

## ENVIRONMENTAL AWARENESS: AN AFFECTIVE GOAL OF SCIENCE EDUCATION

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### ABSTRACT

*Aim of education is the all round development of the learners. The all round development can be attained by providing the learning experiences in all the three domains which are Cognitive, Affective and Psychomotor. Although researches indicate the importance of affective science education, it can be seen that less attention is paid towards it in present educational system. Awareness among the people to utilize science for betterment of world with a conscious care of nature is one important affective goal of science education. Awareness about nuclear energy and issues related to it can be included under the broad concept of scientific awareness. It is needed to emphasize on affective side of science education to make it more humanistic, where students can participate in scientific issues related to society. The attainment of such awareness is possible only if it has been gained since childhood. Are the children getting opportunity to gain such awareness through formal and informal education? This theme paper is focused to discuss the same question by elaborating present status and possibility of inclusion of scientific awareness in science education.*

**Key Words:** *Science Education, Affective Domain, Scientific Awareness, Nuclear Energy*

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### 1. INTRODUCTION:

Modern Science Education is emphasized to make its learner a ‘Scientifically Literate Person’. As per National Science Education Standards (NSES) – 1997 adopted in America, scientific literacy is required for participation in civic and cultural affairs, and economic productivity. In India National Council of Educational Research and Training (NCERT), a reputed guiding authority to the nation for school curriculum designing has defined learning indicators and outcomes of science education. Some of the learning indicators given

by the NCERT for science education at upper primary level are related to encourage the learners to provide meaningful scientific reflections in social context, and to engage them in sustained discussion on scientific issues. When it is matter of participation of the learners in discussion on scientific issues, one important area in which we need to strengthen them is ‘Scientific Awareness’. The scientific awareness makes a learner to cultivate a habit to utilize science with a conscious care of nature. Such awareness also helps him to think over the socio – economic - scientific issues like nuclear

power production without being biased just by science or society. Enrichment of such awareness among the learners of science is again an important factor of scientific literacy and hence becomes a prime aim of science education.

Once sharing his views on need of nuclear energy in our country the missile man APJ Kalam said that nuclear power is our gateway to a prosperous future. It is needed to increase the share of nuclear energy in the total energy production in India. If we wish to move ahead on power generation by means of nuclear energy certainly there will be some human resistance. The resist of nuclear energy from the people with partial knowledge can be made less intense by awareness programs. But we know that it is not that much easy to aware an adult on any issue than a child, so we need to spread the awareness among the young generation during their education to think over such socio - economic - scientific issues. As environmental awareness imbining the nuclear and atomic energy awareness within it is one of the attentions of science education, we need to explore present science and technology textbooks' content and school based science activities carried presently to know that how are they matching the learning indicators. Not only that as the education is accepted as everlasting process, we also need to explore the informal sources providing such awareness among the school learners as well as in civilians.

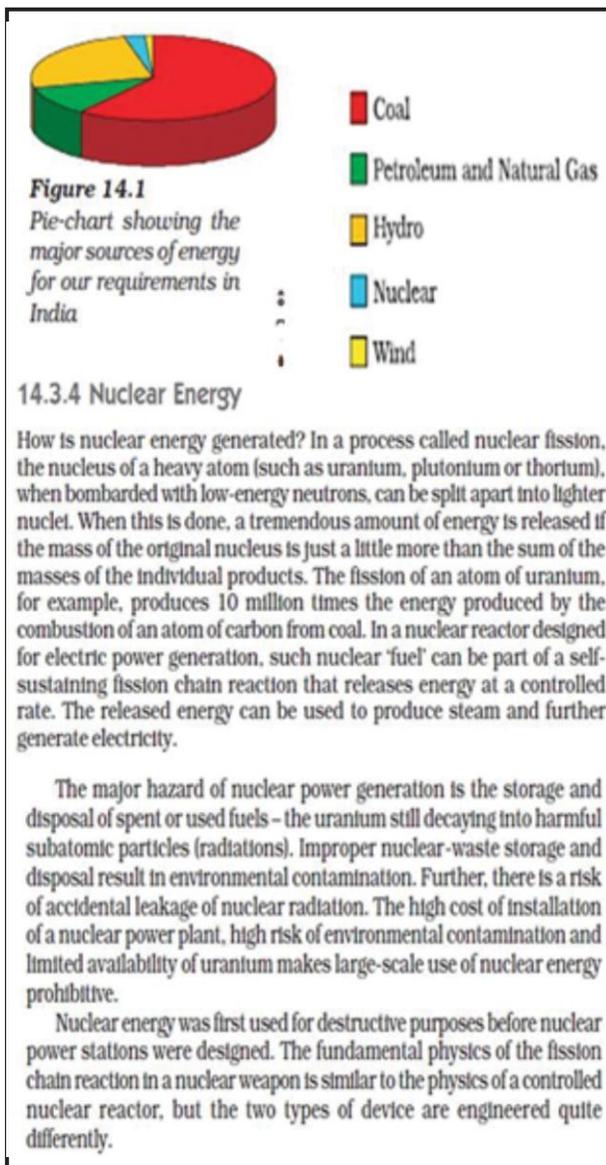
## **2. COVERAGE OF 'NUCLEAR ENERGY AND RELATED ISSUES' IN OUR TEXTBOOKS :**

In Science Education environmental awareness is accepted as one of the learning

indicators. Gopal and Anand (n.d.) identify encouragement of students to examine and interpret the environment from a variety of perspectives (like physical, geographical, biological, sociological, economic, political, technological, historical, esthetic and ethical) as the aim of environmental education. However the textbooks based on National Curriculum Framework (NCF) – 2005 cover the concepts of knowledge of sources and types of energy including nuclear energy from primary to secondary education, found to be less concentrated on the nuclear energy and the issues related to it. The coverage of nuclear energy and related concepts in the textbooks used nationwide and prepared by NCERT, and in the textbooks prepared by Gujarat Council of Education and Training (GCERT) or Gujarat State Board of School Textbooks used in Gujarat is as shown here.

### **2.1 COVERAGE IN NCERT BOOKS:**

In the Science and technology Textbooks from standard 6 to 9 no points related to nuclear energy are elaborated. In the text book of standard 10 under the chapter 'Sources of Energy' a graphical presentation of nuclear energy share in India is given. Under the title of 'Alternative or Non-Conventional Sources of Energy' the concept of nuclear energy and its hazards are covered in just 3 small paragraphs. There is no discussion of nuclear energy and related concepts in the textbooks of Physics textbooks of standard 11. In the Physics textbooks of standard 12, the concepts of nuclear fusion and fission with equations are given. The energy generation by nuclear reactor is shown with diagram. India's three stage atomic energy program is also given in box item.



Snap 1: Content in NCERT STD 10 Text Book

## 2.2 COVERAGE IN GUJARAT STATE BOOKS:

In Gujarat the textbooks used in standard 6 to 8 are prepared by GCERT and in the standards 9 to 12 are prepared by Gujarat State Board of School Textbooks. Out of eleven textbooks of standard 6 to 11 only in books of standard 7 and 9 points like atomic energy, its uses, benefits – limitations and hazards of radiations are given. In textbook of standard 7, an activity of discussion on Japan's Fukushima Daiichi is

given, which can be related with the indicator of participation in environmental issues by the students. In standard 9<sup>th</sup> textbook of Sem - 2 in the chapter titled 'Work, Energy and Power' the concept of nuclear fission is given in very brief.

**ન્યુક્લિયર ઊર્જા (Nuclear energy) :** ન્યુટ્રોન, પ્રોટોન જેવા સૂક્ષ્મ કણો  $10^{-15}m$  ના ક્રમના અંતરે એકબીજા સાથે આંતરક્રિયા કરે છે અને ન્યુક્લિયસની રચના કરે છે. ન્યુક્લિયસનું દળ તેમાં રહેલ ન્યુટ્રોન અને પ્રોટોનના મુક્ત અવસ્થામાં કુલ દળ કરતાં ઓછું હોય છે. દળના આ તફાવતને સમતુલ્ય ઊર્જા ન્યુક્લિયર ઊર્જા અથવા ન્યુક્લિયર બંધન-ઊર્જા કહે છે. યુરેનિયમ જેવા ભારે તત્વના ન્યુક્લિયસ પર ન્યુટ્રોનનું પ્રતાડન(મારો) કરવામાં આવે ત્યારે યુરેનિયમના ન્યુક્લિયસમાં તે શોષાઈ જાય છે અને અસ્થાયી બને છે. આથી અસ્થાયી બનેલા સંયુક્ત ન્યુક્લિયસ (યુરેનિયમ + ન્યુટ્રોન)નું બે લગભગ સરખા ભાગમાં વિખંડન થાય છે અને અમુક ન્યુટ્રોન ઉત્સર્જિત થાય છે. આ પ્રક્રિયામાં વિપુલ પ્રમાણમાં ન્યુક્લિયર ઊર્જા મુક્ત થાય છે. આ પ્રક્રિયાને ન્યુક્લિયર ફિશન (Fission) કહેવામાં આવે છે. પરમાણુ બોમ્બ (Atom bomb)માં આવી પ્રક્રિયા થાય છે. ન્યુક્લિયર રિએક્ટર (Nuclear reactor)માં પણ આવી પ્રક્રિયા નિયંત્રણ હેઠળ થવા દેવામાં આવે છે.

હલકા ન્યુક્લિયસ જેવાં કે હાઈડ્રોજન, ડ્યુટેરોન ઘણા ઊંચા તાપમાને જોડાઈને હિલિયમ ન્યુક્લિયસ બનાવે છે. આની સાથે પણ ન્યુક્લિયર ઊર્જા છૂટી પડે છે. આ પ્રક્રિયાને ન્યુક્લિયર સંલયન(Nuclear fusion) કહે છે. સૂર્ય તથા તારાઓમાં સતત ઉત્પન્ન થતી ઊર્જા આવી પ્રક્રિયા દ્વારા જ મળે છે.

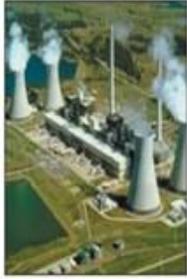
Snap 2: Content in STD 9 Text Book (Gujarat)

**કાચદાઓ:**

- ખૂબ જ ઓછા જથ્થાના યુરેનિયમમાંથી વિપુલ પ્રમાણમાં ઊર્જા મળે છે.
- આ ઊર્જાસ્રોતના વપરાશથી કાર્બન ડાયોક્સાઈડ જેવા વાયુ-પ્રદૂષકો ઉત્પન્ન થતા નથી.

**મર્યાદાઓ:**

- પરમાણ્વિક ઊર્જા માટે જરૂરી એવું યુરેનિયમ પૃથ્વીના પેટાભાગમાં ખૂબ અલ્પ માત્રામાં છે.
- પૂરતી કાચકા લેવામાં ન આવે કે પછી ભૂકંપ, ત્સુનામી જેવી કુદરતી હોનારતના લીધે જે યુરેનિયમમાંથી વિદિરણનું લીકેજ (ચુવાક) થાય તો પર્યાવરણ તેમજ માનવ સહિતના સજીવો પર અતિ ગંભીર અસરો થાય છે. આ અસરો લાંબા ગાળાની હોય છે.
- વિદિરણો  
હાલમાં પરમાણુશક્તિનો વિવિધ કાર્યમાં ઉપયોગ થતો હોવાથી વિદિરણોત્સર્ગી પ્રદૂષણ વધવા લાગ્યું છે. પરમાણુભય જેવા સત્તોના પ્રયોગોથી વાતાવરણમાં હાનિકારક વિદિરણો ફેલાય છે. અણુવીજમચકો તથા પરમાણુબંદીઓ દ્વારા નીકળતા કચરામાંથી પણ આ પ્રકારનું પ્રદૂષણ ફેલાય છે.



આકૃતિ 10.5



આકૃતિ 10.6



જાપાનમાં કુદરતીમા અણુમચક પર બનેલા ઘટનાની ચર્ચા તમારા શિક્ષક સાથે કરો અને નોંધો.

### Snap 3: Content in STD 7 Text Book (Gujarat)

In the textbook of physics of standard 12 concepts of nuclear chain reaction and nuclear reactor are explained with diagrams and equations. The hazard of ‘Nuclear Winter’ is also introduced in one line.

### 3. SCHOOL ACTIVITIES: AWARENESS OR FEAR?

The schools are guided to form science clubs to conduct various science activities and celebrations of different days. Some of the schools initiated to give a talk on Hiroshima –

Nagasaki day with some visuals to the children. Generally during such talks the children come across the destructive power and hazardous nature of the nuclear energy as they see some images of Japanese people and places affected by the atomic bombs and their post effects. During such talks they can connect the points given in their textbooks about nuclear hazards. Gradually the activities introduced for nuclear awareness lead the children to believe that nuclear energy is so hazardous that somewhen it will take us to the doomsday. There can be a scope to aware people on nuclear energy during the science exhibitions conducted at various levels in the state and nation, but rarely a team coming with such idea has been seen during the science exhibitions.

### 4. NUCLEAR ENERGY AWARENESS IN STUDENTS AND SOCIETY THOUGH SOURCES OTHER THAN THE SCHOOLS:

The Schools are addressing the awareness regarding nuclear energy within a circle of limited radius due to their less technical knowledge about nuclear energy. In this situation the institutes working specially in the sectors of science education and nuclear power production like Science Centers and Nuclear Power Corporation of India Ltd. (NPCIL) play a major role to spread the nuclear energy awareness in the students and the society. Again the media plays vital role while addressing nuclear energy awareness nationwide. But the media can mislead the people by generally highlighting the destruction power of nuclear weapons by comparing its range and capacity with other countries’ artilleries. In news examples of some countries reducing share of nuclear energy by shutting off the nuclear power

plants are given which may guide the people to wrongly justify the need of rising the nuclear power generation in India.

Looking at all these circumstances the NPCIL has to take the lead to aware the people regarding the nuclear energy need and challenges to us.

### **5. NPCIL ACTIVITIES FOR NUCLEAR ENERGY AWARENESS :**

The NPCIL is doing the work of production of nuclear energy as well as reaching the public effectively and spreading awareness among them regarding the nuclear energy. The NPCIL is conducting various activities like 1.Rallies 2.Film shows 3.Lectures followed by interactions 4.Quiz Competitions 5 Display of Comics and animation series 6.Drawing Competitions 7.Craft Making Competitions 8.Essay Writing Competitions trough out the year and across the country. The NPCIL is also taking part at state level science exhibition by setting up its stall and aware a huge number of visitors. The NPCIL also emphasize on vernacular languages to make an effective public outreach and to spread the news related to its activities among the people those regions.

### **6. WHAT CAN BE INCORPORATED IN OUR TEXTBOOKS ?**

At present our textbooks includes the points like definition of nuclear energy, nuclear chain reactions, working of a nuclear reactor and nuclear hazards. Some statistical highlights, fact figures and descriptions should be included in the textbooks answering questions like these :

1. What is current and projected (say in 2020) need of energy in our country?
2. How nuclear energy can fulfill the future energy need of country?

3. What is the rank of our country in nuclear power generation?
4. How many nuclear power plants are in our country and what amount of power they are generating?
5. What is the cost effectiveness of a nuclear power plant in comparison with a traditional power plant generating the same amount of energy?
6. What are the safety standards adopted and fulfilled to avoid any undesired situation?
7. What are the environmental changes occurred in the vicinity of the nuclear power plants?
8. What type of problems occurred at any of the plant right from the first power plant till today?
9. Did we face any disaster? (If the answer is in a precise no – then this success can be highlighted)

### **7. CONCLUSION :**

Being a developing country our energy requirement will remain high. To cop up this demand we need more efficient energy production which is in current situation is the nuclear energy. Though it has some hazards, looking at the need of the country, we must aware the people to accept this clean and green energy. This can be done best by spreading the awareness since school education. The present textbooks from standard 6 to 12 offer very less coverage to the nuclear energy awareness. The textbooks theoretically must be factual so it is necessary to include the nuclear hazards in texts but the benefits of the nuclear energy also be highlighted. In our textbooks the concept of nuclear energy should included right from the beginning of upper primary and awareness

related to it should be inculcate hierarchically. As per Han's (2015) research finding the nuclear power education is an effective way to change the level of awareness and attitude of school children positively, the interactions of school children should be made more frequent and wide with institutions like science centers and NPCIL to have some concrete outcomes related to nuclear energy awareness.

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