CHAPTER- II:

PERESENT STUDY AND THE REVIEW OF THE RELATED LITERATURE

2.1. INTRODUCTION

Related studies of any research give a pinpointed direction of the study. A general trend of past study able to find the area covered by the previous research and current related literature review of Abroad and India helps much about the objectives, methodologies, analysis and findings of the research. Researcher tried to cover all these areas with his best efforts. A general trend of the yester years up to 1990 has been studied in all the three areas namely Concept in Science, Aptitude in Science and Awareness of Environmental Pollution. Followed by an updated literature has been studied for Abroad and India for the same.

2.2. RELATED STUDIES:

2.2.1. RELATED STUDIES: CONCEPTS IN SCIENCE

2.2.1.1. General trends of concepts studies (in yester years)

The first stage of research on concept was confined only to the definitions of the concept by different psychologists. But the pioneering work in the area of concept learning has been done by Bruner and his associates (1956) under the work “A Study of Thinking”. Weiss and Hobland (1953) suggested learning of concept through positive and negative examples. Mascole( 1967) found that conceptually organised course contributes to better yielding of concepts. Klausmeier (1970) found relation between analytic ability and learning, and learning of concepts. Feldman (1975) found that a series of examples is more effective than single example in concept attainment. Tener(1980) studied students’ mastery of classification of concept in introductory college Zoology wherein definition of concept was preferred to examples of the concept.

Concept formation is significantly and positively related to intelligence (Sing, 1965; Joshi, 1970). Concept mapping is significantly correlated to achievement
(Bodolus, 1986; Loncaric, 1986; Spaulding, 1989). Speed of acquiring concept is greater for urban pupils (Basu, 1977).

2.2.1.2. Studies on concepts in science abroad

Tull; University of Texas (1990) made an ethnographic study to examine elementary science students’ conceptions in Biology. The study is conducted with the goal of examining the botanical knowledge of nine to six grade students. The language, meanings, classifications and interpretations of botanical concepts presented by the students are compared to those found in the elementary text book series, science, by Silver Burdett 1985. It is found that the children’s explanation for abstract botanical phenomenon are poor and somewhat idiosyncratic, based partly on text taught information and partly on folk cultural knowledge. The text books often do not provide enough information to bridge the gap between the child’s knowledge and scientist knowledge. The text books do not promote the stated goals for science education put forward by various educational organisations.

Haack; University of Oklahoma (2000) conducted a study of students’ use of scaffold problem-solving learning approaches and understanding of concepts in an introductory college of physics class. The sample consists of 48 students who have completed all study instruments. Of this number 23 do homework assigned that included scaffold problems. The other 25 students do non-scaffold homework assignment. It is found that students who do scaffold problems attained significantly greater understanding of physics concepts than students who do non-scaffold assignments.

Buchholz; (2000) conducted a kindergarten case study on understanding the biological concept “bird”. 14 students in a metropolitan public school in the Deep South constitutes the sample of these qualitative multiple case study. The research is conducted in three phase-pre-instructions, instructions and post-instructions interviews. The theoretical frame work for this research is based on the human constructivism theory of learning (Mintzes, Wandersee and Novak, 1997). The findings suggest that young children’s knowledge of “bird” is limited chiefly to birds’ anatomical and morphological characteristics. There is a positive significant difference in young children’s pre and post instruction scientific knowledge of birds.
Powers; University of Northern Colorado (2000) conducted a study to explore the relationship between secondary chemistry students’ conceptual presentations of acid base chemistry, as shown in student-constructed concepts maps, and their ability to solve acid base problem represented by their scores on an 18-items paper and pencil test, the Acid-Base Concept Assessment (ABCA). The ABCA consist of both multiple choice and short answer items. The instruments were administered to chemistry students at two high schools and 108 subjects completed both instrument of study. The results suggest that several factors influence success in chemistry problem solving, including concept, knowledge and organisation.

Bickerton; (2001) made a developmental study to investigate children’s understanding of scientific concepts. The main goal is to determine whether or not children’s conceptual levels of understanding change systematically with age in a progressive manner. Participants attended one elementary school district near Vancouver B.C. 60 children were individually exposed to a set of five buoyancy tasks that vary in level of difficulty. A statistical analysis of the responses shows significant differences between the age groups.

Ledger; University of Massachusetts Lowell (2003) conducted a study which seeks to examine whether Collaborative concept mapping would affect the achievement, science self-efficacy and attitude towards science of female eighth grade science students. The research questions are: i) will the use of collaborative concept mapping affect the achievement of female students in science? ii) Will the use of collaborative concept mapping affect the science self-efficacy of female students? iii) Will the use of collaborative concept mapping affect the attitudes of females towards science?

The study is quasi-experimental and utilizes a pre-test-post test design for both experimental and control groups. Eighth grade female students from three schools in a large north eastern school district participate in the study.

The achievements test consist of 10 multiple choice and 2 open-response questions and uses questions from State-wise and national assessment as well as
teacher-constructed items. A 29 item Likert type instrument (McMilla, 1992) was administered to measure science self-efficacy and attitude towards science.

2.2.1.3. Studies on concepts in science in India

Sing (1990): Studied the effectiveness of Inquiry Training Model (ITM) and Concept Attainment Model (CAM) over Traditional Method of Teaching on Pupils’ Achievement in Physical Science. Three groups of 120 students in each are selected from three colleges of Dehradun. These class IX students – groups were matched on intelligence and socio-economic status scores. Non-random control groups pre-test-post test quasi-experimental design as used. It is found that the post-test achievement scores are significantly higher than the pre-test scores when taught through ITM or CAM, but this is not in the case of TMT.

Bawa (1991) carried a study that centres round concept learning, which is the most important part of academic discipline. Concepts acquired with understanding serve as tool not only for acquisition of new concepts but also for solving problems. The researcher reviewed all possible sources in the library from among the documented studies. The researcher used qualitative methods for analysis. It is found that the concept Attainment Model (CAM) is more effective than the conventional method for the teaching of concepts, especially at the knowledge and understanding levels.

Masih Aejaz (1991) conducted a survey based research to study the understanding of the nature of science and concept-attainment in science middle school students with a comparison of the effects of the Hosangabad Science Teaching project (HSTP) and the NCERT (adopted science curriculum). A sample of 1147 grade-VIII students (HSTP-564, NCERT-583) was taken from 28 government middle schools from the districts of Madhya Pradesh. Tools used are “Carier and Geis” test of understanding science and test of Concept attainment in science developed by the investigator. It is found that both groups lacked a sound understanding of the nature of science.

Khan and Siddiqui (1992) reviewed the researches in the area of concept attainment at different levels. The author reviews the studies conducted earlier in
India and abroad on concept attainment Strategies at different levels. After classifying them into two broad categories i.e. selection strategies and reception strategies, the author also touches upon their effectiveness for learning. Major findings are: i) All concepts possess at least four components: attributes, examples, definitions and hierarchical relations. ii) The factors that affected the selection strategies and reception strategies to attain concepts are definition of task, nature of the instances encountered, nature of validation, anticipating consequences of categorising, and nature of imposed restrictions. (iii) Personality factors have no significant effect on the concept attainment process (iv) Disjunctive concepts is significantly more difficult than the attainment of conjunctive concepts.

De(1999) conducted a study on the concept on the achievement of students in Physical Science. The sample of the study consists of 850 students just promoted to class X in schools located in 24-Paganas districts of West Bengal and Calcutta. However, complete data-sets of only 794 students were considered for analysis. A Standardised concept test in physical science developed by De(1991) was used to collect data. Examination scores were used for representing achievement. Major findings are : (i)In concept Test boys are dominant over girls in general and urban boys are dominant over urban Girls in Particular. (ii) Urban students are superior to rural students of both the genders.(iii) Rural Boys are not significantly superior to urban girls. (iv) Achievement in Physical Science is found highly correlated with concept in Physical Science.(v)High scorers in concept are high achievers in Physical Science.

De and Saha(2000) studied different type of concepts in chemistry, their inter correlations and relative difficulties and compare the scores of the students gender-wise and strata-wise. The sample consists of 130 students just promoted to class X of North- 24- Parganas district of West Bengal. A standardised test of measuring concept attainment in chemistry was developed by the investigator following the model of De (1991) in Physical Science. The test developed after Bruner et al. (1956) comprises three types of concepts, i.e. Conjunctive concept, Disjunctive concept and Relational concept. t-test was used for the analysis. Major findings are: (i) Boys are higher than girls and urban students are higher than rural students in their
performance on concept test. No significant difference exists among rural boys and rural girls in concept test.

Reddy & Reddy (2002) stated from their study that Concept of pollution ranges from dust and mud to the nuclear fallout from atomic wastes. India, due to her large population and poverty has easily been vulnerable to pollution.

Senapati & Sahoo (2009) studied the knowledge of environment and environmental pollution – their understanding, causes and consequences.

Saxena (2009) made a study on the concepts of pollution of the primary grade students. The students of polluted zones (or location) have to suffer due to pollution and as such their awareness, concepts and reaction to their environment becomes different from the students of pollution free regions.

Kharatmal (2014) in his study states that one of the ideas in cognitive psychology is that learning takes place by assimilation of new concepts and propositions into existing and prior concept and propositional frame works held by the learners (Ausubel, 1978) also referred to as the individual’s knowledge structure or cognitive structure.

2.2.2. RELATED STUDIES: APTITUDE IN SCIENCE

2.2.2.1. General trends of the aptitude in science studies (in yester years)


Vhora (1977) observed aptitude and achievement are positively correlated.

Chatterjee et al. (1978) observed that Scientific aptitude and interest are the determinants of achievement in science.

Joshi (1981) “Development of Science Education for Upper Primary Class based on Environmental aptitude” in his study found that environmental education at the upper primary level is essential and vital to develop insights and skills needed
related studies: to influence not only the environmental attitudes and the behaviour of the students but also to stimulate their reorientation of values regarding the importance of environment. He found that environment outside the school is potentially significant for the purposes.

Pal (1982) equated scientific attitude, prima facie, with reasoning ability and observed that Science Attitude is significantly responsible for the learning of science. Ghosh (1986) studied scientific aptitude as a dependent variable to find the effect of scientific attitude and academic motivation. He found positive relationship among the variables.

2.2.2.2. Studies on aptitude in science abroad

Margareta (2000) Students developed limited ability to use science in discussing and arguing in a complex environmental issue. A reason for not using science may be that they did not develop a firm conceptual framework, which according to Gräsel (2000) is necessary for ability to apply knowledge in new situations.

Rickinson (2001) proposes that the current evidence based on learners and learning can be understood in terms of six concentrations or nodes of evidence. Three of these are well established students’ (i) environmental knowledge (ii) environmental attitudes and behaviours, and (iii) environmental learning outcomes, while three can be regarded as emerging students’ (i) perceptions of nature, (ii) experiences of learning, and (iii) influences on adults.

Bruce & Constantinos (2010), The 2- MEV(Modified Environmental Values) scale in the United States. They have developed the questionnaire in modified way for use with 9-12 year-old children in the USA. The revised scale was able to measure statistically changes in the environmental attitudes and other variables of participants in earth education programs but not in a control group.

Lingqiong (2012) used a Chinese version of the revised NEP scale in a Survey among 507 students (age 10-12 Years) from the elementary schools in Shenzhen,
China. The results show an acceptable level of internal consistency considering cultural difference between China and Western nations.

Leppanen et al. (2012) have done their study in Finland with 15 years old students and their parents. A significant positive correlation emerged in Environmental Attitude between mothers and fathers. It is also revealed that girls attitude relate more with father. Boys attitude were noticeably more negative than with their parents or girls of the same age.

Muchinsky (2004) in his studies has identified primary mental abilities in relation to aptitude in any specific field which are as – General intelligence, verbal ability, numerical ability, spatial ability, memory, perceptual speed, psychomotor ability. In relation to aptitude in science and science related domain he also considered the ability of mechanical comprehension.

2.2.2.3. Studies on aptitude in science in India

Rao (1990) observed that scientific aptitude and attitude have positive association with biology achievement.

Sharma (2004, CASE) studied Development and Tryout of a Strategy for Environment in Multi-Grade teaching for class III and IV.

Ramkumar (2004, CASE) studied Acquisition of Process Skills by IV Standard Pupils through an Instructional Programme in Environmental Studies.

AnuRadha (2005, Punjab University) studied Attitude towards Environment and Perception of Environmental Education among Student-Teachers and Teacher-Educators.

Sharma (2005, CASE, MSU) studied Effectiveness of an Instructional package in Environmental studies among students of standard VII.

Ray (2006), In this study it is found that Secondary level of school draw the attention of the majority of researchers in the field of Environmental Education apart from the level. The study is directed towards five specific directions which include awareness study, development of teaching methodology and learning sites,
supplementation towards curriculum, school climate, and interrelationship of Environmental Education with other psycho social factors.

Sen and Mukhopadhyay (2012) stated that the study was designed to investigate gender difference on creativity in physics in relation to three factors namely aptitude in physics, scientific attitude and study approaches. 703 number of Class-XI school students both boys and girls around Kolkata were chosen as sample. Intergroup difference in scores of creativity in physics was estimated in terms of mean scores, standard deviation and t-tests. Relationship of creativity in physics with other selected variables at bivariate level was estimated using bivariate correlation and critical ratio, and the same relation at multivariate level was investigated using multiple regression analysis. The relationships, at both the bivariate and multivariate levels were investigated separately for boys and girls groups.

Findings obtained were as following: 1. Gender is found to be significant in all the scores of creativity in physics (scores for each separate dimension and also on overall scores). 2. Relationship of creativity in physics with other selected variables (both at bivariate and multivariate levels) are strong and significant and this relationship is also found to be gender fair. 3. Results of step-wise regression analysis indicates that for both the group of boys and girls, the variables aptitude in physics, deep approach, and scientific attitude play the dominant roles in prediction.

Chakraborty, Sen and Maity (2014) stated that aptitude test on chemistry for secondary Passed students consists of seven dimensions namely scientific information in chemistry, vocabulary in chemistry number series, spatial ability, formulation, verbal comprehension and non-verbal comprehension. Items of each dimension were finally selected by item analysis method. Reliability of the test was estimated by Cronbach’s alpha coefficient method and found it is 0.72 for the entire test and ranges from 0.09 to 0.83 for seven dimensions. The intrinsic validity was estimated by Pearson’s product moment correlation method and the construct validity was determined by exploratory factor analysis method. Significant results were obtained. Test norm was also estimated.
Narayana and Suhane (2010) attempted to explore the extent of which scientific attitude and scientific aptitude help in improving environmentally sensitive behaviour. Environmental practices pertaining to conservation of nature, control of noise pollution, water conservation, health and hygiene, energy conservation and limited use of poly products have been taken consideration. The sample consisted of 480 students who were studying in IX and X standards. It was found that scientific aptitude is influencing environmental practices of children whereas scientific aptitude is not. Curiosity and open-mindedness components of scientific attitude do contribute in developing environmental sensitive behaviour among secondary school students. Environmental practices that could be developed through scientific attitude are conservation of nature, control of noise pollution and limited use of poly products.

Narayana and Suhane (2010) found negligible effect of ‘Aptitude in Science’ on ‘Environmental Awareness’ but this result apparently contradicts our expectations on theoretical ground. It, therefore, requires further investigation to verify whether science aptitude has at all any effect on awareness for environment and hence for environmental pollution. Furthermore the innate part of Aptitude may be constant in case of an individual but the other part is psychologically subjected to variation depending on the following factors: Study skills, persistence of learning, motivation, and satisfaction derived from learning a subject, Physical development, interests, attitudes etc. [Ediger&Rao (2003)].

2.2.3. RELATED STUDIES: AWARENESS OF ENVIRONMENTAL POLLUTION

2.2.3.1. General trends of the studies on awareness of environmental pollution (in yester years)

Indian Education Commission (1964-66) suggested that school education has to offer EE and relate it to the life needs and aspirations of the people and the nation. Such education could generate awareness about environment and environmental degradation.

After the Stockholm Conference (1972), Belgrade Charter (1975) and Tbilisi conference on environmental education(1977), an all-out preparation was made
to introduce environmental education at all levels of general and technical education to encourage our young generation to fight the environmental pollution and to keep the earth safe. “In our daily activities and in our jobs, we have to make a concerted effort to educate ourselves, our children and our communities about the environmental consequences for our actions and to **take responsibility for them**.” (Ronald Epstein, 1992).

**Joshi (1981)** in his study found that environmental education at the upper primary level is essential and vital to develop insights and skills needed to influence not only the environmental attitudes and the behavior of the students but also to stimulate their reorientation of values regarding the importance of environment. He found that environment outside the school is potentially significant for the purposes.

### 2.2.3.2. Studies on awareness of environmental pollution abroad

**STUDIES ABROAD:**

**Palmer (1997)** stated on the basis of global research base in environmental education during the decades of 1970 & -80 that the researches sought to find the cognitive and affective determinants of **responsible environmental behavior**. This trend of research experiences shifts in emphasis to aesthetic and spiritual experiences in the environment and in the development of individuals' environmental awareness and concern.

**Shobeiri and Pra hallada (2006)** found significant differences between Indian and Iranian school students in their level of environmental awareness. Also there are significant differences between them in environmental awareness across and within two groups with regard to their gender. Also type of school management (Government and private) is a factor, which can affect student’s environmental awareness in both countries.

**Cankurt, Miran, Günden & Şahin (2008)** found that environmental awareness is evaluated from the standpoints of water, air and soil. Among the pollution categories, people are mostly aware of the pollution in air. In policies related to converting sensitivity to environment into action, the government and institutions
should take into account gender, education, income, age, industrial city and number of information sources.

Islam (2008) showed that the level of understanding awareness and participation of the respondents in the environmental friendly activities are low in Bangladesh. Along with many other recommendations, respondents in this country put stress on acquiring environmental information and tree plantation to overcome this situation.

Jackson (2010) criticized the existing school curricula stating that introduction of ‘Environmental Problems’ & ‘Discussion’ into existing school curricula have caused incoherence due to lack of presence of science paradigm and solutions of environmental problems. It was also seen that majority of the teachers have moderate levels of environmental awareness. Female teachers have significantly higher levels of environmental awareness as compared to their male counterparts. Age-wise analysis also revealed that teachers with 31-50 years had higher levels of environmental awareness and lastly, teachers working in private schools were found to have significantly higher environmental awareness than teachers working in government schools.

Evelyn and Tyav (2012) examined the issue of environmental pollution and its consequences on the Nigerian Society. In doing so, the paper has on the basis of personal observation and secondary sources examined the effects of environmental pollution in Nigeria. The findings of the paper show diverse of environmental pollution in Nigeria both in industrial and agricultural areas are due to man’s interaction with environment which are detrimental to their well-being, natural existence and stability, and which impede the socio-economic development of Nigeria as a Nation. The paper recommends awareness creation and change in Attitude for effective environmental and resource management strategies as a way forward.

2.2.3.3. Studies on awareness of environmental pollution in India

Dash & Mishra (2001) have experienced about environment and the basic concepts on natural processes including Structure and function of ecosystem,
Pollution of air, water and soil, energy, public health and environmental Laws with an orientation towards social and economic issues.

Gakhan; KairaBindu and Saini Kiran (2001) had taken a study on Environmental Pollution Awareness among urban and rural school-going youth in relation to intelligence by using environmental pollution scale. In their study they found out that there exists significant positive difference between variables for high & low intelligent group of students from both urban and rural areas. They also found high intelligent youths have higher awareness about environmental pollution than the low intelligent groups.

Sengupta & Maji (2005) made a comparative analysis of environmental awareness and pro-environmental behaviour between sighted and visually impaired students belonging to secondary stage of education in the state of West Bengal, India and found that the sense of sight or the gender does not have impact on the environmentalism.

Kakreti et al. (2006) have suggested alternative strategies for developing environmental awareness and creating sense of responsibility towards Environmental protection and conservation in students and masses. They found the impact of different orientation strategies on environmental awareness, consciousness, attitude and sense of responsibility among students and people, towards environmental protection and prevention of pollution.

Senapati and Sahoo (2009) launched a project under Board of Secondary education Orissa, but it could not delve deep into the crises but still tried to find the impact of science concepts to perceive and estimate environmental pollution.

Maryam Larijani (2010) attempted to study the environmental awareness of higher primary school teachers of Mysore City in India age-wise, gender-wise and management-wise and found higher awareness with females, middle aged and private school teachers.

Mondal & Mete (2010) conducted to study the status of environmental awareness among the secondary school students residing either at rural or urban
sector. They found that urban boys have higher environmental awareness than that of their rural counterpart. No significant difference upon environmental awareness was found between boys and girls students.

Poonam (2012) stated that environmental education in school level has been accorded high priority by the National Curriculum framework (NCF) 2005. The country is trying to solve local and national issues and problems. Environmental Science as one of the subjects has been included in the school subject. Inspite of that, Secondary school students of government and private schools of Gurudaspur District differ significantly on the Test of Environmental Awareness and its different component. The study reveals that various steps taken for developing awareness for environment is not sufficient and various measures have to be taken to balance the ecology. To study this 125 students from10 Government and125 students 13 Private schools have been taken as sample using Environmental Awareness Test of Sood (2003) at Gurudaspur District of Punjab.

Some of the other studies conducted at the school levels in India are reported briefly in different journals:

*Environmental Education (Gupta, 1997), Quality of Instruction in Environmental Science for Primary Level School Children (Tomar, 1998, MSU, Baroda); learning strategies (Sen, 1999), development of Environmental Education through mass media with Video instruction (Indubala, 1999, S. G. University, Surat); effect of creativity on environmental development (Hanumantia, 2000; Rekha, 2004), environmental education and development of different personality factors (Nag, 2000), development of Supplementary Curricular Programme on Environmental Education for Higher Primary Schools (Suneetha, 2000, University of Mysore); Socioeconomic status vis-à-vis on environmental education (Bishnoi, 2001), development of environmental awareness among the school students (Bishnoi, 2002) etc.*
2.3. CRITICAL APPRAISAL OF THE RELATED STUDIES

2.3.1. Critical appraisal of the related studies on concepts in science

Different studies on ‘concept in science’ in yester year clearly stated that initially research works got importance on defining the concepts in science; identifying learning concepts; developing science concepts among the learners; contribution of conceptually organized course; effectiveness of various example in developing concepts on science; relation between intelligence with concept formation and attainment on concept mapping. The studies of Mascole (1967), Klausmeier (1970), Tener (1980), (Sing, 1965; Joshi, 1970), (Bodolus, 1986; Loncaric, 1986; Spaulding, (1989) were consulted in this connection.

Later, studies on concepts in science in abroad gave importance on ethnographic studies to examine conception on science among the elementary students; problem solving approaches and understanding concepts in science; kindergarten case study on understanding science concepts; exploring the relationship between concepts in science; and their problem solving ability; children’s understanding of scientific concepts and effectiveness of collaborative concept mapping on achievement. The studies of Tull(1990), Haack(2000), Buchholz(2000), Powers(2000), Bickerton (2001), Ledger(2003) were consulted in this connection.

Studies in India basically performed on effectiveness of models of teaching and achievement in physical science; Concept learning as a tool in acquisition of new concepts and solving problem at different levels of students; comparative study on concept in chemistry and their inter correlations among the students gender and strata wise; concepts of pollutions and their awareness; knowledge on environment and environmental pollution; learning with assimilation of new concepts. The studies of Sing(1990), Bawa(1991), Masih Aejaiz (1991), Khan and Siddiqui(1992), De(1999), De and Saha(2000), Reddy & Reddy(2002), Senapati & Sahoo (2009), Saxena (2009), Kharatmal(2014) were consulted in this connection.

From the literature survey on the studies of concepts in science, it is found that: understanding concepts in science may develop depending on the problem
solving abilities, age & maturation, method of teaching, intelligence along with gender and habitat of the students etc.

Controversy of findings arises in the awareness of pollution among the students of rural-urban and boys- girls though they possess better concepts in science.

Gaps in the related studies of concepts in science are as follows:

No such studies explicitly express their findings in relations to the concepts in sciences with awareness of environmental pollution.

Similarly no study was found that could explain the differences of awareness among the students of schools of pollution and non-pollution zones.

2.3.2. **Critical appraisal of the related studies on aptitude in science**

Initially research work was done on Aptitude of a person for a particular thing or practice is also variable being subjected to the effect of educational and environmental factors- aptitude for the study of physics of the high school science sensors; on aptitude and achievement; scientific aptitude and interest as determinant of achievement in science; development of science education based on environmental aptitude determination of some determinant . The studies of Wrightstone et al. (1956), Giri(1976), Vhora(1977), Chatterjee(1978), Josi(1981), Ghosh(1986) were consulted in this connection.

Different Studies in abroad on aptitude in science related to limited ability to use science in discussing arguing in a complex environmental issue; Development of scale in measuring environmental attitude; Learners and learning can be understood on six nodes of evidence related to environment; Correlation studies in environmental attitude between parents and their kids; identification of primary mental abilities in relation to aptitude. The studies of Margareta (2000) Muchinsky(2004), Bruce(2010), Rickinson(2010), Leppanen(2012) were consulted in this connection.

Studies in India related to association of science with aptitude and attitude; development and try-out of a strategy for environment in multi-grade teaching; acquisition of process skills through environment related Instructional Programme; attitude towards Environment and perception of environmental Education;
effectiveness of an Instructional package in Environmental Studies; interrelationship between environmental education and psycho social factors; studied Aptitude in Chemistry on the basis of some categorical variables like sex, habitat, grade etc; contribution of scientific aptitude and scientific attitude to develop environmentally Sensitive practices, aptitude in science on environmental Awareness; scientific aptitude develops with the study of science as a favourite subject Investigation in gender difference on creativity in physics in relation to three factors namely aptitude in physics; scientific attitude and study approaches; construction and Standardisation of a test on aptitude in chemistry; about the impact of immediate environment on Aptitude. The studies of Rao(1990), Cronbach (2002); Sharma(2004), Ramkumar(2004); AnuRadha(2005); Sharma(2005); Ray(2006); Patel (2010), Narayana(2010); Narayana(2010); (Raja &Shah: 2011). Sen (2012); Chakroborty(2014); were consulted in this connection.

Review of the related literature on aptitude in science shows that

- Essentiality of environmental education to develop insight and skills and to change behaeviour of the students of different levels irrespective habitat and gender.
- Essentiality of science in developing firm conceptual framework of aptitude and attitude.
- Primary mental abilities are related to aptitude in science and environmental education.
- Creativity is related to aptitude in science
- Aptitude in science has an important role to develop environmental sensitive behaviour.
- However controversial findings are seen on attitude in science and other psycho social factors on developing creativity.

Gaps in the studies related to aptitude in science is that no such study would predict the effectiveness of aptitude in science on developing environmental pollution awareness.
2.3.3. **Critical appraisal of the related studies on awareness of environmental pollution.**

Initially the research studies and international understanding on environment were related to develop the familiarity with environment among the students. The studies of IEC(1964), Stockholm Conference(1972), Belgrade Charter(1975), Tbilisi Conference(1977), Josi(1981) were consulted in this connection.

Studies at abroad related to cognitive and affective determinant of environmental behavior; comparative studies on environmental awareness among school students between India and Iran; understanding awareness and participation of the respondents; introduction of environmental problems & discussion in existing school curricula; environmental pollution in Nigeria: The need for awareness creation for sustainable development. The studies of Palmer (1997), Shobeiri,(2006), Islam,(2008); Jacson(2010), Evelyn(2012) were consulted in this connection.

Studies in India related to the different aspects namely basics of the environment like ecosystem, pollution, laws, social & economic issues were discussed in their books; environmental pollution awareness among the school going youth in relation to the intelligence; comparative analysis of environmental awareness and pro-environmental behavior of the visually impaired students; developing environmental awareness and creating responsibility towards environmental protection and conservation among students and masses; status of environmental awareness among the students with respect to the habitat; comparative study of environmental awareness among government and private school students. The studies of Dash(2001); Gakhen(2001); Sengupta(2005); Kakreti(2006), Canccurt(2008), Senapati(2009), Mondal(2010); Poonam(2012) were consulted in this connection.

Findings from the related literature are

- To develop environmental awareness outside school environment plays important role
- Inability of proper development of environmental awareness is due to unused science properly
• Degradation of environmental condition is due to human detrimental behavior to environment.

• Females are more aware about environment than males

• Students are differ in awareness about environment due to their habitat

• However some controversies are also found as

• Different behavior of teachers also with respect to gender and strata of students.

• Intelligence has an impact on environment awareness

Gaps of these literatures are

• No such study revealed behavior relation of the students with respect pollution awareness

• No study correlate science concept with pollution awareness

• Any study was not found which express relation between aptitude in science and environmental pollution awareness.

2.4. THE PRESENT PROBLEM AGAINST THE BACKDROP OF PREVIOUS STUDIES

2.4.1. Summary of the studies Identifying Research Gaps:

However, these studies did not explicitly consider the variables like Environmental Pollution Awareness, Environmental Pollution in the vicinity of the schools the students read in and the Aptitude in Science of the students.

Reddy & Reddy (2002) suggested integration of science and environmental studies. The proposal was no doubt good but sufficient data could not be submitted by them to substantiate the proposal. The analysis of the two subjects would show that more than 100 concepts are common to science and environment up to primary level. So concepts in science might have impact on Awareness of Environment Pollution (AEP). But no viable study is available on the effect of concept on Awareness of Environmental Pollution. Wrightstone(1956) mentioned the effect of environment on Aptitude in Science (AS). Cronback(2002) mentioned the influence of immediate environment on Aptitude in Science. But no study is available to show the effect
Aptitude in Science (AS) on Awareness of Environmental Pollution (AEP). Aptitude in Science is based upon reasoning and other logical factors but Narayana (1981) belittled its effect on environment. There is a large number of researches on environmental awareness of the school students at elementary and secondary levels but only a few on environmental pollution awareness.

2.4.2. Research Questions:

From the gaps and anomalies of the studies referred above (2.5.1) it is incumbent upon the present investigator to arrange a study on Concepts in Science (CS) & Aptitude in Science (AS) seems to be necessary on the effect of them on Awareness of Environmental Pollution (AEP) to answer the following questions:

1) Is there any appreciable effect of Concept in Science (CS) on Awareness of Environmental Pollution (AEP)?

2) Is there any appreciable effect of Aptitude in Science (AS) on Awareness of Environmental Pollution (AEP)?

3) Whether Concept in Science (CS), Aptitude in Science (AS) & Awareness of Environmental Pollution (AEP) of the students are affected by category or strata like sex or gender of the students and pollution situations surrounding their schools? The investigator intends to search the reasonable answer from the present study.

2.5. OBJECTIVES OF THE STUDY:

1. To find out the differences on Concept in Science (CS) among the students on the basis of their gender and the locality of the school.

[viz. i)Boys-Girls; ii)polluting – non-polluting zones; iii)Boys &Girls of Polluting zones; iv)Boys &Girls of non-Polluting zones; v)Boys of Polluting &non-polluting zones; vi)Girls of Polluting &non-polluting zones]

2. To find out the differences on Aptitude in Science (AS) among the students on the basis of their gender and the locality of the school.

[viz. i)Boys-Girls; ii)polluting –non-polluting zones; iii)Boys &Girls of Polluting zones; iv)Boys &Girls of non-Polluting zones; v)Boys of Polluting &non-polluting zones; vi)Girls of Polluting &non-polluting zones]
3. To find out the differences on Awareness of Environmental Pollution (AEP) among the students on the basis of their gender and the locality of the school.

[viz. i)Boys-Girls; ii)polluting –non- polluting zones; iii)Boys &Girls of Polluting zones; iv)Boys &Girls of non –Polluting zones; v)Boys of Polluting &non -polluting zones; vi)Girls of Polluting &non- polluting zones]

4. To find out the impact of Concept in Science (CS) on Awareness of Environmental Pollution (AEP).

5. To find out the impact of Aptitude in Science (AS) on Awareness of Environmental Pollution (AEP).

6. To find out the coefficient of correlation among the variables under study

7. To find out whether DV scores can be predicted with the help of Concept in Science

8. To find out whether DV scores can be predicted with the help of Aptitude in Science

9. To find out whether DV scores can be predicted with the help of IV’s jointly.

2.6. HYPOTHESES ( \( H_0 \rightarrow 24H_0 \)) OF THE STUDY:

1. On Concept in Science:

\( H_0 \): The boys and girls of the schools do not differ in the mean scores on Concept in Science.

\( H_0 \): The students of the schools situated in polluting &non- polluting zones do not differ in the mean scores on Concept in Science.

\( H_0 \): The boys and girls of the schools of polluting zones do not differ in the mean scores on concept in science.

\( H_0 \): The boys and girls of non-polluting zones do not differ in the mean scores on Concept in Science.
CHAPTER II: HYPOTHESES (H0-24H0) OF THE STUDY:

5\textbf{H}_0: \text{The boys of schools of polluting zones and non-polluting zones do not differ in the mean scores on Concept in Science.}

6\textbf{H}_0: \text{The girls of schools of polluting zones and non-polluting zones do not differ in the mean scores on Concept in Science.}

\textbf{II. On Aptitude in Science:}

7\textbf{H}_0: \text{The boys and girls of the schools do not differ in the mean scores on Aptitude in Science.}

8\textbf{H}_0: \text{The students of the schools situated in polluting & non-polluting zones do not differ in the mean scores on Aptitude in Science.}

9\textbf{H}_0: \text{The boys and girls of the schools of polluting zones do not differ in the mean scores on Aptitude in Science.}

10\textbf{H}_0: \text{The boys and girls of the schools of non-polluting zones do not differ in the mean scores on Aptitude in science.}

11\textbf{H}_0: \text{The boys of schools of polluting zones and non-polluting zones do not differ in the mean scores on Aptitude in science.}

12\textbf{H}_0: \text{The girls of schools of polluting zones and non-polluting zones do not differ in the mean scores on Aptitude in science.}

\textbf{III. On Awareness of Environmental Pollution:}

13\textbf{H}_0: \text{The boys and girls of the schools do not differ in the mean scores on Awareness of Environmental Pollution (AEP).}

14\textbf{H}_0: \text{The students of the schools situated in polluting & non-polluting zones do not differ in the mean scores of Awareness of Environmental Pollution (AEP).}

15\textbf{H}_0: \text{The boys and girls of the schools of polluting zones do not differ in the mean scores on Awareness of Environmental Pollution (AEP).}

16\textbf{H}_0: \text{The boys and girls of the schools of non-polluting zones do not differ in the mean scores on Awareness of Environmental Pollution (AEP).}

17\textbf{H}_0: \text{The boys of schools of polluting zone and non-polluting zones do not differ in the mean scores on Awareness of Environmental Pollution (AEP).}

18\textbf{H}_0: \text{The girls of schools of polluting zone and non-polluting zones do not differ in the mean scores on Awareness of Environmental Pollution (AEP).}

\textbf{IV. Impact of IV’s on DV}

19\textbf{H}_0: \text{High and Low scorers on Concept in Science (CS) will not differ significantly in their mean scores on Awareness of Environmental Pollution (AEP).}
20\textit{H}_0: High and Low scorers on Aptitude in Science (AS) will not differ significantly in their mean scores on Awareness of Environmental Pollution (AEP).

V. Inter Correlation among the Variables (both IV’s & DV)

21\textit{H}_0: There will be no significant inter correlation among Concept in Science (CS), Aptitude in Science (AS) and Awareness of Environmental Pollution (AEP).

VI. Prediction of DV by IV’s

22\textit{H}_0: Awareness of Environmental Pollution (AEP) scores cannot be predicted by Concept in Science (CS) scores

23\textit{H}_0: Awareness of Environmental Pollution (AEP) scores cannot be predicted by Aptitude in Science (AS) scores

24\textit{H}_0: Awareness of Environmental Pollutions (AEP) scores cannot be jointly predicted by Concept in Science (CS) and Aptitude in Science (AS) scores.

2.7. THE TERMS DEFINED:

2.7.1. CONCEPTS IN SCIENCE

Definition of Concept:

Any meaningful learning of science and other branches of knowledge mostly involves concept, concept formation and concept attainment. Human learning differs fundamentally from the learning of animals in its massive use of concepts. A few importance definitions are outlined below.

According to Piaget (1952), schemas refer to classes of total acts, which are distinct from one another, and yet share common features. Although the term schemas and concepts are not completely interchangeable, Piaget has recognised certain similarity between them: The scheme as it appears constitutes a sort of sensory motor concept or more broadly, the motor equivalent of a system of relations or class.

According to Osgood (1953): A concept is the acquisition of a mediating process that can be abstracted from the stimulus objects.

Bruner et al. (1956) use the term conceptualising and categorising interchangeably. According to them, to categorise is to render discriminable different things equivalent to group the objects and events and people around us into classes,
and to respond to them in terms of their class membership rather than their uniqueness.

**Dressel (1960)** defines concept as abstraction which organizes the world objects and events into small number of categories.

**Klausmeir (1960) states**: a concept is the meaning or meanings that the individual associates with words, other signs, and direct sensory experiences and meaning are based upon discriminations and associations.

**The Pocket Oxford Dictionary (1961)** defines concept as ‘idea of attributes common to a class of things.

**According to Hunt (1962)**, a concept is the label of a set of things that has something in common, a situation in which a subject learns to make an identifying response to members of a set of not completely identical stimuli.

**Caorrol (1964)** defined concept exists whenever two or more distinguishable objects or events have been grouped or classified together and set apart from other objects on the basis of common features or property characteristic of each.

**According to the Webster’s New International Dictionary of the English Language unabridged (1966)**, concept is something conceived in mind : thought, ideas, notion as (a) philos : a general or abstract idea : a universal nation : (i) the resultant of a generalizing mental operation : a generic mental image abstracted from precepts, a directly intuited object of thought; (ii) a theoretical construct ; (b) Logic : an idea comprehending the essential attributes of a class or logical species.

**According to Archer (1969)**, a concept is simply the label of a set of things that has something in common. A concept is different from a fact, a principle and a generalization.

**According to the Encyclopaedia of Psychology (1972)**, concept is the categorisation of objects and events on the basis of features and relationships which are either common to objects perceived or are judged to be so by the individual.
Usually a concept is a symbol, a name. The word, therefore, is not concept itself but only a symbol.

In a later version Bourne (1974) extends his definition to include the relationship between critical features as integral to the concept. Thus, concept is viewed as relationship which governs the set of criteria features of properties.

According to Jurd (1978), extensively a concept involves enumeration of all those examples seen as belonging to specified group. Sometimes it may involve the matching of new objects with others in the group. Intensively a concept is defined by the statement of essential similarities between objects belonging to a group, such statement including both the relevant attributes and relationship between them.

According to Wickelegren (1979), a concept is a basic unit of information that represents a category. He goes further to state that a concept grows out of some other concepts, and as such, it is difficult to determine whether there exist some basic (i.e. primitives, analysable) concepts.

In a later version Klausmeir (1985) describes concept as a mental tool with which one thinks. Concepts as a mental construct of an individual consists of his organized information about one or more entities – objects, events, ideas or processes – that enable the individual to other entities or class of entities. Concept as a public entity corresponds to the meaning of the word that names concept.

Bourne J. and Ekstrand (1985) observe: (1) a concept can best be thought of as basic unit of knowledge; (2) a concept is a mental quantum. In psychology a concept is a bundle or packet of knowledge (information). These packets of knowledge are highly structured both within themselves and among one another.

According to Petrovsky and Yaroshevsky (1987), concept refers to a logical form of thinking; the highest level of generalization characteristic of verbal – logical thinking.

De Cecco (1988) maintains that a concept is stimuli which have common characteristics. The stimuli are objects, events or persons.
Selevens (1993) brings about the meaning of concept. A concept is a mental representation or a mental picture of some object or some experience. A concept is a basic limit of information that represents a category. A concept consists of an individual’s organized information about one or more things, objects, events, ideas, process or relations that enable the individual to discriminate a particular thing or class of things and also relate it to other things or classes of things.

Drever in his Psychological Dictionary states that concept is: that type or level of cognitive process which is characterised by the thinking of qualities, aspects and relations of objects at which, therefore, comparison, generalization, distraction and responding become possible, of which language is the great instrument and the product of concept normally represented by a word.

Aasubel in his Educational Psychology say – concept tends to group themselves into meaningful, interrelated patterns. Considered in isolation they lose some of their meanings. The extent to which the learner is able to visualise relationships between and among the subdivisions of large concept will determine the meaning the concepts convey to him when he is able to visualise the existing relationships, the learner is said to possess insight. It is not equally simple to acquire all different types of mental pictures, but all conceptual learning begins with concrete concepts. Furthermore, it is observed that generalisations, abstractions, and the involved processes of analysis and synthesis on the concrete concept for their basic meanings.

**Concrete concepts:**

Concrete concepts are related to individual sensory impressions when these impressions are a meaningfully interrelated, mental picture form that gives direction to behaviour. Concrete concepts, those that result form direct sensory experience are the most vivid pictures the mind commands. Furthermore, they constitute the basic raw materials of which the more complicated concepts are comprised.

**Generalised Concept:**

Having at its disposal a large number of mental pictures that are particularly clear because of their closeness to the sensory process, the mind begins to classify. At
all school levels, generalizations are formed. This is true in all fields, but it most apparent in the highly organized disciplines e.g. Social sciences.

Abstract Concept:

The formation of the concept, like that of the generalized concept, is dependent upon the learner’s mental pictures of concrete referents. After he has a range of experience with specific objects possessing definite characteristics, he finds that he is able to think of the characteristics quite independently of the object. Thus the learning is able to think meaningfully of goodness in the abstract without the necessity for relating it to a good person. He has now engaged abstraction or has abstracted (removed) a particular quality from its concrete setting.

Concept in Science:

According to the Encyclopaedia of Educational Research (1960) science concepts often involve measurement, in addition, they go beyond specific measures to grasp of relation (cause and effect etc.) and to process, such as scientific method.

According to the Encyclopaedia of Education (1971) the concepts in science can be broadly divided into four categories noted below:

(1) Concepts in science are generalisation which attempt to make sense out of great variety of observable objects and phenomena in nature. They are man’s views of how and why nature behaves as it does.

(2) Some concepts are categorization of objects or events designed to facilitate scientific study.

(3) Some concepts, generally referred to as scientific principles, go beyond merely classifying objects and events, and deal with observed relationships between other concepts. A scientific principle is a statement of an inferred general relationship between scientific concepts.

(4) The explanation of why a relationship (generally cause and effect) exists is another type of concept, which is called a scientific theory and is not based on observation.
According to Oxford Advanced Learner’s Dictionary of Current English, Oxford University Press, Sixth Edition (2000), concept means an idea or a principle that is connected with something abstract.

Concept in Science:

Though the concept or categories used by Bruner and his associates (1956) are artificial, they can be used profitably in learning Science. Bruner classifies the concept into three types:

(i) Conjunctive Concept – It refers to the joint presence of appropriate value of several independent attributes or characteristics.

(ii) Disjunctive Concept – It refers to attributes which individually or jointly represent to concept.

(iii) Relational Concept – It is one defined by a specifiable relationship among the defining attributes.

In science the students come across different facts, processes, terms which are apparently diverse. Efforts may be made by the teacher to find consequence in those facts, processes etc. and group them under a common class or concept. Students find some definitions or statements in the form of concepts, but many more may be formed by the teacher as well as by students through their own experience and considerations. However, the grouping may take place in different ways, and accordingly, there may be different types of concepts.

Different unrelated characteristics of attributes may be grouped together to give a resultant impression of a scientific concept. Such concept is termed as conjunctive concept. In a given conjunctive concept the students are to identify the characteristics or attributes which jointly define the concept. Science has more scope for conjunctive concept.

In Science some concepts are available or may be formed which may be designated as disjunctive concepts. A disjunctive concept can be represented as a bunch of characteristics or conditions such that any of them can refer to the concept independently. If two or more characteristics or conditions are taken together, even then, they refer to the same concept.
CHAPTER- II: 

The Terms Defined:

There are some concepts, both qualitative and quantitative, such that each of them can be defined by specifiable relationship between the defining attributes. Here, it is not the presence of attributes, but the relation between them, that defines the concept. So, the students learning science should carefully study the relationship among the attributes belonging to any relational concept.

After carefully considering the content and teaching-learning practices in science up to class-VIII level in the secondary schools of West Bengal and studying the literature, journals and periodicals, the present researcher identified the following types of Concept in Science known as: Conjunctive Concept

In Conjunctive Concepts of Bruner the salient but independent features/characteristics jointly represent a concept.

Operational Definition of Scientific Concepts: In this study only Conjunctive concepts in science have been used. A person is able to identify such a scientific concept only when s/he can identify the salient but independent features of a concept and can mention them together.

A conjunctive concept in Science = feature_1 + feature_2 + feature_3 --- of the concept

In the environment many conjunctive science concepts are available which have two or more independent but joint features. In the present study only those conjunctive scientific concepts in physical science and life science are selected which have only two joint features. These are as follows: In Physical Science- Solution/Mixture, Structure of matter, Separation of mixture, Combustion, Acid–base, Motion and Chemical Reaction, and In life Science- Concept of Pollution and Waste Materials.

2.7.2. APTITUDE IN SCIENCE

In the Dictionary of education (Good,1959), aptitude is defined as “a pronounced innate capacity for or ability in a given line of endeavour such as particular art, school subject or vocation”. In this definition, an aptitude refers to an individual’s inborn potentialities or capacities which are indicative of some special abilities.
Aptitude is an individual characteristic of a person and mostly cognitive. According to Freeman (1965), aptitude is the state of readiness and promise for training in a particular field. A person’s experience gives him an added advantage of gaining more success in a field—any performance or achievement. Intelligence tests and aptitude tests work in a similar fashion in predicting achievement. Freeman (1965) mentioned the Stanford Scientific (and Engineering) Aptitude Test with the following dimensions:

‘Aptitude’ in Great Illustrated Dictionary (1984) is considered as “a natural talent, skill or ability, quickness in learning and understanding”. In the above two definitions, it has been emphasized on that an aptitude refers to the capacity of an individual to be skilled in some work receiving formal and informal training.

Aptitude is not a specific skill; rather it is the capacity to acquire that specific skill (Freeman, 1965). If an individual has no aptitude for a particular type of work, he/she will not be skilled or proficient in that task in spite of training given to him/her. Whereas, right aptitude of a person, in any specific field, indicates his/her ability of acquiring skills in that particular field, on the basis of which a prediction may be made regarding the amount of improvement of that person in that field, which further training might effect. (Pal, 1982): Sometimes reasoning, prima facie, works similar to Aptitude.

Majority of the psychologists agree on the point that aptitude is innate, yet environmental factors on aptitude have also been recognized (Rao, 1996). As a matter of fact, aptitude is influenced by both biological and cultural factors of an individual.

“Scientific aptitude is a complex of interacting hereditary and environmental determinants producing predisposition or ability in science. Through these abilities, it is possible to predict future accomplishment of a person in science” (Rao, 1996).

Rao (1996) also explained that scientific aptitude depends upon a variety of factors. Presence of certain study skills and persistence in learning science, motivation, satisfaction derived from learning science subjects, socio-economic factors and cultural background are some of the important determinants of scientific
aptitude. In the present context of science learning, explanation of the concept aptitude in science, in particular is deemed necessary.


Aptitude and more particularly science aptitude as an instrument for possible development of environmental pollution awareness is not a constant thing in case of an individual (Narayana and Suhane: 2010).


2.7.3. AWARENESS OF ENVIRONMENTAL POLLUTION

Definition of environment:

We all know that space and places around the human society and habitat is called as environment. Environment has two components abiotic and biotic. Abiotic components are water, air and soil whereas all living beings are biotic.

Definition of Pollution:

Any kind of degradation of quality of abiotic components of environment endangers the biotic existence of environment on the earth. Now it is also considered that environment engulfs not only physical and biological aspects it also considered the educational practices, socio-economic condition, political, psychological, social-beliefs and practices, culture, religion and many more aspects.
CHAPTER II:

THE TERMS DEFINED:

AWARENESS:

According to Audio English.net Dictionary

Awareness means having knowledge of/ state of elementary or undifferentiated consciousness Attribute:(cognizant having or showing knowledge or understanding or realization or perception)

According to English dictionary

Awareness means knowledge or perception of a situation or fact. More concern about and well-informed interest in a particular situation or development.

According to Cambridge Dictionary:

Knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience: Public awareness of the problem will make politicians take it seriously.

According to Wikipedia:

In biological psychology, awareness is defined as a human's or an animal's perception and cognitive reaction to a condition or event.

According to Dictionary Environmental Pollution Awareness Means

1. Advocacy for work toward protecting the natural environment from destruction or pollution.

2. The theory that environment rather than heredity is the primary influence on intellectual growth and cultural development.

Awareness of Environmental Pollution:

The sensitivity or the minimum working knowledge about the phenomenon of pollution is treated as Awareness of Environmental Pollution (AEP). Generally ‘environmental awareness’ precedes Awareness of Environmental Pollution. Pollution awareness can’t meaningfully develop if a person does not possess awareness at basic level i.e. environmental awareness.
**Operational Definition of Awareness of Environmental Pollution:**

A person having Awareness of Environmental Pollution i) might identify the different sources of pollution, ii) might know the cause & effect relationship in different pollutions engulfing people miserably and iii) can suggest some preventive and remedial measures.