**MODULE-3- INTER AND INTRA DISCIPLINARY NATURE OF NATURAL SCIENCE**

**3.1 - Correlation of Science with Its Branches**

Science is a very vast subject for which experts have divided it into some specific branches, by which its study can become simple and easier, it is not possible to separate the various branches of science from each other as all these subjects or branches consist of some common features or principles.

Various scientific subjects have been developed by the science as they have realized the fact that there exists inter-dependence in among them. It is necessary to correlate a lesson in all branches of science as it is only through this that spirit of general science can be kept alive. This can also be done by making use of examples from other branches of the science.

The main branches in which subject of science are being divided are botany, physics, chemistry, agriculture, geology and physiology. More research works are being conducted to find newer subjects or branches of the general science. As all of these subjects have been originated from the general science, thus they contain some of the features present in the general science.

It is because of this reason that experts consider it difficult or impossible to teach the subject of science in isolation with other branches of it. A teacher who has specialised knowledge in one branch of science, but lacks any kind of knowledge in others cannot prove to be much successful in implementing his function and in fulfilling the set objectives.

The main reason which is found to be responsible for the fact that large number of students loses their interest from the study of science is that teachers are not ready to widen their level of knowledge through getting information relating to other branches of the science. It is also necessary for the teacher to have thorough knowledge of the limits up to which he should venture into areas which are not his own.

The main objective for which teacher should co-relate science with its other branches is to make the teaching and learning process more interesting and meaningful. No teacher can perform this function without getting information relating to different branches of science.

One can find various common topics in different branches of science subjects. Teacher should attempt to relate all these science subjects with each other and to bring integration among them by which interest of the students can be kept lively in the learning process and they can be encouraged to apply knowledge of one subject while acquiring other subjects also.

**3.2- Correlation of Science with Other Subjects**

As known that for over all development of the students, various subjects are being included in the curriculum. These subjects are not selected on ad-hoc basis, but this decision is taken after proper consideration and analysis. Generally those subjects are included in the curriculum which is found to be complementary to each other, as the main objective of all of them is to achieve set objective of education that is to bring about over all development of the students.

Science is quite a complex and vast kind of subject, because of which the task of correlating it with other subjects of curriculum seems to be quite an easy task. Deliberate effort should be done by the science teacher to bring about co-relation in between the science and other subjects of the curriculum, which are being imparted to the students.

Through this, students will find the opportunity to relate the knowledge which they have already gained, with the knowledge which they are gaining. This kind of relation activity leads to development of interest among the students.

While imparting knowledge of one subject, teacher gets much help in communicating his ideas if he makes use of examples or reference of concepts covered by other subjects. Although it is not very easy to co-relate various subjects with the complex subject like science, but it is not impossible. This can be done in the following manner:-

* **Science and Language:**

Although science is a practical subject, but it is very important for its learners to be able to express their views and ideas in clear and attractive form. For this purpose, it is necessary that they should have thorough knowledge of language which they use. Student who does not have good control over the language cannot express his views and various scientific laws and principles in front of others and especially in front of teacher.

Today, as a result of adoption of uniform technical terms and symbols, vocabulary of different languages have been enriched to considerable extent. In making students able to give answers of various scientific queries, in effective manner, either in written form or orally, science teacher and language teacher should take up a joint responsibility on their shoulders.

To co-relate science with language subjects, students can be asked to write essays on some scientific topic. If student make any kind of grammatical mistake, then the teacher can ask him to make correction in his language. Likewise, language teacher can give the task of writing about some scientific happening in the assignment designed for them. In this manner, he can correlate science with the language.

* **Science with Mathematics:**

A large number of scientific principles and rules are represented in the form of mathematical expressions, for which it is very necessary for the student or person intending to get advanced study of science subjects to have sound mathematical basis. Without making use of mathematical expressions and rules, it is not possible for any teacher to conduct science teaching in effective manner.

The significance of mathematics in the science can be proved by the views of the experts that mathematics has given sound footing to the scientific laws and principles. Before beginning any topic in the science, it is essential for the teacher to make sure that mathematical basis of all the students is strong and vast.

Probably, mathematics is considered to be sole language of science because of which real understanding of science is considered to be impossible without adequate knowledge of mathematics. Some of the useful mathematical tools which are generally used in the science teaching are Algebraic equations, Geometrical formulas, Graphs etc.

Correlation existing in between one of the subject of science and mathematics can be understood. Astrology is an advanced branch of science in which it is predicted or enumerated that which planet revolves at which speed and when it will get appeared to the people of earth.

This is quite complex area, and no one can enter into this complex area without having a sound mathematical basis. Likewise, mathematical rules and theories are also applied to considerable extent in physics, in which no one can intend to take even single step without relying on the subject of mathematics.

Thus, it can be said that science teacher should make all efforts by which he can establish co-relation in between the subjects of science and mathematics. It will not be improper in any way to consider both of these subjects as complementary to each other, which can be studied simultaneously or at the same time.

For this reason it can be said that without making use of examples from mathematics, it is not possible for science teacher to explain various scientific principles and concepts properly to the students. To make it possible, sincere and deliberate efforts should be made by science as well as mathematics teacher to co-relate both the subjects in accordance with the syllabus.

* **Science and Social Studies:**

If one explores the history of development of human society, he will find various incidences in which human got victory over forces of nature, by which he got control over the land, sky and seas. As said that an important impact of science teaching is that outlook and perspective of students or people become scientific in nature, as a result of which, various kinds of changes take place in their way of living.

Scientific thinking affects the standard of living of human beings to considerable extent, as through such information, outlook and perspective of human beings become more wide and they can freed themselves successfully from the clutches of superstitions and false beliefs.

Various evidences can be found in our life which can show the significant way in which life style of human beings have got affected by inclusion of scientific developments in their life. Today, we can found various kinds of machines for performing different functions, about which primitive men even did not think.

As a result of these machines, our life has become very easy and smooth and now we can accomplish complex functions within short period of time, which were considered to be very time consuming. Not only this, various research works has led to development of various medicines with the help of which physicians have found the remedies of various diseases, which were once considered to be incurable and were responsible for bringing about heavy loss of life in earlier times.

Not only this, earlier a large number of manpower was being engaged in the agricultural sector, but now we are moving towards highly developed industries, as a result of which we are ready to participate in the competition taking place in global market. We have third highest number of professionals engaged in different areas of the world.

Now a large number of students intend to get education from foreign universities, but they want to serve their own nation and want to play effective role in bringing about development of the nation with greater pace. Earlier people were not provided with the developments taking place in the scientific area, as a result of which they used to accept all the orders imposed on them.

But now, in a scientific advanced time, people have learned that being human beings, they have certain rights, and if any attack is being made on their rights, they begin to agitate. This can be the possible reason that why women of our nation has attained those rights which were not permitted to them in the earlier time.

Another change which has taken place in our society through such reasoning ability is the manner in which people belonging to minority section of the society are asking or reservations in various spheres of the life. They are asking about reservations in educational institutions and even in parliament of the nation.

Thus it can be said that science and social sciences are two subjects which can be co-related with each other without much problem. A science teacher can correlate science with social studies on different occasions by providing suitable relations of relevance.

* **Science and History:**

It sounds quite amazing that some kind of correlation can exist in between the science and history as earlier subject is practical in nature while nature of later subject is purely theoretical. However, it is possible to co-relate these subjects with each other.

While mentioning about the various scientific discoveries taken place in the earlier periods, teacher can relate with the major events of the world history. Students should be told about that what was the situation of science at the time of reigns of various famous kings or rulers. Teacher should narrate to the incidences which inspired various scientists to found out the medical remedies of various diseases.

Not only this, the function of co-relating science with history can be done by mentioning the kind of living standard people used to experience at different parts of the human history. With such knowledge, they will become aware of the scientific concepts like sanitation and healthful living.

* **Science and Geography:**

Geography is the subject in which various concepts relating to earth on which we live are dealt with. Everything existing on earth, on different planets of the universe are also main subjects of geography. Which kind of crop should be sown in which kind of soils, how many kinds of rocks are found on the earth are some of the main topics which are covered by Geography. One will be surprise by this fact as these topics are also covered by the subject of Science.

In science, various concepts relating to the atmosphere and earth in which living and non-living beings exist are made. For this reason, temperature, wind directions and measurement of rainfall are conducted in the subject of science by making use of various apparatus.

Results obtained by the science in terms of climate and the manner in which it affect the human beings and earth are being interpreted by subject of Geography. The manner in which it is mentioned by the geography that how soil gets produced through crushing process of rocks, it makes the subject a special branch of science.

Therefore, geography lessons on these subjects will be best understood and appreciated if they have been discussed in length by the science teacher. There are various topics which are of common interest for geographers and scientists. Thus, it can be said that both of these subjects are complementary to each other. Both of these subjects are very near to each other, thus science teacher will not find any kind of problem in relating science with the subject of geography.

* **Science and Civics:**

The main objective of imparting information of both the subjects is to create good and useful citizens for the nation, thus it is possible to correlate both of these subjects with each other. Through science, students become able to understand the utility of scientific inventions in their life, by which they become more responsible.

They begin to realise a sense of responsibility, which help them in playing important role in development of the nation. Through information of scientific facts, students get to know about various kinds of diseases and the role which they can play in creating a healthy and clean atmosphere around them. Through this kind of information, they become more responsible citizens and play an important role in creating an ideal civic life in the society and nation as a whole.

* **Science and Art:**

It is considered by the majority of people that it is science who has contributed a great deal in developing the field of art, but this is not true, as both of these subjects or areas has played important roles in enriching each other. All types of arts have got enriched as a result of scientific developments, but it is not possible for a science teacher to impart information relating to various scientific facts and principles without having thorough control over the art.

As known that science is a practical subject, as a result of which, science teacher is required to draw various kinds of diagrams, models and charts, which cannot be performed unless he does not have sound artistic skills. Not only this, it is equally important for an artist to have thorough knowledge of scientific principles, as without it, he will find it difficult to keep the colour contrast of his images in attractive and controlled position.

An artist should know the principles of light and shade, objects and background for drawing or keeping the colour contrast in attractive condition. Thus, it can be said that some common features are found in the subjects of science and art, because of which they can be co-related with each other effectively.

* **Science and Music:**

In our nation, music has its own importance as different kinds of songs are found in different parts of the nation. There are songs and theories of music in different languages. Various musical stars got born in our nation, but the number of persons engaged in musical area has diminished to considerable extent as now people consider it as wastage of time and efforts.

To encourage people and especially students to get involve themselves in professions having their roots in music, this has been accepted as an independent subject in various schools and institutions and it forms an integral part of school curriculum. For the students of music, knowledge of resonance, vibration systems in strings and air columns is very necessary and important.

To make improvements in their voice and manner of singing, various scientific equipment is being used today, which could not come into being without scientific developments. Thus, it is only through the utilization of scientific developments in the real life that led to development of various apparatuses used in the musical field. Science teacher can relate subject of science with the music by narrating the students that what led to development of various equipment used by the musicians and on which principles do they operate or function.

* **Science and Craft Works:**

Some people will find it quite unsound to relate science and craft works with each other, but various kinds of improvements can be brought about in ability of students to understand various scientific principles and facts. During craft periods, students can be provided with the task of designing various pieces of scientific apparatuses and equipment.

Through such step, scientific interest can be developed in the students, which will help in arousing the interest of students in various scientific incidences. An urge will get developed in them to see or observe the equipment or apparatuses designed by them in reality, by which they will be motivated to get more and more information regarding the research functions conducted in the scientific field through various means and sources.

Thus, it can be said that if science teacher will relate science with other subjects of the curriculum, then he will get more justifiable and satisfactory results.

* **Science and ICT:**

Rapid progress of information and communication technologies is considered as one of the key factors of change in humankind society. The main impact of ICT in education can be seen in improving the capabilities of instructors, changing the educational structure, creating opportunities for greater and more comprehensive learning, enhancing educational quality and improving teaching skills.

There are changes in the views of the nature of science and the role of science education, the increasing prevalence of Information and Communication Technologies (ICT) also offers a challenge to the teaching and learning of science, and to the models of scientific practice teachers and learners might encounter. ICTs, for example, offer a range of different tools for use in school science activity, including:

* Tools for data capture, processing and interpretation – data logging systems, databases and spreadsheets, graphing tools, modelling environments
* Multimedia software for simulation of processes and carrying out ‘virtual experiments’
* Information systems
* Publishing and presentation tools
* Digital recording equipment
* Computer projection technology
* Computer-controlled microscope.

These forms of ICT can enhance both the practical and theoretical aspects of science teaching and learning. The potential contribution of technology use can be conceptualized as follows:

* Accelerating and enhancing work production; offering release from difficult manual processes and more time for thinking, discussion and interpretation.
* Increasing scope of relevant phenomena by linking school science to contemporary science and providing access to rich experiences.
* Supporting exploration and experimentation by providing immediate, visual feedback.
* Focusing attention on issues, increasing salience of underlying abstract concepts.
* Fostering self-regulated and collaborative learning.
* Improving motivation and engagement.

**ICT Use and Pedagogy – An Inseparable Link**

Current research would suggest, however, that it is not appropriate to assume simply that the introduction of such technologies necessarily transforms science education. Rather, we need to acknowledge the critical role played by the teacher, in creating the conditions for ICT-supported learning through selecting and evaluating appropriate technological resources, and designing, structuring and sequencing a set of learning activities. Pedagogy for using ICT effectively includes:

* ensuring that use is appropriate and ‘adds value’ to learning activities
* building on teachers’ existing practice and on pupils’ prior conceptions
* structuring activity while offering pupils some responsibility, choice and opportunities for active participation
* prompting pupils to think about underlying concepts and relationships; creating time for discussion, reasoning, analysis and reflection
* focusing research tasks and developing skills for finding and critically analyzing information
* linking ICT use to ongoing teaching and learning activities
* exploiting the potential of whole class
* interactive teaching and encouraging pupils to share ideas and findings.

Teachers’ motivation to use ICT in the classroom is, at present, adversely influenced by a number of constraints including: lack of time to gain confidence and experience with technology; limited access to reliable resources; a science curriculum overloaded with content; assessment that requires no use of the technology; and a lack of subject-specific guidance for using ICT to support learning. Research shows that even where technology is available; it is often under-used and hindered by a set of practical constraints and teacher reservations.

Whole class interactive teaching is also under-developed. At present, effective use of ICT in science seems to be confined to a minority of enthusiastic teachers or

departments. On the whole, use of ICT in school science is driven by – rather than transformative of– the prescribed curriculum and established pedagogy. In sum, teachers tend to use ICT largely to support, enhance and complement existing classroom practice rather than re-shaping subject content, goals and pedagogies. However, teacher motivation and commitment are high and practice is gradually changing. The New Opportunities Fund (NOF) scheme for training teachers in using ICT in the classroom appears to have had more success in science than in other subjects. Teachers are now beginning to develop and trial new strategies which successfully overcome the distractions of the technology and focus attention, instead, on their intended learning objectives.

Teachers are currently working towards connecting the powerful potential of using ICT to support science learning as far as possible, given the very real operational constraints. Further development depends on providing them with more time, consistent access to reliable resources, encouragement and support, and offering specific guidance for appropriate and effective use. Assessment frameworks (and their focus on end products) may also need to change in order to evaluate – and thereby further encourage – ICT-supported learning. To meet the new aims for the science curriculum is poised to move in a new direction. The approach taken by the proposed new science curriculum for all pupils is eminently well-suited to the supportive use of interactive digital technology. As the school curriculum begins to copy links with the external scientific and social communities, opportunities arise for ICT use to play a central and core role in supporting development of scientific reasoning and critical analysis skills. Those in the process of developing new digital tools for use in the science classroom need, therefore, to engage with the new aims of science education and the science curriculum, and to develop resources that can be used by teachers both in facilitating key aspects of scientific thinking and in building bridges between schools and with the wider social and scientific communities.

* **Science and Theatre:**

The relationship between science and theatre can be twofold: either theatre is used primarily as a means for conveying scientific concepts and ideas, or it borrows its contents from science while maintaining its own features as an artistic expression. Theatre preserves its artistic and aesthetic characteristics, thus enhancing the scientific imagination for the public.

It is quite evident that, in the last few years, science has been winning more and more space on the stage. Even if the results are not always the best, this facts stimulate a reflection on the possible contact points between science and theatre. Since we deal with a problematic relationship, it would seem difficult to build a structured theory.

Starting from the assumption that theatre is, first of all, an encounter between the audience and the actors , the following classification for performances combining science and theatre:

* theatre as a set of performing techniques to support **didactics** (practical application of teaching and learning).
* theatre deriving from the “scientific conferences” tradition
* theatre posing ethical questions on the responsibility of science and scientists towards the society
* theatre pointing to existential reflection
* theatre staging either biographies of scientists or episodes from the history of science
* theatre using certain sciences (such as neurobiology, anthropology, anatomy, cognitive sciences) as a support for the artistic creation

There is quite a marked difference between theatre used merely to communicate science, and theatre maintaining its characteristic of an artistic expression, drawing elements from the scientific universe to create drama.

**Theatre with pedagogical purpose**

When theatre is used as a means of supporting didactics, the performing elements (the acting area, lights, sound, images, the “dramatic vocabulary” of movement, the body and verbal language), help to lower the barriers between an inexperienced public and scientific contents through the main strengths of theatre: emotional and sensory communication. Thus, the pedagogical activity is reconciled with the entertainment, the aim being to excite curiosity towards the scientific world. This practice is often applied in the museums or scientific institutions.

In the same context can be placed some performances deriving from the tradition of the “scientific conferences”, which started in the XVII Century, coinciding with the origin of the first scientific Academies, and widely spread for the next two centuries, mostly emphasizing the facet of the “marvellous” in science and being warmly appreciated by the audience. The roots of the contemporary “science shows”, frequently put on in the science centres, may be found in this tradition.

 **Theatre drawing up motif of inspiration from science**

A different scenario comes when dramatic creation is inspired by science without any specific purpose of communicating its contents.

Within this framework, the following classification is proposed:

* Plays dealing with ethical issues generated by the scientific discoveries;
* Plays portraying episodes of famous scientists’ lives;
* Theatrical activities drawing on scientific ideas to support the creation of dramas.

By using arts-based teaching and learning, learners are able to express themselves as well as their knowledge through different, creative and novel approaches. Arts play a fundamental role in teaching and learning since they provide challenges and opportunities to children in exploring their own questions and queries. Such approaches also serve as a mode of expression when working with ideas and feelings. Hence, the positive and constructive role the arts play in engaging children’s learning can be acknowledged .One of those art forms considered to be of great use in this context is drama. However, there are very few studies on the use of drama for science education.

Through drama children are given the opportunity to construct their own knowledge by allowing them to have control over this knowledge. In addition the notion of drama contributing to children’s learning of science can also be considered as a creative and innovate aid and a means for teaching knowledge which is otherwise difficult to achieve through conventional educational approaches. The use of drama activities in science has indicated the positive role that drama has on children’s learning as an aid to expressing meanings.

**3.3- Correlation of Science with Daily Life**

Today's life is considered to be scientific life, as life of human beings have been influenced to considerable extent by the developments taking place in the fields of science and technology. All of the activities performed by human beings are governed and controlled by science to some extent and in different ways.

Scientific principles and knowledge play an important role in influencing the activities of human beings to considerable extent. Revolutionary changes have taken place in the society as a result of scientific developments. Through such changes, social and the physical environment in which human beings exist have gone through unexpected and unbelievable changes.

One of the main objective of teaching science as a part of sound liberal education is to provide background knowledge of various broad scientific principles to the students. Therefore, it becomes the duty of science teacher to bring home to his students these broad scientific principles and their many applications in daily life.

There cannot be any person in the world who can expect to live and adjust in the world by keeping himself aloof and ignorant of scientific facts and knowledge. It is for this reason that various experts are of the view that developments taking place in the science should be imparted to the students of the nation as they are the future governor of the nation. It is with this view that today science has been included in the curriculum for all the levels of students.

However, teachers should understand the fact that their main objective is not only to impart knowledge of such developmental procedures taken place in the field of science to the students, but to perform this function in such a manner by which they can make use of obtained knowledge in their daily life.

This objective can only be fulfilled if teachers will impart their knowledge by relating them with the real incidences taking place in everyday life. While imparting information of various scientific facts, teachers should make use of examples taking place in the daily life of the children.

If science teaching will be done by relating it with the actual happenings of the student's life, then it will become more interesting and meaningful and purposeful for the students. An effective method in which science can be correlated with the everyday life of the students is to make use of community resources found in the immediate environment in which students exist or live.

It is not possible for any human being to understand the application techniques of various electronic appliances and apparatuses which have made life of human beings so comfortable and easy. If teacher does not take into account everyday experiences of the students, then teaching process will fail in fulfilling its objective. Thus, for planning study of sciences, more importance should be provided to the excursions, tours, visits and trips by which students can get opportunity to observe the various objects and places themselves or personally**.**