UNIT 5  CONCEPT AND NATURE OF KNOWLEDGE

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5.1 INTRODUCTION

Knowledge and its transmission is a central concern of education. What aspects of the vast fund of human knowledge are to be selected for transmission and what criteria are to be used for selection of critical issues in curriculum planning? In this context, knowing about the philosophical basis of knowledge and knowing various sources of knowledge and their validity become important.

Philosophy is conceived as critical inquiry, and as a second-order discipline, is concerned with the claims of various concrete forms of intellectual activity involving Knowledge. It is an activity of analysis, clarification and criticism of concepts. This view of Philosophy has been inspired by the realization that the results of any sort of enquiry are acceptable only in so far as they are publicly testable, reliable and coherent with the rest of public knowledge. Knowledge must never be thought of merely as vast bodies of tested symbolic expressions. These are only the public aspects of the ways in which human experience has come to be shaped. To acquire knowledge is to become aware of experience as structured, organized and made meaningful in a specific way. The varieties of human knowledge constitute the highly developed forms of curriculum planning and the choice of disciplines. It is necessary to know how knowledge has evolved and epistemological considerations of different forms of knowledge that go under 'Disciplines'.
In this unit, we shall examine human knowledge - its nature, sources and its various kinds. This is the principal task of the branch of philosophy called 'Epistemology'.

5.2 OBJECTIVES

After going through the unit, you should be able to:

- relate 'knowledge' with 'knowing';
- list the requirements of 'knowing';
- differentiate between a priori and a posteriori knowledge;
- explain the different theories of knowledge;
- analyse the different sources of knowledge for their validity and limitations;
- differentiate between a law and a theory;
- cite examples of laws and theories from your subject background (science, maths or social science);
- cite examples of a theory being refuted and succeeded by another theory;
- explain the role of explanation with examples;
- explain the role of assumptions and its limitations; and
- explain the ways of validating the knowledge.

5.3 CONCEPT OF KNOWLEDGE

The nature of knowledge has been a central concern in philosophy from the earliest times. In the history of thought, "Theory of Knowledge" has been construed as a branch of philosophy known as Epistemology. 'Epistemology' comes from the Greek words 'episteme' meaning Knowledge and logos meaning discourse or science. Epistemology is an area of philosophy concerned with the nature and justification of human knowledge. It is that field of philosophical inquiry which investigates the origin, nature of knowledge, methods, validity and limits of knowledge. Epistemologists, historically, have concerned themselves with such questions as: What is knowledge? Is knowledge one or many? What is the structure of knowledge and what are its logical categories? And so on.

5.3.1 Definition of Knowledge

According to the most widely accepted definition, knowledge is justified true belief. That it is a kind of belief is supported by the fact that both knowledge and belief can have the same objects and that what is true of someone who believes something to be the case is also true, among other things, of one who knows it. For example, sun rises in the east is the knowledge or true belief that is supported by the fact which is arrived at through daily observations for millions of years by people.

It is obvious and generally admitted that we can be said to have knowledge only of what is True. If one admits that a proposition (p) is false, it must be admitted that the person did not "know" it and that no one else did, although the person may have thought and said so. Beliefs that merely happen to be true cannot be regarded as knowledge, because knowledge is justified belief.

First of all, knowledge is expressed in propositions.

A meaningful sentence that conveys truth or meaning is said to be a proposition. For a sentence to be meaningful, the words in a sentence should be meaningful. That is, the concepts expressed in the form of words should be true. They should correspond to the state of affairs that is existing at present or existed once upon a time.
A proposition (p) is what the sentence means. Two or more sentences can be used to express the same proposition. It is the proposition that is true or false, but it is the sentence that has meaning or fails to have it. Not every sentence states a proposition. Only sentences that we use to assert something express proposition. For example, a square has four sides that are equal. I know that ice melts on heating.

But in order to understand any proposition, we should first of all know the concepts involved in a proposition.

According to John Hospers, there are two requirements for knowing: (a) objective requirement (p must be true) b) subjective one (one must believe p)

These two requirements are discussed in the following sub-sections.

5.3.2 Requirements of Knowing

a) A proposition (p) must be true.

One cannot “know” p if p is not true. If one says “I know p, but p is not true” - the statement becomes self-contradictory, for a part of what is involved in knowing p is that p is true. Therefore, ‘knowing p is knowing p to be true’.

John Hospers in his analysis of requirements of knowing differentiates the term “know” from other verbs like “believe”, “wonder”, “hope” and so on. For example, one can wonder whether p is true, and yet p may be false; one can believe that p is true, though p is false and so on. Hospers states that believing, wishing, wondering and hoping are all psychological states, which are occurrent and dispositional in nature. Unlike these psychological states, knowing is not merely a mental state. It requires that the proposition one claims to know is true. But the truth requirement, though necessary is not sufficient. For example, one may not know certain concepts in physics like “energy” and “light wave” unless one happens to be a specialist in that area though they are true. But the fact that they are true does not imply that one knows them to be true. Though there are many true statements, one may not be in a position to know that they are true. There are other conditions that are required for knowing a proposition.

b) Not only must a proposition (p) be true; we must believe that a proposition (p) is true.

This is the subjective requirement, which implies that one must have certain attitude towards p - not merely wondering or speculating about p, but positively believing that p is true. There may be numerous statements that one believes but do not know them to be true, but there can be none which one knows to be true, but does not believe them, since believing is a part (a defining characteristic) of knowing. “I know p” implies “I believe p” and “he knows p” implies “he believes p”, for believing is a defining characteristic of knowing. For example, “I know that the Sun rises in the east” implies that I believe in it. But believing p is not a defining characteristic of p’s being true; p can be true even though one does not believe in it.

c) Necessity of evidence or a reason to believe p.

There is a necessity for evidence or a reason to believe a proposition to be true. For example, ‘I know that the sun will rise tomorrow’, ‘I know that ice melts on heating’ have excellent reasons or evidences to believe them to be true, because of their certainty. The knowledge that we gain about the physical world through our senses and our judgements about them amount to be true. But there are other kinds of propositions where only self-experience is involved like, one ‘feeling headache’ or ‘feeling drowsy’ or ‘feeling depressed’, to which one may not require evidence. Knowing these propositions is not well covered by the definition of knowing that require evidence. To
say "I feel pain", the experience itself constitutes all the evidence that one requires. One can know the statement to be true, simply on the basis of having an experience. This holds only for propositions reporting the occurrence of sense-experiences. There are also statements, which are analytical in nature for which evidence is not claimed. The statements of this class are called 'truths of reason' for which evidence is not required. Even if it is required, it is not in the sense as described above. These are truths in the “realm of necessity”. Based on the above analysis of knowledge, one can distinguish three divisions of knowledge, which are as follows:

5.3.3 Three Divisions of Knowledge

Based on the way or manner in which it is obtained, knowledge can be classified under three heads:

1. *A priori Knowledge* is knowledge whose truth or falsity can be decided before or without recourse to experience (a priori means ‘before’). Knowledge that is a priori has universal validity and once recognized as true (through the use of pure reason) does not require any further evidence.

Logical and mathematical truths are a priori in nature. They do not stand in need of empirical validations. Traditional philosophers have regarded a priori knowledge as superior to all other knowledge. The propositions that come under this category of knowledge are known as analytical propositions.

An analytic proposition is one whose truth can be determined solely by an analysis of the meaning of the words in the sentence expressing it and whose truth or falsity can be decided by pure reason without recourse to verification with experience, for example, the propositions “bachelors are unmarried men” or “two plus two equals four”

2. *A posteriori knowledge* is the knowledge based upon observation and experience. This is the knowledge of the scientific method stressing accurate observation and exact description. The propositions that fall under this category can be looked at from the point of view of whether they contain any factual content and from the standpoint of the criteria employed for deciding their truth or falsity. For example, we have propositions like

- Ice melts.
- Snow is white.
- Metals conduct heat and electricity.

These propositions give us factual information whose truth or falsity can be decided only through observation and verification. These are called synthetic propositions.

An analytic proposition is a statement whose negation is self-contradictory. If someone said, ‘Black is not black’ he would be contradicting himself. If a true analytic proposition is denied, one would get a self-contradictory proposition. One can negate the proposition “Snow is white” - assuming that whiteness is not a defining characteristic of snow - we get “snow is not white”, which though false, is not self-contradictory. Thus we get

<table>
<thead>
<tr>
<th>Analytic Proposition (snow is snow)</th>
<th>Synthetic proposition (snow is white)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative : Self-contradictory propositions (snow is not snow).</td>
<td>Negative : False synthetic propositions (“snow is not white”).</td>
</tr>
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It can be clearly demonstrated that mathematical knowledge is of the analytic- a priori type and scientific knowledge is of the synthetic- a posteriori type.

3. *Experienced knowledge* is always tentative and cannot exist prior to experience or be concluded from observation. It must be experienced to have value.
Basic to the three types, is propositional knowledge (a priori and a posteriori) and it is to this type that the structure of the knowledge question is addressed. This has important implications to curriculum planning.

Conflicting systems of philosophy have arisen from different initial choices among the ways of knowing. It is important to know in advance some ideas about the main ways in which knowledge could be related to the things known. There are six theories of knowledge in the field of Epistemology which are as follows:

5.3.4 Six Theories of Knowledge and Truth

a) The Revelation Theory: This view holds that the final test of the truth of assertions is their consonance with the revelations of authority. We recognize this as one of the views, but not the only one, favoured in religious thought. However, weight of authority has played its part in areas other than religion. Aristotle's utterances, for instance, were depended upon for centuries as the sine qua non of wisdom. It is said that even scholars of Galileo's time refused to look through the telescope because Aristotle had not indicated this as permissible.

b) The Coherence Theory: This theory says that a statement is true if it is consistent with other statements accepted as true. Statements, of course, must be "true" to the particulars to which they refer, just as revelations accepted as valid in religion are not necessarily extended to other areas of belief. But on the hypothesis that the entire universe expresses a single unified and rationally consistent order, each statement accepted as true must be congruent with all other statements accepted as true. Thus, in a system of geometry, all propositions are congruent with all other statements accepted as true in that geometry. But geometry does not usually assume that such congruence is to be found everywhere outside geometry, nor even as between different systems of geometry. Certain idealists in philosophy have held the view that the whole universe is a perfect façade of reason in which all particular truths are united into one congruent whole.

c) The Presentative Theory: This view holds that reality as presented to the mind in perception is known directly and without alteration. Errors of perception occur, but further observation is able to detect and explain them. Realists, specifically the neo-realists, favour this view. The presentative view is typical in common-sense thinking; although common sense, with admirable impartiality, may adopt all six of our theories of knowledge as convenience requires. The presentative theory regards such traits as the colors, shapes, and odors of objects, which appear to our senses as true objective characteristics of the objects, except for the occurrence of detectable errors.

d) The Representative Theory: This view, again favoured by certain realists, holds that our perceptions of objects are not identical with them. This differs from the presentative view sketched above which goes the length of saying that when we perceive truly, our perception is identical with the object perceived. This implies that the object perceived literally enters the mind, which perceives it. The representative realist tries to be more cautious on this point. What we see when we look at a tree is only its image. The tree cannot be identical with this image. The image is in one's mind, and the mind is somehow located in the brain; if the tree is fifty feet high, there is not room enough in one’s brain to accommodate it. Although the representative realist does not identify the perception with the object, he believes that the perception usually represents the object with accuracy. The image is usually a reliable replica of the object. Again, we consider that the tree continues to exist whether or not we are seeing it.

e) The Pragmatic Theory: This view holds that statements are true if they work successfully in practice. If an idea or principle is effective in organizing knowledge
or in the practical affairs of life, then it is true. The belief of the pragmatist that the function of knowledge is to guide thought and action successfully is at the root of the important development in American education known as the progressive movement.

The Intuition Theory: This view varies so much in its definition that it sometimes becomes identical with some of the other theories sketched above. At one extreme, intuition refers to a mysterious and immediate inner source of knowledge apart from both perpetual observation and reasoning. In this sense, intuitionism is encountered in some philosophies (e.g. neo-Platonism and Bergsonism), in religion, philosophic spiritualism, and in the twilight areas of mysticism in general. At the other extreme, the term intuition has been used to designate generally accredited and immediate ways of knowing, such as in immediate sensation, or the immediate awareness we may have of some self-evident or axiomatic truth. Thus Aristotle's principle in logic that any object A cannot be at the same time be not-A is said by some to rest on immediate intuition. It does not arise from proof because all proof presupposes it. A related concept denoted by the term "insight" occurs in the literature of modern Gestalt psychology.

5.3.5 Sources of Knowledge

A proposition may be true although one does not know it to be true. By what means, then do we come by knowledge? There are six sources of knowledge, which are as follows:

1. Knowledge through sense experience

We can know many things about the external world, their characteristics and so on through our senses - by seeing, smelling, touching, tasting, hearing and so on. It is through touching and seeing we know that there is a table in front of us. Our senses on various occasions inform us of what a thing's characteristics are. But sometimes we commit mistakes while perceiving things around us through our senses. For example, we may mistake a rope for a snake which is known as perceptual error. Here it is not our senses that have deceived us. We have been led to make judgements that we subsequently found to be untrue. The error lies in the judgement, but not in sensation. All the senses can do is to present us with experiences which requires judgement. The existence of perceptual errors show that our judgement is fallible, but not our senses. When we make a perceptual error owing to incomplete or fragmentary sense experience, it is always further sense experiences that lead us to discover our error. For example, one can get closer and confirm whether it is a rope or a snake so the fact of error based on sense experience does not show that we must appeal to something over and above sense experience; it only shows that we need more sense - experience. Thus one can get the knowledge about the external world through external senses.

There are also the 'internal senses', acquainting us with our own internal states (feelings, attitudes moods, pains and pleasures), as well as our own mental operations such as thinking, believing and wondering. In these cases, sense-organs are not involved in knowing; nevertheless, on the basis of certain experiences one may state certain propositions like "I am having a headache", "I feel sad"; "I feel ill" and so on. In all these cases the fact that we are having the experience in question is the only guarantee we have or need for the truth of the proposition. In general, feelings are occurrent states, and their occurrence warrants one to say that he or she has a headache, or feels sad or ill.

The words that can be used to describe people's 'inner states' or 'modes and emotions' are ‘dispositional words’. For example, "I am in an irritable mood" means that if someone were to annoy me, I would be irritated more quickly than usual. It is
important to make a distinction between occurrent and dispositional state in order to understand knowledge through internal senses. A seed having a potency to grow into a plant, but kept in a jar is said to be dispositional; when it grows into a young plant being provided all favourable conditions, then it is said to be in an occurrent state. Thus we have the knowledge of our inner states of mind which can be occurrent in a situation or dispositional (having the potency or properties) to be something given a chance.

**Knowledge through Reason**

Certain types of knowledge like 'two plus two equals four' are arrived at by means of reasoning. There are two types of reasoning which serve as the source of knowledge (i) deductive and (ii) inductive. The most familiar kind of reasoning, which is often taken as the model for all reasoning is 'deductive reasoning'.

In a deductive argument, the conclusion logically follows from the premises. If the premises are true, the conclusion that follows must be true. For example,

a) 'If it is raining, the streets will be wet.  
   It is raining.  
   Therefore, the streets will be wet.

b) All men are mortal.  
   John is a man.  
   Therefore, he is mortal.

The above two examples represent a valid argument. If one accepts the two premises, one must also accept the conclusion - conclusion follows from the premises. It is important to distinguish validity from truth. In a valid argument, the premises need not be true; it is only required that the conclusion follow logically from the premises. For example,

c) All cows are green.  
   She is a cow.  
   Therefore, she is green.

In this example, the argument is valid, i.e. conclusion follows from the premises. But the premises are not true. Therefore, the conclusion arrived at is also not true. When chains of reasoning are involved, affirmation of the consequent does not logically corroborate the theory. Bertrand Russell demonstrated it through a syllogism which is as follows.

d) If bread is made of stone  
   And if stone is nourishing  
   Then bread is nourishing.

Although the empirical evidence strongly affirms the consequent, we can hardly say that it corroborates either of the premises. Sometimes, the premises may be true, but there may not be valid arguments. For example,

e) India is a democratic country.  
   2 plus 2 equals 4.  
   Therefore, he is driving the car.

In the above example, the conclusion does not follow from the premises, although all premises happen to be true.

In order to know that a conclusion is true, (a) we have to know that the premises are true and (b) the argument is valid i.e. the conclusion follows logically from the premises. In deductive reasoning, the conclusion is, however, contained in the premises in the sense it is deducible for a specific case from the premises. In order to know if the conclusion is true we have to know that all premises are true and that the argument is valid.
ii) **Inductive Reasoning**: In inductive reasoning, the premises provide evidences for the conclusion - but not complete evidence. The conclusion is not certain but only probable to a certain degree. For example,

a) Crow 1 is black.
   Crow 2 is black.
   Crow 3 is black. (and so on for 10,000 crows or more than that)
Therefore, all crows are black.

Similarly,

b) Iron conducts heat and electricity.
   Copper conducts heat and electricity.
   Aluminum conducts heat and electricity.
   (and so on for all metals).
Therefore, all metals conduct heat and electricity.

Here, though 10,000 premises where crow being black are true, the conclusion is not established. It is always possible; the next crow, which we may come across, might be white. Similarly, there may be a metal, which does not conduct heat and electricity.

In inductive reasoning, truth is established based on earlier evidences for something, which is not observed. For example, the proposition like ‘tomorrow the sun will rise in the east’ is made based on so many years of observations of seeing sun rising in east. Though the phenomenon for next day is still not witnessed. Based on the repeated observations. We can say inductively that the sun will rise in the east. This conclusion has some probability on the basis of evidence presented in the premises. In an inductive argument, we rely on certain laws of nature, which are formulated based on certain recurring uniformities in the course of our experience. For example,

i) Green plants prepare their own food.
ii) Water vapourises on heating.
iii) Metals expand when heated.

There are countless uniformities that are quite familiar in our experience, and on the basis of them we construct inductive arguments. In an inductive reasoning, the conclusion is not certain but only probable.

**Authority**: It is not a primary source of knowledge where one experiences knowledge through one’s own reasoning or sense experiences. We accept certain things as true on the basis of authority. But certain precautions have to be observed in the case of knowledge coming from authority (one who has an authority or claim over particular knowledge).

1. The person whose word we take on authority must really be an authority, one who is a specialist in his field of knowledge.
2. Whenever one accepts another person’s statement on authority, he should be able to find out for himself or verify the knowledge. For example, we can empirically check the truth of Einstein’s theory of relativity, though it would take years of special training and experimentation.
3. The authority should be able to provide evidential proof for the knowledge he possesses and explain it in mathematical and scientific language. In other words, the true knowledge should yield to experimental verification and logical explanation.
4. The knowledge claimed by the authority should have acceptance by the community members who are also experts in that area.

“Authoritarianism” asserts that knowledge is guaranteed or validated by authority. Since man is naturally suggestible and is not in a position to verify all of his so-called
"knowledge", it is not surprising that such a source is propounded. Although authority is mentioned as one of the sources of knowledge, it should rather be construed as a source concerning the psychology of belief. It is decidedly weak when compared to sense experiences and reasoning and completely helpless in adjudicating between conflicts of authority which are prevalent in all fields, such as science, philosophy, arts, religion and politics.

Intuition

It is a label for a certain kind of experience when a conviction of certainty comes upon us quite suddenly like a flash. Here also we should exercise certain precautions.

a) Intuitions sometimes conflict. For example, two people can intuit about tomorrow’s weather in different ways. How do we decide which of them is true in that case? If ‘X’ asserts that it would rain tomorrow and Y asserts that it will not, we can wait for tomorrow to find out which of the claims is true. But this we do through sense experience (seeing it rain), not by intuition. Intuition itself provides no way of deciding which of two conflicting intuitions is correct.

b) Knowing by intuition does not really explain “knowing how”. It tells us nothing about the validating procedure.

We have examples from history of scientific investigations (Archimedes principle) and mathematical discoveries where the knowledge was discovered through intuition and proved to be valid also. One can argue here saying, the knowledge was not arrived at as through a flash of thought without certain amount of presuppositions. The problem was contemplated upon for a long period in search of a solution in cases where the scientists were supposed to have intuited. In the process, the scientist must have intuited the solution, which was explained later with sufficient grounds of evidence and reasoning. However, this does not guarantee that every time the scientist intuited, it had carried a valid piece of knowledge.

Revelation

This source has the same problem as intuition. Sometimes one claims to know something by means of revelation. For example, “It was revealed to me in a dream” (or a vision). What if one person had a vision that told him one thing, and another person had a vision that told him the opposite? The fact that the person had a dream or a vision, does not show that its message is true or can be trusted. If what it says is true, its truth can be discovered only by other means.

Faith

This source of knowledge overlaps the previous one having the same problems. “I know this through faith”; “I have faith in it, so it must be true”; “I believe it through faith, and this faith gives me knowledge”. The same difficulty that plagued the claims to knowledge by intuition and revelation occurs here. People have faith in different things and the things they claim to know by means of faith often conflict with one another. Faith is a firm belief in something for which there is no evidence. It is an attitude of belief in something in the absence of evidence. What feeling or attitude one has towards the belief, and whether that belief is true, are two very different things. So it cannot be a valid source of knowledge.
Check Your Progress

Notes: a) Write your answer in the space given below.
    b) Compare your answers with those given at the end of the unit.

1. Describe the kind of sense-experiences, which would be relevant to ascertain
the truth or falsity of the following propositions:
   a) Ice floats on water.
   b) I feel anxious.
   c) Where there is smoke, there is fire.
   d) I feel that God exists.
   e) The weather will be hot tomorrow.

2. Which of the following statements would you be justified in accepting on
authority from some expert in the field? Which would you have to reason to
take on authority at all, and why?
   a) Gold is malleable.
   b) God will reincarnate in some form, to remove miseries from the world.
   c) Some day there will be no more war.
   d) Every even number is the sum of two prime numbers.

3. Analyse the following examples for their source of knowledge and validity of
knowledge.
   a) All dogs are mammals.
      All cats are mammals.
      Therefore, all dogs are cats.

5.4 NATURE OF KNOWLEDGE

By means of sense experience we learn many things about the physical world. We
perceive countless things, processes and events. But if our knowledge ended there,
we would have no means of dealing effectively with the world. The body of knowledge
consists of a series of facts, concepts, principles, classifications, generalizations, laws
and theories. These will be discussed in detail in the sub-sections that follow.

5.4.1 Classification

No two things are exactly alike in the universe in all aspects. Even though they may
be alike, we may still use the characteristics in which they differ as a basis for putting
them in different classes. Similarly, there is no doubt that primitive man’s approach to
temperature was based on his classification of temperature into very hot, hot, moderately
warm, lukewarm, cool, cold and very cold. In daily life, what we do is to use rather
inclusive class words, such as ‘dog’ and then if the need arises, we can make
differences within the class the basis for further distinction, such as “Alsatian,
Pomeranian, German shepherd” and so on; marking out as many sub-classes as found
convenient within the same class.

The classification depends on one’s interests and one’s need for recognizing both the
similarities and the differences among things. Animals are classified in one way by
the zoologist, in another by the fur industry, in still another way by the leather industry.
There are as many possible classes in the world as there are common characteristics
or combinations thereof, which can be made the basis of classification. Nature guides
us in the selection of classes, through certain regularly occurring combinations of
characteristics, which are useful in assigning a name to the combination.
Are classes in nature or are they man made? Classes are in nature in the sense that the common characteristics can be found in nature, waiting to be made the basis for classification. On the other hand, classes are man-made in the sense that the act of classifying is the work of human beings depending on their interests and needs.

5.4.2 Generalizations

A generalization is a statement expressing relationships between or among concepts. To generalize is to treat things that may appear to be different as if they are the same. A generalization may be a rule, law, principle, probability statement or sentence defining critical attributes. Here are some examples:

"Thrones are the official chairs of rulers".

"Elephants, whales and mice are all mammals".

A generalization expresses the relationship among concepts. The knowledge and understanding of the concepts that are related in a generalization are essential steps before the generalization can be understood and subsequently applied to a new situation. The term molecule as used in the molecular theory is a concept.

Generalizations are used by scientists interchangeably with facts because they are based upon so many direct observations and repeatable demonstrations. Some of the scientific generalizations are:

- Heated metals expand.
- Light is refracted when it passes from less dense to more dense media.
- Metals conduct heat and electricity.

Generalizations enable man to construct broader, more inclusive explanations for the phenomena he observes.

5.4.3 Laws

Scientific knowledge begins only when we begin to notice regularities in the course of events. Many events and processes in nature occur the same way over and over again. For instance, iron rusts, chicken lays eggs, lightening is followed by thunder; cats catch mice and the Sun rises in the east. Nature does contain regularities. We are interested in regularities not because we enjoy contemplating them for their own sake, but because we are interested in prediction and control over events. Most of the regularities that we find have many exceptions. They are not invariants. For example, chickens lay eggs, but how many eggs they do lay and at what intervals is extremely variable. The scientific enterprise consists in searching for genuine invariants in nature, for regularities without exceptions so that we can say, "whenever such and such conditions are fulfilled, this kind of thing always happens".

Some scientific statements make assertions about unique events. For example, 'This egg smells rotten'; 'This baby has a temperature of 105°F'. Such assertions are termed singular statements. Other scientific statements offer generalizations about relationships between concepts i.e. they are statements about classes of events. For example, 'curdling of milk can be brought about by the action of bacteria'; 'Aspirin usually reduces fever symptoms'. Such assertions are termed general statements.

Law statements such as Newton's Laws of Motion, Ohm's Law and Boyle's Law belong to the latter class. Each of these laws makes assertions that a relationship exists between two or more concepts; each of the concepts is tied (either directly or indirectly via chain of inference) to observable phenomena.
A law describes a situation which, to use a phrase coined by Norman Feather, 'might conceivably have been otherwise'.

Examples

"Objects fall with increasing velocity".

"Gas pressure is inversely proportional to volume".

These are clear general statements about events of nature, make truth claims which may be checked by experiment.

Prescriptive and Descriptive Laws

Laws of nature are *descriptive*. They describe the *way nature works*. For example, Kepler's laws of planetary motion describe how planets actually *do* move. Laws describe uniformities in nature.

Laws of nature are a smaller class of propositions than empirical statements in general. (Any statement whose truth can be tested by observation of the world is an empirical proposition). Laws of nature are the very basis of the empirical sciences.

**Characteristics of Laws of Nature:**

1. **It must be a true, universal, empirical proposition.**

   It must be applicable to all members of a given class. A proposition about a single thing may be *material* for a law of nature, but it is not a law.
   
   - This piece of iron rusts
   - Some iron rusts
   - All iron rusts

   In behavioural sciences, unlike in the physical sciences, we come across many such singular propositions and very few genuine laws.

   A law must be an empirical truth of the form "All A is B" where B must be connected with A not as a matter of necessity, not a priori but as a matter of contingent fact. The law ‘Metals expand when heated’ is a taxonomy of law statement involving a relationship between classes of objects (‘metals’, and ‘things which expand when heated’).

   The so-called “laws of human nature” on examination turn out to be analytic. Consider “people always act from the strongest motive”. The strongest motive turns out to be the motive from which one acts.

   Even true propositions about some members of a class are not considered as laws of nature. They are called *statistical laws*.

2. **These universal propositions are hypothetical in form.**

   They are usually interpreted as propositions of the "if...then..." form.

   i) "All iron rusts when exposed to oxygen" is actually "If there is iron, it will rust when exposed to oxygen".

   ii) "If molecules are in rapid motion, then finely divided particles suspended in water are seen".

   The hypothetical interpretation of laws can get us into trouble sometimes.

   For example, if p is true then q is true - It is not the case that p is true but q is false. If there is friction, there is heat - It is not the case that there is friction but no heat (true).

   “All unicorns are white” though a universal hypothetical proposition is not a law of nature because there is no evidence from *other laws that this law is true*. 

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3. A law of nature is open-ended. It has an infinite range both in time and space. It is an open class with no structures of time and space.

i) All the chickens in this poultry are white.
   (limited to a definite area in space and time).

ii) All the chickens I have ever had in my poultry are white.
   (It would say nothing about all chickens).
   (They are universal in form but universality restricted in time and space).

The number of things covered is finite and this finiteness may be inferred from the terms of the proposition itself. Evidence for the proposition exhausts the domain of application.

But “all crows are black” does not have these difficulties.

The claim of the laws of nature extends into the future and this enables them to be made the basis for prediction.

4. A law of nature should have some indirect evidence for it.

“All crows are black” is not a law because the only evidence for it is direct evidence.

Laws of Science are not viewed in independence of one another. Together they form a vast body or system with each law mutually reinforcing others.

“All crows are mortal” is supported by much indirect evidence such as the mortality of organisms in general, the biochemical deterioration of tissue, increase in auto-allergenic response. But “all crows are black” relates to their significant regularities of either greater or lesser generality. A crow that was not black would change no other laws known to us but a crow that was immortal would excite considerable scientific surprise because it might force us to reconsider many other laws (about deterioration of tissue etc.) with which it is interlocked. Similarly, “All metals are good conductors” is so fundamentally tied to other laws (of atomic structure) that a counter instance would have far-reaching consequences.

Whether or not something is called a law, then, depends to a large extent on how deeply embedded it is in a wider system of laws.

5. Universal propositions whose degree of generality is greater are more likely to pass as laws.

As explained earlier, the assertions that have more generality can be considered as laws, when compared to singular statement. For example,

“Silver is a good thermal conductor”.

“All metals are good thermal conductors” (more general).

“Tungsten melts at 3370°C.

“All rare-earth metals have higher melting points than the halogens” (more general).

Sometimes one of those conditions works against another and the outcome is not certain.

Einstein refers to the constancy of the velocity of light in a vacuum as a law of nature (limited generality, but a very fundamental item).

The mass of the electron, (not considered a law as its precise value remains largely independent of the main body of science.

5.4.4 Theory

Theories are statements that explain a particular segment of phenomena by specifying certain relationships among variables. A theory is general in its approach it is not
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Specific in nature like facts and principles. It is of a higher order of abstraction than a fact or principle; Theories relate, explain and predict wider varieties of experimental and observational findings in the simplest and efficient way.

Scientific theories serve as means and ends in the development of science. As means they provide a framework, which guide scientists in making observation and discovery. They summarize knowledge and put knowledge in an order within a given field. As ends, theories provide scientists explanations for observed events and relationships for specific phenomena with objectivity. They do so by showing the relationship between variables and explaining how they are related. On the basis of understanding of such relationships, scientists make deductions and predict about what will happen in certain situations under specific conditions. In a scientific theory, predictions are generated and empirically tested.

The most powerful question that we can ask of a theory is not 'Is it true', but 'Is it capable of being proved false?'. According to Karl Popper, it is the ability of a theory to be refuted that is, the most important criterion for judging whether the theory is scientifically sound.

Difference between a law and a theory

The terms Law and Theory are sometimes interchangeably used in science. Newton's \( F = G \frac{m M}{R^2} \) relationship, for example, is frequently referred to as his law of gravitation, occasionally as his Theory of Gravitation.

Nevertheless, it can be argued that in most cases, it is possible to distinguish between laws and theories because they have rather different syntactical structures. In case of laws, overt observational or laboratory procedures are available to give operative meaning to the terms in the relationship, whereas in case of theories, no such direct procedures are possible. For example, it is possible to operationally define the potential difference for Ohm's law (in terms of number of standard batteries in series and mass of metal deposited at an electrode). While in the kinetic theory of gases there are no direct operational procedures for testing the relationship of pressure with the number of molecules per unit volume, molecular mass and the average of the square of the molecular velocity \( p = \frac{1}{3} n \bar{V}^2 \).

In general, we construct or devise theories, but we discover laws of nature. A scientific theory always contains some term that does not denote anything that we can directly observe. If we can observe something only through a telescope or microscope, we are still said to observe it. But if there are no conditions under which we can observe it, it is a theoretical entity; and when the theory-word is a part of a statement, that statement is said to be a theory. For example, protons and electrons cannot be observed, though we do observe many things that are presumed to be effects of them. So the statements about protons and electrons are theory but not law.

Difference between a fact and a theory

A fact is something we already know. It reports a single event (Eg. there is a sun in the sky right now). A theory states things that are not yet observed. (Eg. protons and electrons). It reports an infinite number of events resulting in an universal statement. (Eg. The Sun rises every 24 hours). A scientist makes observations and records them in mathematical language, while a theoretician tries to formulate a general mathematical proposition by incorporating the facts observed and develops his theory by seeing relationships between variables in operation and deriving certain predictions of facts in mathematical propositions.

Theories often offer a crude and general explanation of a phenomenon. They are refined and modified as knowledge in the presence of facts. The discovery of facts is essential in order to determine whether a theory can be confirmed or rejected or
reformulated. A scientist holds the theories tentatively, always prepared to abandon them if the facts do not bear out the predictions and look for a new or improved theory. 

A theory provides means for its own interpretation and verification. In other words, it provides deductions, which can be tested empirically.

It comprises a model which is a mental picture, analogy or mathematical relationship that permits the theoretical concepts to be visualized in more or less familiar terms.

**5.4.5 Explanation**

The great advantage of theories is that they possess tremendous explanatory power. Without them no advances in any field of knowledge would be possible.

**What is a scientific explanation?**

A question seeking explanation begins with ‘why?’. “Why” questions may be a request for reason or a request for explanation. Giving reasons is not the same thing as explaining. Reasons are given for holding beliefs or believing something to be true. Explanation is of events and processes in the course of nature (Why does iron rust? Why do rivers flood? Why does CO kill?).

If a person is rational, the reason he holds a certain belief also explains why he holds it; he wants to believe what is true. But this is not always so. The reason a person may give for belief in a benevolent God (“Why do you believe in a benevolent God?”) may be different arguments for God’s existence. Explanation of why he holds this belief may be that he wants a father substitute or a protector in a cold, harsh world.

“Why” as a request for explanation of occurrences in nature.

Let us consider ‘why’ questions seeking specifically explanation of a particular event.

Why does this book fall if dropped?

*Why did the window break?*

Why does ice float on water?

Our explanation includes:

1. Certain laws of nature or well established general theories (The fragility of glass, the mass and velocity of the object striking it).
2. Certain particular facts (someone threw a stone at the window).

We have to have both of these in order to explain the event.

The particular facts may be known from direct observation or may be a hypothesis. The hypothesis alone does not explain the event without the law nor does the law alone can explain the event without the observed fact or hypothesis.

Since all scientific facts are subject to small errors governed by statistical laws, the best we can ever hope to achieve is to explain why something very much like what happened did happen. The same explanation would apply if a slightly different event took place.

**Explanation of laws of nature**

Sometimes it is not a particular event that we wish to explain but laws of nature themselves.

For example,

*Why do balloons rise?*

*Why does iron rust?*
Why does water expand when it freezes?

Why does sugar dissolve in water?

Here both theories and laws are involved in explaining.

Sometimes we telescope the process-explaining events and then explaining laws.

In either case – explanation of a particular event or a general law – laws and theories are invariably involved. But the law/theory must be one we already accepted and well-established.

Eg. “Why does not this red liquid mix with the transparent liquid?”

Because the red liquid is coloured water and the transparent liquid is gasoline”.

“Because it is red” is unacceptable as an explanation for there is no law of nature according to which transparent liquids will not mix with red ones”.

Sometimes the law may be a law in a loose sense. It may only be a rough-and-ready generalization that is true much of the time but does not hold for all cases.

a) Why does Y have a cold?”

“Because he played with X who had a cold”.

b) “Why were so many members absent from the meeting tonight?”

“There was a conflict with a meeting of another organization to which most of our members also belong”. (There is no “law” here).

Unsatisfactory Explanations

Many times we offer “explanations” which do not really explain. For example,

a) 1. “Why does morphine put people to sleep?”
   “Because it is a soporific”.
   2. “Why does plants prepare their own food?”
   “Because they are autotrophs”.
   3. “Why does a rabbit eat grass”?
   “Because it is a rodent”.

These are name-giving explanations. Instead of information we are giving names ‘soporific’, ‘autotrophs’, ‘rodent’, etc.

Explanation and Prediction

The test of an explanatory principle (law or theory) is that it should have predictive power enabling us to make accurate predictions on the basis of it. (Knowing that water expands on freezing, we can predict the conditions under which water pipes will burst in the future, etc.)

But some laws known to us are very well established and yet virtually have no predictive power (laws involved in the occurrence of earthquakes). This is not because the laws are not known but the specific facts (initial conditions) are not known. On the other hand, Newton’s Law of Universal Gravitation and Atomic Theory have great predictive power.

As far as the logic of the problem is concerned, there is no essential difference between explanation and prediction. The apparent difference is that an explanation refers to something already known to be true while a prediction is a commitment to knowing what is going to happen in the future.

Example, a computer succeeded in “predicting” a storm that would take place several years from now. Whether an explanation is scientifically acceptable is decided by an “yes” to the question “If we knew these theories in time and had all presently known facts available to us, could we have predicted that this particular event or something very much like it, would take place?".

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We can explain an event by means of laws, we can often explain the law by means of other laws or theories and these in turn by other laws and theories and so on. But soon our knowledge comes to a stop.

Why did the pipes burst? (Water expands on freezing)
Why does water expand or freezing? (Theory about the structure of the water molecule).

It appears that there are basic or ultimate laws of the universe that cannot be explained by any other laws. But we can never be sure that any law that actually confronts us is basic. Tomorrow it may be explained by means of another (Newton’s law of Universal Gravitation is a special case of Einstein’s Theory of Relativity).

If a certain law is really an ultimate one then to request an explanation of it is self-contradictory. To explain a law is to place it in a context of a wider and more inclusive law. A basic or ultimate law is by definition one of which this cannot be done. One always explains in terms of something else. It is logically impossible to explain when there is no something else in terms of which to do the explaining.

The hierarchy of explanations

Explanations form a hierarchy where the facts on the lowest level are explained by theories (Kepler’s laws of planetary motion, Galileo’s law of free fall, law of tides) and then each theory in turn is explained by the theories on a higher level (Newton’s Laws - Relativity Theory - Unified Field Theory) until we reach the limits of our present knowledge.

As already stated, the process of explaining a theory by another higher theory is similar to explaining a single fact by a theory and is governed by the same four rules viz.

1. A general theory
2. Should be well-established
3. Facts which are known independently of the facts to be explained and
4. Fact to be explained to be a logical consequence of the general theories and of the known facts.

The only difference between explaining a single fact and a theory is that in the case of the latter we use the higher theory to explain not a single fact but a theory and what we deduce from the higher theory is not a fact but a general theory.

Features of this hierarchy

1. The higher theory is an improved theory. It is more accurate and explains the deviations from the earlier laws also. (Eg. Planets moving in elliptical orbits and also deviations).
2. The higher theory covers more ground than all the lower ones put together. It has wider applicability (motion of comets or bullets).

The role of “purpose” in explanations

Our dissatisfaction with many scientific explanations (“Science only tells us how things happen it cannot tell us why things happen”) may be traced to our relating explanations to the concept of “purpose”.

Teleological (purposive) explanations are the oldest type of explanations. For example, storms and other natural catastrophes were thought to be explained by the wrath of
God in order to take vengeance on human beings etc. We no longer use such explanation for natural events. But we do explain events in the human realm by bringing in purpose. “Purpose” means “intent of a conscious being” or “function”. Purposive explanations are acceptable only when there are conscious beings who can conceive purposes and carry them out. In science, they have no value, unless we know what the purpose of the universe or God’s will is.

The test of a good explanation is whether we could have predicted the event with the given theory and known facts. Neither of the two theories (purpose of the universe, God’s purpose) help us in predicting future events. But if we know the purpose, then we no longer have to make use of the given type of explanation. Eg. “God wills it that there should be a major war once every twenty five years”. Suppose 20 years have elapsed and there has been no war, we should then predict that there is going to be a major war within the next five years. We now have a correct scientific explanation but the relevant part of the explanation is

“There is a major war at least once every twenty five years” (Theory).

“There has been no major war for the last twenty years” (Fact).

That the theory is part of God’s will plays no role in the explanation.

5.4.6 Succession of Theories

A theory is formulated by a scientist through the process of induction which explains the observed facts. For example, Galileo’s law of free fall and law of the tides. All these explained certain known and observed facts. Then Newton asked “why” and constructed a theory which explained all three of the previous theories. This process is similar to that governed by the rules which we use to explain a theory, not a single fact. In other words, what we deduce is not an isolated fact, but a general theory. From Newton’s various laws, we can deduce all the laws of Kepler, Galileo’s law and the law of the tides. Later Einstein formulated his general theory of relativity from which he could deduce not only Newton’s laws, but also laws about the motion of rays of light. Thus, we get a hierarchy of explanations, where the facts on the lowest level are explained by theories, and then each theory in turn is explained by the theories on a higher level until we reach the limits of our present knowledge.

The second notable feature is that ‘higher’ theories cover more ground than all the lower ones put together. This could be seen from Einstein’s theory of Relativity. Even if a single theory were found to unify our body of knowledge, we would still strive to improve this law in a specified direction, broaden it and make it more accurate.

But there are certain things, which cannot be observed, yet we do not deny their entities (electrons). All the things we see and touch are composed of very small particles that no longer be sub-divided, which we cannot see with our naked eyes. But if we assume that they exist, we can account for enormous number of different things that we do observe. The atomic theories of Democritus (460 B.C.) and Lucretius (96-55 B.C.) were primitive but the principle involved was no different from that of modern theories. The unobserved was invoked to explain the observed. More refined atomic theories today have explained countless phenomena undreamed of by the ancients.

Coming to other theories, Freudian psychology has as its first premise that there is a vast reservoir of unconscious mental events consisting of three states of mind; id, super ego and ego. This is a theory, since these states of human psyche cannot be observed. Yet in postulating these entities, Freudian Psychology endeavours to explain a vast number of psychological phenomena like mental conflicts, neuroses, dreams, moods, depression, slips of the tongue and so on, on the basis of a comprehensive theory involving these concepts.
In either case, it is important to remember that the theory contains more than the observed facts that are explained by means of it. A theory that was merely a summary of the observed facts already known will have no explanatory power whatever.

A theory can be refuted or falsified by a new theory which is more justifiable, and scientific. An existing theory can be replaced by a successive new theory with its better explanatory power (The criterion of the scientific status of a theory is its falsifiability or refutability or testability. For example, Einstein's theory of relativity has satisfied the criterion of falsifiability.

### Check Your Progress

**Notes:**
- a) Write your answers in the space given below.
- b) Compare your answers with those given at the end of the unit.

4. Which of the following propositions would you consider to be laws of nature? Why?
   a) Iron rusts when exposed to oxygen.
   b) Gold is malleable
   c) All human beings are mortal.
   d) All oceans contain water.
   e) All white cats with blue eyes are deaf.

5. Which of the following 'why' questions are requests for a reason, and which are requests for an explanation?
   a) Why did the water boil? Because I lighted a burner under it.
   b) Why do you think it will rain this afternoon? Because dark clouds are gathering.
   c) Why did you go to see a movie? Because I want to be happy.
   d) Why do birds build nest? Because they wanted to lay eggs.

### 5.5 Validation of Knowledge

We have seen that knowledge is obtained through sense experiences, reasoning, authority and other sources. How do we confirm that the knowledge obtained through these sources is valid?
Verification, Confirmation and Refutation:
(Empirical and Logical)

Can a statement be verified? Can every statement stating knowledge be verified? What is wanted is a rule or principle which will tell us what sorts of statements have or do not have empirical content, for we cannot examine every individual statement. It is easy to verify statements like "this pot of water will boil at 100 degrees centigrade", since it has empirical content. We can find out whether the statement is true or false by taking the pot of water, heating it and measuring its temperature when it boils.

How about statements like two plus two equals to four? It has no empirical content. But this is an analytical statement and its truth can be shown by purely formal methods. Not all statements are so straightforward as the above empirical statement. Consider statements like "all water is composed of hydrogen and oxygen"; "Saturn is made of green cheese. In the first case, how could we analyse all the water there is to see if it is composed of H₂O? In the second case, we cannot go to Saturn to look or taste.

To verify a proposition is to make such observations, which would entitle us to conclude definitely that the p is true or false. To confirm it is to make one or more observations that would increase or decrease the probability of its truth or falsity without definitely establishing it either way. If 50 marbles out of 100 are found to be black, we have only confirmed but not verified the proposition that all the marbles in the bag are black. It is not verified until one has examined the entire 100. Verifying and confirming are both things we do, operations we perform. We cannot verify or confirm pnt* we know the meaning of the statement to be verified or confirmed. What the testability criterion prescribes is that we know the meaning only when we know how it would be verified or confirmed, whether any one has actually done so or not. Considering the example of a star which is 1000 light years away, it is empirically impossible for us to discover what is occurring on the surface of that star today, since at the rate of 186,000 miles per second the light leaving the star today will not reach the earth for 1000 years; yet we say that there are spots on the surface of the star today. This is not meaningless.

What is required is logical possibility of verification. So, it is possible to verify a statement for its true knowledge logically, though empirically not possible.

There are certain issues to be considered in verification, which are as follows:

a) When must the verification take place?

This is an important consideration, for no statement about the past or the future can be verified now.

"Julius Caesar was assassinated in 44 BC".

This statement describes a past event. It is true that we are not in a position to verify it, since it would require our being present at the Roman senate in 44 B.C., which is logically impossible for us to do now. The sentence is about a past event, but any evidences we may find of the statement are present evidences, because nothing will bring us back to the past. The most we can do in the present is to confirm it, that is find some evidence as to whether it is true.

The same provison will help us with regard to statements about the future.

"There will be a severe economic depression in the world within the next five years".

This statement cannot be verified now, though it has a meaning. But it can be verified in the future and this is sufficient to make it meaningful according to the criterion. In general, with statements about the future, we simply wait and observe what happens at the time predicted.
b) By whom must the verification be performed?

The idea of verifiability by only one has been considered somewhat suspect in the fear that it would permit many statements as meaningful, which should not be so permitted. For example, 

“I verified the p that infinity is like glass, because I experienced it today”.

But we should keep clearly in mind that any such statement must be about one’s feeing – states only, and that it makes no claims to an objective reality apart from that which could be tested by someone else. Concerning one’s own experiences (I have a toothache; I feel the pain) it would seem preferable to say that one doesn’t need to verify them rather than that one verifies them by introspecting, reassuring oneself that one feel pain and so on. We talk about verification when we are confronted with a statement about something other than our own experiences, when we have to find out through some procedure whether the statement is true.

c) How can statements with an infinite or indefinitely large range ever be verified?

Consider the example, “all crows are black”.

There are not an infinite number of crows, but the class is open-ended. Besides, one could not examine future crows as well as all the crows that lived and died before one’s birth.


d) There is a small but peculiar class of statements whose verifiability has a different status in the affirmative than in the negative.

Consider the statement “the earth will continue to exist even after living things no longer exist on it”.

No human being can verify this statement, since no one would be there to verify it. Still we do know what the statement means and can speculate about its truth. We can draw a picture of the earth without living things on it. It is logically impossible to verify this for there would be no one to do the verifying. It is necessary for certain state-of-affairs to occur (present), or to have occurred (past) in order to make a statement true but it is not verifiability. Verifying is something we do, and it requires someone present to do the verifying.

Confirmability

In view of such difficulties, we speak of confirmability instead of verifiability. For example, one cannot verify that “all crows are black”, but one can confirm it by examining thousands of crows and finding all of them to be black. One cannot verify that some day there will be no life on earth, but one can confirm it now by noting that inanimate objects constantly go on existing even after living things die and infer that when the heat and light of the Sun is exhausted, the earth will become too cold to support life. It is easy to see how we can confirm laws of nature (sun rises in the East; water boils at 212° F and so on) not how we could verify them.

Confirmability also involves some special problems of its own. How can I know that observing that this crow is black is a confirmation of “all crows are black” unless I already know what “all crows are black” means? If one does not already know what the statement to be confirmed means, how can one exclude any observation that is put forth as confirmation of it? This implies that

a) One must know whether “p” describes a logically possible situation before one can know whether it is logically possible to test it.

Whether p is logically possible is a priori consideration to whether it is logically possible to test it. One has to know what a sentence means before one knows what observations
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would verify or confirm it. Knowing what the sentence means is primary, and knowing how to verify it, is a consequence of knowing its meaning.

In conclusion we can say that verifiability or confirmability criterion, as a general criterion of meaning will not suffice,

i) It will not cover analytic statements, since they are not verified by observation of the world at all.

ii) It will not cover non-assertive sentences such as question, imperative and exclamation. Since these assert nothing, there is nothing that could be true or false.

iii) It will not cover statements about one’s own experiences, since these are not verified in any easily intelligible sense of “verified”.

iv) It will not cover statements such as “this is good” or “this is praiseworthy” which are of an entirely different order. They are value statements.

v) It will not cover metaphysical statements.

The only area in which verifiability or confirmability is plausible is in reference to empirical statements such as one made in daily life and in science.

Refutation

Knowledge that is expressed in the form of laws or theories can be refuted on the grounds of incompatibility of an event with the theory. It is easy to obtain confirmation or verification for nearly every theory — if we look for confirmations, confirmations should count only if they are the result of risky predictions, i.e., to say, if unenlightened by the theory in question. When the event is incompatible with the theory in question, it can be refuted. Confirming evidence should not count except when it is the result of a genuine test of the theory, and this means that it can be presented as a serious but unsuccessful attempt to falsify the theory (in such cases of corroborating evidence).

Every genuine test of a theory is an attempt to falsify it or to refute it. Testability is falsifiability. But they are degrees of testability. Some theories are more testable, more exposed to refutation than the others.

In his classic work Conjectures and Refutations, Popper uses Marx’s theory of Society and Freud’s theory of human behaviour as outstanding examples of theories, which fail to meet this important criterion. If political event X occurs, (or human behaviour Y is displayed), then Marx (or Freud) provide a ready explanation. If X or Y do not take place, when they were expected to, then (using a different chapter and verse of the relevant text) that can be explained. Such theories are incapable of making definite and therefore, falsifiable, predictions. In attempting to explain everything, they explain nothing.

5.5.1 Assumptions and their Limitations

Assumption means taking for granted the truth of a proposition for the sake of the argument. The earlier Latin logicians used this term as a technical name for the minor premise of a syllogism. Later this term was used in a double sense to designate the mathematical truths serving as the point of departure in a proof and to designate the starting point of any deduction in abstraction from the question of the truth or falsity of the statement. It is this sense of meaning, which is commonly taken. Assumption is accepted as having the least specific meaning in the family of terms like Axiom, Hypothesis and Postulates. Some of the scientific theories are based upon certain assumptions.

At the same time, we have examples like “Laws of Nature” where no assumption is needed to assure us that nature obeys certain laws. A Law is no more than a description of what actually happens. Let us consider an assumption that the law of nature or
some laws of nature are continuous. This is a very interesting assumption. Although it has factual content, it is impossible to disprove the assumption. Since human beings can make only a finite number of observations, we find ourselves in a position where we can always keep the assumption that laws of nature are continuous. Another example of non-empty assumption is the assumption that the space we live in has 3 dimensions. Physical evidence convinces us that we live a space of at least 3 dimensions. But we cannot get conclusive evidence that there are no more dimensions. We can only say that everything we have observed so far can be explained satisfactorily with laws assuming only three spatial dimensions.

If the basic assumption is true, the conclusion that follows through deducibility would also be true. If the assumption is false, or built upon false premises, the conclusion that follows would also be false. However, the rules of deducing a true case from the basic assumption should be valid. There are cases where propositions are true, but it may not be possible to deduce a specific case, as each of the proposition may stand independently as a true state of affaire.

The assumption can never be proved complete (eg. three dimensional world and infinity of observations related to certain natural phenomena).

5.5.2 Sharing of Knowledge and its Growth

That human knowledge presents many problems is evident even to the least reflective man of 'common sense'. Man discovers through his experiences, reexamines the knowledge when in doubt, discards his theory in the advent of new ideas and theories and so on. Man has over millennia objectified the various conceptual schemata acquired through the experienced knowledge and progressively developed these and shared them through explanation. The brilliant results of nineteenth century science which brought forth the machine, the locomotive, the radio, television, radar and release of atomic energy, all made an epistemology along empirical lines, examined by men like Max Planck, Albert Einstein, Werner Heisenberg, Bertrand Russell and others. Sigmund Freud showed that unconscious factors dominated thought and thinking. Karl Marx showed that society and economic conditions direct the thought of society's members. Man's interaction with physical and human phenomenon around through using different sources has resulted in different forms of knowledge as cited above.

The distinctions between the various forms of knowledge, which principally govern the scheme of education, are based entirely on the analysis of their conceptual, logical and methodological features. The forms of knowledge contribute in their own way to cognitive and moral understanding, thereby resulting in development of all human aspects.

5.6 LET US SUM UP

Epistemology is that branch of philosophy, which deals with theories, sources, and the validity of knowledge. Knowledge is expressed in the form of propositions. In order to know a proposition is true, one must know the words involved in the propositions and the concepts underlying the words. There are certain requirements for knowing a proposition, that is, a) the p must be true, b) we believe that p is true and c) there is evidence or reason to believe p. Knowledge is categorized broadly into three divisions depending upon the ways it is obtained. They are a) A priori knowledge, b) A posteriori knowledge and c) Experienced knowledge.

There are six theories of knowledge based on the sources of knowing sense experience, reason, authority, intuition, faith and revelation. Among these, the knowledge through sense experience and reasoning were considered to be the most reliable sources of knowledge.
The knowledge that is accumulated through man’s different ways of knowing consists of various concepts and facts, related to physical phenomenon and human being evolved through continuous observation of natural events in life. True knowledge provides for its own interpretation, verification and explanation. The laws and theories provide explanation of occurrences in nature. Explanations form a hierarchy where the facts on the lowest level are explained by theories, and each theory in turn is explained by the theories on a higher level in a logical manner. Verifiability and confirmability criterion is applied to test the knowledge for its validity. Knowledge with its distinctive features of concepts, facts, generalizations, laws and theories get structured in different forms of knowledge (a-priori, a-posteriori and personal knowledge) under different disciplines. This has great implication to curriculum planning and understanding of the methods and domain of a discipline.

5.7 UNIT-END ACTIVITIES

1. Analyse the primary school curriculum and identify examples of a priori knowledge and a posteriori knowledge.
2. Analyse the secondary school curriculum and identify the contents where theories have been explained. Find out the assumptions behind those theories.
3. Give some examples from secondary school curriculum where verification, confirmation and refutation can be used to validate knowledge.

5.8 POINTS FOR DISCUSSION

1. How is the structure of knowledge and its sources useful for a classroom teacher?
2. Implications of structure of knowledge and its different forms to curriculum planning.

5.9 SUGGESTED READINGS


5.10 ANSWERS TO CHECK YOUR PROGRESS

1. a) This is an empirical statement. To know the truth or falsity of this statement one can observe for oneself using the sense experiences and ascertain whether iron conducts heat and electricity or not.
   b) This proposition indicates the inner state of a person who is undergoing a feeling of 'anxiousness'. This cannot be observed directly as there is no direct empirical object concerning anxiety. But one can still understand the anxiety 'which is in 'occurrent' state that is manifested indirectly through facial expressions and movements.
   c) Where there is smoke, there is fire – this proposition can be tested through deductive reasoning. This proposition forms the major premise from which the logic of the argument leads to a specific conclusion. Where there is smoke, there is fire (major premise). This mountain has smoke (minor premise). Therefore there is fire on the mountain (conclusion). The conclusion can be verified through sense experience also.
d) I feel that God Exists – This proposition does not yield to either sensory experience or reasoning. It is a feeling state like ‘belief’.

e) The weather will be hot tomorrow – This proposition is intuitive in nature, which does not yield to immediate verification. One has to wait till tomorrow to know about the weather condition.

2. ‘a’ and ‘d’ may be considered as they are proposed by knowledge authorities in the field.

3. a) Reasoning - But the knowledge expressed in the example is not a valid truth. It lacks valid argument even.
   b) Reasoning - Inductive in nature.

4. a, b, c, d are laws of nature, as it has been observed since millions of years that the occurrences have never failed to be so.

5. ‘a’ and ‘c’ are the questions asking for Reason.
   ‘b’ and ‘d’ are the questions asking for Explanation.

6. Knowledge is validated though the process of verification, confirmation and refutation.

7. Assumption means taking for granted the truth of a proposition for the sake of argument. For example, the law of nature is continuous.