

UNDERSTANDING THE CONCEPTS

Q#1 Describe the steps involved in biological method taking malaria as an example.

Ans: Study of malaria - an example of biological method:

In the last part of the nineteenth century many different causes of malaria were being suggested.

Observations about malaria:

By that time there were four major observations about malaria.

1. Malaria and marshy areas have some relation
2. Quinine is an effective drug for treating malaria.
3. Drinking the water of marshes does not cause malaria.
4. Plasmodium is seen in the blood of malarial patients. We know that a scientist uses whatever information and observation he has and makes one or more hypotheses.

Hypothesis about malaria:

The hypothesis made in this case was:

"Plasmodium is the cause of malaria."

Scientist does not know whether his hypothesis is true or not, but he accepts it may be true and makes deductions. One of the deductions from the above hypothesis was: "If Plasmodium is the cause of malaria, then all person ill with malaria should have Plasmodium in their blood."

Experiment about malaria:

The next step was to test the deduction through **experiments** which were designed "Blood of 100 malarial patients was examined under microscope. For

the purpose of having a control group, the blood of 100 healthy persons was also examined under microscope."

Results about malaria:

The results of the experiments showed that almost all malarial patients had Plasmodium in their blood while 07 out of 100 healthy persons also had Plasmodium in their blood (now we know that Plasmodium in the blood of healthy people was in incubation period i.e. the period between the entry of parasite in host and appearance of symptoms). The results were quite convincing and proved that the hypothesis "Plasmodium is the cause of malaria" was true.

Q#2 If a test shows that some people have Plasmodium in their blood but they do not show any symptoms of malaria, what? Hypothesis would you formulate to answer this problem?

Ans: Hypothesis:

If some people have Plasmodium in their blood but they do not show any symptoms of malaria, then plasmodium is present in them in incubation period.

Q#3 How the principles of ratio and proportion are used in biological method.

Ans: Principles of ratio and 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 $a : b : c : d$.

In every proportion of two ratios there are four terms i.e. the first and fourth terms are called extremes, the second and third are called means. So, in the above

proportion 'a' and 'd' are extremes while 'b' and 'c' are means. The basic rule used to solve problems through ratios and proportion is that the product of the extremes is equal to the product of means. When three values in a proportion are known, the fourth one (X) can be calculated by using this rule.

For example, a biologist can calculate how many birds would get malaria when he allows infected mosquitoes to bite 100 healthy sparrows. In the previous experiment he noted that when he allowed mosquitoes to bite 20 sparrows, 14 out of them got malaria. Now he uses the proportion rule.

$x: 100 :: 14: 20$ $\frac{x}{100} = \frac{14}{20} \rightarrow x \times 20 = 100 \times 14$ $x = \frac{14 \times 100}{20} \rightarrow x = 70$	<p>It means 70 out of 100 sparrows would get malaria.</p>
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Q#4 Justify mathematics as an integral part of the scientific process.

Ans: 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, and the modeling of evolution.

Bioinformatics:

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

Computational biology:

Computational biology refers to hypothesis-driven investigation of a specific biological problem using computers.

SHORT QUESTIONS

Q.1 Differentiate between theory and law.

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. Productive theory keeps on suggesting new hypotheses and so testing goes on. Many biologists take it as a challenge and exert greater efforts to disprove the theory.

Law and Principle:

If a theory survives such 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. The examples of biological laws, are Hardy-Weinberg law and Mendel's Laws of inheritance.

Q.2 Quantitative observations are better in biological method. How?

Ans: Quantitative observations:

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	Quantitative observations
<p>i. The freezing point of water is colder than the boiling point.</p> <p>ii. A liter of water is heavier than a liter of ethanol.</p>	<p>i. The freezing point of water is 0°C and the boiling point is 100°C.</p> <p>ii. A liter of water weighs 1000 grams and a liter of ethanol weighs 789 grams.</p>

