FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION
H-8/4, ISLAMABAD

No.1-10/FBISE/RES/334 14 March, 2025

NOTIFICATION

Assessment Frameworks for Practical Based Assessment (PBA) containing lists of experiments/praticals along with instructions and Model Question Papers (Composite) in the subjects of Physics, Chemistry, Biology and Computer Science at SSC and HSSC levels based on National Curriculum of Pakistan 2022-23 (Scheme of Studies 2006) are hereby notified for implementation with effect from Annual Examinations 2026 and onwards.

2. The Assessment Frameworks for Composite PBA (Scheme of Studies 2006) are available at FBISE website. The weblink is **https://www.fbise.edu.pk/curriculum_model_paper.php .**

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at SSC & HSSC levels

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ASSESSMENT FRAMEWORK

FOR PRACTICAL BASED ASSESSMENT (PBA) - COMPOSITE

BIOLOGY

HSSC LEVEL



NATIONAL CURRICULUM OF PAKISTAN (2022-23)

SCHEME OF STUDIES 2006

WE WORK FOR EXCELLENCE

FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION (FBISE), ISLAMABAD

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ACKNOWLEDGEMENT

It is a great honour that we at the Federal Board of Intermediate and Secondary Education (FBISE) have developed the Assessment Framework (AF) for the Practical Based Assessment (PBA) of Biology at the Higher Secondary School Certificate (HSSC) level. The primary objective of the Assessment Framework is to optimize the Student Learning Outcomes (SLOs) of curriculum 2022-23 that are associated with practical concepts and laboratory work. This comprehensive framework has been crafted meticulously by subject matter and assessment experts who conducted an in-depth review of all learning outcomes of HSSC level Biology curriculum.

This significant undertaking was the result of a series of extensive meetings and collaborative efforts of the subject and assessment experts. Their dedication and expertise have been instrumental in bringing this framework to fruition.

The Assessment Framework for Practical Based Assessment (PBA) will serve as a guiding document for students, teachers, and paper setters. Students will receive clear directions for preparing themselves for the PBA examinations. Similarly, teachers will use it as a guide to perform laboratory work and to prepare students for the final PBA examinations. Paper setters of PBA will also seek guidance from this document and prepare PBA paper accordingly for annual examinations. It may be noted that only those students will be able to attempt the PBA paper who have performed all the practicals in laboratory.

Following subject as well as assessment experts remained constantly engaged in the development of the Assessment Framework for PBA:

1. Dr. Muhammad Ilyas, Associate Professor, Islamabad Model College for Boys, G-10/4, Islamabad
2. Ms. Ruqayya Shaikh, Associate Professor, Islamabad Model College for Girls, F-6/2, Islamabad
3. Dr. Kashif Ali, Associate Professor, Islamabad Model College for Boys, F-7/3, Islamabad
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5. Dr. Abid Ali Mughal, Associate Professor, Islamabad Model College for Boys, H-9, Islamabad

The whole work was successfully accomplished under the able supervision and guidance of Dr. Ikram Ali Malik, Chairman, FBISE and due to the hard work and dedication of the staff of Research Section of FBISE, in particular, Syed Zulfiqar Shah, Deputy Secretary, Research and Academics who played pivotal role in finalizing the Assessment Framework for PBA.

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ABOUT THE PBA ASSESSMENT FRAMEWORK

To ensure clarity and precision in the understanding of Practical Based Assessment (PBA) Question Paper, the Student Learning Outcomes (SLOs) have been categorized into two distinct groups: formative for PBA and summative for PBA in the separately composed Assessment Frameworks for Classes HSSC-I and HSSC-II. Subsequently, all the SLOs of HSSC-I and HSSC-II meant for summative PBA have been translated into workable and functional composite lists of major and minor experiments which are part of this booklet. This extraction of lists of experiments helps in effectively measuring student progress and understanding of the scientific concepts linked with laboratory work. These experiments must be performed by the students under the supervision of their teachers in the laboratories in order to prepare themselves for the PBA Examinations.

The Assessment Framework for Practical Based Assessment (PBA) will act as a comprehensive guide for students, teachers, and paper setters. Students will receive clear instructions in order to perform experiments in the laboratory and prepare themselves for the PBA examination. Teachers will use the same to strategize the optimal use of the laboratory for performing experiments (major and minor).

The Model Question Paper for Practical Based Assessment (PBA), along with clear instructions, has also been developed and made part of this booklet to provide a structured format for upcoming examinations. The model question paper ensures consistency and fairness, offering students a comprehensive understanding of PBA examination.

All the experiments have been aligned with their corresponding SLOs marked summative for PBA. The purpose of this alignment is to explain how the experiments relate with their corresponding summative SLOs for PBA.

Instructions for paper setters have also been included before the PBA model question paper, providing self-explanatory guidance on the selection and nature of each question which is part of the model paper.

Guidelines/instructions for Students/Teachers/Paper Setters

i. The paper will consist of two sections i.e section A and B.

ii. Section A will include Major Practicals. This section will have three questions, each question carrying 6 marks having parts in it, and each question will be performance / calculation/procedures/observations based encompassing a single practical.

iii. Section B will include Minor Practicals. This section will also have three questions, each carrying 4 marks having parts in it. Each question may be based on single or multiple practicals.

iv. The weightage of section A will be 60% i.e 18 marks, while that of section B will be 40 % i.e 12 marks.

v. In Practical Based Assessment (PBA), there is no marks for practical notebooks. But students are suggested to record procedures, observations, apparatus and calculation etc on any type of plain papers/work sheets / practical folders for their future memory of all aspects of practical performance in order to attempt the PBA Examination amicably.

vi. It may be noted that performance of all the prescribed practicals is mandatory in the laboratory during the whole academic session because only those students will be able to attempt the PBA who have performed the practicals in the laboratory as per requirement of each practical.

vii. MCQs will not be included/assessed in the Practical Based Assessment paper.

viii. Questions carrying 0.5 marks will not be included/assessed as single part in any section of the PBA paper.

Note: In the Practical-Based Assessment (PBA), questions will be taken/developed from the list of experiments provided below, aligned with the summative SLOs listed in the corresponding column.			
	Section A (60% of practical marks — 18 Marks)		
	No.	**List of Experiments**	**Aligned SLOs**
Major Practicals	1.	Study of effect of temperature on the rate of enzyme activity or rate of reaction. OR Study of effect of pH levels on the rate of enzyme activity or rate of reaction. OR Study of effect of enzyme concentration on the rate of enzyme activity or rate of reaction.	**[SLO: B-11-F-06]** Explain the effect of temperature on the rate of enzyme action with example of human and thermophilic bacteria **[SLO:B-11-F-07]** Investigate the effect of pH on enzyme activity Compare the optimum pH of different enzymes like trypsin, pepsin, papain. **[SLO:B-11-F-08]** Demonstrate that the concentration of enzymes affects the rate of enzyme action
	2.	Preparation of weight/Volume solutions (% or molar solutions) and making simple and serial dilutions from stock solution.	**[SLO:B-12-X-02 (iv)]** Describe, where appropriate, suitable volumes and concentrations of reagents. Concentrations may be specified in % (w/v), or mol dm-3 **[SLO:B-12-X-02 (v)]** Describe how different concentrations would be prepared by serial dilution or proportional dilution
	3.	To investigate the concentration of reducing sugar (glucose) by Benedict's Test using the colorimeter.	
	4.	To measure the size of a tissue or cell using eye piece graticule or ocular micrometer and stage micrometer.	**[SLO: B-11-X-02 (xiii)]** Calculate actual sizes of tissues or cells from measurements of photomicrographs, using magnifications, scale bars or representations of eyepiece graticules and stage micrometers **[SLO: B-11-X-02 (xiv)]** Estimate the number of cells or cell organelles in a given area using a sampling method, such as grids or fields of view. **[SLO: B-11-X-03 (vi)]** Measure tissue layers or cells from photomicrographs using a ruler or given scale, including representations of eyepiece graticule
	5.	To measure the actual size, image size and magnification of a tissue or cell from photomicrographs using scale bar or millimetre ruler. a) Calculating the real size of an object from its magnification. b) Calculating magnification from a scale bar c) Calculating the magnification of a photomicrograph or image	

	6.	To investigate how much a bacterial pathogen shows sensitivity or resistance to a particular antibiotic by Disc Diffusion Method (Kirby-Bauer test)	**[SLO: B-12-T-02]** Define 4 classes of antibiotics (penicillin, Tetracycline, Fluroquinolone and Sulfonamide) and describe their mode of action.
	7.	Analysis of use and misuse of specific antibiotic through provided data.	
	8.	a) Measuring variability in leaf surface area by graph paper method using different plant species. OR b) Determination of human height or weight variability among students of same age group (for example HSSC students.) OR c) Comparing the increase in plant heights in different soil types (having different concentrations of minerals e.g., N, P, K) OR d) To investigate the effect of the amount of fertilizer used on plant growth (height and number of leaves). OR e) To investigate the effect of temperature/pH on enzyme activity OR f) To investigate the effect of light intensity on plant growth (height and number of leaves) OR g) To investigate the effect of light intensity on the rate of Photosynthesis OR h) To investigate the effect of different amounts of water in soil on plant growth (height and number of leaves).	**[SLO: B-12-K-03]** Calculate mean, median, mode, standard deviation, range, percentile from a given set of data. **[SLO: B-12-K-04]** Sketch a bar chart for a given set of data. **[SLO: B-12-K-05]** Sketch error bars based on range or standard deviation for a given set of data on bar chart. **[SLO: B-12-K-06]** Evaluate the appropriate type of figure or chart for a given set of data and/or experiment (bar chart, pie chart, x- y axis data figure etc). **[SLO: B-12-K-07]** Make the appropriate chart with proper title, labeled axes, legend, axes units. **[SLO: B-12-K-08]** Design an appropriate experiment with a control group and dependent, independent and control variables. **[SLO: B-12-X-01 (ii)]** Identify the independent and dependent variables **[SLO: B-12-X-01 (iii)]** Identify which key variables must be standardized in order to test a hypothesis. (Variables expected to have minimal effect, such as variation between test-tubes of the same type, do not need to be standardized.)
			Methods **[SLO: B-12-X-02]** Using the context provided, students should be able to: (i) Describe how to vary the independent variable (ii) describe how to measure the values of the independent and dependent variables accurately and to an appropriate precision (iii) Describe how to standardize each of the other key variables ***(iv) This SLO will be assessed in experiment No. 2 and 3 in the list of experiments.*** *(v)* ***This SLO will be assessed in experiment No. 2 and 3 in the list of experiments.*** (vi) Describe appropriate control experiments (vii) Describe, in a logical sequence, the steps involved in the procedure, including how to use the apparatus to collect results (viii) Describe how the quality of results can be assessed by considering:

			• The occurrence of anomalous results • the spread of results including the use of standard deviation, standard error and/or 95% confidence intervals (95% Cl). (ix) Describe how to assess the validity of the results by considering both the accuracy of the measurements and the repeatability of the results (x) Prepare a simple risk assessment of their plans, taking into account the severity of any hazards and the probability that a problem could occur (xi) Describe the precautions that would need to be taken to minimize risks where possible.
			Dealing with data **[SLO: B-12-X-03]** Using the context provided, students should be able to: (i) use tables and graphs to show the key points in quantitative data (ii) sketch or draw suitable graphs, displaying the independent variable on the x-axis and the dependent variable on the y-axis including, where required, confidence limit error bars (iii) decide which calculations are necessary in order to draw conclusions (iv) carry out appropriate calculations to simplify or explain data, including means, percentages and rates of change (v) carry out calculations in order to compare data, including percentage gain or loss (vi) use values of standard deviation or standard error, or graphs with standard error bars, to determine whether differences in mean values are likely to be statistically significant (vii) choose and carry out statistical tests (limited to those described in the Mathematical requirements section of the syllabus) appropriate to the type of data collected and justify use of these tests (viii) state a null hypothesis for a statistical test recognize the different types of variables and the different types of data presented, as shown in the table below.
			[SLO: B-12-X-04] **Type of variable Type of data** (i) Qualitative • categoric nominal, i.e. values or observations belonging to it can be sorted according to category, e.g. colour of flowers ordered ordinal, where values can be placed in an order or rank and the interval between them may not be equal, e.g. the order in which test-tubes

			containing starch and iodine become colourless after adding amylase (ii) Quantitative • continuous, which can have any value within a specific range, e.g. body mass, leaf length
			Conclusions **[SLO: B-12-X-05]** Students should be able to: (i) summarize the main conclusions from the results (ii) identify key points of the raw data and processed data, including graphs and statistical test results (iii) discuss the extent to which a given hypothesis is supported by experimental data and the strengths and weaknesses of the evidence (iv) give detailed scientific explanations of the conclusions (v) make further predictions and hypotheses based on the conclusions.
			Conclusions **[SLO: B-12-X-06]** Students should be able to: (i) identify anomalous values in a table or graph of data and suggest how to deal with anomalies (ii) suggest possible explanations for anomalous readings (iii) assess whether the results have been replicated sufficiently (iv) assess whether the range of values of the independent variable and the intervals between the values were appropriate (v) assess whether the method of measuring is appropriate for the dependent variable (vi) assess the extent to which selected variables have been effectively controlled (vii) make informed judgements about: • the validity of the investigation • the extent to which the data can be used to test the hypothesis • how much confidence can be put in the conclusions (viii) suggest how an investigation could be improved to increase confidence in the results.
	Section B (40% of practical marks — 12 Marks)		
Minor Practicals	9.	Set up a light microscope to view and observe specimens.	**[SLO: B-11-X-02 (ix)]** set up a light microscope to view and observe specimens
	10.	To find and draw particular tissues in plant specimens preserved in permanent slides: a) Transverse section of monocot root.	**[SLO: B-11-X-02 (x)]** Follow instructions to find and draw particular tissues in plant and animal specimens and label the drawings appropriately

		b) Transverse section of dicot root. c) Transverse section of monocot stem. d) Transverse section of dicot stem. e) Transverse section of bifacial leaf	
	11.	To find and draw particular tissues in animal specimens preserved in permanent slides: a) Transverse section of seminiferous tubules in human testes. b) Transverse section of Graafian follicle in human ovary. c) Transverse sections of artery, vein and capillary. d) Transverse sections of pancreas (Islets of Langerhans)	
	12.	Preparation of temporary slides of animal cells using differential staining and their identification under light microscope: a) Squamous epithelium (Skin) of frog/ Blood cells from human blood smear. b) Epithelial cells of human oral cavity (Cheek cells)	**[SLO: B-11-X-02 (xi)]** follow instructions to find and draw particular cells and structures within the cells **[SLO: B-11-X-02 (xii)]** make a temporary slide of stained cells or tissues
	13.	Preparation of temporary slides of plant cells and their identification under light microscope. a) Lead Epidermis (Stomata, Guard cells and epidermal cells) b) Onion epidermal cells	
	14.	Identification of ABO and Rh blood groups using antisera. OR Determination of child's blood group from the phenotypes or genotypes of the parental blood groups and vice versa	**[SLO: B-11-H-16]** Explain the case where two alleles have equal dominance through the genetics of human blood group AB.
	15.	To identify and draw different parts of sporophyte and gametophyte generation of a fern plant (Adiantum) through plant specimen and prepared slides	**[SLO: B-11-B-13]** Explain the life cycle of ferns
	16.	To study the structure of male and female cone of *Pinus*	**[SLO: B-11-B-15]** Describe the life cycle of *Pinus*

	17.	To observe and identify the characteristics of representative vertebrate animals (amphibians, reptiles, birds and mammals) through preserved animal specimens or diagrams.	**[SLO: B-11-B-22]** Describe the general characteristics of amphibians, reptiles, birds and mammals.
	18.	To observe and identify the characteristics of representative major examples of kingdom Protista (Protozoa, Algae, Myxomycota and Oomycota) through preserved specimens or prepared slide.	**[SLO: B-11-0-27]** Describe the salient features with examples of protozoa, algae, myxomycota and oomycota as the major groups of protists.
	19.	To observe and identify the characteristics of representative examples from different divisions of kingdom fungi (Zygomycota, Ascomycota, Deuteromycota and Basidiomycota) through preserved specimens or prepared slide or diagrams.	**[SLO: B-11-0-31]** Classify fungi into Zygomycota, Ascomycota, Deuteromycota and Basidiomycota and give the diagnostic features of each group.

Total Marks: 30 Time: 2 hours 30 minutes

Note: Attempt all questions and write answers within provided spaces on E-sheet.

SECTION-A (18 Marks)

Q.1 Figure 1.1 shows the setup of an experiment in which activity of catalase enzyme is being studied.

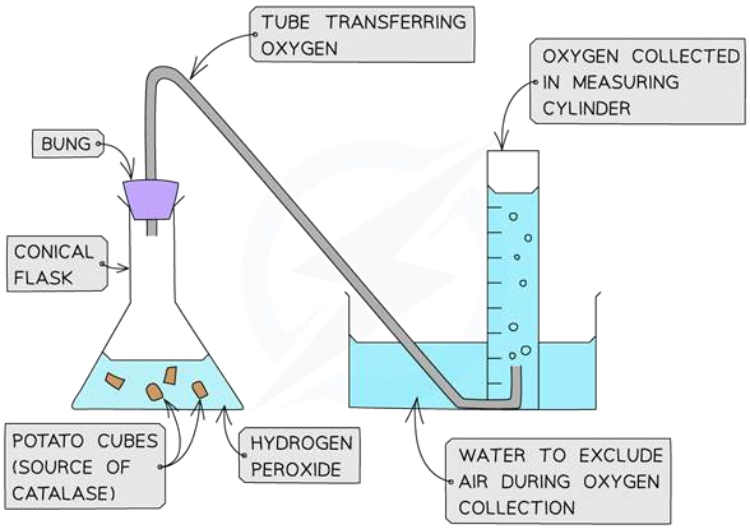


Figure: 1.1

a) If the effect of substrate concentration is to be investigated, what would be the independent variable and dependent variable in this activity: [2]

b) If the conditions for the above experiment are kept constant and the amount of oxygen collected in the cylinder is 10ml at 5 minutes. Predict the amount of oxygen at 15 minutes: [1]

c) In the above experiment 1 molar solution of hydrogen peroxide is taken in the flask, how the solution of this concentration is prepared. Show your calculation: [2]

d) Which apparatus can be used to maintain the temperature in the above experiment: [1]

Q.2 The antibiotic sensitivity test, also known as the Kirby-Bauer test, is a widely used laboratory method for determining the effectiveness of antibiotics against specific bacterial strains. Table 2.1 below presents the diameters of the zones of inhibition for

antibiotics A, B, C, D, and E, measured across five replicates (R_1, R_2, R_3, R_4, and R_5). One column displays the diameters of the zones of inhibition from control experiments, where only a filter paper disc of the same size, without any antibiotic, was applied. The diameter of antibiotic disc was 2.5 mm.

Table 2.1: Diameters of Zones of inhibition in millimeters

Replicates	Antibiotics under investigation					
	A	**B**	**C**	**D**	**E**	**Control**
R_1	6.0	10.0	2.5	12.5	4.5	2.5
R_2	7.0	10.1	2.5	11.0	5.0	2.5
R_3	6.5	12.0	2.5	12.5	5.0	2.5
R_4	7.0	10.2	2.5	12.0	4.0	2.5
R_5	6.0	2.5	2.5	12.5	5.0	2.5
Average/ Mean	6.5	10.5	2.5	12.1	4.7	2.5

a) Analyze the data given in table 2.1 and pinpoint the anomalous reading: [1]

b) Interpret the data given in table 2.1 and conclude the most effective and least effective antibiotics with reason for your interpretation. [2]

c) What is the purpose of control experiment in this test? [1]

d) Draw a bar chart of the data presented in table 2.1 and label it. [2]

Q.3 Following is the data of height of 10 students studying in class 12 (same age group):

Student Names	Height (cm)
A	180
B	182
C	175
D	171
E	160
F	172
G	170
H	158
I	165
J	168

a) Calculate the mean value of the data given in table 3.1. Also show your working. [1]

b) Calculate the standard deviation of the data given in table 3.1. Show your working.[3]

c) Calculate standard errors, draw a bar chart and show the error bars. [1+1]

SECTION-B (12 Marks)

Q.4

a) Figure 4.1 shows a light microscope in which ocular and objective lenses are used to magnify the object. The source of illumination in this microscope is visible light. Observe the figure carefully and select the numbers that label the objective lens and the source of illumination. [1]

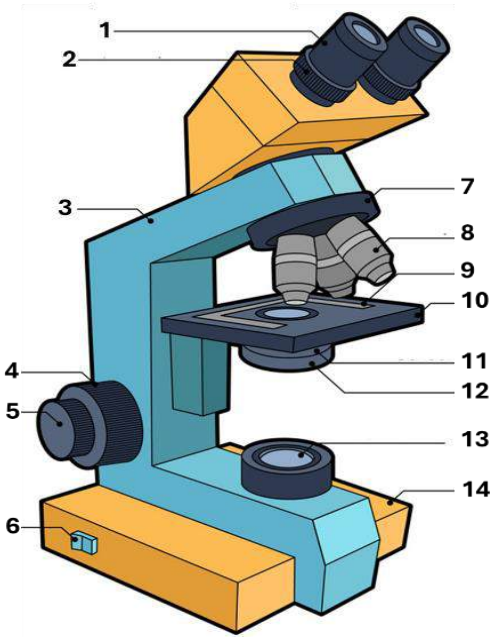


Figure: 4.1

b) Identify A and B in the figure 4.2. [1]

c) Write any four differences between tissues A and B shown in figures 4.2 [2]

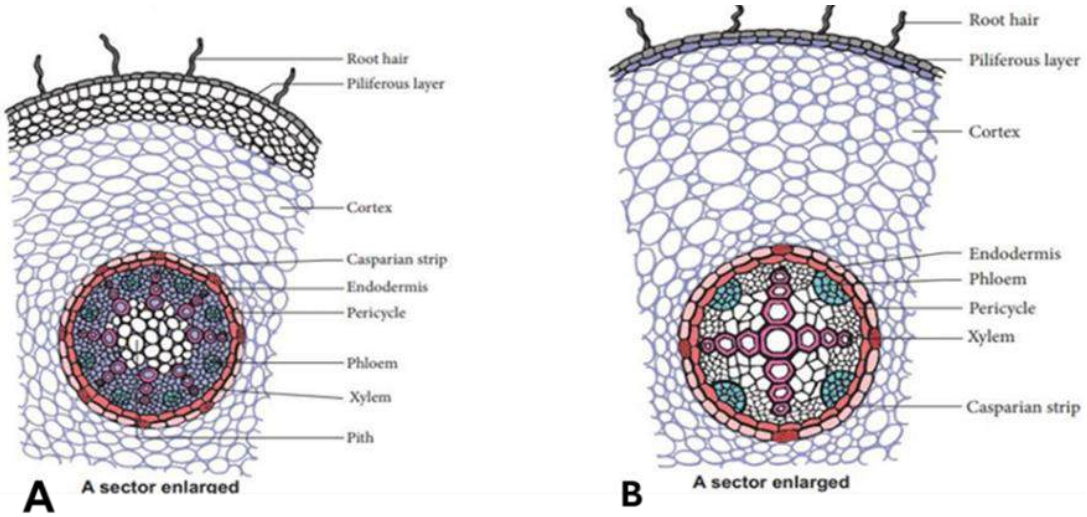


Figure: 4.2

Q.5 ABO and Rh blood group systems are very significant. These blood groups are always determined before any blood transfusion. Figure 5.1 shows the results of blood group testing of Sikandar's family. Maria is Sikandar's wife while Asad and Hira are their children.

Individuals	Anti-A Antiserum	Anti-B Antiserum	Anti-Rh Antiserum
Sikandar			
Maria			
Asad			
Hira			

Figure 5.1

a) Identify the blood group of each person. [2]

b) Draw a genetic cross of Sikandar's family and workout all possible phenotypes and genotypes in their children [2]

Q.6

a) Identify the figure 6.1 and draw its line diagram and label it. [2]

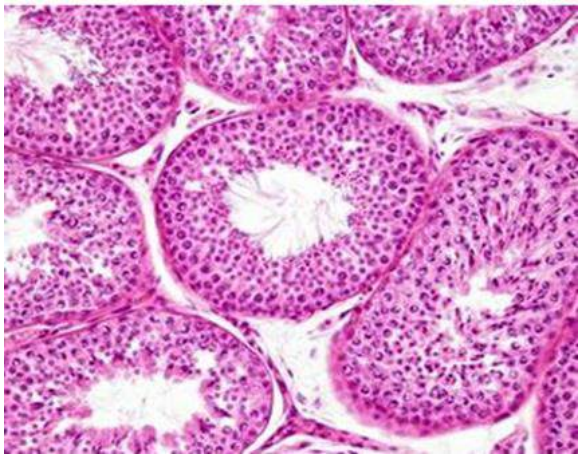


Figure 6.1

b) Explain how to prepare temporary slides of plant cells of leaf epidermis to observe under light microscope. [2]



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