Chapter = 02

Biology 9th - Detailed Question Answers

➔ SOLVING A BIOLOGICAL PROBLEM

Q.1: What is science and scientific method?

Ans: **Science:** Science is the systematic study of nature and how it affects us and the environment. It is a body of knowledge that is constantly changing through the use of better and more accurate tools for investigation.

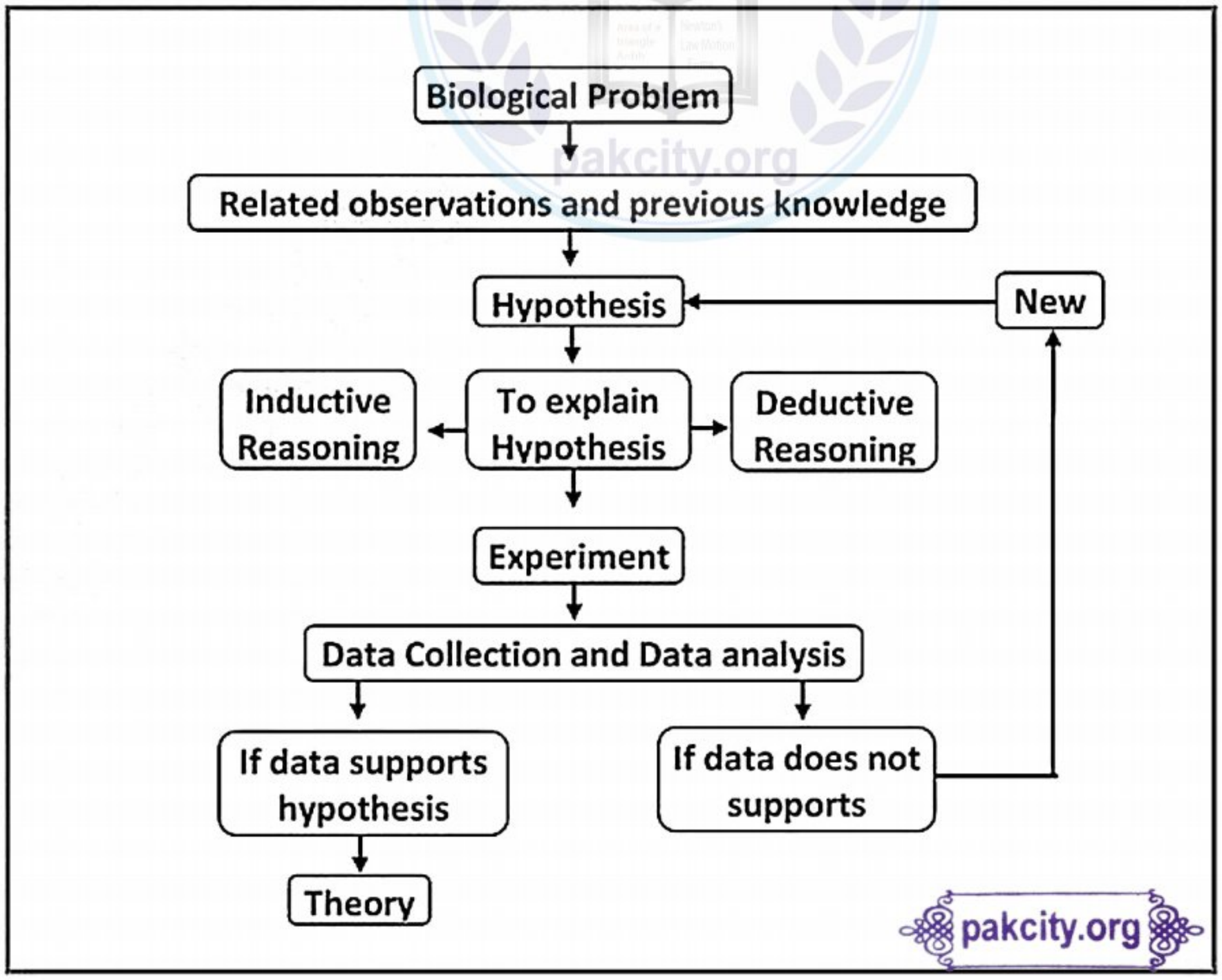
Scientific Method: At the core of biology and other science lies a problem-solving approach called the scientific method. The scientific method is a series of steps followed by scientific investigators to answer specific questions about the natural world.

Q.2: Explain the steps of biological method in detail.

Ans: **Steps of Biological Method :** Biological method consists of the following steps :

1. Observation
2. Hypothesis
3. Reasoning
4. Experiment
5. Result
6. Conclusion

Chart to show the steps of Biological Method:



(i) Observation: The first step is to identify the reason of the problem followed by the formulation of a question about what has been observed. The solution of biological problem starts with observation. An observation is a statement of knowledge gained through the senses (quantitative) or through the use of scientific equipment (quantitative).

In 1880, a French physician, Laveran, studied the blood sample of malaria patient under microscope and observed tiny creatures in it and named as Plasmodium. So the observation was made that Plasmodium is present in the blood of malaria patients.

(ii) Hypothesis: Hypothesis is a key component of the scientific process. It is defined as "the intelligent guess made by a scientist in the form of statement". A hypothesis must be testable through experimentation. Hypothesis must either be supported or falsified by experiment.

For Example: In malaria case, an intelligent guess is made after observation that Plasmodium is the cause of malaria.

(iii) Reasoning: Biologists collect information about the problem and formulate the hypothesis by using a reasoning process i.e. "inductive reasoning and deductive reasoning".

Inductive reasoning moves from specific to general e.g. shark is a fish. All fishes have scales therefore sharks also have scales.

Deductive reasoning moves from general to specific. It is based on "if-then" statement.

Deductive reasoning can be tested and verified by experiments. In malaria case, the following deduction is made:

"If Plasmodium is the cause of malaria, that all the malaria patient should have Plasmodium in their blood".

(iv) Experiment: Once a problem has been observed and a hypothesis is suggested, the next step in the scientific method is to design an experiment based on reasoning. Experiment is a practical performance of a scientist to identify the real cause of a problem based on inductive and or deductive reasoning. A key assumption is that the experiment will be repeated many times by other scientists. Scientist performs two types of test i.e. control group and experimental group. To find out the cause of malaria, blood samples of 100 malaria patients (experimental group) and the blood samples of 100 healthy persons (control group) were examined under microscope.

(v) **Result:** The results are where we report what happened in the experiment. That includes detailing all observations and data made during experiment. Result verifies the hypothesis. In the case of malaria, it was found that all the malaria patients (experimental group) had Plasmodium in their blood whereas the blood samples of healthy persons (control group) were free from Plasmodium,

(vi) **Conclusion:** The final step of the scientific method is developing conclusion. This is where all the results from the experiment are analyzed and a determination is reached about the hypothesis. If our hypothesis was supported, it's great. If not, we repeat the experiment or think of other ways to improve our procedure.

Example: Conclusion is made that "Plasmodium is the cause of malaria".

Q.3: Explain theory, law and principle.

Ans: **Theory:** As more and more evidences come to hand in the favour of hypothesis, the hypothesis gains increasing acceptance and eventually is promoted to the rank of a theory. A theory is a set of scientific assumptions consistent with one another and supported by evidence, but not fully proved. Scientific theories are well-tested and highly reliable scientific explanations of natural phenomena. They unify many repeated observations and data collected from lots of experiments. For example, theory of evolution

Law: A scientific law is a uniform or constant fact of nature. It is virtually an irrefutable theory. Biology is short in laws due to puzzling nature of life.

Principle: When a theory can explain many natural phenomena and is consistently supported by experiment and also universally accepted by the scientist it becomes a scientific principle.

Q.4: Distinguish between the following in tabulated form.

(i) Theory and Law **(ii) Inductive reasoning and deductive reasoning**

Ans: (i) Difference between theory and law

	Law	Theory
1.	A law is an observation	A theory is the explanation of that observation
2.	A law does not require experimentation	A theory requires experimentation under various conditions.
3.	A law does not become obsolete with time.	A theory may become obsolete with time.
4.	A law cannot be replaced or changed	A theory can be replaced by another Theory
5.	A law is a universally observable fact.	A theory may be strong or weak according to the amount of evidence available.

(ii) Difference between Inductive and Deductive reasoning

	Inductive Reasoning	Deductive Reasoning
1.	It is the form of valid reasoning, to deduce new information or conclusion from known related facts and information.	It arrives at a conclusion by the process of generalization using specific facts or data.
2.	Deductive reasoning follows a top-down approach.	Inductive reasoning follows a bottom-up approach.
3.	Deductive reasoning starts from Premises.	Inductive reasoning starts from the Conclusion.
4.	Use of deductive reasoning is difficult, as we need facts which must be true.	Use of inductive reasoning is fast and easy, as we need evidence instead of true facts. We often use it in our daily life.
5.	In deductive reasoning, arguments may be valid or invalid.	In inductive reasoning, arguments may be weak or strong.
6.	Deductive reasoning reaches from general facts to specific facts.	Inductive reasoning reaches from specific facts to general facts.

Q.5: Why experiment is necessary for theory?

Ans: Natural science is a reasonable enterprise based on valid experimental evidence, criticism, and rational discussion. It provides us with knowledge of the natural world, and it is experiment that provides the evidence that grounds this knowledge. Experiment plays many roles in science. One of its important roles is to test theories and to provide the basis for scientific knowledge. It can also call for a new theory, either by showing that an accepted theory is incorrect, or by exhibiting a new phenomenon that is in need of explanation. Experiment can provide hints toward the structure or mathematical form of a theory and it can provide evidence for the existence of the entities involved in our theories. Finally, it may also have a life of its own, independent of theory. Scientists may investigate a phenomenon just because it looks interesting. Such experiments may provide evidence for a future theory to explain.

Q.6: Describe data organization and data analysis.

Ans: For data organization we will prepare a table or graph of the data. We shouldn't throw out data points we think are bad or that don't support our predictions. Some of the most incredible discoveries in science were made because the data looked wrong! Once we have recorded the data, we may need to perform a mathematical analysis to support or refuse our hypothesis.

In data analysis, the statistical methods (ratio and proportion) are applied.

Ratio: It is a comparison of two values expressed as a quotient (1st/2nd).

Example: A flower has 4 sepals and 12 petals. The ratio of sepals to petals is 4:12. This ratio can also be expressed as an equivalent fraction 1:3.

Proportion: It is an equation stating that two ratios are equal.

Example: 4:12::1:3.

Q.7 Why mathematics is an integral part of the scientific process.

Ans: For example, if a biologist is studying the insect population. He goes into the field and counts the population sample in a specific region, then compares his sample with other regions to get population estimated. At every step of this process, he depends upon mathematics to measure, predict, and understand natural phenomena. One key role of mathematics in biology is the creation of mathematical models. There are equations or formulas that can predict or describe natural occurrences, such as organism behavior patterns, population changes over time, structure of protein, height of living organisms, population of an endangered species, bacterial growth and so on. We can say that mathematics plays a critical role in better understanding the natural world.

Q.8: Why table or graph is necessary for data organization?

Ans: Table and graph is necessary for visual representation of results. Before conducting a meaningful investigation, it's important to organize the data we collected. By organizing data, a scientist can more easily interpret what has been observed. Since most of the data scientist collect is quantitative, data tables and charts are usually used to organize the information.

They allow the investigator to get a visual image of the observations, which simplifies interpretation and drawing conclusions. Valid conclusions depend on organization and clear interpretation of data.

Chapter = 02

Biology 9th - Short Question Answers

➔ SOLVING A BIOLOGICAL PROBLEM

Q.1: What is biological method?

Ans: The system of advancing knowledge by formulating a question, collecting data bout it through observation and experiment, and testing a hypothetical answer about Living things is called biological method.

Q.2: Define biological problem.

Ans: Biological problem is a set of questions to be solved, about the natural world. These problems can be environmental, ecological, health related, etc. No matter what types of problems are being studied, scientists use the same problems-solving method to find answers that the logical and supported by evidence.

Q.3: Mention the steps of Biological method.

Ans: **Steps of Biological Method** : The steps of biological method are as follows:

1. Observation
2. Hypothesis
3. Reasoning
4. Experiment
5. Result
6. Conclusion

Q.4: What is mathematical biology?

Ans: **Mathematical Biology:** It is a field of research that examines mathematical representations of biological systems.

Q.5: Why biological sciences need mathematical models?

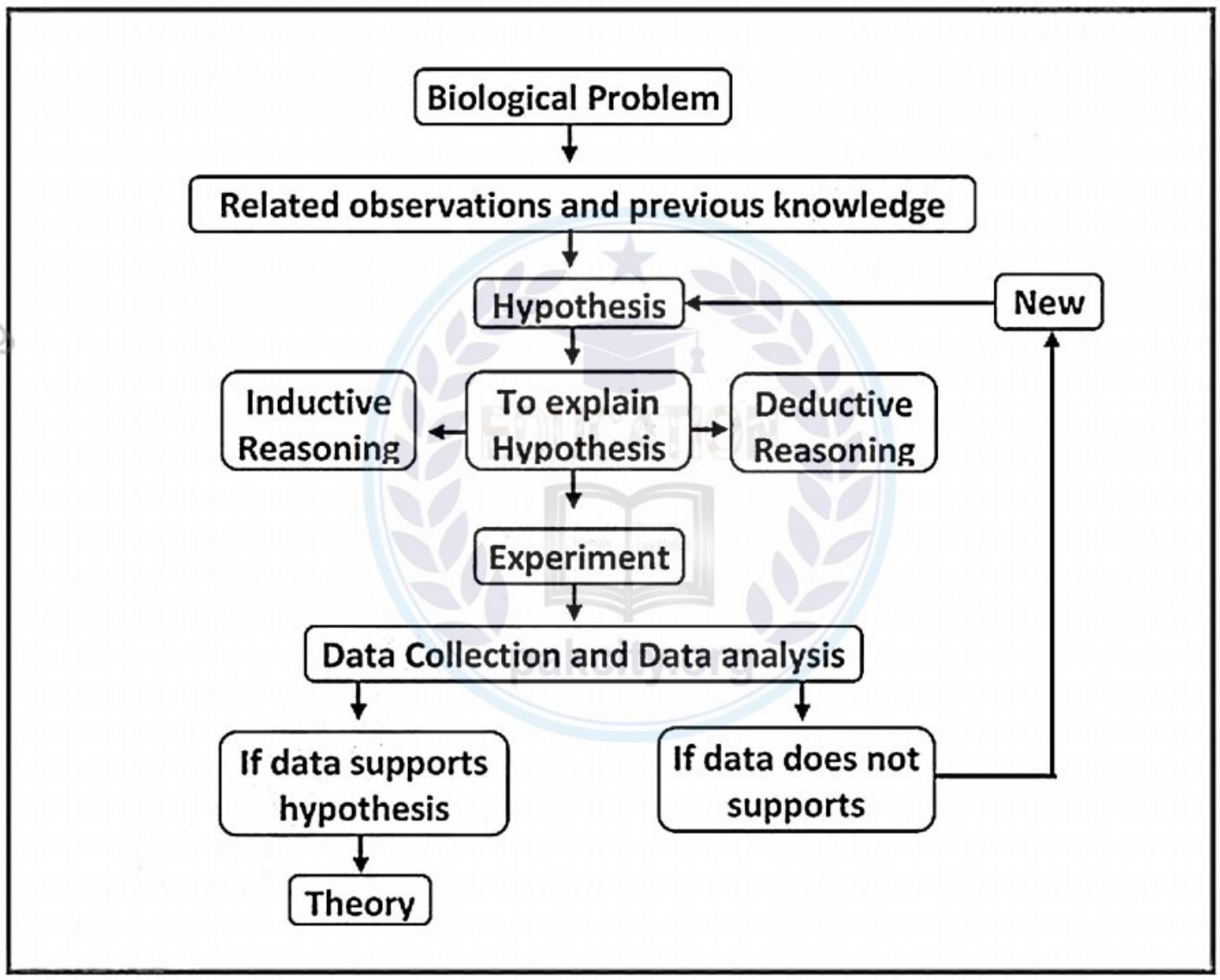
Ans: One key role of mathematics in biology is the creation of mathematical models. There are equations or formulas that can predict or describe natural occurrences, such as organism behavior patterns, population changes over time, structure of protein, height of living organisms, population of an endangered species, bacterial growth and so on.

Q.6: Theory is highly reliable scientific explanations, why?

Ans: As more and more evidences come to hand in the favour of hypothesis, the hypothesis gains increasing acceptance and eventually is promoted to the rank of a theory. A theory is a set of scientific assumptions consistent with one another and supported by evidence, but not fully proved. Scientific theories are well-tested and highly reliable scientific explanations of natural phenomena. They unify many repeated observations and data collected from lots of experiments.

Q.7: Draw a chart showing steps involved in biological methods.

Ans: Chart to show the steps of Biological Method:



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