S.4 BIOLOGY NOTES

DATA ANALYSIS AND BIOLOGICAL EXPERIMENTS

These can be done in two broad ways:

a) Using tables
b) Using graphs
   a) **Presentation of data in tables**:

A table is an arrangement of information or data into columns and rows or condensed list.

COMPONENTS OF A GOOD TABLE:

- A table should have an accurate, descriptive title which is always written at the top.
- Columns should have headings to identify each set of data
- Independent variables should be in the left columns and dependent variables should be on the right column.
- Columns that need comparisons should be placed alongside each other.

Example

A table showing the volume of plant cylinders varying with concentration of sucrose

a	**b**	**c**
Concentration of sucrose(M)	Final volume(cm^3)	Change in volume(cm^3)
0.1	1.10	+0.71
0.125	0.72	+0.33
0.25	0.39	0.00
0.5	0.32	-0.17
1.0	0.23	-0.16

Note: Part (**a**) represents an independent variable put on the left.

Part (**b**) and (**c**) represents dependent variable put on the right.

Worked example:

b) Presentation of data on graphs:

A graph is a diagram used to indicate relationships between two or more variable quantities or parameters. The quantities are measured along two axes set at right angles to each other.

There are different types of graphs, namely: Line graph, Bar graph and Pie chart.

LINE GRAPH

Components of a line graph

- **Title:**

A graph should have a title stating relationship between variables.

Use words such as variation, varying, relationship or effect, not against or versus when stating the title even if they appear in the question. Reason is variables (data) are not at war or conflict. Units are not necessary in the title.

Note:

(i) When using relationship, the order of the independent variable does not matter.
(ii) When using effects, you must start with an independent variable followed by the dependent variable. For example: A graph showing the effect of concentration of sucrose solution on volume of plant cylinders.

- **Axes:**

The axes must have arrow heads.

The independent variables are put on the x-axis while the dependent variables in the y-axis. The axes should have units obtained from the table. If units are missing, take the units to be arbitrary.

- **Scale:**

Each axis should have an appropriate scale.

There are various ways of obtaining the scale. However, must be divisible by five to give one significant figure. E.g. 1 cm represents 5 units or 1 cm represents 10 units. The chosen scale should give at least half page of the graph paper.

Write your scale on the top right-hand side of the graph after plotting.

E.g. vertical scale: 1 cm represents 5 cm^3 of filtrate and

Horizontal scale: 1 cm represents 0.01 mm of soil particle size.

Avoid the following:

- Use of arrows, e.g., 1 cm $\longrightarrow$ 5 cm^3 of filtrate X.
- Use of short hand of represent as reps.
- Use of small squares represents 5 cm^3 of filtrate.

- **Plotting**:

Use a small dot or a small star to represent each independent (x-axis)-dependent (y-axis) variable (relationship).

- **Graph curve/ drawing curve:**

Never use a ruler to join points plotted but use free hand to join the plotted points from the first to the last in their respective order.

<u>Graphical Analysis and Interpretation:</u>

After plotting the graph/curve or when a plotted graph, you can be required to analyze and interpret it. This calls for subject content both theory and practical knowledge about a particular topic or phenomenon.

Common words in graphical analysis:

a) Describe the nature, changes, shape or trend of the graph.
   For horizontal axis: If the values/range of values are given then quote a range of values/units first and then a statement.
   If the values/range of values are not given then use the following:
   Initially (for the initial trend of the curve), then (for the intermediate trend of the curve) and finally (for the last trend of the curve).
   For vertical a-axis: the following words can be used;
   - ❖ slow or gradual decrease
   - ❖ rapid or sharp decrease
   - ❖ slow or gradual increase
   - ❖ high or sharp increase.

   E.g. from 0 to 30^0c (range), the rate of photosynthesis increases rapidly (statement).

b) Explain the trend/shape of the graph:
   This requires to give range/units followed by statement then a reason; or range/units and the reason(s).
   E.g. From 0 to 30^0c, the rate of photosynthesis increases rapidly because of/due to activation of enzymes.

Worked example:

A S.4 student carried out an experiment to find out the effect of temperature on the activity of an enzyme ptyalin acting on starch. The results are shown in the table below:

Temperature (^{0}C)	Enzyme activity
0	0.0
10	2.0
20	4.0
30	15.5
40	30.0
50	10.0
60	0.0

(i) Represents the information in the table above on a graph.
(ii) Describe the shape of your graph.
(iii) Explain the shape of your graph.

Solution:

i) A graph showing the variation of enzyme activity with temperature

ii) From 0 to 20^0C, the enzyme activity increases gradually/slowly. From 20 to 40^0C, the enzyme activity increases rapidly. From 40 to 60^0C, the enzyme activity decreases rapidly.

iii) From 0 to 20^0C, the enzyme activity increases gradually/slowly because at low temperature enzymes are less active/inactive.
From 20 to 40^0C, the enzyme activity increases rapidly because enzymes are more active at optimum temperature.
From 40 to 60^0C, the enzyme activity decreases rapidly because at high temperature, enzymes are denatured.

Note:

- ✓ The description must be in a consistent tense throughout, for example: Increased and then remained constant or increases and remains constant.
- ✓ Describe the rate/concentration: Requires one to start from the initial point. Then range/ units and statements.
- ✓ Comment: Requires a candidate to use him/her own in order to bring out the facts shown on the graph.
- ✓ Compare: Requires one to give both similarities and differences.
- ✓ Suggest: Requires one to answer in your own in order according to the text.

Assignment 1:

The table below shows the numbers of contractile vacuole discharged by amoeba under different salt concentrations. The results obtained were as shown:

Concentration of salt in water (%)	Number of vacuoles discharged per minute
1.0	13
1.3	11
1.5	10
1.9	08
2.3	05
2.7	04
3.4	03
3.9	02
4.9	00

(a) Using the results in the table above, draw a suitable graph.
(b) (i) From the graph, state the relationship between the concentration of the surrounding solution and the number of times vacuoles form in ten minutes.
(ii) Explain the relationship stated in (b) above.
(c) Determine the percentage of salt solution that will make the amoeba form 7 vacuoles in 10 minutes.
(d) State any other two substances the contractile vacuole removes from protozoan.