

**A Short course on  
Energy & Environment for Middle School Students  
and a Study of Students' Ideas on the Topic**

**Fieldwork Project Report**

**submitted in partial fulfillment of Graduate Course in Science Education**

by

**Saurav Shome**

under the supervision of

**Chitra Natarajan**

**Homi Bhabha Centre for Science Education**

**Tata Institute of Fundamental Research  
(Deemed University)**

**V N Purav Road, Mankhurd, Mumbai 400 088.**

**May 2009**



## Acknowledgement

The field work had three phases: literature survey, conducting the workshop and analysis of the data. I have received enormous amount of help during my journey through all the phases.

In conducting the course Ms Ankita Patel took active part. As a resource person she delivered a lecture on Photosynthesis and conducted some experiments on the same. Without her support the workshop would have been incomplete. Without Dr Ritesh Khunyakari's help on the day of the students' exhibition, I could not have held the exhibition in a successful way. Ms Pranita Sawant and Ms Shubhra Mishra helped me in making code-sheets.

I am thankful to Prof. Arvind Kumar, former Director, HBCSE, and Prof. H.C. Pradhan, present Director, HBCSE, for extending all possible support for the workshop. I extend my deep gratitude to Prof. Jayashree Ramadas, Dean, HBCSE for extending her support in the entire process.

The workshop was conducted with secondary school students. I owe my sincere thanks to the students and their guardians, the principals and the teachers of the respective schools. No doubt, without their support the work would not have been possible.

Prof. Chitra Natarajan guided me through the project with her critical insights. She went beyond the conventional role of a supervisor and extended her help and creativity in every aspect of the work. Without her constant and enormous support the field work would not have been presentable in every respect, either in quality or in quantity. I will be responsible for hiding the truth if I do not mention that her contribution was in no way less than mine right from the beginning till the end of the work .

I thank the members of our technical staff for arranging display boards for the exhibition. The entire HBCSE family deserve appreciation for the help they extended to me in the work.

Several errors have been corrected through the several drafts of this report. However, I am sure errors still remain. I appreciate your positive criticism for the improvement of the report.



# Contents

A	Introduction	9
	A.1 Humans and the environment	9
	A.2 Environmental education (EE)	10
	A.2.1 Goals and objectives of EE	10
	A.2.2 The EE curriculum	12
	A.2.3 Role of the teacher in EE	13
	A.2.4 Pedagogic strategies	14
	A.2.5 Complexity of EE in Indian schools: A proposed Model	15
	A.2.6 Ideas about environment and energy in the CBSE syllabus	16
	A.3 Students' ideas about energy and environment	19
	A.3.1 Energy	19
	A.3.2 Concepts about ecosystem	20
B	Method	23
	B.1 Objectives	23
	B.2 Sample	23
	B.3 Course organisation, structure and Data	24
	B.4 Activity sheets	24
	B.5 Photosynthesis experiments	25
	B.6 Energy use over time	25
C	Analysis and discussion	27
	C.1 Environment	27
	C.1.1 Activity sheet on environment	27
	C.1.2 Context map on “Humans and environment”	34
	C.1.3 Photosynthesis	36
	C.1.4 Activity sheet on photosynthesis	36
	C.2 Energy	41
	C.2.1 Activity sheet on energy	42
	C.2.2 Essay on a world without energy	45
	C.2.3 Semi-structured whole class session on energy	47
	C.2.4 Poster: Human civilization 500 years from now	49
	C.2.5 A power-plant for Shaktipur	53
D	Conclusions	58

<b>References</b>	61
<b>Appendix A:</b> Bio-geographical regions of India	66
<b>Appendix B:</b> Immersion Model of Environmental Education	67
<b>Appendix C:</b> Schedule of Events of the course	68
<b>Appendix D:</b> Structure of Energy and Environment Course for middle school students	69
<b>Appendix E:</b> Photosynthesis Experiments Sheets	70
<b>Appendix F:</b> Activity Sheet on “How much do I consume?” - Home Energy Audit	73
<b>Appendix G:</b> Survey sheet on Energy Use in different Periods	75
<b>Appendix H:</b> What appliances do you need?	76
<b>Appendix I:</b> Activity Sheet on Environment	77
<b>Appendix J:</b> Activity Sheet on Photosynthesis	80
<b>Appendix K:</b> Activity Sheet on Energy	82
<b>Appendix L:</b> Role play	85
<b>Appendix M:</b> List of Reading Material for Role Play on Shaktipur Power plant and Activity sheet supplied on Renewable energy source	86

## List of Tables

Table 1: Students' profile	23
Table 2: Students' responses to the question, “Which is not an animal?” in Environment activity sheet	28
Table 3: Students' responses to the question, “Which is not in any food chain?” in Environment activity sheet	29
Table 4: Students' responses to the question 8, Environment activity sheet	31
Table 5: Students' response on photosynthesis activity sheet, Question 4	37
Table 6: Students' response on photosynthesis activity sheet, Question 5	39
Table 7: Students' response on photosynthesis activity sheet, Question 2	41
Table 8: Frequency of students' responses to the items, question 6, Energy activity sheet	43
Table 9: No. and % of students responding as “correct” to the items in question 15, Energy activity sheet	43
Table 10: Students' typical responses to two questions on energy	48
Table 11: Forms of energy as mentioned by the students of morning and afternoon sessions	49
Table 12: Objects depicted by students in the posters	51
Table 13: Ideas about energy sources and vehicular use reflected in the posters	52
Table 14: Energy sources by category	53
Table 15: List of roles played by students of morning and afternoon sessions (fewer students)	55
Table 16: Some interesting remarks by students during role play	56
Table 17: Combination of energy sources chosen by morning and afternoon sessions for the Shaktipur power plant	57

## List of Boxes

Box 1: Environment activity sheet, Question 2	27
Box 2: Environment activity sheet, Question 7	29
Box 3: Environment activity sheet, Question 8	30
Box 4: Examples of correct and incorrect responses in relating global warming to greenhouse effect	34
Box 5: Photosynthesis activity sheet, Question 2	40
Box 6: Energy activity sheet, Question 6	42

## List of Figures

Figure 1: The relation between three essential insights of the ecosystem	21
Figure 2: Conceptual framework for the study of ecological understanding	21
Figure 3: Diagram of a possible “no change” model showing (a) initial flow of food in the food web, (b) flow of food when frog population increased, (c) flow of food when frog population decrease	32
Figure 4: Context map on “Human and Environment” showing (a) complex interconnections between components and several pictures, and (b) no interconnections and fewer pictures	35
Figure 5: A student's diagram on photosynthesis showing important aspects, including soil	38
Figure 6: A student's diagram on photosynthesis showing a few aspects	38
Figure 7: Quality of life as indicated by HDI increases steeply with increasing per capita energy consumption and saturates at high energy consumption	44
Figure 8: (a) Poster to left shows high rise structure, solar energy, small flying vehicles, robotic systems, and (b) Poster to right shows some greenery besides high rise structure, public transport, and nuclear power plant	50

