

AIMS AND OBJECTIVES OF SCIENCE TEACHING:

Education is imparted for achieving certain ends and goals. Various subjects of the school curriculum are different means to achieve these goals. Aims are like ideals. Their attainment needs a long-term planning. Their realization is not an easy task. Therefore they are divided into some definite, functional and workable units named as objectives. The objectives are those short-term, immediate goals or purpose that may be achieved within the specified classroom situation. They help in bringing about behavioral changes in the learners for the ultimate realization of the aims of teaching science.

AIMS	OBJECTIVES
Aims are long-term statements of purpose that may be achieved over a long period of time, say one or more years. Example - Developing a sense of inquiry in learners is an aim that may be achieved over a number of years.	Objectives are bound in a short and specified time says one teaching-learning period or during teaching-learning of one chapter. Example - conducting an activity to generate a question.
The aim is a foreseen end.	Objectives are influenced by aims.
Aims are broader in sense.	You may need to state a number of objectives to achieve one aim. In this sense, objectives are narrower.
It may or may not be easily observable and measurable	Learning objectives are easily observable and measurable.
Assessment of all the aims may not be objective in nature.	You can carry on the process of assessment objectively to know whether the objectives have been achieved.

The objectives for teaching science in the school curriculum are as follows

- Towards a better understanding of the nature of science
- Towards the acquisition of skills
- Towards the development of scientific attitudes
- Towards training in scientific method
- Towards the development of interest and appreciation
- Towards helping the student fit themselves better into society
- Towards helping students develop suitable career interest
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AIMS OF SCIENCE EDUCATION :

National Curriculum Framework (NCF-2005) proposed five guiding principles for curriculum development:

- i)connecting knowledge to life outside the school;
- ii)ensuring that learning shifts away from rote methods;

iii)enriching the curriculum so that it goes beyond textbooks

iv)making examinations more flexible and integrating them with classroom life;

v)nurturing an overriding identity informed by caring concerns within the democratic polity of the country.

The entire teaching-learning process at school level revolves around these five guiding principles. NCF emphasized that “teaching of science should be recast so that it enables children to examine and analyze everyday experiences. Concerns and issues pertaining to the environment should be emphasized in every subject and through a wide range of activities involving outdoor project work. Some of the information and understanding flowing from such projects could contribute to the elaboration of a publicly accessible, transparent database on India’s environment, which would in turn become a most valuable educational resource. If well planned, many of these learner projects could lead to knowledge generation.

It means, science teaching should be organized around learners’ experiences and opportunities should be provided to learners to explore science around them. This marks a clear shift from classroom and laboratory centered science pedagogy. Integration in science teaching-learning is very important and scientific knowledge should not be compartmentalized in subject domains like physics, chemistry, biology, environmental science up to secondary level.NCF-2005 and Position Paper of National Focus Group on Teaching of Science(2006) have proposed 6 criteria for validity of a science curriculum i.e. cognitive ,content, process, historical, environmental and ethical. On this basis, following general aims of science education have been conceptualized:

Science education should enable the learner to:

- know the facts and principles of science and its applications, consistent with the stage of cognitive development,
- acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge,
- develop a historical and developmental perspective of science and to enable her to view science as a social enterprise,
- relate to the environment (natural environment, artifacts and people),local as well as global, and appreciate the issues at the interface of science, technology and society,
- acquire the requisite theoretical knowledge and practical technological skills to enter the world of work,
- nurture the natural curiosity, aesthetic sense and creativity in science and technology,

•imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment,

•cultivate ‘scientific temper’-objectivity, critical thinking and freedom from fear and prejudice.{**Aims of Science Education, Position Paper, National Focus Group on Teaching of Science (2006) p. 11.**}

Aims :

The aims of the teaching and study of sciences are to encourage and enable students to:

- develop inquiring minds and curiosity about science and the natural world
- acquire knowledge, conceptual understanding and skills to solve problems and make informed decisions in scientific and other contexts
- develop skills of scientific inquiry to design and carry out scientific investigations and evaluate scientific evidence to draw conclusions
- communicate scientific ideas, arguments and practical experiences accurately in a variety of ways
- think analytically, critically and creatively to solve problems, judge arguments and make decisions in scientific and other contexts
- appreciate the benefits and limitations of science and its application in technological developments
- understand the international nature of science and the interdependence of science, technology and society, including the benefits, limitations and implications imposed by social, economic, political, environmental, cultural and ethical factors
- demonstrate attitudes and develop values of honesty and respect for themselves, others, and their shared environment.

Aims of a Science education for all (from age 11 to 16) are:

- to excite and enthuse children with a sense of awe and wonder at the natural world.
- to develop an appreciation of how science has contributed to the historical and cultural development of our society.
- to give practical experience of how scientists make observations of the natural world, come up with hypotheses and do experiments to obtain evidence to support or disprove these hypotheses.

- to cause children to understand the importance of evidence when making decisions and to be able to judge whether the claims of the media, advertisers, politicians, journalists, etc, are evidence-based and reliable.
- to give pupils enough evidence-based knowledge to be able to make informed personal judgements in order to lead healthy, safe, comfortable and environmentally sustainable lives.
- to develop awareness of the conclusions of important scientific theories in a concrete and accessible way.

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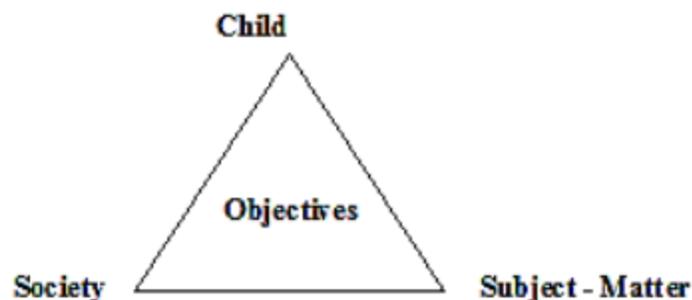
Education is imparted for achieving certain ends and goals. Various subjects of the school curriculum are different means to achieve these goals. The term aims of teaching science stands for the goals, targets or broader purposes that may be fulfilled by the teaching of science in the general scheme of education. Aims are like ideals. Their attainment needs a long-term planning. Their realization is not an easy task. Therefore, they are divided into some definite, functional and workable units named as objectives. The objectives are those short-term, immediate goals or purposes that may be achieved within the specified classroom situation. They help in bringing about behavioural changes in the learners for the ultimate realization of the aims of teaching science. The aims are broken into specified objectives to provide definite learning experiences for bringing about desirable behavioural changes.

TAXONOMY OF EDUCATIONAL OBJECTIVES

Based on the above clarification, objectives related to education as a whole, are known as 'educational objectives'. In the words of B.S.Bloom "By educational objectives, we mean explicit formulations of the ways in which students are expected to be changed by the educative process, that is , the ways in which they will change in their actions". In order to save time and effort, it is very important that the objectives of a subject be clearly identified and defined.

The formulation of educational objectives is a matter of careful choice on the part of the teachers and administrators. The following factors are involved:

1. The needs and capabilities of the pupils.
2. The specific demands of his social environment.
3. The nature of the subject matter.



The criteria of a good educational objective is that it is,

1. In accordance with general aims of education
2. Unambiguous
3. Useful
4. Specific
5. Feasible

CLASSIFICATION OF EDUCATIONAL OBJECTIVES

Educational objectives indicate the nature of the education system and show the direction in which education will act. Educational objectives serve as guides for teaching and learning. These also develop awareness among the teachers about the importance of their work and provide guidelines in selecting teaching-learning activities. For teaching which aims at worthwhile behaviour changes, a clear understanding of educational objectives is essential.

Some educators have attempted classification of educational objectives. Classification is a valuable system to group similar things under one heading based on common characteristics or common relationship that exists between groups and individuals.

The main functions of classifying educational objectives are as follows.

1. It is helpful in planning curriculum.
2. It is helpful in planning, teaching and learning activities.
3. It is helpful in identifying desired behavioural outcomes among the learners.
4. It is helpful in preparing evaluation or testing materials.
5. It is helpful in comparing curricular goals with wider educational objectives.
6. It is helpful in the search for the relationships that exist among groups and individuals.
7. It is helpful in defining, translating and exchanging educational thoughts in a uniform way.

BLOOM'S TAXONOMY

A number of attempts have been made by experts in the field of classification of educational objectives. Perhaps the most widely used system of classification of objectives is the one prepared by a group of college and university teachers and later reported in "Taxonomy of Educational Objectives" (1956) edited by Benjamin S. Bloom. 'Taxonomy' is a term derived from two Greek words 'taxis' meaning 'arrangement' and 'nomos' meaning 'law'. In this derivative sense, taxonomy means 'orderly arrangement'. They classified the educational objectives into three broad categories or domains.

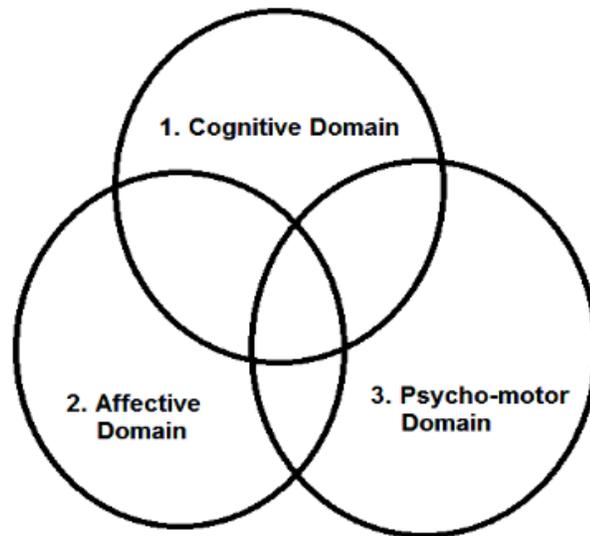
The Domains are:

1. Cognitive Domain (knowing)
2. Affective Domain (feeling)
3. Psycho-Motor Domain (doing)

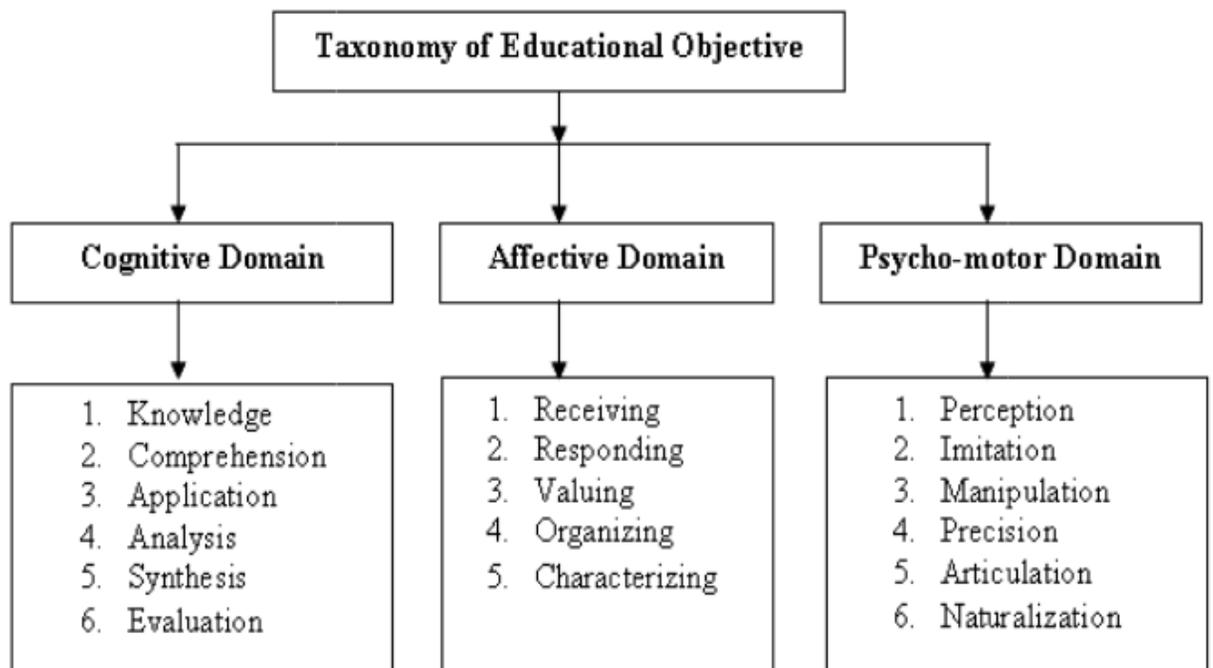
These domains are hierarchical because when learning takes place, the first activity is a mental process of trying to understand, analyze, synthesize and associate the information with something already known. This thought process comes under cognitive domain.

In the second stage, the knowledge acquired begins to produce changes in the interest, attitude and feelings of the individual. These types of behavioural changes are grouped under affective domain. In the third stage, the feeling acquired gives way to exhibit muscular skills and manipulative skills. These changes are grouped under psycho-motor domain.

Besides, the above classification, each domain can be further split up into major categories which are also hierarchical. The major categories are as follows.



Bloom's Taxonomy



CATEGORIES IN THE COGNITIVE DOMAIN

The arrangement in this category can be observed as follows.

Knowledge

This is the first and the lowest level of cognitive domain. It includes recall of information such as specifications, facts, methods, processes, generalizations, patterns etc., and thus the knowledge objective emphasizes what can be described as memory.

Comprehension

This second category includes Translation, Interpretation and Extrapolation. This is also related to the use of ideas. It refers to a type of understanding of the materials or literal message contained in a communication.

Application

The third level includes the ability to apply abstract ideas to a concrete situation. The abstractions may be in the form of general ideas, rules or procedures or generalized methods.

Analysis

It means the “break down of the materials into its constituent parts and detection of the relationships of the parts and of the way they are organized. “Analysis includes analysis of elements, analysis of relationships and analysis of organizational principles.

Synthesis

This category is just the opposite of analysis. Synthesis is the “Putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts, elements and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before”.

Evaluation

It is the assignment of symbols to phenomenon, in order to characterize the worth or value of a phenomenon, usually with reference to some social, cultural or scientific standards. Evaluation involves judgments in terms of internal evidence as well as external criteria.

To conclude, it may be pointed out that the above six major categories in the cognitive domain do not always appear in the isolation from one another.

CATEGORIES IN THE AFFECTIVE DOMAIN

The arrangement in this category can be observed as follows.

Receiving

This is at the lowest point on the affective domain. Receiving may be defined as “Sensitivity to the existence of certain phenomena and stimuli, that is, the willingness to receive or attend to them”.

Responding

Responding refers to a behaviour which goes beyond merely attending to the phenomena; it implies active attending, doing something with or about the phenomena, and not merely perceiving them.

Valuing

Valuing implies “Perceiving them as having worth or value. The three sub-categories of this objective are acceptance of value, preference for a value commitment.

Organising

This involves building up of organized system of values. The individual organizes a set of values such as truth, goodness and helping others in determining their relationships and deciding their need and priority.

Characterising

In this category, the individual displays the integration of values and it becomes a lifestyle with him. He gets these values organized into some kind of internally consistent system, which has controlled the behaviour of the individual for a sufficient time. This category is concerned with one’s view of the universe and one is philosophy of life.

CATEGORIES IN THE PSYCHO-MOTOR DOMAIN

The arrangement in this category can be observed as follows.

Perception

Skill of keen observation, skill of sensing a problem and skill of developing self-motivation are the specific objectives under this category.

Imitation

Skill of repeating the actions and skill of reflective thinking are the specific objectives under this category.

Manipulation

Skill of operating upon the intelligence and manage cleverly by using unfair method are the specific activities that fall in the category.

Precision

Skill of experimentation, skill of précised movements and neat execution of skills are the activities that fall under this objective.

Articulation

Skill of global thinking, reflective thinking, skill of mind and body and the development of mathematical skills are specific objectives of this step.

Naturalization

As we practice a skill, in due course it becomes our natural habit. Skill of attaining success and skill of multiple actions are the specific activities under this objective.

Since science is a study usually involving direct experimentation, the psycho-motor domain has got great relevance.

Although there are various educational objectives classified under the three domains, the objectives of the teaching of science are different for different levels of education.

OBJECTIVES OF SCIENCE EDUCATION AT VARIOUS LEVELS

Levels	Cognitive	Affective	Psycho-Motor
K.G.	-----	Receiving and Responding	Observation
Primary (I, II, III and IV)	Knowledge and comprehension	Receiving and Responding	Observation
Higher Primary (V, VI & VII)	Knowledge, comprehension and application	Receiving and Responding	Observation and induction

Secondary (VII, IX & X)	Knowledge, comprehension, application and analysis	Receiving, responding and valuing	Observation, induction and deduction
Higher Secondary (XI & XII)	Knowledge, comprehension, application, analysis, synthesis and evaluation.	Receiving, responding, valuing, organizing and value orientation.	Observation, induction and deduction.

AIMS OF TEACHING SCIENCE AT DIFFERENT LEVELS

The whole process of the teaching of the science directs the students towards these objectives. These objectives are guided by the content materials of the curriculum, lessons and topics. Various standards and stages of education of science for the primary classes shall be different from the objectives of the teaching of science at the secondary stage of education. Principles of education are applied in the field of education up to secondary stage only. Teachers who teach up to secondary classes have to acquire a degree in teaching or education. Teachers in the field of higher education are not required to possess any such degree. We shall, therefore confine our stage up to secondary stage of education. Up to the secondary stage of education, we have three stages,

1. Primary stage.
2. Junior High School or Lower Secondary stage of education consist of classes VI to VIII.
3. Secondary stage of education consists of classes IX to XII.

Primary Stage of Education and the Objectives of the Teaching of Science

The objectives of the teaching of science are different for different stages of education. While laying down the objectives for the teaching of science for primary classes, we have to keep in mind the psychological requirements of the students of this age group. It is also necessary to keep in mind the capacity of these boys of the tender age to adapt themselves to their environment.

Following are generally accepted as the objectives of the teaching of science.

(a) Development and training of the power of observation

Generally, children of the age group of five to ten years come under the primary stage of education. Normally, children of this age group are very active. They are curious to know about all the things they come in contact with. They are keen observers. It is, therefore, necessary to develop and train their power of observation. The teacher should therefore try to achieve this objective. He should train and encourage them to collect plants, different kinds of flowers etc. He should also train them to know about various things about these collected objects.

(b) Knowledge of the relationship between physical and social environment

Children of their group come in contact with the natural as well as social environment. They should, therefore, be trained to know about the relationship that exists between the community and the nature. They should be taught about the various gains that community or the society derives from nature.

(c) Objectives with regard to character and behaviour

It is also necessary to develop certain qualities of character in the young boys and girls of this age group and also to bring about changes in their behavioural pattern. They may be taught the lesson of conservation of national wealth. They may also be taught to have respect for the agencies of nature. These two qualities may be, later on, transferred to other fields of life.

(d) To develop the habits of personal, family and community cleanliness

Children may be taught about the habits of personal and social hygiene. They should be taught to keep themselves and their environment clean.

(e) Importance of science in life

Students should be trained to know about the utility of science in life and several contributions made by science for the betterment of human life.

(f) Knowledge of casual relationship

Normally young boys are inquisitive by nature. Sometimes their curiosity is explained away and it dies down. The teaching of science must develop in the students the consciousness of the relationship of cause and effect. They should be encouraged to know about the causes of the several events that they observe around them. This will ultimately help them in the development of the scientific outlook.

(g) Development of practical outlook

Mere giving of knowledge of facts is not sufficient. We have seen that the students of this stage of education are pretty active. This activity may be so channelised to develop practical outlook. This practical outlook would help them to make proper use of their theoretical knowledge.

Objectives of the Teaching of Science for Junior High School Classes

Here we find students of the age group of II. We have already seen that the students of classes VI, VII and VIII comprise this stage of education. Children of this stage of education are more developed. They are more balanced. They are less impulsive

and are not pleasures and pains are not the sole guides of their actions. They are no more children only. The objectives of teaching of science for this stage of education may, therefore, be laid down on the following lines.

(a) Development of knowledge and skill for social life

Developing knowledge, skills, outlook and interests in the students may help in them the building of the background for vocational and social lives that may come later on.

(b) Development of the power of reasoning

At this stage of education, we find that students have developed a power of reasoning. They may be given opportunities for the development of the power of reasoning while teaching science.

(c) Practical use

At this stage, we find that the students have developed a sense of practical use. They are able to apply the knowledge acquired. They should be given opportunity for practical use.

(d) Development of the quantitative sense and the capacity to solve problems

The students of this stage have the quantitative sense developed in them. They should be given opportunity to solve problems for further development of this sense and they may also acquire ability to solve the actual problems.

(e) Numerical Sense

The students at this stage should be given numerical problems to solve. This would give them an opportunity to solve numerical problems and also to develop a sense of application of theoretical knowledge to numerical aspect of things.

(f) Economic efficiency and knowledge about society and natural environment

Economic conditions of the country are such that many students have to give up education after this stage. It is, therefore, necessary to make them efficient to earn their livelihood. In other words, economic efficiency should be developed in them. This can be acquired properly when they have proper knowledge about their social and natural environment.

Objectives of Teaching of Science at Higher Secondary Stage of Education

The students of this stage of education are more developed than the students of the Junior High School Classes. They have certain interests and aptitudes developed in them. These students have to be prepared for future life as well as higher education. The students of this stage of education should be taught science with a view to achieve the following three things.

- (a) Development of the psychological aptitude and interests
- (b) To prepare and equip for higher education
- (c) Economic efficiency and capacity to earn livelihood

In order to achieve the above mentioned things, certain objectives must be kept in view. It is these objectives that have to govern the teaching of science in the higher secondary stage for education. The following are the objectives.

(a) Knowledge

This perhaps, is the major aim of teaching science. The pupils studying science should acquire the knowledge of:

1. Scientific Terminology.
2. Scientific facts to understand scientific literature.
3. Ways and means of dealing with specifications.
4. Conventions.
5. Trends and sequences.
6. Natural phenomenon.
7. Correlation and interdependence of different branches of science.
8. Methodology.
9. Theories and structure.
10. General rules of health and human machine.

The students should be able to apply this knowledge in their daily life.

(b) Understanding

This is the second objective in the cognitive domain and includes translation from one form to another and interpretation. It has been found that up to 70% to 80% of the scientific facts learned in science course are forgotten within one year after the completion of the course. For understanding, the students must be trained to generalize the facts and events which are having common characteristics, constantly seeking generalizations that make things more understandable. These generalizations are frequently referred to as concepts, principles and laws-which are very essential to understand science in every day life and forms a strong base for higher education.

(c) Application

The third aim of teaching physical science in higher secondary schools is to make the students into more alert citizen and better equipped to improve the community life. In order to achieve this, the student should be able to apply the generalizations to their daily life. This will serve as a bridge to fill the gap between classroom work and real life activities. Moreover, the application of principle will help in verifying the principle itself.

(d) Skills

Knowledge of content alone is not enough for enriching a student. Therefore, stress is not on the memory of the content but on development, improvement and refinement of tools with the passage of time. The various skills which can be developed through science teaching are, Observational Skill, Experimental Skill, Constructional Skill, Problem Solving Skill and Drawing Skill.

Possession of these skills is very essential in solving practical problems.

(e) Attitude

By definition “Attitude is a condition of readiness for a certain type of activity” Finding answers to problems through direct observation, experimentation, verification and testing of knowledge are some of the initial manifestations of scientific attitude. Science teacher, on the other hand, should make special efforts to develop them by employing democratic procedures in the classroom activities.

(f) Interest

The teaching of science should also aim at developing some interest in reading scientific literature, in scientific hobbies, in activities of science club and so on. Interest should not be super imposed; on the other hand, everybody should be free to select the activity according to one’s own inner appeal.

(g) Appreciation

The students of science should be able to appreciate the contributions of science in the progress of civilizations. The basic idea of this aim is to develop a real feel of science. Application cannot be taught as such. It develops from understanding and attitudes.

(h) Personality Traits

The teaching of science aims to develop personality traits also. The pupil should report his results and observations faithfully. Science teaching should provide suitable opportunities for every individual to unfold environment, must be provided to draw out the best in the child-body, mind and soul.