CHAPTER - I

CONCEPTUAL BACKGROUND OF THE STUDY

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1.0 Introduction

Science has occupied almost all spheres of human life and living. We are living in a society which is completely drawn into the scientific environment. Now, we cannot think of a world without science. The wonderful achievements of science have glorified the modern world and transform civilization into a scientific civilization. Science is no longer confined to a few seriously devoted persons. Since life in the present world invariably warrants, to variable degrees, knowledge of scientific facts and laws, science has now become everyday science for everybody. Teaching of everyday science for everybody has become an unavoidable part of general education. Nobody question its inclusion as a subject in the school curriculum. It is included in a school’s curriculum for the same reasons as any other subject, but in addition science inculcates certain special values peculiar to it and which no other subject can provide. But beside satisfying the usual needs for its inclusion as a subject in the curriculum such as intellectual, cultural, moral, aesthetic, utilitarian and vocational values –science learning provides training in scientific method and also helps to develop a scientific of mind in the learner. The qualities imbibed the learner through learning are of great values to a citizen living in the society. Hence, science is now made a compulsory subject in every system of school education right from the elementary stage.

Science and Technology have been playing an important role in our Social and Cultural Life. Various activities are controlled and governed by Science. It has helped man to acquire supremacy over nature. Science is an interconnected series of concepts and conceptual schemes that have been developed as a result of experimentation and observation. In other words, Science is a cumulative and endless series
of empirical observation which result in the formation of concept and theories, with both concept and theories being subject to modification in the light of other empirical observations.

The most important and essential aim of Science Education is the development of Scientific Attitude among Learners. A person having Scientific Attitude has (i) an open-minded attitude (ii) has a burning desire for the acquisition of correct knowledge and search for truth (iii) has confidence in his abilities to seek knowledge and search for truth and (iv) possesses adequate abilities of problem solving and beliefs that the problems can be solved through proper efforts involving Scientific Observation and Experimentation.

Psychologist try to measure intelligence and teachers try to cultivated intelligence but none seem to know precisely what intelligence is. Different Scholars have defined intelligence in different ways. Terman said that an individual is intelligent in proportion to his/her ability to carry on abstract thinking. According to Stern, Intelligence is a general capacity of an individual consciously to adjust his thinking to new requirements. It is a general mental adaptability to new problems and conditions of life.

Achievement on the other hand is the end product of all educational endeavours. The main concern of all educational efforts is to see that the learner achieves. Quality control, quality assurance and of late, total quality management of achievement have increasingly gained the attention of research in Education

Science is something to be tolerated in high school, details of which are promptly forgotten after tests are over. This may be understandable, since, regrettably, the basic science curriculum can often
consist of lectures on taxonomy or analogous facts about what science has discovered, along with the painful need to memorize long lists of strange words.

As the pace of scientific research accelerates, the average citizen is faced increasingly with having to grapple with matters of science in his everyday life. It is imperative science issues does have an impact on our lives, in their own self-interest, to best thrive in modern society. Furthermore, students must understand what a question of science is and what is a question of public policy that can be informed by science. On a less weighty level, science is everywhere in society; a part of each person's everyday life – even grocery shopping is more informed by a basic understanding of science. But most citizens are not equipped to personally assess the facts, nor often even to separate the facts from opinion or political spin; science from non-science. They therefore are likely to be predominantly influenced on these issues by the prevailing perception in their communities.

How can we equip our students with sufficient scientific skills to enable them to develop informed opinions about important issues, without imposing the unrealistic expectation that they be trained as scientists? This question is distinct from the question of how Educational Institutions can continue to produce the world's leading scientists.

1.1 The Importance of Science Education

It’s hard to put in specific terms, but science as a concept (as opposed to just learning facts and theories, or heating stuff in test tubes) has some nice ideas to offer that would be useful for many people to learn and would be useful throughout their lives. Concepts such as logical deductions and inference, parsimony, and not accepting
arguments (or dismissals) based on authority but from evidence and scepticism would all be handy. Teaching someone how to appraise and evaluate conflicting evidence and any bias in that evidence would be useful ‘life skills’ for pretty much everyone. It ultimately comes down to trying to spot patterns, work out reasons for them, and to spot errors and mistake: how can learning these skills be bad or unimportant?

Of course many of these are taught in various ways and in subjects well beyond Science, a teacher formally teaches students what it means and why Science is important. Something that laid out the ideas and reasons behind accurate formal writing, using good judgement, formulating rules, testing ideas, parsimony, and bias would be an excellent introduction to the scientific method, but also to thought itself. Teachers teach students how to think, how to evaluate and judge, how to process information and come to rules and conclusions about the world. Get that right and they will be armed with a powerful set of tools that will literally last them a lifetime, and frankly it’s hard to see how that cannot be good. Students are capable of learning things as concepts and entities, and already many if not all of them *are* taught – but in a more systematic and integrated framework. The benefits to science teaching (and many of the arts) are clear if the children had an established concept of how to present and test their ideas independently and to evaluate material put in them, as well as having something to take outside the classroom for the future.

The importance of science and technology in today’s world is overwhelming and therefore the education system throughout the country has to gear itself to provide the required training in scientific skills to meet this growing challenge. Undoubtedly the application of science and technology have transformed the world through dramatic
advances in almost all fields including medicine, engineering, electronics, aeronautics etc. and in more recent times dramatic leaps in computer technology have revolutionised in particular the information and communications sector.

Then there is also an attitudinal problem with respect to science where many students feel that science subjects are too difficult and therefore shy away from it. Therefore it would seem that the issue has to be tackled on two fronts-providing the incentives and motivation for the pursuit of science and changing the attitude of students. Achieving these tasks will not be easy because of the numerous difficulties and complexities involved but a good start is to equip our school system to make them science friendly.

The state of science education for adolescents is at an important crossroads. There are enormous scientific challenges that the youth of today has to confront. Science teachers are facing a myriad of issues. Some of the complex issues in the field of science education include the availability of appropriate textbooks and classroom resources; the preparation and training of science teachers (including both pre-service training and in-service professional development); political and religious opposition to cutting-edge science instruction; the need to meet standards and to prepare students for standardized examinations; and the dramatically increasing use of the internet as a source of information. Given these and other issues, it is extremely important to understand, acknowledge, and build upon the abilities of adolescent learners, while at the same time tailoring instruction to address the unique challenges faced by this age group.
The field of educational psychology has much to contribute to science education. There have been many important recent developments in the study of adolescent cognition and motivation, and this new knowledge has much to add to the enhancement of science education. Learning about science requires the coordination of a complex set of cognitive, affective, and motivational strategies and skills. Specifically, research from educational psychology can contribute greatly to our understanding of how adolescents acquire and process scientific knowledge; overcome misconceptions; learn the discourse of scientists; learn to think and reason like scientists; evaluate sources of scientific information; and reconcile personal beliefs (e.g., religious and political beliefs) with science content\(^1\).

1.2 Scientific Attitude

An attitude can be defined as a way of regarding things; it can also be considered as a feeling or pattern of thoughts. The scientific attitude on the other hand can be defined as a way of looking into things that are governed by facts which are known as well as demonstrative. There are certain attitudes that should be considered to be a successful scientist. These are the curiosity, the careful judgment, the open-mindedness, the critical mindedness, the objectivity, the rationality and the intellectual honesty. These attitudes should be considered by any aspiring scientist.

An attitude can be defined as a positive or negative evaluation of people, objects, event, activities, ideas, or just about anything in your environment. Eagly and Chaiken define an attitude as "a psychological tendency that is expressed by evaluating a particular entity with some

degree of favour or disfavour.”

Though it is sometimes common to define an attitude as affect toward an object, affect (i.e., discrete emotions or overall arousal) is generally understood to be distinct from attitude as a measure of favourability.

This definition of attitude allows for one's evaluation of an attitude object to vary from extremely negative to extremely positive, but also admits that people can also be conflicted or ambivalent toward an object meaning that they might at different times express both positive and negative attitude toward the same object. This has led to some discussion of whether individual can hold multiple attitudes toward the same object.

Curiosity is an attitude to be curious about the different things around. A curious individual wants to know about what is a particular thing all about, what is it for, how it is done, how it works and other else. He or she seeks for the answers of the things that he or she want to understand. Careful judgment is an attitude of being willing to suspend judgment in anything till it is proven to be true. An individual who posses this character does not jump to a conclusion and bases the judgment on the facts as well as on the reliable information. Open-mindedness is an attitude in which an individual does not reject any knowledge that conflict with his or her idea. His or her mind is free from any prejudice and is not biased. Here, an individual might accepts ideas

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from other person and consider these ideas as potentials than can help in doing any work or in solving scientific problems. Critical mindedness is an attitude of an individual that is willing to evaluate any evidence that is presented in order to support a certain conclusion; with this he or she observes the accuracy of any information. Here, an individual should always make sure and always examine anything and aims for perfection. Objectivity is an attitude of an individual that records data and observations. He or she tends to interpret these data prior to the actual observations and experimentation that was made as well as verifies the observation’s consistency. Rationality is an attitude of an individual that believes that things happen with a cause. He or she does not believe in the superstitious belief rather’ he or she accepts facts but only with supported as well as convincing proofs. Intellectual honesty is an attitude where one should be truthful by for example acknowledging the sources of information.

Scientific attitude is really a composite of a number of mental habits, or of tendencies to react consistently in certain ways to a novel or problematic situation. These habits or tendencies include accuracy, intellectual honesty, open-mindedness, suspended judgment, criticalness, and a habit of looking for true cause and effect relationships. It is a cognitive concept; scientific attitudes are normally associated with the mental processes of scientists. These habits are important in the everyday life and thinking, not only of the scientist, but of everyone. Scientific attitudes possess attributes thought to be either true or false and do not express an evaluative quality. To lessen the semantic confusion, scientific attitudes may be better labelled as "scientific
attributes". Bhaskara Rao (1989)\(^5\) stated that the most useful scientific attitudes are open mindedness, critical mindedness, respect for evidence, suspended judgment, intellectual honesty, willingness to change opinion, search for truth, curiosity, rational thinking, etc.

Scientific attitudes possess attributes thought to be either true or false and do not express an evaluative quality. The attributes of scientific attitude are rationality; curiosity; open mindedness; aversion to superstitions; objectivity and intellectual honesty; and suspended judgment.

Development of scientific attitude is considered as an important objective of science learning all over the world. Many teaching techniques are evolved and suggested to develop scientific attitude. Some out of them are the outcome of elaborate efforts of researchers.

Scientific discoveries shape the way we view the world and influence our decisions. Indeed, as reported in Discover (2010, 1)\(^6\) magazine, the scientific discoveries in the last thirty years have "touched nearly every aspect of our daily lives." Science teaches people how to think critically about not just scientific subjects, but all subjects. As Schafersman (1994)\(^7\) explains, the scientific method has proven to be "the most reliable and successful method of thinking that "results in the acquisition of reliable knowledge”, and therefore scientific thinking can and should be used in other human endeavours. People use the methods and principles of scientific thinking in everyday life, such as "when studying history or literature, investigating societies or governments,

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seeking solutions to problems of economics or philosophy, or just trying to answer personal questions about oneself or the meaning of existence" (Schafersman, 1994). In short, whether we are aware of it or not, science is an integral part of our lives – even if we are non-science majors.

However, despite the fact that science informs our thoughts and behaviours, many people do not seem to place a high value on science. According to (Rogers and Ford, 1997).

Studies depict that the general public (that is, non-science majors) does not generally have positive feelings toward science and scientists. These findings imply that such attitudes may have negative effects on the entire society. Further they also revealed that; since non-science majors are potential lawyers, presidents and managers of companies, politicians, and civic leaders, they will influence how research and development funds are spent, how scientific discoveries and technological innovations are implemented, and how scientific evidence is used in courts and other social organizations. An appreciation of science may provide a positive influence on these decisions.

In addition, a positive attitude toward science may improve students' academic performance in not only science classes, but in other classes as well. Why should this be so? Science is a way of knowing and understanding through the exercise of reason, a construction of the mind based on actual observation to explain natural phenomena. Science, by choice, "is limited to questions that can be approached by the use of reason, questions that can be answered by the discovery of objective knowledge and the elucidation of natural laws of causation" (Futuyma

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The practice of the discovery of objective knowledge involves observation of events (or the acquisition of data), followed by inference regarding possible causes (forming alternative hypotheses), and, finally, testing to select the best explanations (Cherif et al. 2001). The mental discipline and rational approach of "the scientific method" have been successfully adopted in many other disciplines, such as business, law, the social sciences, and others.

It is therefore in the interests of society, and the responsibility of educators, to improve students' attitudes toward science, and to prepare students to live in a highly scientific and technological society. The future of our society will be determined by citizens who are able to understand and help shape the complex influences of science and technology on our world (Ungar, 2010).

**Why Negative Attitudes toward Science Exist**

Some students have developed negative stereotypes of science and scientists, whom they view as "nerds" or "mad scientists." Others describe scientists as "hard," "old," "frightening," and "colourless" (Rogers and Ford 1997). Several reasons have been suggested for these negative attitudes including students' undesirable experiences in previous science courses and with instructors, lack of needed skills to learn and apply scientific concepts, lack of motivation to work hard in science classes, home backgrounds, school and classroom environments, biases of peer groups, the media's portrayal of scientists, and students'

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perceptions of rewards associated with learning, to name a few (Rogers and Ford 1997). Science anxiety, the fear of science learning, and apprehension toward scientists and science-related activities are also results of these factors (Rogers and Ford 1997).

The way science is taught, both at the high school and college level, also plays a major role in shaping students' attitudes toward science. According to a study by Cherif and Wideen (1992)\textsuperscript{13}, which addresses the question of whether a problem exists for science students moving from high school to the university, students are being presented with selected aspects of scientific dogma at the high school and university levels rather than being taught the innovative and visionary character of science and the value that such knowledge has to the educational process. Some of the students in this study reported that they were confused because the information they learned in college contradicted the information they gained in their high school science classes. As the study concluded, this dogmatic approach to teaching science, coupled with the drastic cultural changes that students undergo as they transition from high school to college, affect students' attitudes toward and performance in college-level science courses.

Though the development of desirable attitudes toward science is not the primary goal of introductory science courses, instructors usually recognize that attitude formation is one of the important aspects of instruction (Cherif and Wideen 1992; Garcia and McFeeley 1978\textsuperscript{14}). There is growing evidence that students who possess positive attitudes


toward science will perform better academically. Russell and Hollander (1975)\(^{15}\), who created the Biology Attitude Scale—a tool designed specifically to measure students' attitudes toward biology—support this claim. "The tool was developed on the assumption that an important consequence of instruction is a positive change in the student's attitude toward the subject, and the authors argue the importance of focusing on attitudes by stating that there usually exists a positive correlation between attitudes and achievement" (Russell and Hollander 1975).

Most instructors, however, focus primarily on increasing the students' knowledge of the subject rather than increasing their favourable attitudes toward it. Many instructors assume that students will naturally acquire positive attitudes toward science as they learn more about it. However, a study by Garcia and McFeeley (1978) found that the positive attitudes of students toward biology in eighteen introductory biology courses at East Texas State University decreased by the end of the term. This necessarily raises the questions of how to improve students' attitudes toward science, and whether the way we teach science plays a significant role in this challenge. In short, it is not only what we teach but also how we teach that are important considerations in how to improve student success (Moore 1989)\(^{16}\).

**How to Improve Attitudes toward Science**

Introductory science courses, such as biology, chemistry, and earth science, are usually required at the college level. It is important to keep in mind that non-science majors take science courses in college largely because they need to satisfy their liberal arts requirements, and

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not necessarily because they have a passionate interest in learning science. It is therefore not surprising that many students in these introductory science classes attend irregularly and do not take advantage of the extra help offered (e.g., meeting with the professor outside of class, going to tutorial and learning centers, doing extra credit). Studies show that students who attend all or most classes perform better academically, and good attendance is associated with high motivation. In other words, the most successful students are usually the most highly motivated; they are most likely to come to class, do extra-credit work, and attend help sessions (Moore 2006)\textsuperscript{17}. A highly motivated student is usually one with a positive attitude toward the subject she/he is learning. Therefore, in order to improve students' attitudes toward science, faculty must motivate students, which they can do through their teaching styles and by showing them the relevance of the learning topics to their everyday lives. In addition, they must create the learning environment that helps motivate students not only to come to classes but also want to learn and enjoy learning.

Etkina and Mestre (2004)\textsuperscript{18} suggest that instructors of introductory science classes try to motivate their students by asking them to consider the preconceptions about science-related topics that they bring to the class. In a biology class, for example, teachers can ask students the following questions: "What do you know about HIV and about how AIDS is transmitted? What do you think is the reason that some cancers are curable and others are not? What do you think about


genetic engineering, about cloning, about stem-cell research—are these good or bad things, and under what circumstances" (Etkina and Mestre 2004, 18). Questions like these will demonstrate to students that there are others in the class who have similar views and concerns, that there is a diversity of views in the class, and that they cannot all be scientifically correct. This divergence of views leads naturally to discussions about the process of doing science (experimentation, evidence-based model building, hypothetical-deductive reasoning), the application of scientific discoveries, and the impact of science on society (Etkina and Mestre 2004). The resulting discussions can also help instructors move away from a dogmatic approach to the teaching of science—to a more engaging and interesting approach that encourages critical thinking rather than just fact accumulation.

Furthermore, using controversial issues to introduce topics and concepts in biology classes helps to "raise questions that deserve answers and also generate interest among students, and interest can improve motivation to learn biology" (Leonard 2010, 407)¹⁹. In addition, making the learning and the teaching of the topics more relevant to students' lives helps them see the value of science and in turn motivates them to develop a better attitude toward science and science education.

The importance of science is clear to most people, however the majority of the population is illiterate in science (Crocker, 1997)²⁰. Attitude toward science implies a general positive or negative feeling about science—whether a person likes or dislikes science. Munby

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(1983) defined scientific attitude as the thinking patterns generally characteristic of scientists, such as objectivity, curiosity, questioning, and justifying conclusions with evidence. Zint (2002) wrote that attitudes are learned and taught. This is why science teachers endeavour to understand and improve students’ scientific attitudes and overall attitudes toward science for the enhancement of instruction and students learning.

Attitude toward science was closely related to achievement in science (George, 2000). A significant relationship was found with a mean correlation from 0.16 to 0.70 between students’ attitudes toward science and their achievement (Willson, 1983; Steinkamp & Maehr, 1983; Weinburgh, 1995; Marsh, 1992). Bloom’s educational theory (1976) predicted that attitude would account for up to 25% of the variability in students’ achievement scores. Oliver and Simpson (1988) found that achievement motivation and self-concept were significant predictors of science achievement for about 10% of the variance in achievement scores. Rennie and Punch (1991) also found that

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perception of past performance proved 10% to 40% of the variance in achievement score. These studies showed that the relationship between students’ attitudes and their achievement is not simply a correlation but causation in nature. If so, understanding the causal connection would be a useful educational tool for promoting successful student learning (Mattern and Schau, 2002)\textsuperscript{30}. Gender issues have been major foci in science education. Considerations of gender equity are critical in the science teaching standards (NSES, 1996)\textsuperscript{31}. The Higher Education Research Institute at UCLA, showed a large difference between men and women in intentions to major in science and engineering (NSF, 2000)\textsuperscript{32}. Often college women are thinking ahead to their hopes for children and a family (NECUSE, 1996)\textsuperscript{33}. Women tend to be more passive in labs at coeducational colleges. This may be due to gender differences in socialization. Boys have more positive attitudes than girls, as well as having higher achievement scores (Rosier & Banks, 1990\textsuperscript{34}; Schibeci, 1986\textsuperscript{35}) Over twice as many boys in middle school are interested in futures in science than girls (Catasambis, 1995\textsuperscript{36}). The same results of that females have a less positive attitude toward science, science classes, and careers in science than do males are found in many


studies (Eccles et al, 1989\textsuperscript{37}; George, 2000\textsuperscript{38}; Keeves, 1973\textsuperscript{39}; Kelly, 1978\textsuperscript{40}; Lowery et al., 1980\textsuperscript{41}; Rosier and Bank, 1990\textsuperscript{42}; Schibeci, 1986\textsuperscript{43}; Simpson & Oliver, 1990\textsuperscript{44}; Young & Fraser, 1994\textsuperscript{45}). These differences existed despite the fact that girls performed as well or better than boys, and this gender effect has not changed in 20 years. Obviously, our society will become more scientifically complex. How science is taught, how schools prepare students, and what factors impact science learning all need attention.

1.3 General Intelligence

There are probably as many definitions of intelligence as there are experts who study it. Simply put, however, intelligence is the ability to learn about, learn from, understand, and interact with one’s environment. This general ability consists of a number of specific abilities, which include these specific abilities:

• Adaptability to a new environment or to changes in the current environment
• Capacity for knowledge and the ability to acquire it
• Capacity for reason and abstract thought
• Ability to comprehend relationships
• Ability to evaluate and judge
• Capacity for original and productive thought

Additional specific abilities might be added to the list, but they would all be abilities allowing a person to learn about, learn from, understand, and interact with the environment. Environment in this definition doesn’t mean the environment of the earth, such as the desert, the mountains, etc., although it can mean that kind of environment. It has a wider meaning that includes a person’s immediate surroundings, including the people around him or her. Environment in this case can also be something as small as a family, the workplace, or a classroom.

Intelligence is defined as general cognitive problem-solving skills. A mental ability involved in reasoning, perceiving relationships and analogies, calculating, learning quickly… etc. Earlier it was believed that there was one underlying general factor at the intelligence base (the g-factor), but later psychologists maintained that it is more complicated and could not be determined by such a simplistic method. Some psychologists have divided intelligence into subcategories. For example Howard Gardner maintained that it is comprised of seven components: musical, bodily-kinaesthetic, logical-mathematical, linguistic, spatial, interpersonal, and intrapersonal. Other definitions are: “Intelligence is what you do when you don’t know what to do.” “Intelligence is a hypothetical idea which we have defined as being reflected by certain types of behaviour.”
For years psychologists have tried to understand the elusive concept of intelligence or a general ability that would define and evaluate people. Common, as the word may sound, it has been difficult for the researchers, psychologists and the philosophers to agree upon a single definition for the term. Most people would agree that intelligence is an ability to comprehend and learn from an experience. It allows the person to conduct his day-to-day tasks, use language and solve problems that would define his adaptability in the world. It is commonly accepted that each person is born with his set of distinct abilities or intellectual potential. Society may help mould it but ultimately a person is shaped by his different potentials. The question however remains that whether intelligence is linked to a single general mental ability or is it composed of distinct multiple abilities. General Intelligence is the ability to think about ideas, analyze situations, and solve problems. It is measured through various types of intelligence tests. Currently, through research, psychologists have identified several types of mental abilities that make up intelligence.

General intelligence, also known as g factor, refers to the existence of a general intelligence that influences performance on mental ability measures. The existence of general intelligence was first described by Charles Spearman in 190446. According to Spearman, this g factor was responsible for overall performance on mental ability tests.

**Spearman's g Factor**

One of the key theories for explaining the concept of human intelligence was coined by a British psychologist, Charles Spearman at the turn of this century in an article published by him on intelligence. His

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theory was based on the observation that individuals who scored highly in one test also seemed to display high scores across all tests of mental ability. Whereas people with low scores in a test fared badly across others. Thus he came to the conclusion that all theories of mental ability were positively correlated. Here correlation is the statistical relation between two variables and they reflected the influence of a dominant factor which he termed the general factor or 'g'. This factor was extracted using the method of factor analysis. This widely accepted general factor seems to explain most differences in the mental tests regardless of the ability that the test has to assess. So people who have high scores in mathematical ability would score high in a language test as well. For different tests the mental abilities that were tested varied, thus they reflected the 'g' factor at varying degrees.

Thus a battery of tests is required to judge a person's 'g' factor. Not only does the general factor point out at individual differences, it also provides an insight on intelligence in daily life. Thus it can be associated to smart reasoning, problem solving and quick learning in everyday life. Furthermore this factor analytic research has confirmed a hierarchal model of mental abilities with 'g' factor at the top. Specific aptitudes like verbal ability, memory and mathematical reasoning follow the 'g' factor and at the end are the skills derived by particular profession or job.

Biological Aspect of the g Factor Spearman's general factor has many biological correlations. Researchers have discovered that several attributes of the brain can be linked to general intelligence. It was observed that the brain size and the peripheral nerve conduction velocity seemed to be correlated to 'g'. For example, brains of brighter people seemed to expend less energy than their less able counterparts. One of the other significant factors is the inheritability of the general factor.
Thus the genetic endowments along with an individual's environment shape the differences among individuals. Along with these, measures of 'g' seem to positively correlate with the social measures of success in life, like academic achievement, college, career, etc.

The controversy surrounding the general intelligence factor have been based on improper use of mental tests. Critics argue that these IQ tests affect the capability of a person. Intelligence theorists like Howard Gardner and British philosopher Philip Kitcher have argued that there can be no single measure of intellectual ability. They propounded the theory of multiple intelligence. Countless studies have failed to show the consistency of performances across tests. As scientists continue to debate the existence of the 'g' factor, it is impossible to disregard the fact that the mental abilities among individuals vary. Recognizing this can help the society draw better solutions to address the different intelligence levels of people.

While intelligence is one of the most talked about subjects within psychology, there is no standard definition of what exactly constitutes 'intelligence.' Some researchers have suggested that intelligence is a single, general ability; while others believe that intelligence encompasses a range of aptitudes, skills and talents.

The following are some of the major theories of intelligence that have emerged during the last 100 years.

**Charles Spearman - General Intelligence:**

British psychologist Charles Spearman (1863-1945) described a concept he referred to as general intelligence, or the \( g \) factor. After using a technique known as factor analysis to examine a number of mental
aptitude tests, Spearman concluded that scores on these tests were remarkably similar. People who performed well on one cognitive test tended to perform well on other tests, while those who scored badly on one test tended to score badly on others. He concluded that intelligence is general cognitive ability that could be measured and numerically expressed.

**Louis L. Thurstone - Primary Mental Abilities:**

Psychologist Louis L. Thurstone (1887-1955) offered a differing theory of intelligence. Instead of viewing intelligence as a single, general ability, Thurstone's theory focused on seven different "primary mental abilities." The abilities that he described were:

- Verbal comprehension
- Reasoning
- Perceptual speed
- Numerical ability
- Word fluency
- Associative memory
- Spatial visualization

**Howard Gardner - Multiple Intelligences:**

One of the more recent ideas to emerge is Gardner’s theory. Instead of focusing on the analysis of test scores, Gardner proposed that numerical expressions of human intelligence are not a full and accurate depiction of people's abilities. His theory describes eight distinct intelligences that are based on skills and abilities that are valued within different cultures.
The eight intelligences Gardner described are:

- Visual-spatial Intelligence
- Verbal-linguistic Intelligence
- Bodily-kinaesthetic Intelligence
- Logical-mathematical Intelligence
- Interpersonal Intelligence
- Musical Intelligence
- Intra personal Intelligence
- Naturalistic Intelligence

Robert Sternberg - Triarchic Theory of Intelligence:

Psychologist Robert Sternberg defined intelligence as "mental activity directed toward purposive adaptation to, selection and shaping of, real-world environments relevant to one’s life." While he agreed with Gardner that intelligence is much broader than a single, general ability, he instead suggested some of Gardner's intelligences are better viewed as individual talents.

Sternberg proposed what he refers to as 'successful intelligence,' which is comprised of three different factors:

- **Analytical intelligence:** This component refers to problem-solving abilities.

- **Creative intelligence:** This aspect of intelligence involves the ability to deal with new situations using past experiences and current skills.

- **Practical intelligence:** This element refers to the ability to adapt to a changing environment.
Final Thoughts:

While there has been considerable debate over the exact nature of intelligence, no definitive conceptualization has emerged. Today, psychologists often account for the many different theoretical viewpoints when discussing intelligence and acknowledge that this debate is ongoing.

1.4 Academic Achievement in Science

Determinants of academic achievement in basic education have been widely studied in the literature. Most of the studies that are intended to evaluate the determinants of quality of education by using academic performance tests include as explanatory variables the student’s socioeconomic background, school inputs, and inborn factors. Academic achievement is commonly measured by examinations or continuous assessment but there is no general agreement on how it is best tested or which aspects are most important — procedural knowledge such as skills or declarative knowledge such as facts. Academic achievement can also be defined as excellence in all academic disciplines, in class as well as extracurricular activities.

Individual differences in academic performance have been linked to differences in intelligence and personality. Students with higher mental ability as demonstrated by IQ tests (quick learners) and those who are higher in conscientiousness (linked to effort and achievement motivation) tend to achieve highly in academic settings. A recent meta-analysis suggested that mental curiosity (as measured by typical intellectual engagement) has an important influence on academic achievement in addition to intelligence and conscientiousness.
Children’s semi-structured home learning environment transitions into a more structured learning environment when children start first grade. Early academic achievement enhances later academic achievement.

Parent’s academic socialization is a term describing the way parents influence students’ academic achievement by shaping students’ skills, behaviours and attitudes towards school. Parent influence students through the environment and discourse parents have with their children. Academic socialization can be influenced by parents’ socio-economic status. Highly educate parents tend to have more stimulating learning environments. Children’s first few years of life are crucial to the development of language and social skills. School preparedness in these areas help students adjust to academic expectancies.

Another very important enhancer of academic achievement is the presence of physical activity. Studies have shown that physical activity can increase neurotic activity in the brain. Exercise specifically increases executive brain functions such as attention span and working memory.

Some of the most common findings of these studies are: i) Socioeconomic background, usually measured by the educational level of the student’s parents, has a positive impact on the school achievement (Peragine and Serlenga, 2007\textsuperscript{47}; Checci and Peragine, 2005\textsuperscript{48}); ii) Boys do better than girls in standardized tests of Mathematics and Science (Hyde \textit{et al}, 1990; Benbow and Stanley, 1980\textsuperscript{49}; and Fuchs and


\textsuperscript{49} C. Benbow, J. Stanley (1980). Sex Differences in Mathematical Ability: Fact or Artifact?. \textit{Science} 210 (4475), 1262 – 1264
Woessmann, 2008\textsuperscript{50}); \textit{iii}) the quality and quantity of school’s resources maintain an unclear relation with school attainment (Altinok and Bennaghmouch, 2008\textsuperscript{51}; Al Samarrai, 2002\textsuperscript{52} among others). However, the increase and efficiency of the amount of educational resources in the school will have a higher effect when the student is open to learning and has incentives to study because one of the main components of the ‘effort’ done by the student is his motivation to learn. The role of self-motivation is usually not included in empirical applications as a consequence of the information availability. Self-motivation could positively affect educational attainment by at least two different channels. On one hand, greater motivation is directly related to students’ effort (attendance, discipline, time devoted to homework, among others) (Cooper, 1989\textsuperscript{53}; Betts, 1996\textsuperscript{54}; Bishop et al., 2003\textsuperscript{55}). On the other hand, motivation could increase the perceived utility of learning. Several studies, carried out at personal level, showed that the outcomes of cognitive skills tests are good indicators of pupil’s future income (Boissiere, Knight and Sabot, 1985\textsuperscript{56}; Bishop, 1989\textsuperscript{57}, 1992\textsuperscript{58}; Moll, 1998\textsuperscript{59}).

\textsuperscript{54} J. Betts (1996). The Role of Homework in Improving School Quality..Discussion Paper 96-16. Department of Economics, UCSD.
Intelligence and academic achievement: an investigation of gender differences was conducted by Naderi, Abdullah, Aizan & Sharir (2009) and found that when student's intelligence was measured by three of intelligence test, the result imply that there existed no significantly relation between males and females regarding which aspect of intelligence related to academic achievement, although intelligence was shown not be related to academic achievement for both genders. Hence, different aspect of intelligence and academic achievement doesn't matter for males and females when looking at the relation between intelligence and academic achievement. This could be one reason previous study yielded not decisive results respecting the relation between intelligence and academic achievement. One possible interpretation for this result is that males and females which has not been excelled in different aspect of intelligence. Findings from this study are consistent with those of Habibollah, et.al (2008). Achievement of students in schools has been the concern of school authorities. Several solutions have been offered in order to improve the quality of instruction. Some of these prove to be effective for some time, but later new innovations are introduced thus sometimes affect the teaching-learning situations in the classrooms.

Science subjects are important because this field have greatly benefited mankind in its efforts to improve the quality of life. In view of

this, college education plays a vital role in moulding the minds, interest, awareness and concern of an individual to prepare himself for the future. Recognizing that science makes life easier and meaningful, educational institutions, through the mandate of the government, focus its attention on the advance of science and technology in terms of classroom instruction at all levels. Science curriculum must be taught in terms of how it can develop scientifically literate society and how it can make an individual more responsive to the needs of the times. Based on observations, science instruction nowadays placed more emphasis on the mastery of the subject matter. When students did well in written examinations, teachers believe that the aim of the lesson has been achieved, but evaluation should not only be based on written tests but should also include oral and practical examinations to make sure that learning really has taken place.

1.5 Rationale of the Study

Science teaching in schools can and should make a difference in the lives of children and the difference should be on the positive side of the educational ladder. Much has been said about the importance of children’s understanding the nature of the scientific enterprise. In a free society, scientific advancement is dependent upon the will of the people, their will as decision-making citizens to support it and their will as individual to become scientists. Therefore, liberally educated people in the society should understand the nature of the scientific enterprise, the social, economic, and as a political factors that affect its development and the personal satisfactions that come to one who pursues a career in it. Science has been referred to as a self corrective process of finding out. Niels Bohr states that, ‘science includes the methods by which man puts limiting values on his preconceptions’. Percy Bridgeman opined that the
methods of science consist of doing your demands to get the answer with no holds barred. Regardless of whether we refer to them as the methods of science, as problem solving, as enquiry or as discovery, there processes of investigation in science that has been found to be effective in advancing our understanding of natural phenomena. Elements of the process have been defined in various ways and research has clearly indicated that pupils can be taught how to perform them in conducting their own investigations. Furthermore, as they learn to perform the process, they become more independent or self directive in their learning. To become independent in these ways meets a basic need of all children and thus represents a kind of satisfaction that can be achieved in no other way. If properly taught, science can help all children learn how to learn. Galileo Galilei once said ‘the authority of thousand is not worth the humble reasoning of a single individual’. While learning science, the learner develops certain faculties through reasoning and experimentation which no other subject can provide.

Considering science from the intellectual point of view, it is the most inexhaustible storehouse of knowledge. Since nature is an inexhaustible source of knowledge, science as a subject, offers the widest range of knowledge to the learners. It has exposed the mankind to infinite avenues of knowledge in nature, living and non-living, the world we perceive and also the world beyond human perception thereby makes a conscious of the unknown to be explored.

Science, besides satisfying the intellectual curiosity of man and providing materials and media for intellectual exercise, has disciplinary effect on the mind of the individuals. Since science covers the widest range of knowledge, the learner wonders at the intricacies and mysteries
of the Universe, the known and the Unknown. These tend to create a broader outlook in the life of the learner.

Science is universal in character and it has no barrier of any kind. The scientific revolution began in Western Europe where modern science was born but its home is now the whole world. The fruits of scientific discoveries in one country are enjoyed by the people all over the world. Science is not concern with caste, creed or colour nor recognizes territorial barriers. Such a pattern inherent in science will definitely have an impact on the minds of the learners and is expected to help to develop broad mindedness in them.

The study of science has several other disciplinary values. For instance, science is an interest-awakening subject and its pursuit demands persistent efforts, diligence and patience. Any experimentation in science requires keen observation, concentration of mind as well as accurate representation of facts. There is no place of prejudice or bias in science. Scientific pursuit warrant objective observation and impartial judgement. Engagement in any scientific activity is it theoretical or experimental, therefore pre-supposed intellectual honesty, perseverance, concentration of mind and broad-mindedness. In science we do not conclude or predict anything on the basis of superstition, traditional belief or hear-say, sentiment or emotion except rationality. A scientific result to be acceptable must be valid for all cases.

In pursuing a scientific problem, one has to define the problem, plan the process, collect relevant data, formulate necessary hypotheses, repeat the process if necessary, apply to specific cases before generalizing. During the process, one has to be logical and objective at every step. Thus, scientific pursuit demand such qualities as minute
observation, scientific attitude of mind, persistence, perseverance, concentration of mind, accuracy of measurement, patience, logical, objective and unprejudiced judgement; respect for others opinion, respect for truth, etc. These disciplinary qualities of mind, if cultivated through the teaching of science, may be carried over to manifest in the general behaviour of the learner. This will prove useful for living as an efficient social individual in the society. No other subject provides opportunities for inculcation of so many disciplinary qualities of the mind of the learners.

It is hardly necessary to elaborate the utilitarian or practical values of science. The present world is the world of science and technology. Everything or every event happening around us demands some knowledge of simple scientific facts or principles. Without the elementary knowledge and information of science, we will be at a loss. Science is now everyday science for everybody.

The achievement and the benefits of science touch all sectors and all levels of the modern society. The modern man has applied science and technology for the well-being of mankind by inventing machines and by harnessing the resources of nature. The gifts of science have been profitably used for making life comfortable and raising the standard of living. But the use or abuse of the wonderful in the field of science and technology and the wide application of the achievements of science in industry, agriculture, medicine, transport and communication as well as their uses in domestic life justify, more than ever, the utilitarian values of science.

Science has opened innumerable avenues for pursuing different vocations. A student of science can study engineering and technology,
medicine, agriculture or any similar subject and make his career in that profession. In addition, scientific activities have given rise to many varieties of crafts and allied services. Science therefore, gives opportunities for career-making and pursuing professions and vocations. In fact, if refer to preparation of the individual for the future as one of the aims of education, then science as a subject, is rightly serving this purpose. In this age of science and technology there is a demand for technical personnel. The maintenance and creation of new departments, new establishments need the services of engineers, scientists and technicians and there will always be need for research workers in new fields of science. Educationist Paul Fredman once said, science is no longer the preserve of a few completely-perhaps abnormally devoted men; it is becoming and increasing will become, one of the major professions open to any young man of ability, demanding no more in the way of special bent or devotion than medicine or law. But like those other professions, it too will continue to offer a life with characteristic flavour; it will have its own professional standards and its own typical type of thinking and will call forth its practitioners its own loyalties.

Science has made a tremendous impact on the cultural life of the present day of society which is the product of science. The thinking, feeling and actions of a modern man are practically guided by the effect of science. There is an involvement of science, direct or indirect, in all works as well as leisure of a modern man. Our habits and attitudes have also been affected by science.

The study of science brings behavioural change in the learner and enriches his character and personality. Science gives opportunity for creative thinking and constructive imagination. Further, science is a subject where ideas can be experimented upon and verified. The learner
develops the habits of searching for the truth. These qualities affect the pattern of behaviour of the learner. The significant aspect of science is that whatever the student learns has immediate application in the world around him. This is educationally very sound.

In society, there will always be problems to be solved. One of the very useful outcomes of learning science is the development of problem solving skills. If properly cultivated through the teaching of science, the student can apply this skill to solve problems in his personal or social life.

One of the aims of modern of education is to provide means for utilisation of leisure especially in the industrialized society. There is no end to interesting pursuit in science, intellectual or otherwise. Scientific activities provide the best hobbies and past time for proper utilization or leisure.

At higher level, arts and science are no way different. There can be no good piece of arts without application of science, and no other hand there is artistic or aesthetic element in all scientific activities. The great thinkers have always been stressing the need for unity of science and arts, for they originate from the same root. In the modern civilization, scientific creation glorify arts and aesthetic and science may be said to be the modern substitute for arts in the sense that it is the results of the same kind of creative thought and action which have generated arts.

Arts and aesthetics are components of culture and civilization. The creation of the universe is a great piece of art. There is aesthetics in the mysteries and harmonies of nature. Saunders felt that ‘there is an aesthetic side to the scientist’s activities and to his contribution to human
culture. On the lowest level he has the satisfaction of adding to the sum of human knowledge; on a higher level he enjoys the subtle pleasure of devising some hypothesis which fits a diversity of facts opening up new areas of knowledge. Appreciation of fitness of purpose, the suitability of an apparatus for the job for which it was designed, can give great inward satisfaction. There is a pleasing skill in avoiding or eliminating sources of errors of human observation. Wonder is aroused by neatness with which some material quality or some living activity can be sorted out from other qualities or activities for examination and demonstration. There is an elegance that runs through the logic and handwork of the scientists. It is seen in the formulae of mathematicians, it is equally seen in the experiments and observations of great naturalists. The very simplicity of great generalization of science stirs the imagination. With microscope and telescope the scientist opens up new worlds of wonder and beauty. A speck of living matter becomes a creature of incredible beauty, a snow flake lovelier than diamonds and a distant star becomes a universe. It is at this level that science shares equally with the arts, the privilege of contributing to the aesthetic development of the human race.

Culture in addition to knowledge, includes all activities, thoughts, feelings, attitudes, pattern of individual or social life of men. The study of science gives opportunity for a positive contribution to the cultural life of the society. For instance, the science gaining ground and spreading its influence in the life of man, there has been a profusion of literature based in science. Scientific fiction, being interesting, adds to the cultural heritage of man. Similarly, the literature on history and development of science is no less interesting. It is the study of the origin and development of civilization itself and has developed into a separate branch of study which contributes to the cultural heritage.
The biographies of scientist incorporated in the science course develop a scientific attitude among the learners. The description of the pursuits of the scientists, the tenacity and perseverance, etc, is worth reading. Such a study brings out a scientists ‘attitude towards science and their hopes and frustrations on their way to discovery. Sometimes even after their invention or discovery, it takes a long time for social acceptance. The fact about sacrifices of the scientists for the benefits of mankind stirs one’s imagination. The lives of Galileo, Watt, Curies and others show how the scientist has to suffer to make an original discovery. The lives of the scientists can inspire the minds of the young learners. It is believed that the study of science and the life of the scientists engender praise worthy humanity.

The study of the scientist’s way of discovery is more interesting. It gives the learners an opportunity to grasp the essential steps of scientific method or procedure. For example, the story of the discovery of the Laws of Gravity by Sir Isaac Newton or the story of the discovery of the cause of malaria by Sir Ronald Ross, will help to make the meaning of science clear. It is useful to give the pupils, the idea how scientist sacrifice their personal comfort for the good of society. Broad-mindedness and selfless service to mankind are characteristics of their lives.

A scientist is a seeker of truth and scientific facts give a true picture of nature. In a scientific pursuit, it requires intellectual honesty at each step. In an experiment, one has to record correct data, collect authentic information and make objective interpretation of observation. Anything other than truth will lead to wrong results. For exploration of the unknown, scientist has to proceed carefully on the basis of the true picture at each stage of the process. Intellectual honesty and love for
truth coupled with sincerity purpose and virtues are prerequisites in any scientific pursuit. In science ultimately truth prevails, because science is nothing, but truth. There can be no better moral value of a subject than this virtue.

Scientific progress is faster today than ever before. Science teaching and Learning should empower students to feel confident that what they already know is an excellent starting point for all that they will learn.

Development of Scientific Attitude and General Intelligence are considered an important in Science Learning all over the world. Based on the review of related literature the investigator feels that there is a need to find out the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Students in East Khasi Hills District, Meghalaya since there is no concrete study has been made recently on these areas.

1.6 Statement of the Problem

Development of Scientific Attitude and General Intelligence are considered an important in Science Learning all over the world. Based on the review of related literature the investigator feels that there is a need to find out the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Students in East Khasi Hills District, Meghalaya since there is no concrete study has been made recently on these areas. The main intention is to study whether there is any relationship between Scientific Attitude and Level of Academic Achievement and further whether there is any relationship between General Intelligence and Academic Achievement. Therefore the investigator feels that a study in these areas will bring about an insight
on the Attitude, Intelligence and Academic Achievement of Higher Secondary Students in East Khasi Hills District of Meghalaya.

The statement of the problem is stated as follows: **A Study of Scientific Attitude and General Intelligence in relation to the Level of Academic Achievement in Science among Higher Secondary Students in East Khasi Hills District, Meghalaya.**

**1.7 Operational Definition**

(i) **Scientific Attitude:** Scientific Attitude refers to willingness to change opinion, desire for completeness of knowledge and acceptance of warranted generalization.

(ii) **General Intelligence:** General Intelligence of students will be based on word meaning, Analogy, Classification, Number Series, Code Transformation and Syllogism.

(iii) **Level of Academic Achievement:** refers to the Marks obtained in Science at the Secondary School Leaving Certificate (SSLC) Examination Conducted by MBOSE.

**1.8 Delimitation of the Study**

The study was delimited to SSLC Students of East Khasi Hills District, Meghalaya.

**1.9 Objectives of the Study**

The objectives of the study are stated as below:


2. To find out the Level of General Intelligence of Higher Secondary Science Students.
3. To study the Level of Academic Achievement in Science

4. To compare the Scientific Attitude of Higher Secondary Science Students with reference to Sex, Community, and Management of School

5. To compare the General Intelligence of Higher Secondary Science Students with reference to Sex, Community, and Management of School

6. To compare the Academic Achievement (AA) of Higher Secondary Science Students with reference to Sex, Community, and Management of School

7. To Study the relationship between Scientific Attitude, General Intelligence and Academic Achievement (Science) of Higher Secondary Science Students in East Khasi Hills, Meghalaya.

8. To study the Scientific Attitude and General Intelligence in Relation to the Level of Academic Achievement in Science Among Higher Secondary Students in East Khasi Hills District, Meghalaya

1.10 Null Hypotheses

The null hypotheses of the study are presented below:

**Scientific Attitude**

1. There exist no significant difference in the mean scores of Scientific Attitude (SA) of Male and Female Higher Secondary Science Students.

2. There exist no significant difference in the mean scores of Scientific Attitude (SA) of Tribal and Non-Tribal Higher Secondary Science Students.
3. There exist no significant difference in the mean scores of Scientific Attitude (SA) of Higher Secondary Science Students from Government and Private Schools.

4. There exist no significant difference in the mean scores of Scientific Attitude (SA) of Higher Secondary Science Students from Government and Deficit Schools.

5. There exist no significant difference in the mean scores of Scientific Attitude (SA) of Higher Secondary Science Students from Deficit and Private Schools.

**General Intelligence**

6. There exist no significant difference in the mean scores of General Intelligence (GI) of Male and Female Higher Secondary Science Students.

7. There exist no significant difference in the mean scores of General Intelligence (GI) of Tribal and Non-Tribal Higher Secondary Science Students.

8. There exist no significant difference in the mean scores of General Intelligence (GI) of Higher Secondary Science Students from Government and Private Schools.

9. There exist no significant difference in the mean scores of General Intelligence (GI) of Higher Secondary Science Students from Government and Deficit Schools.

10. There exist no significant difference in the mean scores of General Intelligence (GI) of Higher Secondary Science Students from Deficit and Private Schools.
**Academic Achievement**

11. There exist no significant difference in the mean scores of Academic Achievement (AA) of Male and Female Higher Secondary Science Students.

12. There exist no significant difference in the mean scores of Academic Achievement (AA) of Tribal and Non-Tribal Higher Secondary Science Students.

13. There exist no significant difference in the mean scores of Academic Achievement (AA) of Higher Secondary Science Students from Government and Private Schools.

14. There exist no significant difference in the mean scores of Academic Achievement (AA) of Higher Secondary Science Students from Government and Deficit Schools.

15. There exist no significant difference in the mean scores of Academic Achievement (AA) of Higher Secondary Science Students from Deficit and Private Schools.

**Relationship of Scientific Attitude, General Intelligence and Academic Achievement**

16. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Science Students

17. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Male Higher Secondary Science Students.
18. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Female Higher Secondary Science Students.

19. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Tribal Higher Secondary Science Students.

20. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Non-Tribal Higher Secondary Science Students.

21. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Science Students from Government Schools.

22. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Science Students from Deficit Schools.

23. There is no significant relationship between the Scientific Attitude, General Intelligence and Academic Achievement of Higher Secondary Science Students from Private Schools

**Scientific Attitude and Levels of Academic Achievement**

24. There is no significant difference in the Scientific Attitude of Higher Secondary Science Students at different levels of Academic Achievement.

25. There is no significant Sex difference in the Scientific Attitude of Higher Secondary Science Students at different levels of Academic Achievement.
26. There is no significant community difference in the Scientific Attitude of Higher Secondary Science Students at different levels of Academic Achievement.

27. There is no significant management difference in the Scientific Attitude of Higher Secondary Science Students at different levels of Academic Achievement.

**General Intelligence and Levels of Academic Achievement**

28. There is no significant difference in the General Intelligence of Higher Secondary Science Students at different levels of Academic Achievement.

29. There is no significant gender difference in the General Intelligence of Higher Secondary Science Students at different levels of Academic Achievement.

30. There is no significant community difference in the General Intelligence of Higher Secondary Science Students at different levels of Academic Achievement.

31. There is no significant management difference in the General Intelligence of Higher Secondary Science Students at different levels of Academic Achievement.