CAMBRIDGE AS BIOLOGY PRACTICAL GUIDE FOR PAPER 3

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PART 1
BIOCHEMICAL PRACTICALS

AS PAPER 3 IS MOSTLY INVOLVED PERFORMING EXPERIMENTS AND DATA RECORDING

Many of the experiments that you will do during your course involve investigating **how one thing affects another**. For example:

a. investigating how enzyme concentration affects the rate of activity of rennin
b. investigating how temperature affects the rate of activity of catalase
c. investigating how surface area affects the rate of diffusion
d. investigating how the concentration of a solution affects the percentage of onion cells that become plasmolysed.

VARIABLES

1. Variable anything you can change or control in an experiment.
2. Common examples include temperature, duration of the experiment, composition of a material, amount of light, etc.
3. There are three kinds of variables in an experiment:
    a. controlled variables,
    b. independent variables and
    c. dependent variables.

INDEPENDENT VARIABLE

1. the one factor that you are changing.
2. I say one factor because usually in an experiment you try to change one thing at a time.
3. This makes measurements and interpretation of the data much easier.
4. If you are trying to determine whether heating water allows you to dissolve more sugar in the water then your independent variable is the temperature of the water.
5. This is the variable you are purposely controlling.

DEPENDENT VARIABLE

1. variable you observe/measure , to see whether it is affected by your independent variable.
2. In the example where you are heating water to see if this affects the amount of sugar you can dissolve, the mass or volume of sugar (whichever you choose to measure) would be your dependent variable.

CONTROLLED VARIABLES

1. sometimes called **constant** variables
2. variables that are kept constant or unchanging.
3. For example, if you are doing an experiment measuring the fizz released from different types of soda, you might control the size of the container so that all brands of soda would be in 12-oz cans.
4. If you are performing an experiment on the effect of spraying plants with different chemicals, you would try to maintain the same pressure and maybe the same volume when spraying your plants.

CHANGING THE INDEPENDENT VARIABLE

NEED GOOD SKILLS DURING AS PAPER 3 PRACTICALS

1. You may be asked to decide what values of the independent variable to use in your experiment.
2. You will need to make decisions about the range and the intervals.
3. The range of the independent variable is the spread of values from lowest to highest.
4. In this case, you might use concentrations of rennin ranging from 0 to 1%. If you are asked to do this in an examination, you will usually be given some clues that will help you to decide the range.
5. For example, if you are given a solution with a concentration of 1% to work with, then that will be your highest concentration, because you cannot make a more concentrated solution from it, only more dilute ones. The interval is the gap between the values that you choose within the range.
6. In this case, you could use concentrations of rennin of 0, 0.2, 0.4, 0.6, 0.8 and 1%.
7. The interval would then be 0.2%.

8. Another possibility would be to use a series of values that are each one tenth of each other 0.0001, 0.001, 0.01, 0.1 and 1.0. In either case, you can produce this range of concentrations by diluting the original solution.

EXPERIMENTS SKILL DEVELOPMENT

LABELING

Set out and label the glassware before using the solutions.

Marker pen used with simple label on it.

Keep ll beakers and tubes in order.

VOLUME MEASURING

Step 1:

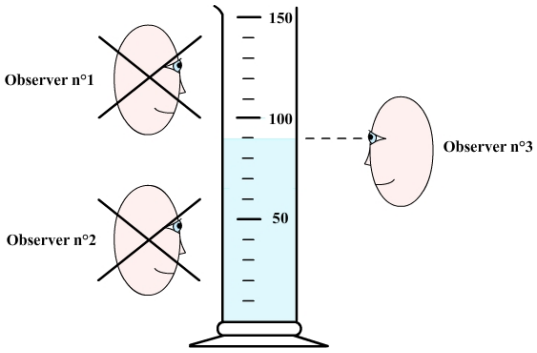
There are some graduated cylinders of various capacities (5 mL to 500 mL in general), each with its own system of graduation.

Therefore, the volume corresponding to each division must first be determinate.

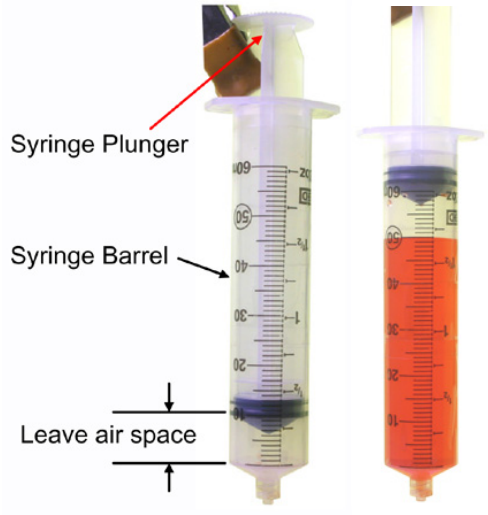
Step 2:

To measure volume, the graduation the closest to the free surface of the liquid must first be determined.

The



VOLUME MEASURING USING A SYRINGE



Step 1:

Pull the Plunger up to suck in a little bit of air. The tip of the plunger should never be in contact with the fluid while measuring.

Step 2:

Insert the syringe tip into the sample and suck up an amount greater than 8 cm3.

Step 3:

Push out the excess fluid until the syringe reads 8 cm3. You are now ready to measure and dispense the sample.

MAKING SOLUTIONS

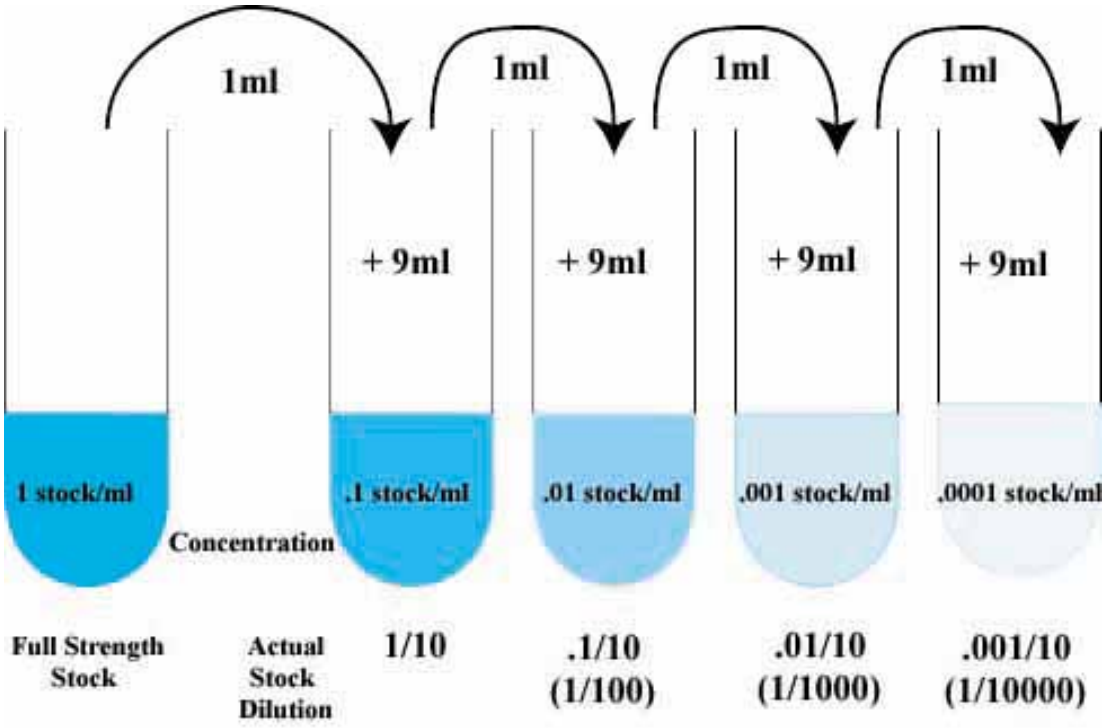
Simple Dilution and Proportional dilution (Dilution Factor Method based on ratios)

1. A simple dilution is one in which a unit volume of a liquid material of interest is combined with an appropriate volume of a solvent liquid to achieve the desired concentration.
2. The *dilution factor* is the total number of unit volumes in which your material will be dissolved.
3. The diluted material must then be thoroughly mixed to achieve the true dilution.

Example: Suppose you must prepare 400 ml of a solution that requires 1:8 dilution from a concentrated stock solution with water. Divide the volume needed by the dilution factor (400 ml / 8 = 50 ml) to determine the unit volume. The dilution is then done as 50 ml concentrated disinfectant + 350 ml water.

Serial Dilution

A method used to stepwise dilute substance into solution with constant dilution factor in each step.



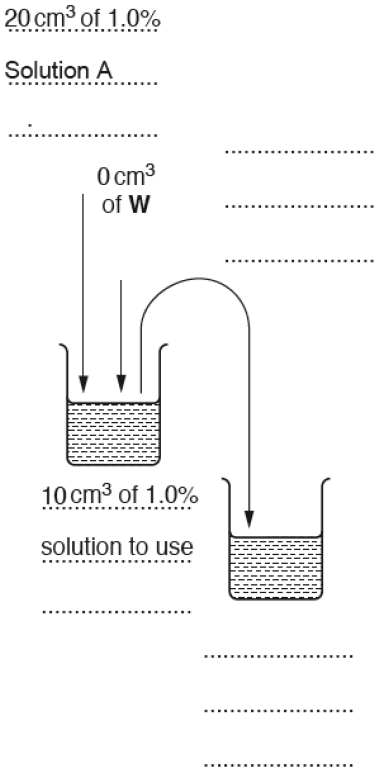
1:1 = 2x

4:1 = 5x

9:1 = 10x

You are required to make a serial dilution of the solution A, which reduces the concentration by half between each successive dilution. This will provide you with a set of solutions A of known concentrations. After the serial dilution is completed, you will need to have 5 cm3 of each concentration

available for use. W = water



DISPLAYING AND RECORDING THE DATA

TABLE

1. Decide on how many **columns and how many rows** you will need.
2. Follow these rules:
    a. use the space provided, do not make the table too small
    b. **leave some space to the right of the table** in case you decide you need to add one or more columns
    c. draw the table outlines in **pencil**
    d. rule lines between the columns and rows
    e. rule lines around the whole table
    f. write brief, but informative **headings** for each column
    g. columns headed with physical quantities should have appropriate SI **units**
    h. The solidus or **slash (/)** meaning per should **not be used in units**. For example, if you have to include concentrations as in a table you do not write **g per 100 cm3** as **g/100 cm3**.
    i. It should always be written out in full using per or, better, as **g 100 cm ^{3}**. The negative exponent, cm ^{3}, means per .

Table 1.1

sucrose concentration /mol dm^{-3}	water potential /kPa x 10^2
0.15	–5.0
0.35	–12.0
0.55	–19.0
0.75	–26.0
1.00	–35.0

A note on the uses of ticks and crosses in tables:

1. Do not use ticks and crosses in tables of results which should show observations, such as the colour obtained in biochemical tests.
2. Ticks and crosses may be used in tables of comparison if there is a key to explain what they mean,
   e.g. ✔= present; ✖= absent.
3. You may want to show **anomalous results** in tables. If so circle them and put a note underneath the table to explain that they are anomalous results.
4. You may be asked to compare specimens viewed in the microscope and/or in photographs.
5. These comparisons must be organised into a table. Draw your table so that it has a first column for the features that you have observed. You can then present both similarities and differences:

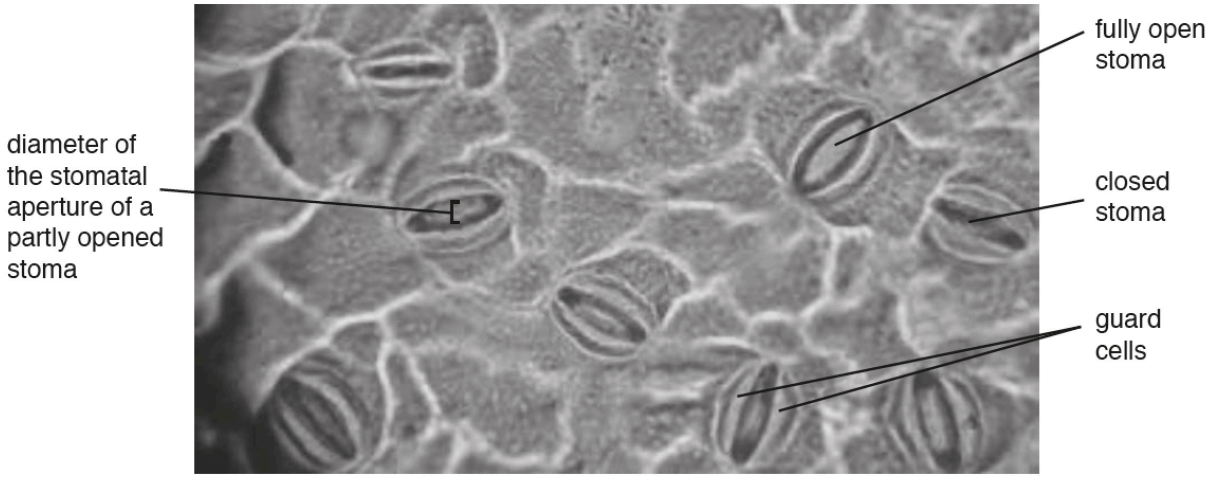
UNCERTAINTY

1. Whenever you take a reading or make a measurement, there will be some **uncertainty** that the value is absolutely correct.
2. These uncertainties are **experimental errors.**
3. In general, **the size of the error is half the value of the smallest division on the scale.**
4. For example, if you have a thermometer that is marked off in values of 1 °C, then every reading that you take could be out by 0,5 °C.
5. You can show this by writing: **21.5 0C 0.5 0C.**
6. If your recorded result involves measuring two values – for example, if you have measured a starting temperature and then another temperature at the end, and have calculated the rise in temperature – then this error could have occurred for both readings. The total error is therefore the sum of the errors for each reading. Your final value for the change of temperature you have measured would then be written: **180C 10C.**

STANDARDIZING THE METHOD

1. In biological experiments, **standardized variables** are those that remain the same throughout the experiment.
2. The independent variable is the aspect of the experiment that is changed or manipulated to find an answer, while the dependent variable is the part of the experiment that is affected by the change in the independent variable.

State two ways in which the method of measuring the diameter of the stomata has been standardised.



IDENTIFYING SOURCES OF ERROR

1. It is very important to understand the difference between experimental **errors** and **'mistakes'**.
2. A mistake is something that you **do incorrectly**, such as misreading the scale on a thermometer, or taking a reading at the wrong time, or not emptying a graduated pipette fully.
3. **Do not refer** to these types of mistake when you are asked to comment on experimental errors.
4. Errors can also occur if there were **uncontrolled variables affecting your results**.
5. Another thing to consider is **how well** a variable has been controlled.
6. If you were doing an enzyme investigation using a **water bath** to control temperature, then you should try to be realistic in estimating how much the temperature might have varied by.

SUGGESTING IMPROVEMENTS

1. The improvements you suggest could include **controlling certain variables** that were not controlled, or controlling them more effectively.
2. For example, you may suggest that the investigation could be improved by **controlling temperature**.
3. To earn a mark, you must also say how you would control it, for example by placing sets of **test-tubes in a thermostatically controlled water bath**.
4. You could also suggest using **better methods of measurement**.
5. For example, you might suggest using a **colorimeter** to measure depth of colour, rather than using your eyes and a colour scale.
6. It is almost always a good idea to do **several repeats** in your investigation and then calculate a mean of your results.
7. The **mean** of these results is more likely to give you the true value

PART 2
MICROSCOPIC PRACTICALS

Drawings

These will be from microscope slides or photographs.

Mars® Lumograph® 100

Drawing pencil

Product information

- High quality drawing pencil
- Special lead formulation for results with a metallic lustre in a wide variety of grey tones
- Particularly suitable for writing, drawing, sketching and hatching as well as for professional graphic and artistic applications on paper and matt drawing film
- For ideal usage in combination with Mars Lumograph black 100B
- High break-resistance through special lead formulation and super-bonded lead
- Available in 24 finely graded consistent degrees: 12B, 11B, 10B, 9B, 8B, 7B, 6B, 5B, 4B, 3B, 2B, B, HB, F, H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H, 10H (NEW: 12B, 11B, 10B, 10H)
- Lead diameter: approx. 12B: 4.5mm, 11B-6B: 3.6 mm, 5B-3B: 2.5 mm, 2B-10H: 2.0 mm
- Lines reproduce well
- Wood from PEFC-certified, sustainably managed forests

1. Read the question carefully, the drawing may have to be an accurate size e.g. twice the original.
2. Make each drawing as big as the space allows without writing over the text of the question and making
3. sure that you leave enough space for labels and annotations, if asked for.
4. Use a ruler for labelling lines.
5. Draw and label in pencil.

6. Use one clear continuous outline not an artistic drawing. Do not shade.
7. Observe details carefully, such as the relative number of chloroplasts in different cells and the thickness
8. of cell walls in different cells in a vascular bundle. Show these accurately on your drawing.
9. A plan diagram shows the distribution of tissues in a section. It also shows the proportions of the different
10. tissues. Although called a low power plan diagram you may use high power to identify the different tissues and to be sure you are putting the boundaries of those tissues in the right place. You should not draw any
11. cells in a lower power plan diagram.

When you make a plan diagram, follow these simple rules:

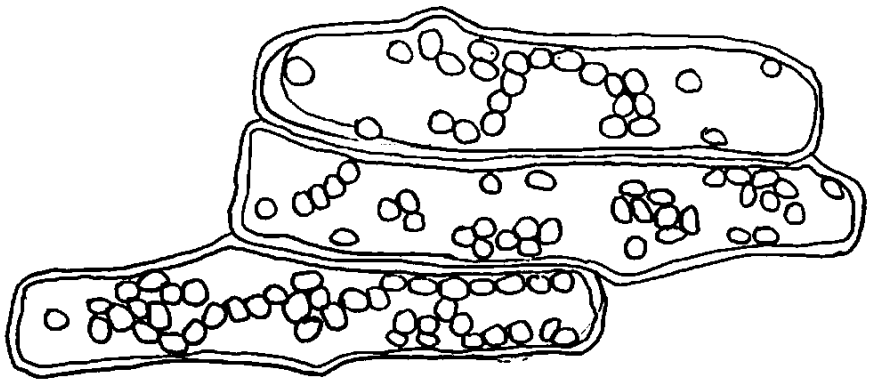
1. make the drawing fill most of the space provided; leave space around the drawing for labels and annotations (if required by the question)
2. use a sharp HB or B pencil (never use a pen)
3. use thin, single, unbroken lines (often called clear and continuous lines)
4. show the outlines of the tissues
5. make the proportions of tissues in the diagram the same as in the section
6. do not include drawings of cells
7. do not use any shading or colouring.
8. Add labels and annotations (notes) to your drawing only if you are asked for these in the question. Use a pencil and a ruler to draw straight lines from the drawing to your labels and notes.
9. Write labels and notes in pencil in case you make a mistake and need to change them. You may leave your labels and notes in pencil do not write over them in ink.
10.

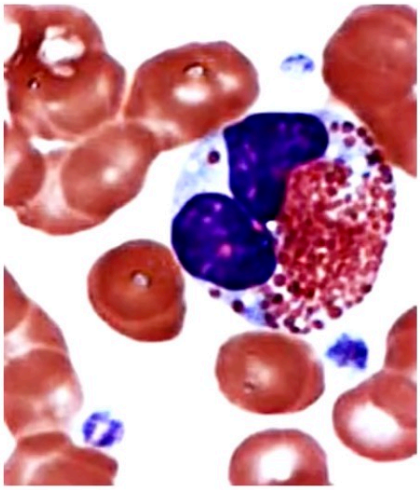
High power drawings

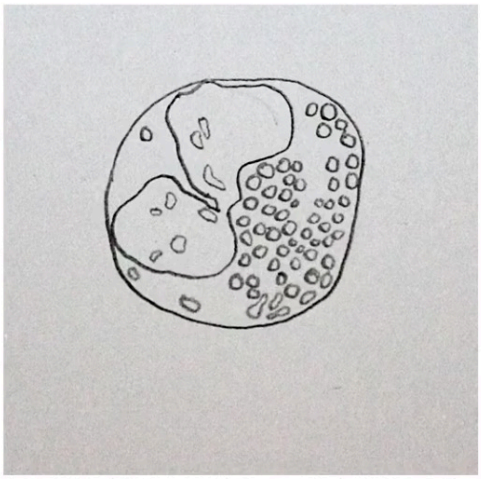
1. High power drawings should show a small number of cells and they should be drawn a reasonable size so you can show any detail inside them. When you make a high power drawing, follow these simple rules:
2. make the drawing fi ll most of the space provided; leave space around the drawing for labels and annotations (if required by the question)
3. use a sharp HB or B pencil (never use a pen)
4. use clear, continuous lines (see above)
5. draw only what is asked in the question, e.g. three cell types or one named cell and all cells adjoining it
6. show the outlines of the cells
7. the proportions of the cells in the drawing must be the same as in the section you are drawing
8. plant cell walls should be shown as double lines with a middle lamella between the cells; the proportions of cell walls should be drawn carefully.
9. show any details of the contents of cells draw what you see, not what you know should be present; for example, in

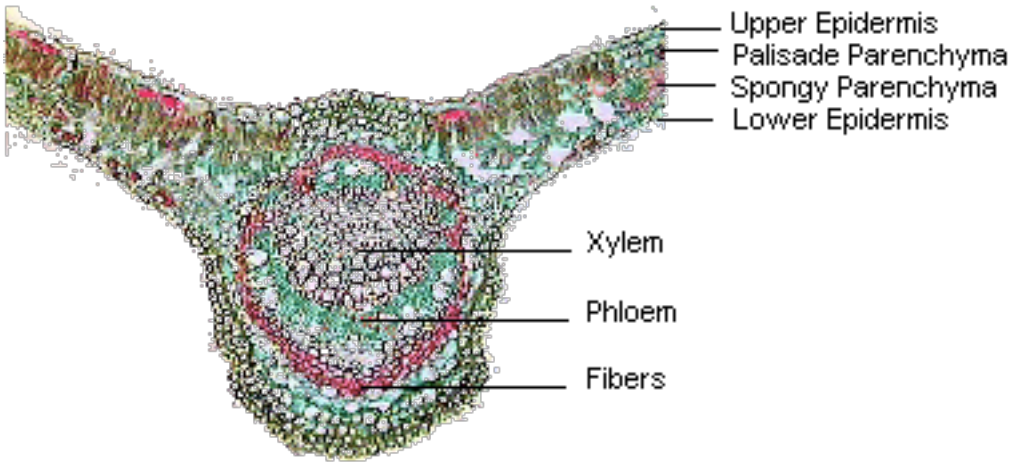
plant cells you may see nuclei, chloroplasts and vacuoles

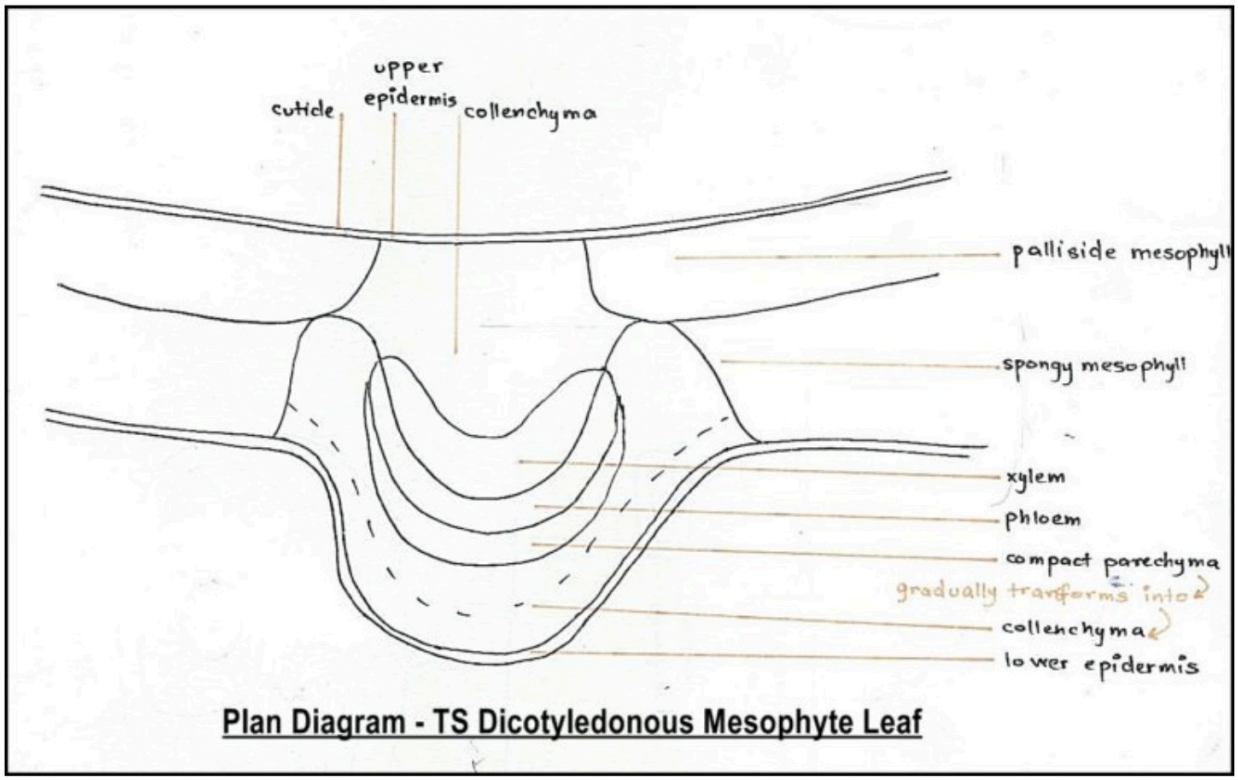
10. do not use any shading or colouring.



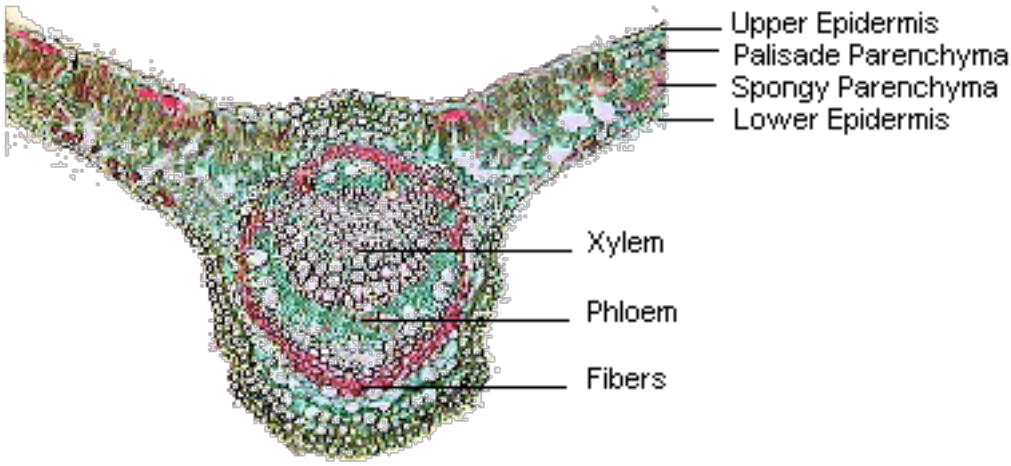


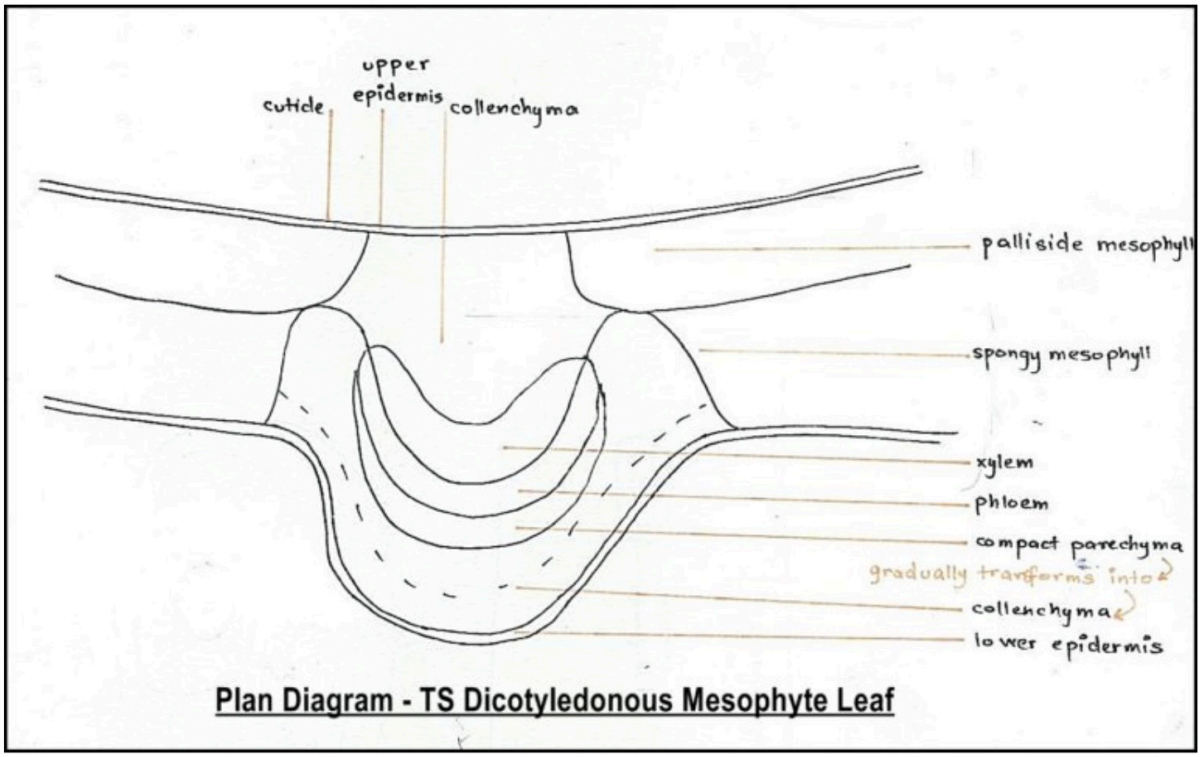




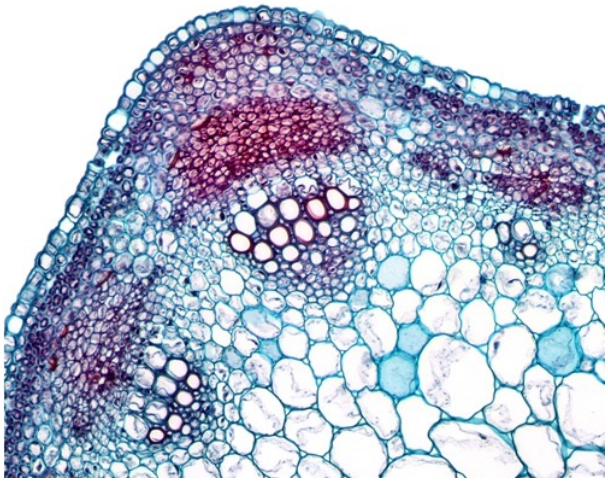


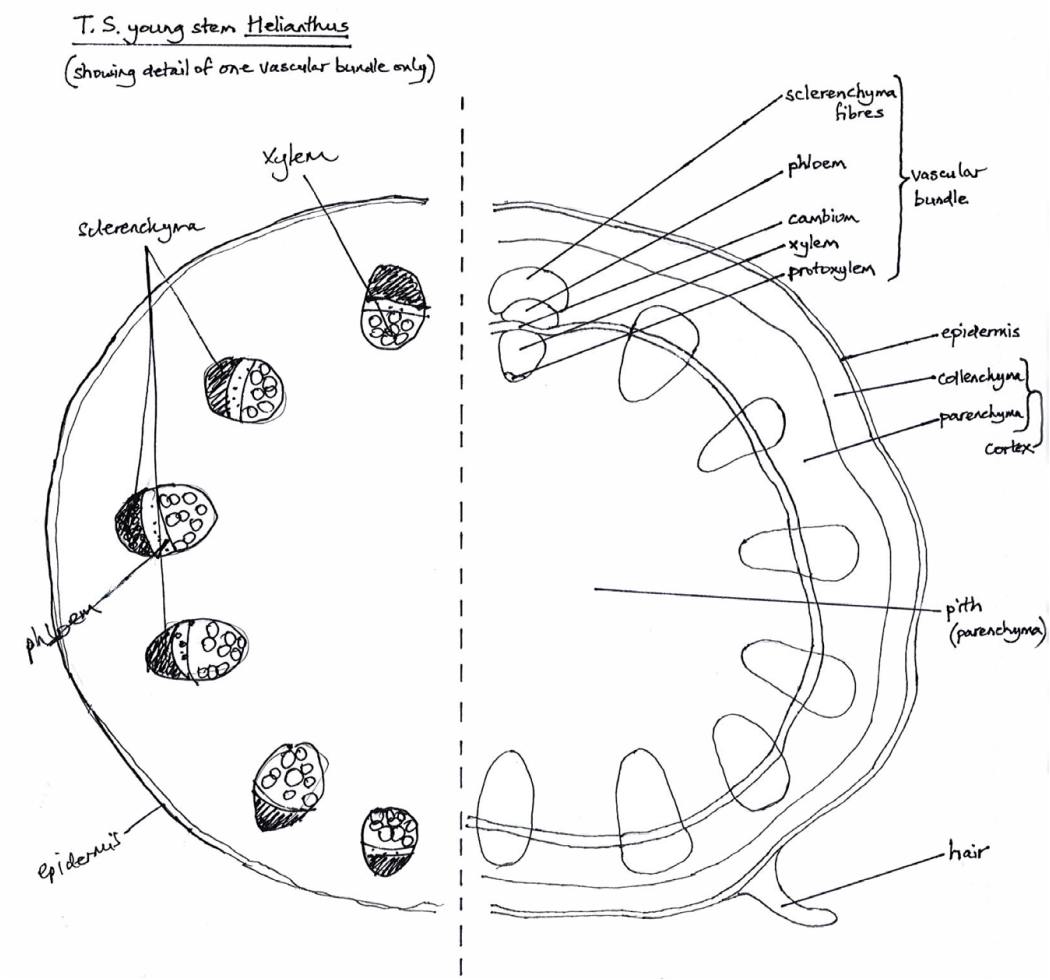
Plan Diagram - TS Dicotyledonous Mesophyte Leaf





Plan Diagram - TS Dicotyledonous Mesophyte Leaf




T. S. young stem Helianthus
(showing detail of one vascular bundle only)
Xylem
Sclerenchyma
Phloem
Epidermis
sclerenchyma fibres
phloem
cambium
xylem
protoxylem
vascular bundle
epidermis
collenchyma
parenchyma
cortex
pith (parenchyma)
hair

Taking measurements of specimens and photographs

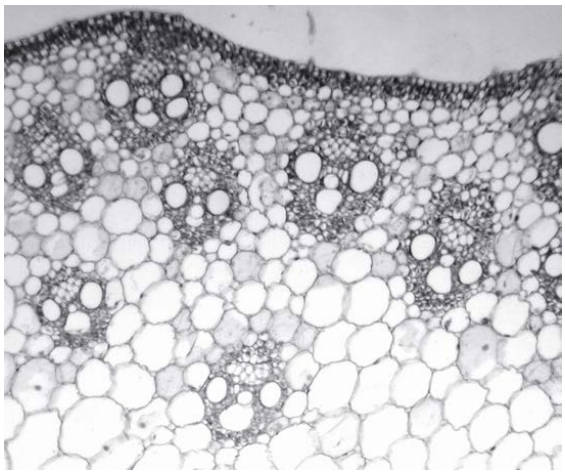
Using an eyepiece graticule

1. An eyepiece graticule is a scale that fi ts inside the eyepiece on your microscope.
2. It allows you to take measurements of the specimens you view with the microscope. You can measure simply in graticule units,
3. but you may be asked to make an actual measurement which involves calibrating the graticule using a stage micrometer. This is done by lining up the graticule with the divisions on the micrometer.
4. Make your measurements as accurate as you can. You will probably be able to measure to the nearest division on the graticule.
5. You may be asked to take several measurements and then calculate a mean.

Taking measurements from photographs

1. You may have to measure an object on a photograph and calculate the actual size of a structure or the magnification of an image.
2. Always measure photographs in millimetres, not centimetres.
3. If you have to use your measurements in a calculation, write neatly and show your working. The person marking your paper might be able to give you marks for knowing what to do even if you make a mistake or do not finish the calculation.

ANNOTATION



What are correct annotations?

1. epidermis darkly stained layer of cells, xylem hollow vessels
2. epidermis formed of a single layer of cells, xylem strengthened by lignin
3. phloem small cells, xylem empty cells to transport water
4. vascular bundles arranged in a regular pattern, xylem large dead cells