

Biology

Chapter#2

Q. 1 What do you mean by scientific method?

Ans: Science is the systemized knowledge derived from observations and experiments. These experiments are carried out to determine the principles about how nature operates. Scientists like chemists, biologists and physicists use the same scientific method to make and test new theories.

Q. 2 What is a biological method? What is its role in scientific research?

Ans: Questions about living things have provided problems that man has investigated to aid his own survival and to satisfy his desire to know. The scientific method in which biological problems are solved, is termed as biological method. It comprises the steps a biologist adopts in order to solve a biological problem.

Role of biological method:

Biological method has played an important part in scientific research for almost 500 years. From Galileo's experiment (in the 1590s) to current research, the biological method has contributed to the advancements in medicine, ecology, technology etc. Biological method also ensures the quality of data for public use.

Q. 3 How do you say that man has always been a biologist?

Ans: Man has always been a biologist. He had to be a biologist in order to live. Early in history, he was a hunter of animals and a gatherer of fruits, seeds, roots etc. The more he knew about animals and their habitat, the more successful hunter he was. The more he knew about plants, the better he distinguished between edible and non-edible plants.

Q. 4 Describe in details the different steps taken by a biologist in solving a biological problem.

Ans: In solving a biological problem, biologist takes following steps;

- Recognition of biological problem
- Observations
- Hypothesis formulation
- Deductions
- Experimentation
- Summarization of results (create tables, graphics etc)
- Reporting the results

The details of these steps are as under:

1. Recognition of the Biological Problem:

Biologists go for adopting biological method when they encounter some biological problem. A biological problem is a question related to living organisms that is either asked by some one or comes in biologist's mind by himself.

2. Observations

As the first step in solving a biological problem, biologist recalls his/her previous observations or makes new ones. Observations are made with five senses of vision, hearing, smell, taste and touch.

Observations may be both qualitative and quantitative. Quantitative observations are considered more accurate than qualitative ones because the former are invariable and measurable and can be recorded in terms of numbers. Examples of qualitative and quantitative observations are given below.

Qualitative observations:

- The freezing point of water is colder than the boiling point.
- A liter of water is heavier than a liter of ethanol.

Quantitative observations:

- The freezing point of water 0 oC and the boiling point is 100 oC.
- A liter of water weighs 1000 grams and a liter of ethanol weighs 789 grams.

3. Formulation of Hypotheses

Biologist organizes his/her and others' observations into data form and constructs a statement that may prove to be the answer of the biological problem under study. This tentative explanation of observations is called a hypothesis. It may be defined as a proposition that might be

true. A hypothesis should have the following characteristics:

- It should be a general statement.
- It should be a tentative idea.
- It should agree with available observations.
- It should be kept as simple as possible.
- It should be testable and potentially falsifiable. In other words, there should be a way to show the hypothesis is false; a way to disprove the hypothesis.

A great deal of careful and creative thinking is necessary for the formulation of a hypothesis.

Biologists use reasoning to formulate a hypothesis.

4. Deductions

In the next step, biologist draws deductions from hypotheses. Deductions are the logical consequences of hypotheses. For this purpose, a hypothesis is taken as true and expected results (deductions) are drawn from it.

Generally in biological method, if a particular hypothesis is true then one should expect (deduction)

a certain result. This involves the use of "if-then" logic.

5. Experimentation

The most basic step of biological method is experimentation. Biologist performs experiments to

see if hypotheses are true or not. The deductions, which are drawn from hypotheses, are subjected

to rigorous testing. Through experimentations, biologist learns which hypothesis is correct.

The incorrect hypotheses are rejected and the one which proves correct is accepted. An accepted hypothesis makes further predictions that provide an important way to further test its validity.

6. Summarization of results

Biologist gathers actual, quantitative data from experiments. Data for each of the groups are then averaged and compared statistically. To draw conclusions, biologist also uses statistical analysis.

7. Reporting the results

Biologists publish their findings in scientific journals and books, in talks at national and international meetings and in seminars at colleges and universities. Publishing of results is an essential part of scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

Q. 5 What is "Control" in experiment? Or Differentiate between Control group and experimental group.

Ans: In science when doing the experiment, it must be a controlled experiment. The scientist must

contrast an "experimental group" with a "control group". The two groups are treated exactly alike

except for the one variable being tested.

Example:

For example, in an experiment to test the necessity of carbon dioxide for photosynthesis, one can contrast the control group (a plant with freely available carbon dioxide) with an experimental group (a plant with no carbon dioxide available). The necessity of carbon dioxide will be proved when photosynthesis occurs in the control group and does not occur in the experimental group.

Q. 6 Which chemical is used for malaria?

Ans: Cinchona bark was found to be excellent for treating malaria. We now know the reason: cinchona bark contains quinine that is effective in treating the disease. In fact quinine was the only effective remedy for malaria from the 17th to the 20th century.

Q. 7 Which organism is the basic cause of malaria?

Ans: Plasmodium is the basic cause of malaria which is transmitted by Anopheles mosquito to human body.

Q. 8 What is incubation period?

Ans: The period between the entry of parasite in host and the appearance of symptoms is called incubation period.

Q. 9 Why Ronald Ross used female Culex mosquito instead of Anopheles mosquito in his experiment?

Ans: Actually Ronald Ross used sparrow for his experiment instead of human. For this he used Culex mosquito because culex is only responsible to transmit plasmodium to sparrow. While Anopheles mosquito is responsible for transmission of plasmodium to human beings.

Q. 10 Differentiate between theory, law and principle.

Ans: **Theory:**

The hypotheses that stand the test of time (often tested and never rejected), are called theories. A theory is supported by a great deal of evidence.

Law or Principle:

If a theory survives some doubtful approach and continues to be supported by experimental evidence, it becomes a law or principle. A scientific law is a uniform or constant fact of nature. It is an irrefutable theory.

Examples:

Examples of biological laws are Hardy-Weinberg law and Mendel's laws of inheritance.

Q.11 How can we organise and analyse data in biological method?

Ans: **Data:**

Data can be defined as the information such as names, dates or values made from observations and experimentation.

Data organization and data analysis are important steps in biological method.

Data organization:

In order to formulate and then to test hypotheses, scientists collect and organize data. Prior to conducting an experiment, it is very important for a scientist to describe data collection methods. It

ensures the quality of experiment. Data is organized in different formats like graphics, tables, flow charts, maps and diagrams.

Data analysis:

Data analysis is necessary to prove or disprove a hypothesis by experimentation. It is done through

the application of statistical methods i.e. ratio and proportion.

Ratio:

When a relation between two

numbers e.g. 'a' and 'b' is expressed in terms of quotient (a/b), it is called the ratio of one number

to the other. Ratio may be expressed by putting a division (\div) or colon ($:$) mark between the two numbers. For example the ratio between 50 malarial patients and 150 normal persons is 1:3.

Proportion:

Proportion means to join two equal ratios by the sign of equality ($=$). For example; $a:b = c:d$ is a proportion between the two ratios. This proportion may also be expressed as $a:b::c:d$.

Summarization of data:

Statistics are thus a means of summarizing data through the calculation of mean value. This step is very important as it transforms raw data into information, which can be used to summarize and report results.

Q. 12 Justify that mathematics is an integral part of scientific process.

Mathematics: As An Integral Part Of Scientific Process:

Biological method also involves the use of applied mathematics to solve biological problems.

Major

biological problems in which knowledge of mathematics is used include gene finding, protein structure, and protein-protein interactions etc.

Bioinformatics:

Bioinformatics refers to the computational and statistical techniques for the analysis of biological data.

