

# Middle School Students' Ideas about Energy and Its Flow Through Organisms

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Presented by  
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# Background

- Any solution to the environmental crisis will need environmental awareness and understanding to be deeply rooted in the education of all people at all levels (Tbilisi, 1977).
- Environmental education (EE) can and should be integrated within school subjects (Shome and Natarajan, 2007).
- Students need opportunities to articulate, defend, explain ideas within social context of classroom (Prain & Hand, 1996).

# Framework used

- Framework for students' ecological understanding
  - Adapted from Carlsson (2002)

Ecological understanding

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graph TD; A[Ecological understanding] --> B[Human's relationship to nature]; A --> C[Ecosystem insights]; B --> D[Ways of thinking about the Human-nature relationship]; C --> E[Ways of thinking about Photosynthesis]; C --> F[Ways of thinking about Energy];
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Human's relationship to nature

Ecosystem insights

Ways of thinking  
about the  
Human-nature  
relationship

Ways of thinking  
about  
Photosynthesis

Ways of thinking  
about  
Energy

# The Study: Objectives

- Develop a course on Energy and Environment for middle school students to explore their understanding of energy and its flow through life forms,
  - with emphasis on the link between humans, environment and energy.

# The Study: Methodology

- Methodology
  - Developing a course on energy and environment for middle school students
  - Selection of participants
  - Collection of data – different kinds
  - Drawing inferences about students' ideas based on semi-quantitative and qualitative analysis of data

# Sample

- A purposive and convenient sampling was used.
- Forty students of Class VIII - 30 Boys, 10 Girls
- Mean age 13 years
- From 3 English medium schools affiliated to the CBSE system
- Course was announced and students voluntarily participated in the course. Parent/ Guardian's written permission was taken.

# Course Structure

- Duration: Conducted over 8 days in two sessions
- Variety of tasks:
  - Open-ended questions
  - Creative writing - A world without energy
  - Activity Sheets
  - Discussions
  - Drawing - context map on “Human and Environment”, poster on “Energy scenario 500 years from now”
  - Role play - A power plant for Shaktipur

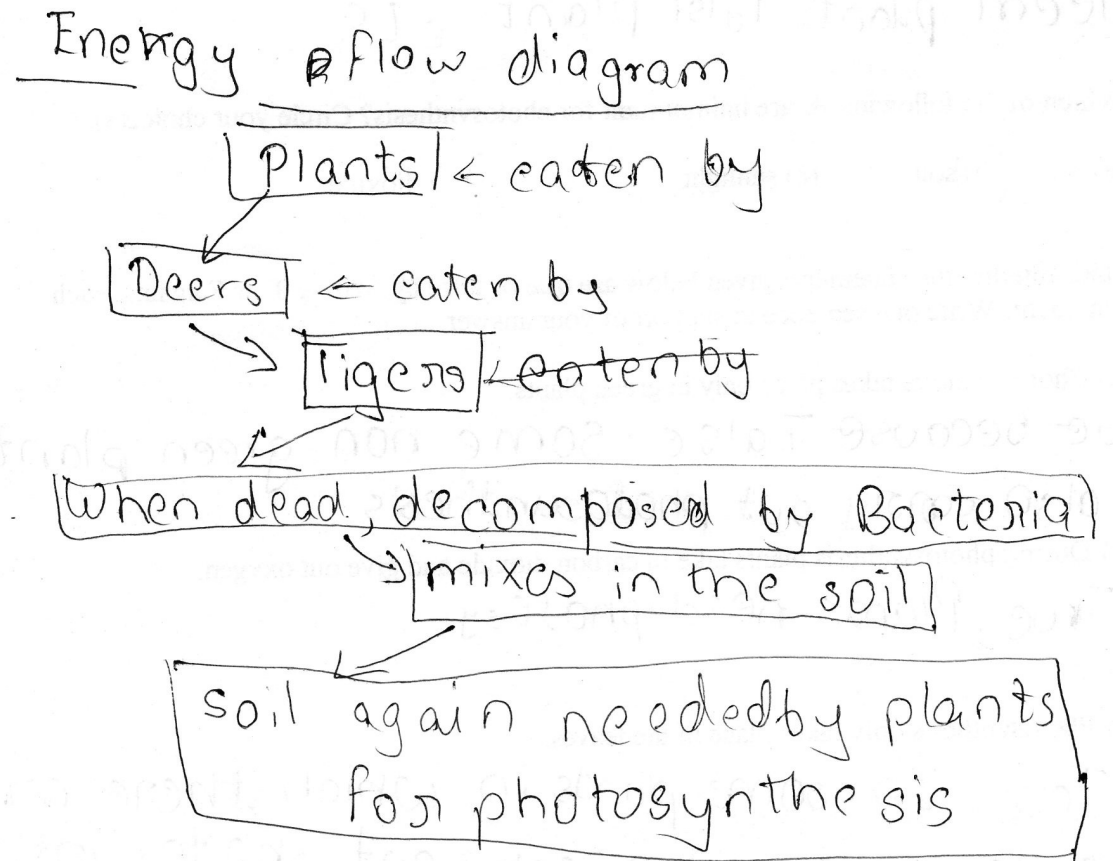
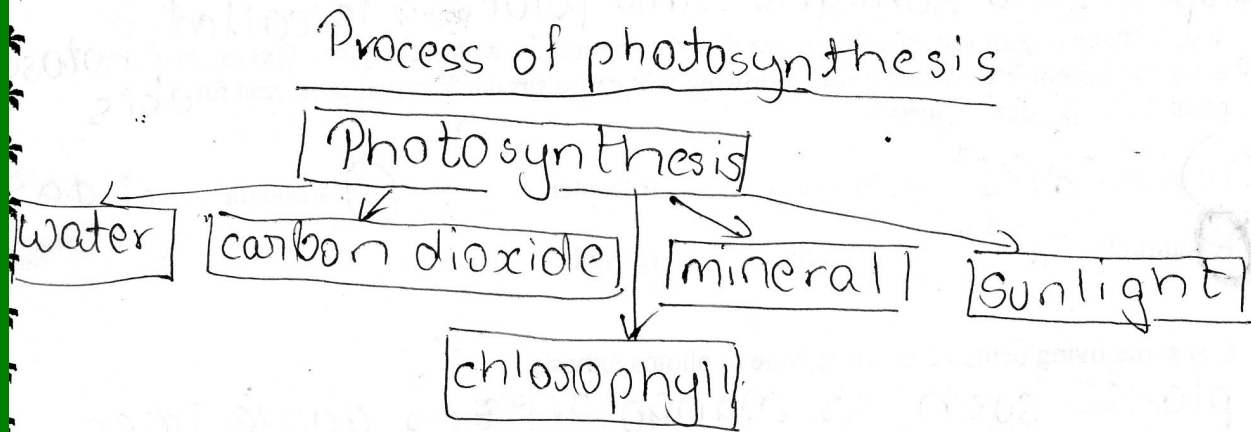
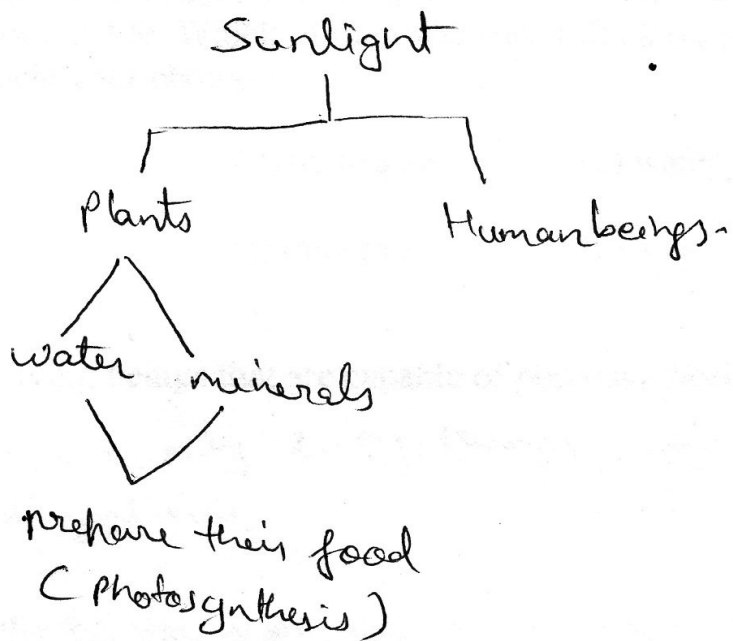
# Data

- Students' responses to questionnaires
- Writings
- Drawings and posters
- Audio-visual recordings of discussions and structured presentations
- Researcher's observations and notes



# Salient results: Photosynthesis and energy flow

Most students see photosynthesis merely as material flow, ignore energy

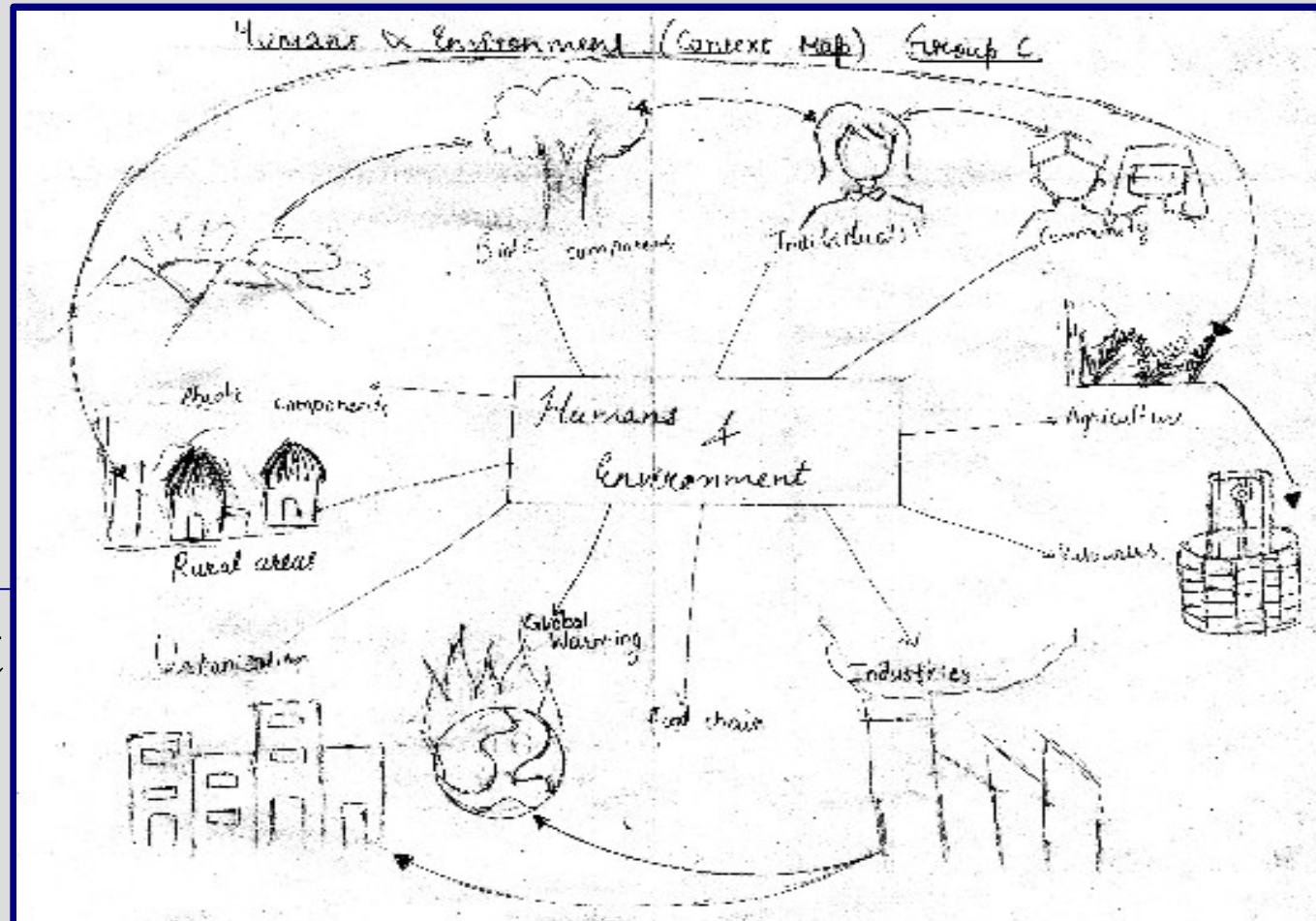


# Salient results:

## Humans and Environment

- Context maps show students' awareness of interactions between humans and environment.
- Students do not link the different factors in map

Example of context map rich in factors, best linkages



# Students' ideas about energy: Discussions

- Semi-structured discussions
- Terms 'power', 'force' used as synonyms for 'energy'
- Can correctly define potential and kinetic energy;  
Unable to give contextual examples, or apply
- Confused between forms and sources of energy
- Use of terms with energy: static, physical, repulsive, frictional, freeze, ubiquitous, and genetic

# Students' ideas about energy: Essay writing

- Groups of students wrote essay: A world without energy
- Consider a world without energy as impossible
- Largely refer to anthropocentric aspects of energy, not natural aspects; E.g. energy for cooking
- Used context of current crisis of non-renewable energy sources
- Some students linked energy with peace – e.g. no energy, no bombs

# Students' ideas about energy: Poster

- Group Poster on “World 500 years from now”
- Emphasize power generation; not distribution
- Most showed private vehicle used by nuclear families
- Did not mention reduced use; biogas
- Most showed combination of solar energy with one or more other renewable energy sources

# Role play: Power Plant for Shaktipur

- Two sessions with different students: selecting energy options for a power plant for Shaktipur, small town
- All largely chose among 6 energy sources for the power plant: solar, wind, biomass, coal, nuclear and hydroelectric
- Session 1: Solar energy with one other renewable source; only 3 out of 21 chose nuclear power plant - with a biomass plant
- Session 2: Chose among 3 options; largely nuclear

# Summary of results

- Middle school students have several ideas relating humans and environment, but they do not see connections between these ideas
- Photosynthesis is seen more as material flow than as a mechanism of energy flow through life forms
- Students' see energy in terms of definitions and are unfamiliar with applications in context.
- Activities can be designed to expose students to the conflict between their own ideas and correct concepts as well as resolve conceptual conflicts.

# Key educational implications

- A variety of activities provide students the opportunity to express themselves in multiple modes (speaking, writing, drawing, acting ,etc.)
- Students learn to respect the strengths of each other in different tasks
- Similar courses in classroom settings require teachers of different subjects, like science, languages, art and craft and social studies, to collaboratively plan the content and sequence of activities to suit the level of students (class)



# Main references

- Carlsson, B. (2002). Ecological understanding: ways of experiencing photosynthesis. *International Journal of Science Education*, 24 (7), 681 – 699.
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- Shome S. & Natarajan C. (2007). *Meaningful environmental education in schools - A proposal for equitable society*. Presented at the XXXI Indian Social Science Congress, Mumbai 27-31 Dec 2007.

**Thank You**