# UNIT 13: HYPOTHESIS: KINDS AND USES

## UNIT STRUCTURE


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## 13.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- explain the meaning of hypothesis
- define hypothesis
- describe the purpose and functions of hypothesis
- discuss the characteristics of a hypothesis
- explain the kinds of hypothesis
- describe the conditions of a valid hypothesis
- explain the uses of hypothesis.

## 13.2 WHAT IS HYPOTHESIS?

Scientific induction aims at establishing a universal real proposition depending upon the observation of particular instances. These particular instances also depends upon two kinds of principles i.e.; the law of uniformity of nature and the law of causation. The law of uniformity of nature states that the same cause produces the same effect under similar conditions. The law of causation states that every event has a cause. These two are known as the formal ground of induction. Scientific induction relies on these two principles in order to establish a universal proposition on the basis of observation of particular instances. On the other hand, these particular instances are the particular facts of experience and they are the materials of induction supplied by observation and experiment. Observation and experiment guarantee the material truth of induction and thus they are known as the material ground of induction.

Scientific induction can establish a universal real proposition on the basis of observation of particular instances only by discovering and proving a causal connection among phenomena. So, to discover and prove a causal connection is an important task of induction. But, before discovering and proving a causal connection, it is necessary to make a supposition or assumption that there is such a connection. Such a supposition or assumption is the starting point of an inductive investigation. This supposition or assumption is known as hypothesis.

A hypothesis is a tentative supposition, the validity of which needs to be tested. A hypothesis, at its initial stage, may be an imagined idea or mere guess. A hypothesis is based on accumulated previous knowledge. A hypothesis is made in order to find out the correct explanation of a phenomenon through investigation. When by verification, the hypothesis is found to be true, a theory is obtained.

The word hypothesis is a compound of two words ‘hypo’ and ‘thesis’ and literally “hypo” means under or below and “thesis” means a reasoned theory or rational view point. Accordingly hypothesis would mean a theory which is not fully reasoned. In other words, hypothesis is a theory entertained in order to study the facts and examine the validity of the theory.

Mill defines hypothesis as follows: “A hypothesis is any supposition which we make (either without actual evidence, or an evidence avowedly insufficient) in order to endeavor to deduce from its conclusions in accordance with facts which are known to be real; under the idea that if the conclusions to which the hypothesis leads are known truths, the hypothesis itself either must be, or at least is likely to be true.” According to Coffey, “A hypothesis is an attempt at explanation: a provisional supposition made in order to explain scientifically some facts or phenomenon.” Moreover, according to Cohen and Nagel, “A hypothesis directs our search for the order.” It is not essential for a hypothesis to be necessarily true. In fact, hypothesis is not a claim of truth but a claim for truth. Hypothesis is a bridge in the process of inquiry or search which begins with some felt difficulty of problem and ends without the resolution of the problem.



**ACTIVITY 13.1**

What do you mean by the word hypothesis? Discuss.

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## 13.3 THE PURPOSE AND FUNCTION OF A HYPOTHESIS

Hypothesis offers explanations for the relationships between those variables that can be empirically tested. It furnishes proof that the investigator has sufficient background knowledge to enable him or her to make suggestions in order to extend existing knowledge. To gather appropriate and relevant data, the investigation needs to have a definite direction. This is done through the formulation of hypothesis. Hypothesis gives direction to the investigation because it indicates which specific data are to be collected. Knowledge is vast and as an investigator begins to study a particular theme or concepts he will be lost in the vast ocean of knowledge which has accumulated in the area. But if he is guided by his hypothesis he will be able

to discriminate relevant areas and focus his studies on those specific aspects which will enable him to test the hypothesis. Only relevant literature will be studied and organized to test the hypothesis in a precise manner. Besides this, hypothesis guides the inquirer in identifying what procedures he should use in the study to gather data which are relevant to test the posited hypothesis. It structures the next phase in the investigation and therefore furnishes continuity to the examination of the problem. Hypothesis provides framework to the inquirer in summing up the conclusions of the study. To sum up, hypothesis is the pivot of a study around which the investigation revolves giving meaningful direction to the investigation particularly with regard to what kind and how much of data is to be collected.

Thus, the functions of hypothesis can be explained as follows-

a) The most important function of a hypothesis is to adequately explain all the facts connected with the hypothesis.
b) It enables us to direct enquiry along the right lines. It suggests experiments and observation. It helps to collect necessary evidence in order to discover the order of nature.
c) Hypothesis determines the method of verification as well as the procedure for enquiry. Hypothesis limits the scope of enquiry to a manageable area, because, instead of random collection of data, it enables us to search only for relevant facts. Therefore, it leads to economy of time and money.
d) It leads to the discovery of laws. It explains facts and laws, and thus seeks to verify knowledge.
e) Hypothesis leads to conclusion which is sometimes very significant for the advancement of knowledge. The significance of an object or event can be determined by a hypothesis.

## 13.4 CHARACTERISTICS OF A HYPOTHESIS

a) A hypothesis should be clear statement of relationship between two or more variables. It should strive to furnish an acceptable explanation of the variables or phenomena.

b) It should be stated in simple and understandable terms. Complex concepts used in the enquiry should be delineated in simple measureable terms.

c) A hypothesis should be consistent with existing facts and theories. In other words it should correspond with existing knowledge.

d) It should be stated in a way that it can be tested for its being probably true or probably false so that conclusions can be drawn as empirical statements.



**CHECK YOUR PROGRESS**

**Q.1:** Fill in the blanks:

a) Hypothesis offers explanations for the relationships between those variables that can be ..... tested.

b) Hypothesis determines the method of ..... and ..... for enquiry.

c) A good hypothesis should be ..... statement be ..... tatement of relationship between two or more .....

## 13.5 STEPS OF HYPOTHESIS

The truth of hypothesis involves observation, imaginative thinking and anticipation and deductive verification. These can be explained as follows:

a) The first stage of hypothesis is observation of facts. Observation presents some facts before us to be explained. We come in contact with the facts through observation. As a result of this contact, questions arise in our mind about the phenomena. Thus the facts call for some explanation.

b) The second stage is the formulation of supposition. A supposition is made to explain the fact which calls for an explanation. At this stage, the materials supplied by observation are not sufficient to explain

accurately the fact to be explained. Yet, we must make some supposition so that we can account for the fact presented.

c) The third stage is deduction. In this stage, certain conclusions are deduced from the supposition. Thus, hypothesis involves deduction.

d) The fourth stage is verification. In this stage, verification is made whether the deduced conclusions tally with actual facts or not. If we find that the conclusions tally with facts, the supposition is true or is at least likely to be true. If, it is proved to be true, it becomes a law. Otherwise, the supposition is not true and thus it is proved to be worthless and must be discarded in favor of another.

## 13.6 KINDS OF HYPOTHESIS

A hypothesis attempts to explain some facts. In explaining any fact, hypotheses are regarded as the agent, the law of operation that is employed by the agent and the collocation or necessary arrangement of circumstances. A hypothesis assumes three different forms, according to the subject-matter about which suppositions are made, viz.:

a) Hypothesis concerning agent
b) Hypothesis concerning law and
c) Hypothesis concerning collocation

**a) Hypothesis Concerning Agent:** In some cases though the law of operation is known, yet the particular agent who is to operate the known law is unknown. In such cases a hypothesis is formed regarding an agent and this type of hypothesis is called hypothesis concerning agent.

For example: finding out the cause of malarial fever or discovering the planet Neptune etc. are some of the examples of hypothesis concerning agent. The planet Neptune was discovered by Adams and Leverrier by a hypothesis of the above kind in 1846.

The law of gravitation was known and it was calculated that the planet Uranus should move in a particular orbit due to the attractions of the then known planets. But when in reality the observation was made it was found that the planet was deviating from its calculated

path. This fact led Adams and Leverrier to the supposition that there was some unknown agents which influenced the planet Uranus to cause this deviation. Such a hypothesis is called hypothesis concerning agent and here in this case the unknown agent was consequently discovered to be the planet Neptune.

b) **Hypothesis Concerning Law:** This hypothesis explains how an agent works to produce a particular effect or event. In such type of hypothesis, through the agent is known to us, yet the law or plan according to which the agent acts is unknown. In such a case, we frame a hypothesis concerning the law of operation or the way or the manner in which the agent acts. This type of hypothesis is called hypothesis concerning law.

For example: Newton established the law of gravitation by a hypothesis of this kind. Here, the agents, viz., the Earth, falling bodies on Earth, the Sun, the Moon and other planets were all known. But the way in which these agents acted was not known. Hence, it was presumed that their motions might be due to their attraction to one another in a particular way. Such a hypothesis is called hypothesis concerning law and finally on the basis of such supposition the law of gravitation was discovered.

c) **Hypothesis Concerning Collocation:** Collocation means an arrangement of circumstances. When a hypothesis is made relating to the circumstances necessary to produce a phenomenon, it is known as a hypothesis regarding collocation. Sometimes, in a given case, both the agents and the laws are known, but the collocation is not known, it becomes necessary to frame a hypothesis concerning the collocation. Hypothesis of this kind is called hypothesis concerning collocation.

For example: the agents, such as the Earth, the Sun, the Moon, etc. were all known. But the collocation of their heavenly bodies was not known.

An Egyptian astronomer, Ptolemy (about 127 A.D.) regarded the Earth as the center of the universe and supposed that the Sun, the Moon and other planets revolves round the Earth.

However, this supposition was proved to be false by a Polish Astronomer, Copernicus (1473-1543 A.D.). Copernicus framed a different hypothesis against Ptolemaic system regarding the collocation of the heavenly bodies that the Sun was the center of the solar system and all other planets revolved round the Sun. Such a hypothesis is called hypothesis concerning collocation. On the basis of such supposition, it was discovered that the order of the solar system was maintained due to this type of collocation. Ultimately the Copernican hypothesis was proved to be true and it was accepted worldwide.

According to another classification of hypothesis based on purposes, hypothesis is of three kinds. L.S. Stebbing who is a modern logician distinguishes hypothesis on the basis of their different purposes– (i) Explanatory (ii) Descriptive (iii) Analogical.

In addition to these, some logicians suggest two other kinds of hypothesis like– (i) Ad-hoc hypothesis (ii) Working hypothesis

i) **Explanatory Hypothesis:** This is the simplest kind of hypothesis. An explanatory hypothesis is formed in order to explain a phenomenon. These types of hypothesis account for the occurrence of a certain fact by the interpolation of facts. When this type of hypothesis explains the happening of a phenomenon, the interpolated facts are such that an observer can observe them under suitable circumstances. Here, the facts which are supposed are of the same types. Such facts constitute the data of the problem. But, in another type of explanatory hypothesis, the interpolated elements are non-observable relations between the occurrences to be connected. One well-known example of this type of explanatory hypothesis is the Newtonian hypothesis.

ii) **Descriptive Hypothesis:** A descriptive hypothesis is generally formed to describe a geometrical representation of the movements of the heavenly bodies. It symbolizes the ordered connection of the facts. One such example of such a descriptive hypothesis is the Rutherford Bohr theory to form a mental picture of the relations between the elements of an atom.

These descriptive hypotheses are neither generalization from experience nor are they anticipations of natural laws awaiting confirmation. They are those descriptions which serve the function of models, enabling the scientists to understand the mode of connection between the facts. However, such hypotheses are necessarily provisional and temporary.

iii) **Analogical Hypothesis:** Analogical hypothesis may be developed from descriptive hypothesis. An analogical hypothesis is that kind of hypothesis where what is true of one set of phenomena may be true of another set because the two sets possess in common certain formal properties.

For example, Maxwell recognized an analogy between certain problems in the theory of gravitational attraction and certain problems in electrostatics. Both the gravitational formula and the formula for electrical attraction are the laws of the inverse square though the nature of attraction in both cases is different.

However, there is a 'structural identity' between these two sets of phenomena. By developing this analogical or 'structural hypothesis', Maxwell formulated his electromagnetic theory of light. By working upon the hypothesis preferred by mathematical analogies, Maxwell arrived at remarkable results in electrostatics, magnetism and current electricity. In this connection, it may be mentioned that according to Welton, Coffey and others, there are two kinds of hypothesis– hypothesis of law and hypothesis of cause. It is so because the agent and the collocation taken together constitute the cause. From this point of view, hypothesis is only of one kind and this is the hypothesis of cause. The supposition or assumption of an antecedent as the real cause of the given phenomenon is known as hypothesis of cause. Some also call such hypothesis of cause as explanatory hypothesis as it explains a phenomenon. Again, a hypothesis of law is also called a Descriptive hypothesis because it describes the manner or the way in which the phenomenon occurs.

- **Ad-hoc Hypothesis:** The word 'ad-hoc' has three different senses.

  In the first sense, it is the etymological meaning of the word 'ad-hoc' which is invented for a particular purpose.

  In the second sense, the word 'ad-hoc' implies a hypothesis which is invented to explain only a particular fact. In this sense, no other testable consequences can be deduced from such hypothesis. These types of hypotheses are unscientific as they are neither testable nor any testable consequences can be deduced from them.

  In the third sense, the word 'ad-hoc' refers to only descriptive generalization. Such a hypothesis merely sates that all the facts of a particular kind occur under a particular kind of circumstances. Such type of hypothesis has no explanatory power. It accounts for only that fact or a set of facts for the explanation of which it is offered. Thus, the hypothesis which is based on observed facts and is formed only through descriptive generalization is called ad-hoc in this sense.

  One example of such ad-hoc hypothesis is the hypothesis that explained the wayward behaviour of Uranus. Bouvard observed that there was a deviation in the calculated orbit of Uranus. The scientists proposed the hypothesis that some planet, beyond Uranus was disturbing the gravitational force of Uranus. This is an example of ad-hoc hypothesis.

  However, such ad-hoc hypothesis may become a part of general theory if it may be established. The planet Neptune was first accepted as ad-hoc hypothesis, but it was established afterwards. But, an ad-hoc hypothesis may even remain purely ad-hoc and so it may even be refuted.

- **Working or Tentative Hypothesis:** A working or tentative hypothesis is a provisional supposition offered merely for guiding the investigation. In some situations it may happen that there is some phenomenon to be explained, and yet people do not know much about the phenomenon. The phenomenon is of an

unfamiliar type. But some provisional supposition is required to study the phenomenon. In such case we may take the help of working hypothesis. Thus, a working hypothesis is a tentative or provisional supposition which is known to be inadequate. In the absence of a better hypothesis, we have to take recourse to such an inadequate hypothesis for the time being to carry on the investigation.

One example of such a working hypothesis is "Electricity is a fluid". Though scientists did not understand the nature of electricity, yet they carried on their investigations by assuming that "electricity is a fluid". But a working hypothesis can be discarded whenever the nature of the phenomenon is understood better. In such situation, we can have a mere reliable hypothesis and then an explanatory hypothesis will take place.

## 13.7 WHEN IS A HYPOTHESIS FORMULATED?

A hypothesis is formulated after the problem has been stated and previous study has been concluded. It is formulated when the investigation is totally aware of the theoretical and empirical background to the problem.

The formulation of hypothesis presupposes some problems for which enquiry is necessary. If there is no problem, no enquiry is needed, and there would be no necessity for a hypothesis. A satisfactory solution of any problem requires that the irrelevant facts must be eliminated from the relevant facts. The formulation of hypothesis gives the direction in which the facts are to be arranged. We cannot go forward unless we begin with a suggested explanation of the phenomenon. This suggested explanation is called hypothesis.

However, there is no definite set of rules which can be laid down for the formulation of hypothesis. Partly, it is a matter of hitting upon an idea on some problem. People with discerning minds are more capable of doing it. According to Stebbing, "every hypothesis springs from the union of knowledge and sagacity". Previous knowledge of the field of enquiry plays a significant role for the formulation of hypothesis. In directing an enquiry, a hypothesis

must take some facts as significant. A relevant hypothesis expresses determinate modes of connections between a set of facts, including the fact that is being investigated. However, in the absence of knowledge concerning a subject matter, we can make no well-founded judgments of relevance.

The deductive development of a hypothesis must follow from its formulation. Therefore, scientific procedure in this regard plays an important role. However, one must be fully acquainted with the facts and theories already existent in respect of the phenomenon with which one is engaged. The possession of such knowledge depends to a great extent on one's experience and insight.

## 13.8 CRITERIA FOR THE FORMULATION OF A HYPOTHESIS

According to Smith, the following criteria are of importance in formulating hypothesis. A hypothesis should-

- Stand a test
- Be expressed in clear language;
- Be in accordance with the general theme of other hypothetic statements in the same field of study, and should be regarded as valid.
- Be co-ordinated with the theory of science;
- Be a tentative answer to the formulated problem;
- Be logical and simplistic;
- Consider available investigation techniques;
- Be specific; and
- Be relevant to the collection of empirical phenomena and not merely conclude value judgments.

  Thus, a hypothesis can be formulated in more than one way.

## 13.9 CONDITIONS FOR A VALID HYPOTHESIS

a) The most important condition for a valid hypothesis is that it should be empirically verifiable. A hypothesis should be compared with the

facts of experience directly or indirectly. A hypothesis ultimately has to be confirmed or refuted; otherwise, it will remain a mere supposition.

b) A hypothesis must provide answers to the problem which initiated enquiry. A false hypothesis is not always useless. It may encourage further investigation and attempts to find out relations among facts and thereby, may increase the evidence for other theories.

c) In case we have more than one hypothesis, we should prefer the one which has a strong power of predictability and which can explain the consequences.

d) If there are two hypotheses on the same problem and if they can be equally confirmed by evidence, the simpler hypothesis is generally chosen. A hypothesis is simpler than the, if the first is more general in nature and has fewer assumptions and a smaller number of independent elements. But simplicity should not be confused with familiarity. A new and unfamiliar hypothesis should never be adopted merely for its simplicity.

e) A valid hypothesis generally does not go against the traditionally established knowledge. But a hypothesis may not always be invalid, if it goes against well-established knowledge; for the traditional knowledge may itself be wrong.

f) A hypothesis must be clear, definite and certain. It should not be vague or ambiguous.

g) A valid hypothesis suggests an explanation which appears reasonably true in the present state of knowledge. A fanciful idea or an absurd imagination does not make a valid hypothesis.



## CHECK YOUR PROGRESS

**Q.2:** State whether the following statements are True or False:

a) A hypothesis is formulated after the problem has been stated and previous study has been concluded. (True/False)

b) A hypothesis must be in accordance with the general theme of other hypothetic statements in the same field of study, and should be regarded as valid. (True / False)

c) One of the conditions of a valid hypothesis is that it should be empirically tested. (True / False)

d) A false hypothesis may sometimes encourage further investigation and also attempts to find out relations among facts and thereby, may increase the evidence for other theories. (True / False)

e) Any fanciful idea or any absurd imagination cannot make a valid hypothesis. (True / False)

## 13.10 ORIGIN OF HYPOTHESIS

There is no particular method of forming a hypothesis. The choice of hypothesis depends upon scientist's range of knowledge and his native abilities. There are, however, certain aids in the making of a hypothesis making. They are as follows–

i) Induction per simple enumeration
ii) Simple conversion of universal propositions
iii) Analogy

**i) Induction per Simple Enumeration:** A hypothesis may originate from induction per simple enumeration. Here, a large number of instances are observed by the observer and it is found that two phenomena always go together. The observer does not find any contrary instance so far as his experience goes. However, he does not know whether there is any causal connection between the two phenomena. But the condition that the two phenomena are constantly associated together seems to be sufficient ground for supposing that there is a causal connection between them and thus a hypothesis is framed. It is a general experience that "all roses are sweet – smelling". Here, we see that all roses irrespective of colour and size are sweet-smelling and from this observation we form the hypothesis that rose is sweet-smelling flower.

ii) **Simple Conversion of Universal Propositions:** A simple conversion of universal proposition suggests that the relation between the subject and the predicate may be reciprocal. For example, the proposition, "all men are mortal" cannot be converted simply. We find that the relation between 'man' and 'mortality' is not reciprocal. We may investigate the element which makes 'men' 'mortal'. This suggests the hypothesis concerning the mortality of men. We find that as men are living beings, so men are mortal. Then we see that a reciprocal relation exists and we arrive at the universal proposition, "all living beings are mortal". This proposition "all living beings are mortal" can be converted simply into the proposition "all mortal beings are living beings".

iii) **Analogy:** Analogy is another source of hypothesis. Analogy is based on imperfect resemblance between two things. When two things resemble each other in certain important respects, we assume that they will probably resemble each other in other respects too. For example, if we find that some hill people we came across are very simple, we shall suppose that other hill people are also simple, because they are inhabitants of hill areas. This hypothesis about hill people is based on analogical reasoning.

Mill formulates five experimental methods for determining causal connections among phenomena.

Through the method of agreement a hypothesis is formed whenever it is found that various objects in a group have a common circumstance. For example, if a doctor finds that all cancer patients he has come across are heavy smokers, he will easily conclude that smoking is a cause of cancer. Similarly, if all guests in a marriage party feel giddy and sick after taking food, we shall conclude that food must be poisoned.

Through concomitant variation, we form hypothesis about two phenomena by observing certain relationship between them. For example, if we find that medicines in attractive containers sell more than those in simple containers, we may form a hypothesis that all medicines presented in attractive containers will sell more than before.

The method of residues is also regarded not only as a method of proof, but also a method of discovery. Some of the important discoveries in different sciences have been made by the application of this method. This method is also a source of hypothesis. Thus, we find that those inductive methods are also helpful in framing hypothesis.

## 13.11 VERIFICATION AND PROOF OF HYPOTHESIS

Verification of hypothesis means the testing of the truth of the hypothesis in the light of facts. For verification, there must be an agreement between the inference of the hypothesis and the observed facts. The greater the agreement, the stronger is the hypothesis. Direct verification means the direct appeal to the fact of experience through simple observation or experiment. Where a hypothesis cannot be directly verified, it should be verified indirectly. In indirect verification, the consequences deduced from the hypothesis are compared to facts. If there is an agreement between consequences and facts, a hypothesis is verified. If facts agree with the hypothesis and, there is no contradictory fact, the hypothesis is verified to be true.

In order to prove a hypothesis, it is essential first to verify it. However, verification is not conclusive proof. Thus, something more is necessary. A hypothesis must adequately explain all facts for which it has been made, and it must be the only hypothesis to do so. It must also explain all related facts, and it should have the power of prediction.

Sometimes, two or more hypothesis may explain facts. Then in order to know which one of them provides the real explanation, we take a crucial instance. This can be found out by observation or by experiment. A crucial instance not only confirms a hypothesis, but it also negates the other. Suppose that a hypothesis is that X has committed a theft, another hypothesis is that Y has committed the theft. In course of investigation, it is found that X was present at a very distant place at the time when the theft was committed. However, displaying and eliminating its rival hypothesis does not imply that the original hypothesis is proved. Elimination of its rival hypothesis or verification of a hypothesis only indicates that the original hypothesis is more

probable. However, a crucial instance obtained by experiment has a greater value for the proof of the hypothesis as compared to the crucial instance obtained by simple observation.

## 13.12 HYPOTHESIS AND INDUCTION

A hypothesis is a tentative supposition that is made in order to explain some fact or phenomenon scientifically. An induction, on the other hand, is the establishment of universal real proposition on the basis of the observation of particular instances by depending on the principles of the uniformity of nature and the law of causation.

One important task of induction is to discover and prove a causal connection among phenomena. By determining a causal connection among phenomena, scientific induction can certainly establish a universal real proposition on the basis of observation of particular instances.

Our nature is very complex and to discover and prove a causal connection is very difficult. But on the basis of our observation we may frame a supposition and if that supposition is verified by experiment, then it will no longer remains as mere supposition and then it will be raised to the status of induction. Moreover, even a legitimate hypothesis may not attain the status of induction.

Thus, a hypothesis is a provisional supposition that forms the starting point of an inductive investigation to determine a causal connection. So, the first step for determining causal connection is to frame a hypothesis. However, there is a controversy among logicians regarding the place of hypothesis in induction.

Bacon, who is considered to be the founder of inductive logic condemns the process of framing hypothesis in induction. According to Bacon, there is no necessity of framing hypothesis to know what the laws of nature probably are. He maintains that the processes called observation and experiment are sufficient for detecting the laws of nature.

Newton, by following Bacon, says, “Hypothesis non fingo” or I do not imagine hypothesis. For Newton, hypothesis means rash and premature conjectures based on insufficient grounds.

In contrast to this, Whewell regards framing of hypothesis as the most important stage in the inductive process. According to Whewell, a good hypothesis and a valid induction both are identical. Like hypothesis, induction is also concerned with only discovery and not with any proof.

However, Mill has maintained a somewhat different view and according to him, induction is more concerned with proof than with discovery. Hypothesis is the only weak form of proof. Induction and hypothesis are thus not identical. Hypothesis is only a subsidiary to induction.

However, all the above views are not fully satisfactory. Because after a close observation, it has been seen that neither Bacon nor Newton nor Whewell and Mill can describe or determine the place of hypothesis in induction.

According to Bacon, observation and elimination are sufficient for detecting the laws of nature. But in reality, observation and elimination necessarily involve the use of hypothesis to produce any good result. In order to explain a particular fact, a tentative supposition or hypothesis is made on the basis of observation as to what the real explanation may be. Similarly, in elimination also, exclusion of accidental and irrelevant circumstances is possible only if we make a supposition. Thus, observation and elimination do not become possible without framing hypothesis. So, Bacon's view is not acceptable in discarding hypothesis.

Newton does not condemn hypothesis in the moral sense of the term. He does not reject legitimate hypothesis. He rejects only mere guesses that provide no real explanation of the fact. He also rejects metaphysical hypothesis which includes causes that lie beyond human observation and so they cannot be verified at all.

Whewell by over emphasizing the importance of hypothesis ignores the necessity of inductive or experimental methods.

On the other hand, Mill overemphasizes experimental methods by saying hypothesis as only subsidiary to induction. But the fact is that hypothesis is indispensable to induction as hypothesis guides observation and observation is known as the material ground of induction.

In fact, the importance of hypothesis in any inductive inquiry cannot be denied at all. Formation of hypothesis is one of the stages of induction.

Simply the difference between hypothesis and induction is one of degree. If a hypothesis stands the test of the experimental methods, it is accepted as a law or induction; otherwise, it is rejected as an idle speculation. So, a hypothesis simply is the starting point of an enquiry; yet it cannot finally settle the enquiry. In spite of that, the importance of hypothesis in any inductive enquiry cannot be denied at all.



## CHECK YOUR PROGRESS

**Q.3:** Write the differences between:

a) Induction per simple enumeration and analogy.

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b) Analogy and simple conversion of universal propositions.

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**Q.4:** Fill in the blanks:

a) Simple conversion of universal propositions suggests that the relation between the subject and the predicate is .....

b) Analogy is based upon imperfect ..... between two things.

**Q.5:** State whether the following statements are True or False:

a) Verification of hypothesis means the testing of the truth of the hypothesis in the light of facts. (True / False)

b) Verification is not conclusive proof. (True / False)

c) Supposition are made on the basis of observation and if those suppositions are verified by experiment, then it will no longer remains as mere supposition and it can be raised to the status of induction. (True / False)

d) The first step to determine causal connection among phenomena of the world is to frame hypothesis. (True / False)

e) Bacon discarded framing of hypothesis in case of induction. (True / False)

## 13.13 HYPOTHESIS, THEORY, LAW AND FACT

Hypothesis, theory, law and fact are inter-connected. At the first stage of enquiry, a hypothesis is made, which is only a tentative supposition or assumption. When a hypothesis is verified and found to be true, it becomes a theory. This theory, when it works satisfactorily and is proved, is generally accepted. It is impossible to point to a definite stage, when a hypothesis is elevated to the rank of a theory and again when a theory is elevated to the rank of a law. It becomes an instrument of further explanation and prediction. At this stage, the theory becomes a law. However, these stages are not very distinct, marked or definite. A fact is anything which is there or which can be conceived of. It is a concrete event of experience. Facts may be external or internal (of mind). External facts are perceived by our sense organs and internal facts are known by our minds. Well-established facts are sometimes regarded as laws. A science begins with facts and ends in facts. As concrete experiences, facts suggest hypothesis. The hypothesis ripens into a theory-a theory into a law, and the law becomes so familiar that it becomes a fact.

## 13.14 USES OF HYPOTHESIS

For explaining some fact or phenomenon, hypothesis is a temporary supposition. Hypothesis are not only necessary in science, but in everyday life also.

The following are the uses of hypothesis–

1) **Hypothesis is the starting point of scientific investigation:** The main aim of scientific investigation is to discover the real nature of events. Nature is complex and it presents the events in a complex way. Hence, scientific investigation must start with hypothesis regarding the possible nature of events and hypothesis is the principle by which the real nature of events can be discovered. A hypothesis lies at the bottom of scientific generalization because science must start with some suppositions.

   A hypothesis must fulfill certain conditions to be 'legitimate' so that it may be accepted as the starting point of scientific investigation. However, sometimes legitimate hypothesis cannot be framed as the subject matter of some investigation is unfamiliar. In such situations, it is necessary to remain content simply with the working hypothesis and this implies that no scientific investigation can begin at all without some sort of supposition.

   In order to establish a universal real proposition by discovering and proving a causal connection among phenomena in scientific induction we must start with a provisional supposition as to what the cause is or what the cause will be. This is what is meant by hypothesis.

2) **Hypothesis makes observation and experiment possible:** Observation and experiment are known as the material grounds of induction and hypothesis controls them. Both observation and experiment supply the materials of induction which are nothing but some particular facts of experience. Observation tries to find out some unity among those particular facts. Observation must not be random perception, but well-regulated perception of particular facts with a definite aim. So, it must be guided by hypothesis to find out the unity among facts. Again, in experiment we artificially reproduce things or events under known conditions. Such artificial reproduction wants some supposition to be verified for its object. Thus, both observation and experiment are guided and controlled by hypothesis.

3) **Hypothesis is an aid to explanation:** Hypothesis explains the facts or phenomenon of nature. A fact or phenomenon is scientifically

explained when its cause or the law of operation is proved. To search the law of operation or the cause, we have to start with some supposition. In general, hypothesis assumes three forms: hypothesis concerning an agent or a collocation, or the law of operation. In each case, when the hypothesis is proved the phenomenon is explained. But in some cases where no logical hypothesis can be framed, then we have to be content with the working hypothesis. Though such hypotheses are inadequate and unsatisfactory, yet they are better than no hypothesis at all. They offer some explanation of the phenomenon. Even a wrong hypothesis which is ultimately proved to be false may offer a provisional explanation and may be useful to some extent. Scientific explanation is inseparably related to hypothesis. In fact, scientific explanation and explanatory hypothesis are two aspects of the same object. They are inseparably related with one another. If the hypothesis which is an aid to scientific explanation is proved, then it becomes a scientific explanation. Therefore, a hypothesis may be regarded as a preliminary stage of scientific explanation.

4) **Hypothesis makes deduction possible:** In some cases, the results of observation are uncertain and experiment cannot be employed. So, in such cases, no causal connection can be proved by direct observation and experiment. In such situation, the only way to carry out scientific investigation is to suppose some principles and deduce consequences from it and compare them with actual facts of experiences.

Hence, from such discussion, it becomes clear that hypothesis is necessary in any kind of investigation.



## 13.15 LET US SUM UP

- Observation and experiment are known as material grounds of induction while the law of causation and the law of uniformity of nature are called the formal grounds of induction.

- A hypothesis is a tentative supposition, the validity of which has got to be tested.
- The word 'hypothesis' is a compound of two words 'hypo' and 'thesis' and literally hypo means under or below and thesis means a reasoned theory or rational view point.
- Hypothesis is the pivot of a study around which the investigation resolves giving meaningful direction to the investigation particularly with regard to what kind and how much of data is to be collected.
- Hypothesis leads to the discovery of laws. It explains facts and laws, and thus seeks to verify knowledge.
- A hypothesis involves four steps i.e.; observation, reflection, deduction and verification.
- From the point of view of subject-matter hypothesis is of three kinds- hypothesis concerning agent, hypothesis concerning law and hypothesis concerning collocation.
- From the point of view of purpose, hypothesis is of three kinds- explanatory, descriptive and analogical. In addition to this, some logicians suggest two other kinds of hypothesis i.e.; ad-hoc hypothesis and working hypothesis.
- A hypothesis is formulated after the problem has been stated and previous study has been concluded. It is formulated when the investigator is totally aware of the theoretical and empirical background to the problem.
- There are certain criteria for formulating a hypothesis like- stand a test, expressed in clear language, valid, co-ordinated with the theory of science, tentative answer to the formulated problem, logical and simplistic, specific, up to date, relevant to the collection of empirical data, or phenomena etc
- A valid hypothesis must fulfill certain conditions- empirically verifiable, provide answer to the stated problem, strong power of predictability, simpler, does not go against the well-established knowledge, clear, definite and certain and suggests an explanation which appears reasonably true in the present state of knowledge.

- A hypothesis may originate from three sources- induction per simple enumeration, simple conversion of universal propositions and analogy.
- The place or role of hypothesis in induction is significant because a hypothesis is a provisional supposition that forms the starting point of an inductive investigation to determine causal connections among phenomena.
- There is an internal relation between hypothesis, theory, law, and fact because a hypothesis becomes a theory, a theory becomes a law and a law becomes so familiar that it becomes a fact.
- The main uses of hypothesis are like–
  a) Hypothesis is the starting point of scientific investigation.
  b) Hypothesis makes observation and experiment possible.
  c) Hypothesis is an aid to explanation.
  d) Hypothesis makes deduction possible.



## 13.16 FURTHER READING

1) Copi, Irving M.; Cohen, Carl and McMohan, Kenneth (2011); *Introduction to Logic* (14th Edition); Pearson Education INC.
2) Ghosh, B. N. (1982); *Scientific Methods and Social Research*; L-10, Green Park, Extension, New Delhi: Sterling Publishers Private Limited; Cunningham Road, Bangalore: G-2, Cunningham Apartments.
3) Read, Carveth (August, 1914); *Logic: Deductive and Inductive*, (4th Edition); London: Simpkin, Marshall, Hamilton, Kent & Co. Ltd, Stationers Hall Court, London, E.C. 4.



## 13.17 ANSWERS TO CHECK YOUR PROGRESS

**Ans. to Q. No. 1:** a) Empirically, b) Verification, procedure, c) Clear, variables

**Ans. to Q. No. 2:** a) True, b) True, c) True, d) True, e) True.

**Ans. to Q. No. 3:** a) In induction per simple enumeration, a large number of instances are observed by the observer and finds that two phenomena always go together. Here, it is observed that two phenomena are constantly associated together which leads the observer to suppose that there is a causal connection among the two phenomena and thus a hypothesis is formed.

Whereas in analogy if two things resemble each other in certain important respects, we assume that they will probably resemble each other in other respects also. Analogy is basically based on imperfect resemblance between two things.

b) In case of analogy if it is found that if two things resemble each other in certain important respects, then it will be assumed that they will probably resemble each other in other respects also. Analogy is basically an imperfect resemblance between two things.

But in case of simple conversion of universal propositions the relation between the subject and the predicate may be reciprocal. For example, “All living beings are mortal” where the subject and the predicate can be simply converted to the proposition “All mortal beings are living beings”.

**Ans. to Q. No. 4:** a) reciprocal, b) resemblance

**Ans. to Q. No. 5:** a) True, b) True, c) True, d) True, e) True



## 13.18 MODEL QUESTIONS

**A) Very Short Questions:**

**Q.1:** What is hypothesis?

**Q.2:** What is the etymological meaning of the word ‘hypothesis’?

**Q.3:** What do you mean by hypothesis concerning agent?

**Q.4:** What is the prime function of a hypothesis?

**Q.5:** What is the first stage of forming hypothesis?

**B) Short Questions: (Answer each question in about 150 words)**

**Q.1:** What is Hypothesis concerning collocation? Briefly explain.

**Q.2:** What do you mean by Analogical hypothesis? Briefly explain.

**Q.3:** Briefly explain the steps of hypothesis.

**Q.4:** What are the criteria for formulating hypothesis? Briefly explain.

**Q.5:** How can you distinguish between– Hypothesis, theory, law and fact.

**Q.6:** Write short notes on:

a) Conditions of a valid hypothesis

b) Induction per simple enumeration

c) Analogy

**Q.7:** Briefly explain the relation between hypothesis and induction.

**Q.8:** What are the uses of hypothesis? Briefly explain.

**D) Long Questions: (Answer each question within 300-500 words)**

**Q.1:** Explain the meaning of hypothesis.

**Q.2:** What is the purpose and function of a hypothesis? Explain.

**Q.3:** What are the characteristics of a hypothesis? Analyze.

**Q.4:** Describe the kinds of hypothesis with suitable examples.

**Q.5:** Explain the criteria for formulating a hypothesis.

**Q.6:** How does hypothesis originate? Elaborately explain.

**Q.7:** Do you find any relation between hypothesis and induction? If yes, then analyze it.

**Q.8:** Do you find any uses of hypothesis. Explain.

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