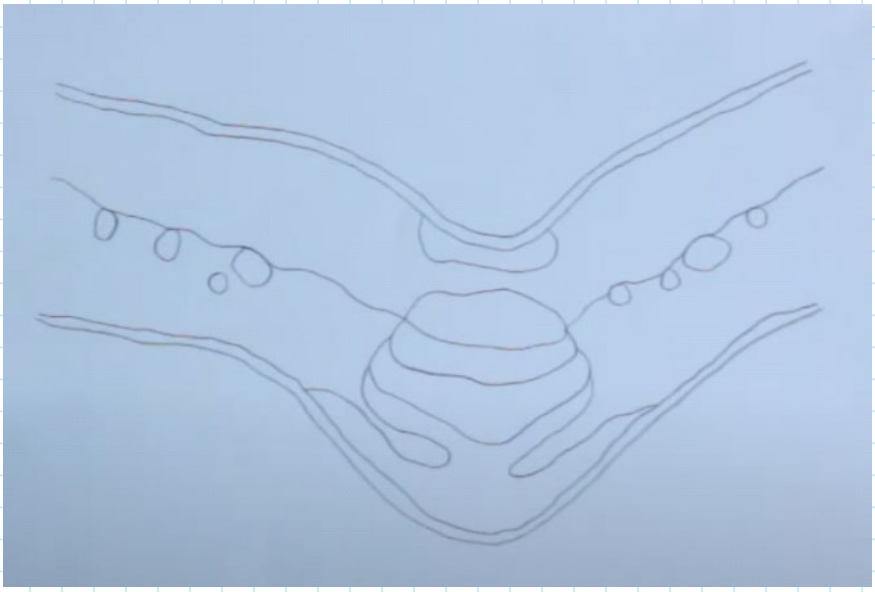

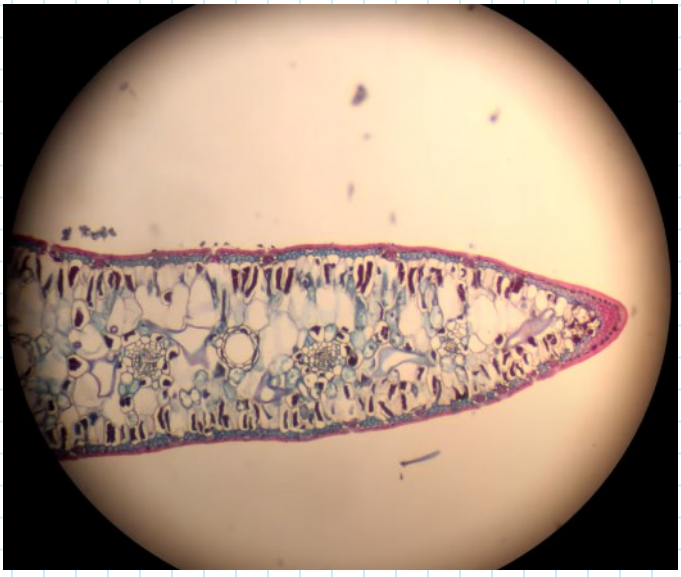

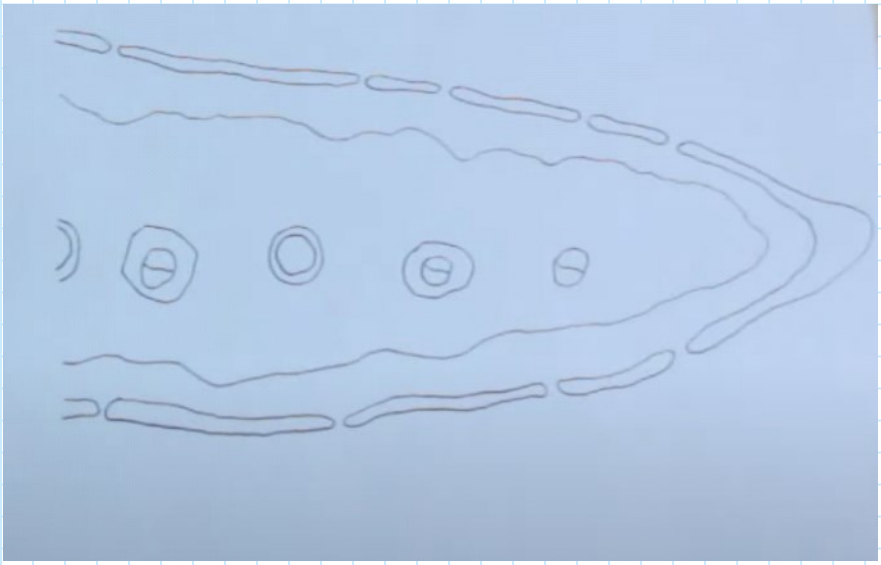

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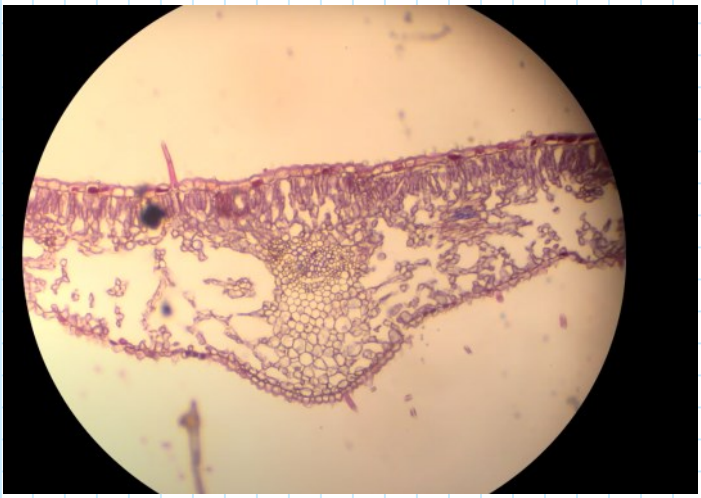

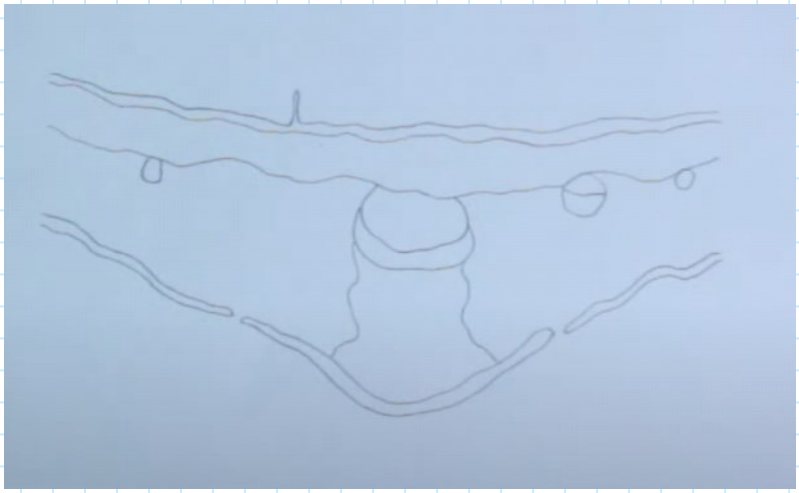

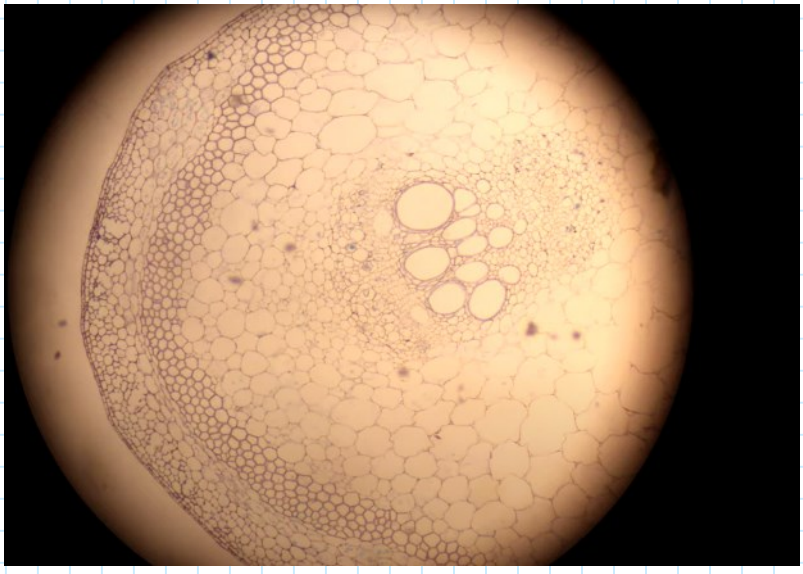

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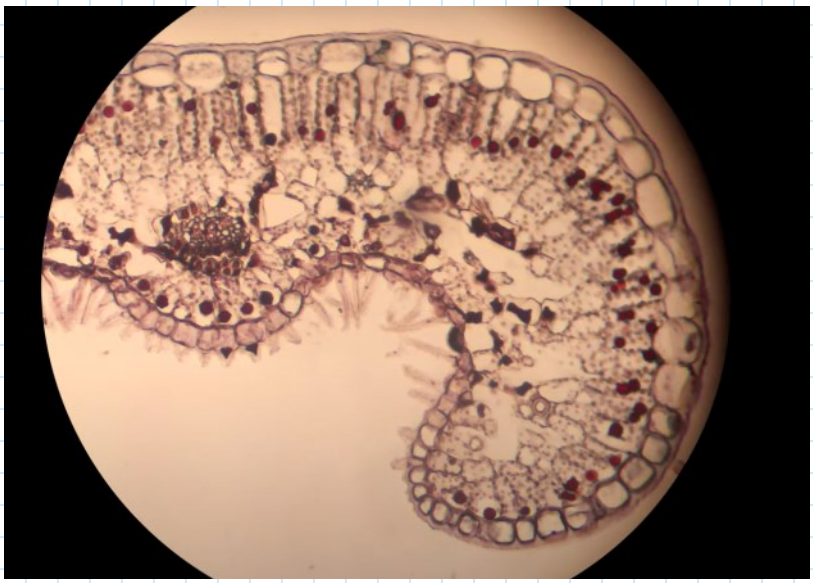

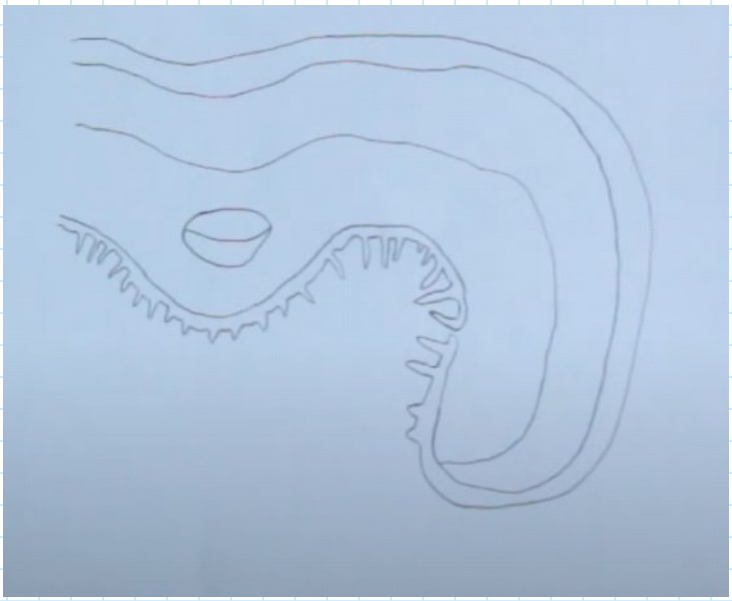

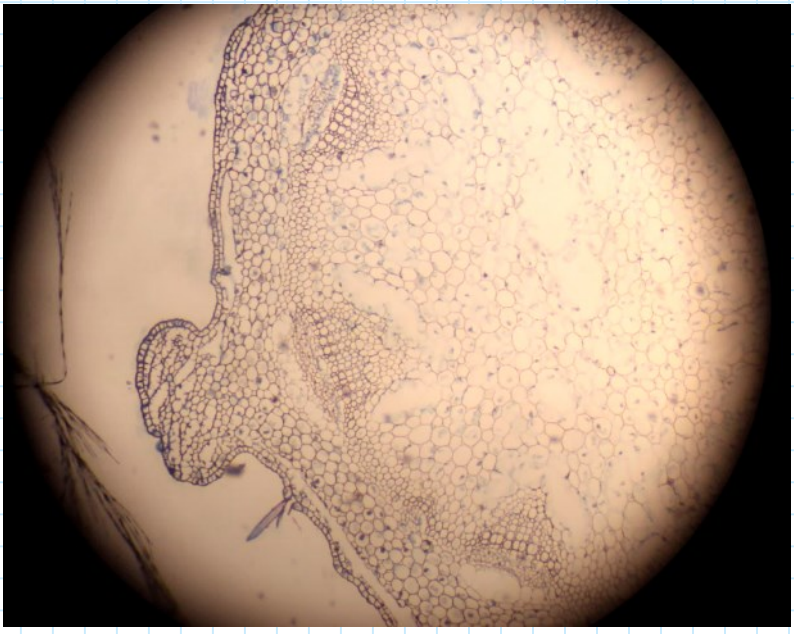

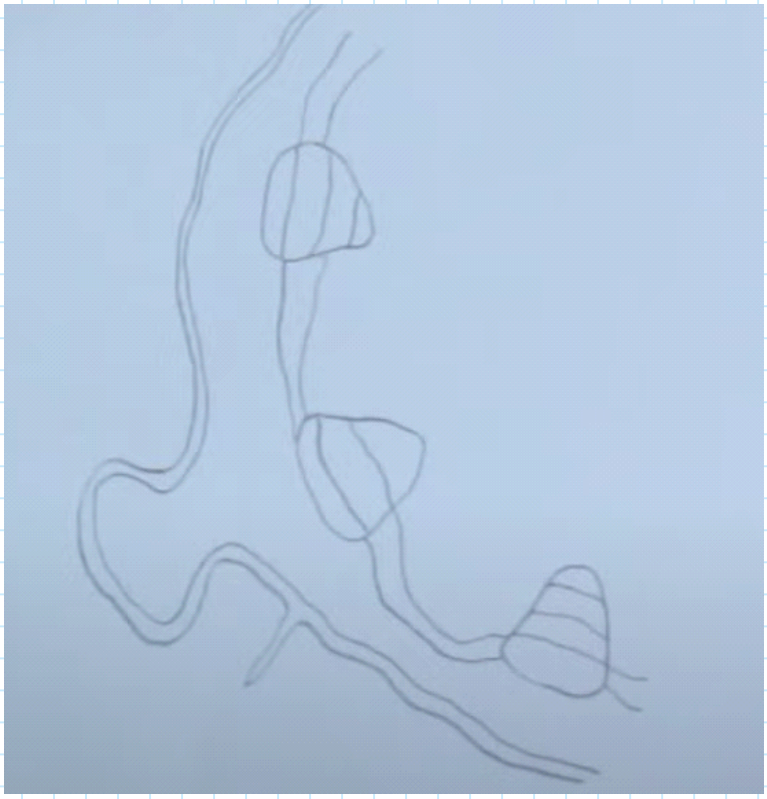

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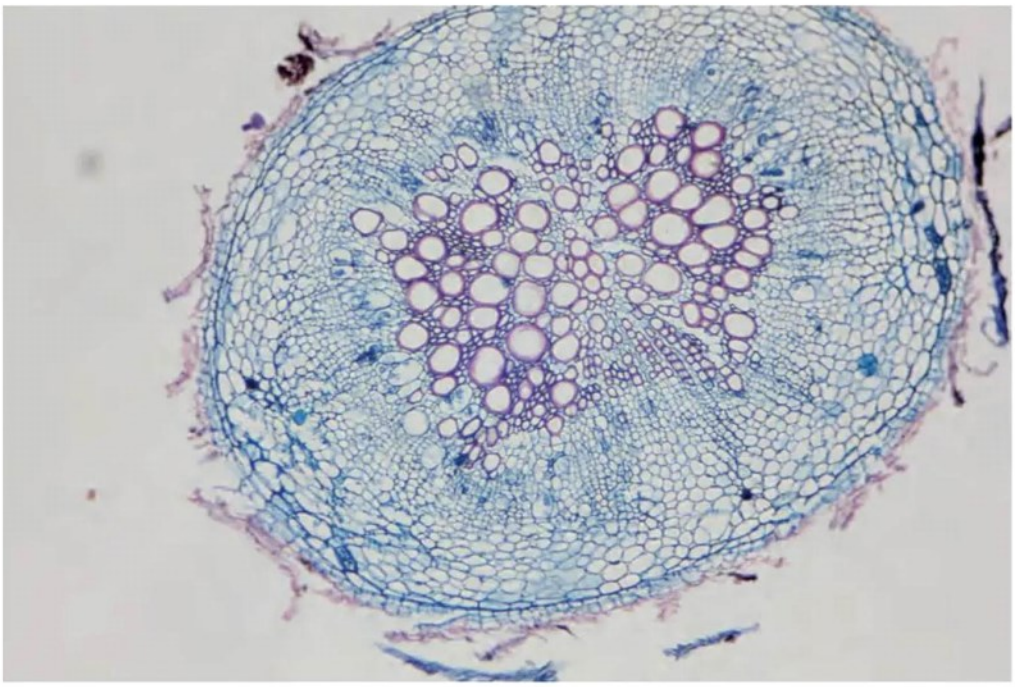
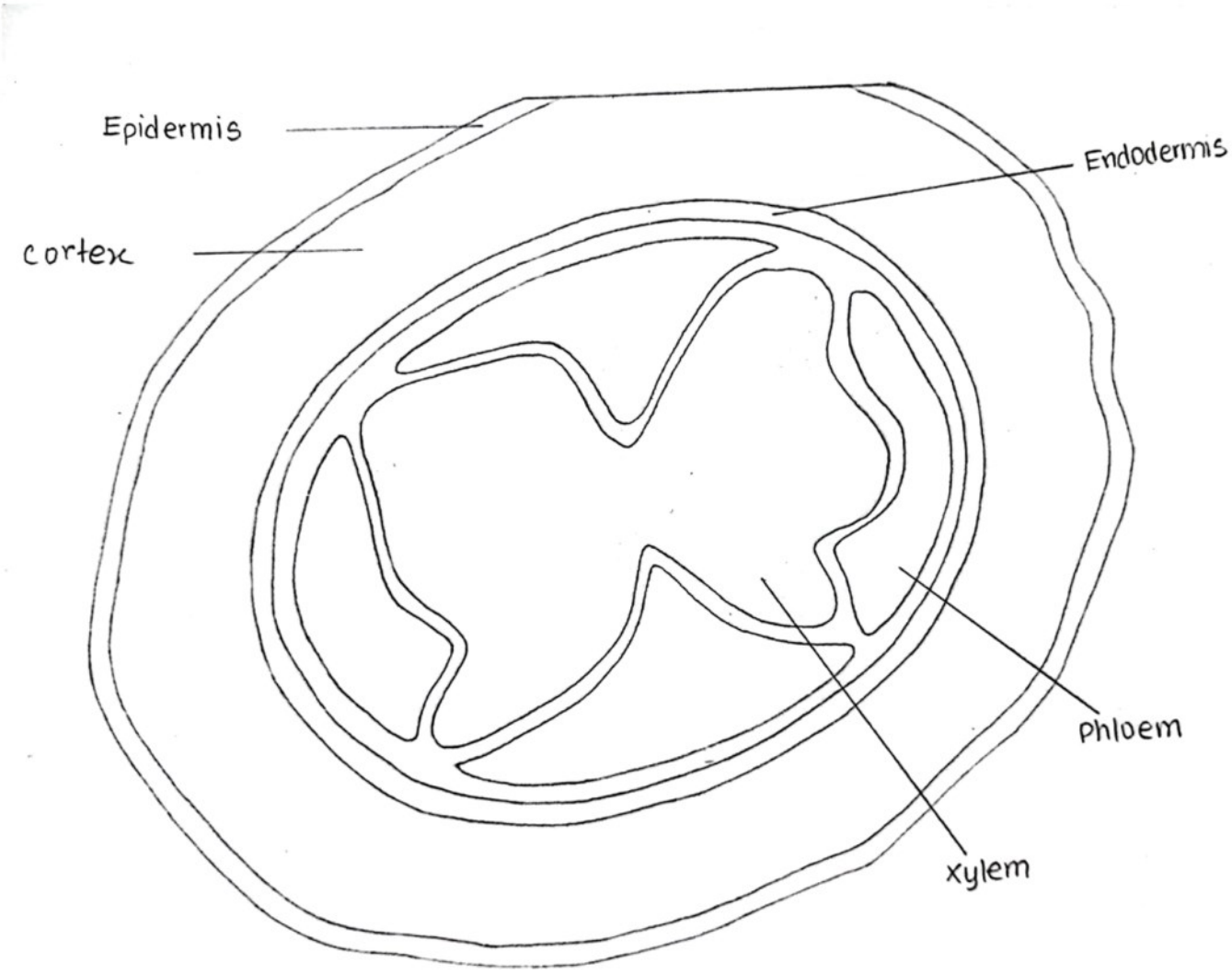
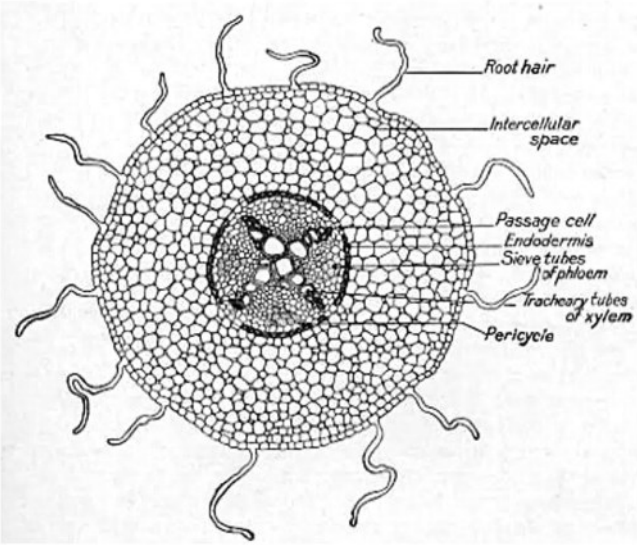
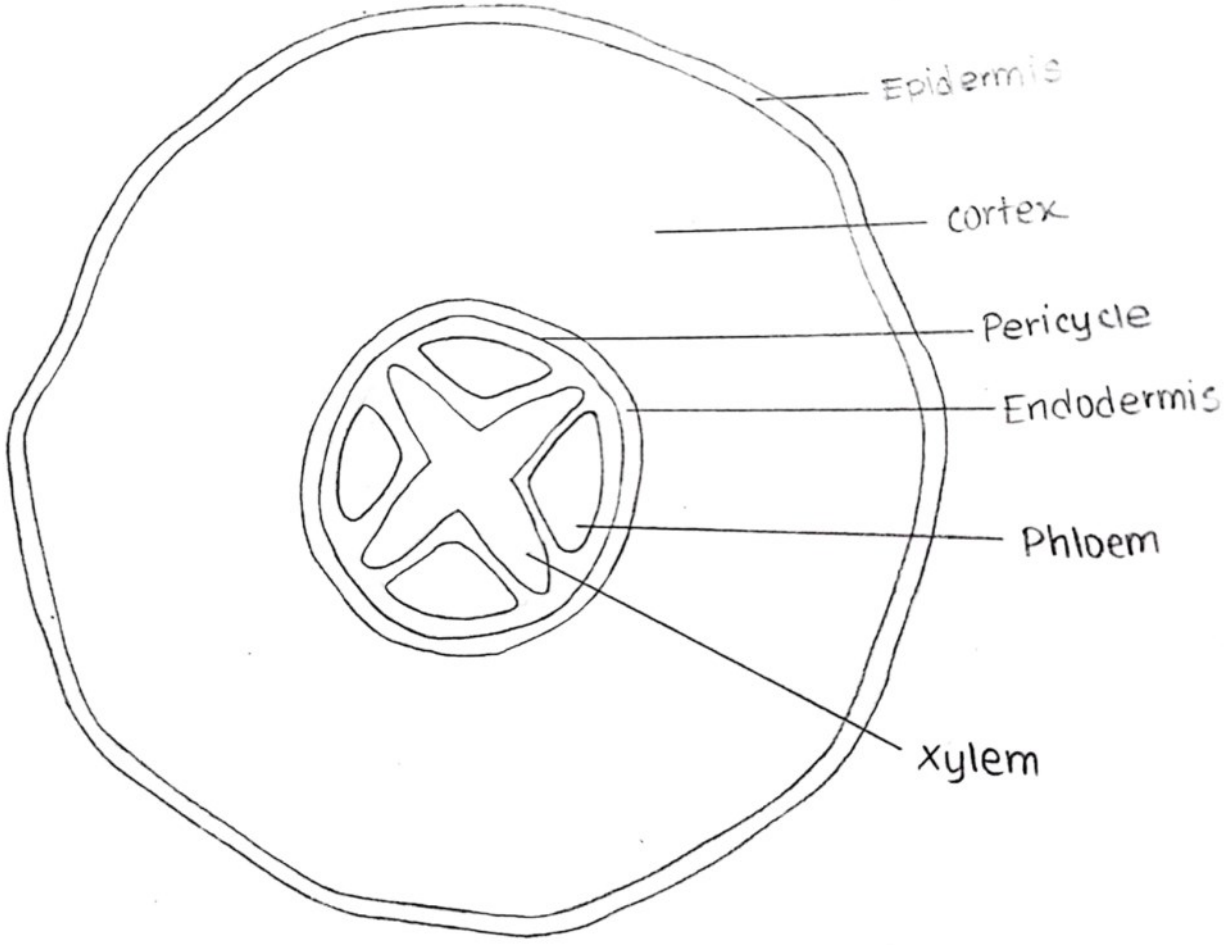



Epidermis
Endodermis
cortex
phloem
xylem

Root:





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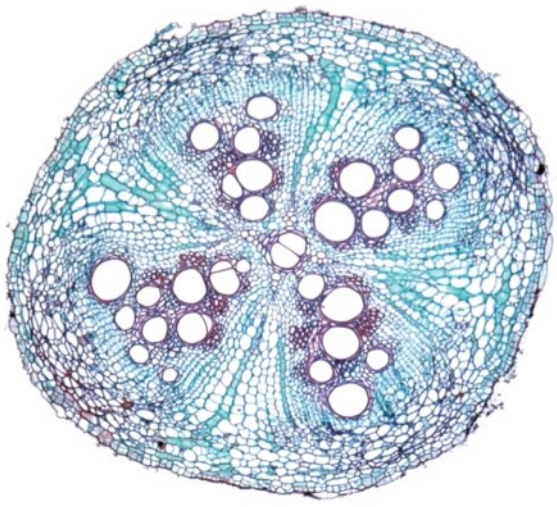
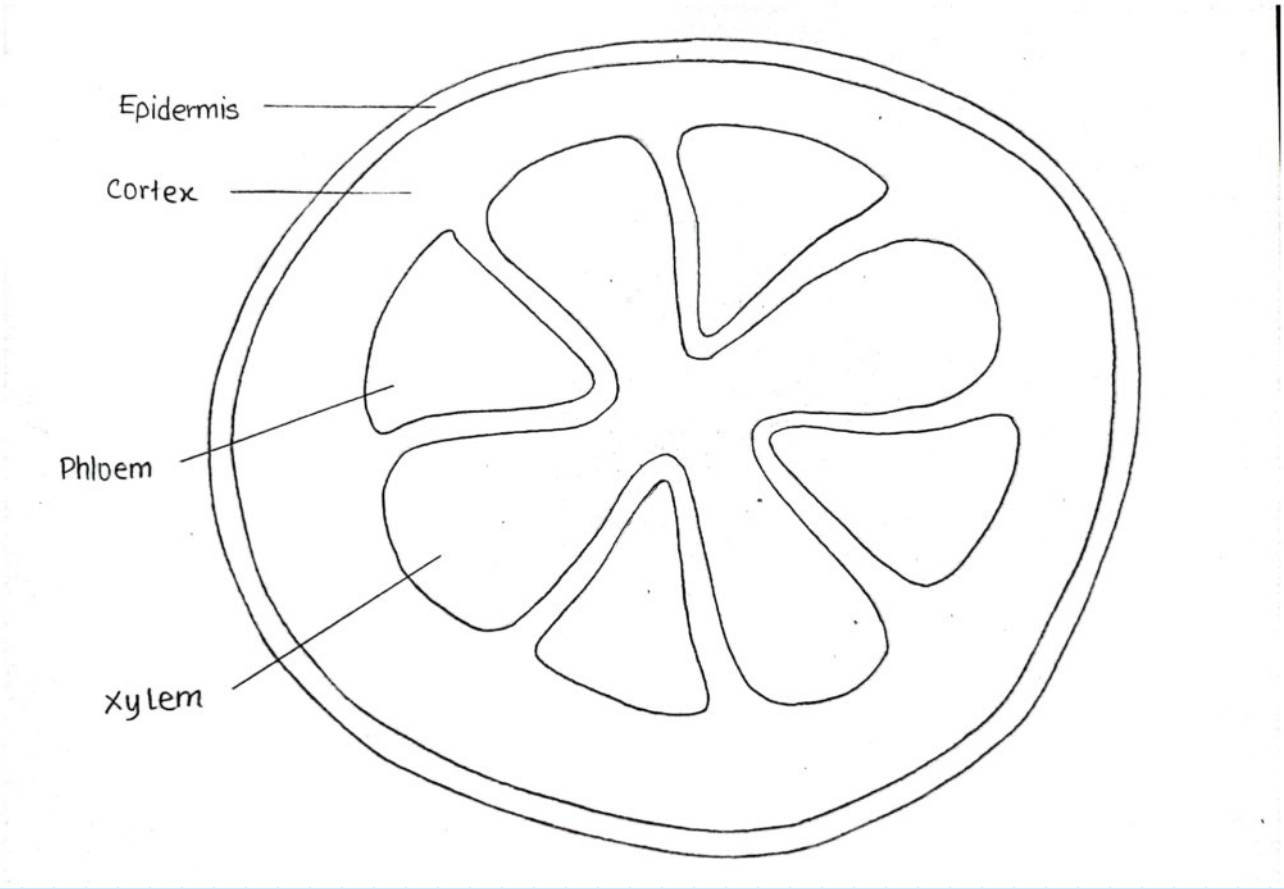


Fig. 2.1



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Exambuddy

Biological test

Reducing sugar test - Benedict's test

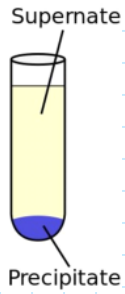
1. Add equal volume of Benedict's solution (blue) to the sample.
2. Heat in a water bath at 80°C for a few minutes.
3. If the color changes from Blue to Green/Yellow/ Red/ Brick red, then reducing sugar is present.

Non-reducing sugar test - Sucrose test

1. HCl is added to the sample.
2. The sample is then heated at around 40°C (to break the glycosidic bonds, this is known as acidic hydrolysis).
3. $NaHCO_3$ of equal volume as HCl is added to neutralize the acid.
4. Equal volume of Benedict's solution is added.
5. The mixture is then heated in a water bath at around 90°C.
6. If the color changes from Blue to Green/Yellow/ Red/ Brick red, then sucrose is present.

Emulsion test - Lipids

1. Sample is grinded and taken in a dry test tube.
2. Ethanol is added so as to submerge the sample.
3. Let the mixture to sediment.
4. Decant the supernatant (supernate) into another test tube.
5. Add water to the test tube.
6. Cloudy emulsion indicates the presence of lipid.



Biuret test - Protein

1. Grind up sample and add Biuret solution (Blue), then shake.
2. If blue color changes into Lilac(purple or light purple), then protein is present.

Starch test

1. Add few drops of iodine solution (orange brown) to the sample.
2. If orange brown color changes to blue-black, then starch is present.

Vitamin-C (ascorbic acid) test

1. Few drops of DCPIP (blue) is added to the sample.
2. If blue color becomes colorless, then vitamin c is present.

Carbon dioxide test:

In atmospheric level, the hydrogen carbonate solution shows a red color.

- In higher concentration of carbon dioxide, it shows Yellow-ish color (pH 7.6).
- In lower concentration of carbon dioxide, it shows purple color (pH 9.2).

So, when exhaled air is passed through hydrogen carbonate solution, the color changes from Red to Yellow.

Oxygen test:

- Glowing splint rekindles.

Water vapor test:

Exhaled air is more saturated with water vapor than inhaled air which turns

1. Cobalt (II) Chloride paper blue (Anhydrous Cobalt(II) Chloride) to Pink (Hydrated Cobalt(II) Chloride).

1. Anhydrous Copper(II) Sulphate white to Blue (hydrated Copper (II) sulphate).