

Unit 2: Solving a Biological Problem

Short Questions

1. Do you think that “Man has always been a biologist”? If so why? Text Book Page # 20

Ans: A man has always been a biologist. He had to be a biologist in order to live. Early in history, he was 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.

2. Define Biological Method. (GRW 2013, DGK 2015, BWP 2015)

Ans: “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.
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3. How biological method has played an important part in scientific research?

Ans: The biological method has played an instrumental role in scientific research for almost 500 years.

- From Galileo’s experiment back in the 1590’s to current research, the biological method has contributed to advancements in medicine, ecology, technology, etc.
- The biological method ensures the quality of data for public use.
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4. Write steps of Biological Method in a sequence.

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Ans: Biological method involves the following main steps:

- Recognition of a biological problem
- Observations
- Hypothesis formulation
- Deductions
- Experimentation
- Summarization of results (tables, graphics etc.)
- Reporting the results
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5. Define Biological Problem.

(FSD 2014, SGD 2014)

Ans: “A question related to living organisms that is either asked by some one or comes in biologist’s mind by himself is called biological problem”.

Example:

Malaria

6. What is the difference between qualitative and quantitative observations?
(GRW 2012, LHR 2013, SWL 2014, MTN 2015, BWP 2015)

Ans:

QUALITATIVE OBSERVATIONS	QUANTITATIVE OBSERVATIONS
<ul style="list-style-type: none">Qualitative observations are considered less accurateThese observations are variable and less measurable.These can not be recorded in terms of numbers. <p>Examples:</p> <ul style="list-style-type: none">The freezing point of water is colder than its Boiling Point.A liter of water is heavier than a liter of ethanol.	<ul style="list-style-type: none">Quantitative observations are considered more accurateThese observations are invariable and measurable.These can be recorded in terms of numbers. <p>Examples:</p> <ul style="list-style-type: none">The freezing point of water is 0°C and the boiling point is 100°C.A liter of water weighs 1000 grams and a Liter of ethanol weighs 789 grams.

7. Why quantitative observations are better in biological method?
(DGK 2014, GRW 2014, RWP 2014, LHR 2015)

Ans: Quantitative observations are better because these are invariable and measurable and can be recorded in terms of numbers.

Example:

The freezing point of water is 0°C and the boiling point is 100°C.

8. How did Darwin formulate the theory of evolution?

Ans: Darwin not only observed and took notes during his voyage, but he also read the works of other naturalists to form his theory of Evolution.

9. Define hypothesis?

Text Book Page # 22 (BWP 2015)

Ans: “A tentative explanation of the observations is called hypothesis.”

OR

“A proposition that might be true is called hypothesis.”

Example:

Plasmodium is the cause of malaria

10. How hypothesis is framed?

Ans: A great deal of careful and creative thinking is necessary for the formulation of a hypothesis. Biologists use reasoning to formulate a hypothesis.

11. What are the characteristics of a good hypothesis?

(LHR 2012, 2015, 2016, RWP 2015)

Ans: A good 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 that the hypothesis is false, a way to disprove the hypothesis.

12. Define deductions. How deduction are formed?

(LHR 2012, MTN 2015, SGD 2015)

Ans: “The logical consequences of a hypothesis are called deductions”.

Formulation:

For this purpose, a hypothesis is taken as true and expected results are drawn from it.

Generally, in a biological method, if a particular hypothesis is true, then one should expect (deduction) a certain result. It involves the use of “if-then” logic.

13. Develop a deduction from the following hypothesis.

“All plant cells have a nucleus.”

Ans: “If I examine cells from a blade of grass, then each one will have a nucleus.”

14. Why a biologist go for experimentation during solving a biological problem?

Ans: A biologist performs experiments to see if hypothesis are true or not.

The deductions which are drawn from hypothesis are subjected to rigorous testing. Through experimentation, a biologist learns which hypothesis is correct.

15. What is control in an experiment?

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(LHR 2013, 2014, DGK 2014, FSD 2015, RWP 2015)

Ans: In science, when doing an experiment, it must be a controlled experiment. A 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:

In an experiment to test the necessity for carbon dioxide during 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.

16. What are different ways of reporting results of biological method? (SWL 2015)

Ans: Biologists publish their findings in scientific journals and books, in talks at national and international meetings and in seminars at colleges and universities.

Importance:

Publishing of results is an essential part of the scientific method. It allows other people to verify the results or apply the knowledge to solve other problems.

17. How did physicians describe malaria in early days?

Ans:

- The early physicians described malaria as a disease of chills and fevers with recurring attacks.
- They also observed that the disease was more common among people living in low, marshy areas.

18. What was the possible cause of malaria in early days?

Ans: It was thought in early days that stagnant water of marshes poisoned the air and as a result of breathing in this 'Bad Air', people got malaria.

19. What does the word malaria mean?

(LHR 2014)

Ans: The word malaria has been derived from two **Italian** words:

- 'Mala' means 'bad'
- 'Aria' means 'air'

20. What was the treatment of malaria in early days?

Ans: In the 17th century, when the New World (America) was discovered, many plants from America were sent back to Europe to be used as medicines. The bark of a tree known as 'quina-quina' was very suitable for curing fevers. It was so beneficial that it soon became impossible to carry enough bark to Europe. Some dishonest merchants began to substitute the bark of another tree, the 'cinchona' which closely resembled quina-quina. This dishonesty proved much valuable for mankind. The cinchona bark was found to be excellent for treating malaria. The cinchona bark contains quinine which is effective in treating the disease. Quinine was the only effective remedy for malaria from 17th-20th century.

21. Describe the contributions of Laveran in discovery of *Plasmodium*. (RWP 2014)

Ans: Contribution of Laveran

In 1878, a French army physician Laveran began to search for the cause of malaria.

Experiments:

He took a small amount of blood from a malarial patient and examined it under a microscope. He noticed some tiny living creatures. His discovery was not believed by other scientists.

Confirmation:

- Two years later, another physician saw the same creatures in the blood of another malarial patient.
- Three years later after this second discovery, the same creatures were observed for the third time.

Naming of Organism:

The organism was named '*Plasmodium*'.

22. What were observations for malaria until 19th century? (FSD 2015)

Ans: In the last part of 19th century, many different causes of malaria were being suggested. By that time there were four major observations about malaria.

- Malaria and marshy areas have some relation.
- Quinine is an effective drug for treating malaria.
- Drinking water from marshes does not cause malaria.
- ‘Plasmodium’ is seen in the blood of malarial patients.

23. What is incubation period? (SWL 2015)

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

24. Design a deduction from following hypothesis.

“Plasmodium is cause of malaria”

Ans: One of the deductions from the above hypothesis can be:

‘If Plasmodium is the cause of malaria, then all persons ill with malaria should have Plasmodium in their blood’.

25. Write down observations of A.F.A King about malaria.

Text Book Page # 25 (LHR 2014, MTN 2015)

Ans: In 1883, a physician, A.F.A King, listed 20 observations:

Some of his important observations were:

- People who slept outdoors were more likely to get malaria than those who slept indoors.
- People who slept under fine nets were less likely to get malaria than those who did not use such nets.
- Individuals who slept near a smoky fire usually did not get malaria.

26. What is required for the maturation of eggs of female mosquito?

Ans: Female mosquitoes need blood of mammals or birds for the maturation of their eggs.

27. Why Ronald Ross used sparrow in his experiment? (GRW 2014)

Ans: Ronald Ross used sparrow in his experiment because scientists avoid using human beings for experiments when results could be so serious.

28. How did Ross prove that mosquitoes transmit plasmodium and spread malaria? (GRW 2012)

Ans: Ronald Ross, a British army physician working in India, in 1880's, performed important experiments.

Experiment 1:

- He allowed a female *Anopheles* mosquito to bite a malarial patient.
- He killed the mosquito some days later.
- On examining the mosquito, *Plasmodium* was found multiplying in mosquito's stomach.

Experiment 2:

- He allowed a female *Culex* mosquito to bite the sparrows suffering from malaria.
- Some of the mosquitoes were killed and studied at various times.
- Ross found that *Plasmodium* multiplied in the wall of mosquito's stomach and then moved into the mosquito's salivary glands.
- He kept some of the mosquitoes alive and allowed them to bite healthy sparrows.

Results:

Ross found that saliva of the infected mosquitoes contained *Plasmodia* and these entered sparrow's blood. When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

29. Why does female mosquito injects small amount of saliva into the wound?

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Ans: When a female mosquito pierces the skin with her mouth parts, she injects a small amount of saliva into the wound before drawing blood. This saliva prevents the blood from clotting in her food canal.

30. Why do welts appear after mosquito bite?

(LHR 2013)

Ans: The welts that appear after the mosquito leaves is not a reaction to the wound, but an allergic reaction to the saliva. In most cases, the itching sensation and swellings subside within several hours.

31. What is scientific law? Give two examples?

(LHR 2013, SWL 2014)

Ans: "If a theory survives 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:

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

32. What is difference between theory and law?

Text Book Page # 27 (SWL 2014, DGK 2014, LHR 2015, 2016)

Ans:

Theory	Law
<ul style="list-style-type: none">• A hypothesis that stands the test of time (often tested and never rejected) is called theory.• A theory may be challenged.• A theory can be altered in case of new evidence.• A theory is always subjected to new testing	<ul style="list-style-type: none">• A scientific law is a uniform, constant fact of nature. It is irrefutable theory.• A law cannot be challenged.• A law is already an established and definite entity. It cannot be altered.• A law is not subjected to further testing.
Example: Darwin's theory of evolution	Example: Hardy-Weinberg Law

33. Define data.

Ans: "The information such as names, dates, or values made from observations and experimentation is called data."

34. In which formats data is organized?

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Ans: Data is organized into different formats like:

- Graphics
- Tables
- Flow-charts
- Maps
- Diagrams

35. Define ratio.

(MTN 2015)

Ans: "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."

Expression of a ratio:

A ratio is expressed by putting a division (\div) or colon (:) mark between two numbers.

Example:

The ratio between 50 malarial patients and 150 normal patients is 1:3.

36. In what major biological problems is the knowledge of Mathematics used?

Ans: Major biological problems, in which knowledge of mathematics is used include:

- Gene finding
- Protein structure
- Protein-protein interactions

37. Define Bioinformatics.

(SWL 2014, BWP 2014, LHR 2016)

Ans: "The use of the computational and statistical techniques for the analysis of biological data is called bioinformatics."