

KYOTO IN THE HOME

D5 Methods of training teachers

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Executive summary

The KITH resources provide a holistic approach to limiting climate change and the potential of small scale renewable energy sources to be applied to the home.

The resources comprise background text, information for students, practical activities and notes for teachers and are part web based and part electronic in format. They provide a systematic approach to the techniques and technologies which can be used to limit the environmental impact of the use of energy in the home.

To utilise these resources, it is important to discuss with teachers how these can be used in their lesson plans and how these can be related to topics in the national science curriculum. The various methods are briefly described.

The experience to date is that the information is useful and its makes science more meaningful as it relates phenomena to societal problems associated with a more sustainable way of life.

These initial experiences will be used to improve both the resources and the methods of informing teachers.

1 Introduction

The KITH resources provide a systematic route to the sustainable use of energy in the home with the goal of limiting climate change. The method is a series of practical activities for students accompanied by an introductory text and guidance notes for teachers. The objective is to create an understanding of this global problem and what action students and their families can take locally to limit the environmental impact of energy use.

It is important to discuss with teachers how the KITH resources can be used in their teaching. The topics are all inter-disciplinary involving science, geography, ethics and global citizenship and form a key part of the education for sustainable development. The KITH resources are extensive and teacher training sessions, whether formal or informal, have enabled the teachers to reflect on how to utilise the materials and how to link to relevant topics in the national curriculum.

2. KITH resources

The partners in this project have developed a set of resources for use by teachers and students on the application of small scale renewable energy sources to the home. These resources cover the following topics which can be grouped into three topics – background information, passive means of reducing heat loss and solar gain and renewable energy sources.

Sustainable use of energy Energy efficiency in the home Renewable energy sources
Heat flow in buildings Passive solar
Solar water heating Heat pump systems Biomass Wind energy Photovoltaic systems

In the KITH handbook, each section of text is followed by a suitable practical activity for the student and notes for teachers (see examples below). These comprise some 60 in total so the teacher has to be very selective in deciding which source materials to use.

Such activities enable the student(s) to explore a topic and then to discuss their analysis or solution(s) with other groups in the class. Some activities involve measurement and uncertainties arise over the reliability and reproducibility of the data which is inherent in making measurements relating to renewable energy sources.

The other set of resources are web based and comprise a systematic rationale of each of the 10 topics in the handbook under the following headings:

- Description
- Advantages
- Disadvantages
- Basic principles
- Climatic and environmental criteria
- Installation
- Economics
- Further advice

This information is useful for older students because it will facilitate understanding of not only the various RES but also how it is possible to reduce energy usage in the home.

Activity 1.1: How energy use has increased over the past 100 years

Tasks

Working in small groups, discuss with each other how life has changed over the past 100 years.

- Identify machines and activities that use energy
- How do these differ from what was available and how things were done 100 years ago?
- How might things be different in 50 years time?

Complete the following table following the example given

Activity	100 years ago	Now	50 years from now
transport	Horse and cart	Car	Electric vehicle

Discuss your findings with the other groups in your class

Notes for teachers: Increased energy usage

Background: This activity is to understand the importance of energy sources in our daily lives. Our houses are filled with electrical appliances that our grandparents never used. Students should be encouraged to think about what energy is and the different forms of energy and how they are used. The students could be asked to talk to older relatives to find out how life was different when they were young and to collect articles and pictures of life in the 1950's and how life might be in the future.

Aims of the activity: To consider the different forms of energy and where energy is used.

Material: Table for completion, magazine articles

Key words: energy, forms of energy, uses of energy

Skills: communicating, observing, investigating and gathering information

National curriculum subjects: science, citizenship, geography, PSHE

Age Range: 9-12, key stage 2-3

3 Activities

Activities are planned to be the core element of each lesson. These activities can be used individually or alternatively, they can be grouped together to generate not only awareness of the environmental problems associated with energy use, but also identify solutions which can reduce energy use.

For each activity there will be

- Resource material providing background information for introducing the subject
- Work sheets for students
- Notes for teachers

Age range

- From age 8 to 15

Topics

- Understanding the importance of energy use
- Understanding the issues associated with climate change
- Explaining and involving their parents
- Considering how appliances are used in the home
- Understanding how the environmental impact of energy use can be reduced

Working in small groups

- Discussing and helping one another
- Exchanging information
- Easier for teacher to supervise

Role of teacher

- Introducing the topics
- Helping the groups
- Discussing the outputs with the pupils
- Summarising and evaluating the results

4. Teaching methodologies

The KITH resources require a reorientation from traditional towards learner focused, issue orientated teaching and learning. In the last ten years subject teaching is moving towards better integration of multi-disciplinary topics which for energy use requires an understanding of the linkage between mankind's ever increasing use of fossil fuels and the rise in greenhouse gas concentrations in the upper atmosphere and global warming. To resolve such global issues requires new teaching methodologies like value orientation, capacity building in critical thinking and future orientation.

This approach is generally easier to adopt for primary than secondary schools as teachers work with a class of students rather than teach a discipline.

5. Inter-disciplinary teaching

The characteristic of using KITH resources is the call for inter-disciplinary teaching

- to improve knowledge (scientific and community based)
- to develop responsible attitude and behaviour
- to develop skills for assessment/decision making/recommendations
- to facilitate the development of active, competent citizenship

This new methodology results in

- attractive and exciting teaching and learning
- use „green lessons” entertaining, illustrative/informative
- focusing on visible problems-discussion future trends/ alternative solutions
- promote co-operative learning
- facilitate communication- building social competences

6. Training courses and workshops

Training workshops was the main method of informing teachers based on the participatory approach and interactive learning methodology. Teachers were involved from all different types of schools including primary, secondary and special

The structure involved

- presentation of the KITH materials
- explanation and discussion how teachers could use materials in their classes
- trials of activities in small groups including feedback of the activity.
- evaluation of materials and collection of comments to improve the resources

Most of the teachers who participated were sufficiently interested that they were willing to test the materials. They needed clear guidance on how to use the questionnaire for evaluation of the KITH resources. This was the pattern of the in-service teacher training in Estonia, Hungary, Poland and Slovakia.

Ecoserveis

We organised a workshop on 28th November 2007 on 'How to deal with Climate Change and renewable energies' in the class. 17 teachers from different types of schools (primary, secondary and special education) participated. We presented the materials in a half day training and explained them in a way so teachers could use materials in their classes.

We gave the grateful participants a certificate and they gave good feedback of the activity which has already been modified in the resource materials. They stated their willingness to test these materials but not without inconvenience because of two causes:

- they do not have much time during lessons.
- they do not dare to spend much time because of the complexity of the topics

KAPE

A **special guide book** for the teachers "Energia odnawialna" was prepared for informing and training the teachers from the schools which have declared interest in participating in the project.

Training program of the teachers improvement titled "Preparation and realization of the education according to teaching program „Renewable energy" consists of three modules:

- module I: - methodical and content-related preparation of teachers for work with the "Renewable energy" program (scenario 1: The analysis of the "Renewable energy" module teaching program, scenario 3: Renewable energy sources(RES): mode, need or necessity? scenario 4: Internet utilization to "Renewable energy" program realization).
- module II: - "Renewable energy" program , and teaching program base (scenario 2: Utilization possibility of the "Renewable Energy" program at teaching process).
- module III: - How to promote RES? (scenario 5: Preparation of school community to promotion RES activities)

Hespul

To trial the resource materials in schools to check their suitability and possible **integration** with other subjects our aims were to

- 1) to organise a regional workshop in Rhone-Alps with teachers and teacher trainers and to support other participants to organise workshops in their countries
- 2) to realise trials of the resource materials in a significant number of schools
- 3) to consequently improve the materials if relevant; to organise at regional level the "soft competition" between posters submitted by the voluntary classes; to ask teachers for feedback regarding pertinence of the resource materials and of the trials, and to build on their answers;
- 4) to report in details and to disseminate lessons learnt from the experience in France.

7. Face to face tutorial training

Face to face tutorial training is an intensive and flexible training method which requires a mediator organisation that can bring new information to the classroom with the presence of teachers. Environmental NGOs or Energy Agencies, who are in partnership with schools, can provide this type of training. This communication/learning enables teachers and students to collaborate with this organisation in the KITH trials. This way of training was implemented in Czech Republic and Estonia as well besides other partner countries.

Ecoserveis

This has been a successful methodology for training teachers to use the KITH resources. One of the teachers' concerns is that they lack motivation because they are not comfortable with concepts like renewable energies and energy efficiency. They find it difficult to communicate about energy and climate topics to students and they preferred to collaborate with us in the trials with students. We undertook a set of trials with their students with the teachers observing and making notes and then trying to undertake their own trials with students. We have trialled the resources through a range of different activities such as our ExpokW exhibition, workshops in classes, municipalities and summer schools. Nearly 50 teachers have followed this methodology.

REC Estonia

We organised training for the teachers with environmental NGOs. The local NGO involved in energy issues were ready to cooperate with schools and teachers. The goal of the training was to inform the teachers about the project "Kyoto in the Home", to introduce renewable energy resources (biomass, solar) to the teachers to introduce and distribute related study materials.

8. Other training methods

There have been discussions with individual teachers and groups of teachers in a school who are interested in using the resources.

Sciotech

For the 'day without energy' activity, a planning meeting was held with all 7 teachers of North Leigh primary school, who selected various activities either from KITH or other resources. A note was then sent around to parents explaining the purpose of the day and seeking their help in assisting their children fill in the form to see how little energy each used during the day.

Two distance learning techniques have also been trialled that is an on line training course for teachers involving 75 hours of studying and video conferencing. These are discussed in detail in chapter 8.

9. Collaboration with other organisations

A feature of this training has been the collaboration with a large number of partner organisations some of which are listed in the following table.

Collaboration between the partners and other organisations

Country	Partner	Collaborator	Type of collaboration
UK	SCP CEP	Global leap partnership Cornish local educational authorities	Video conferencing ½ day workshop
CAT	Eco	Open University of Catalonia	Distance learning courses for teachers
RO	EAF ICI	Romanian Action against Climate Changes Network Dambovita county	½ day workshop Workshops in schools
PO	KAPE REC	Belchatov Municipality Green Pack schools	3 day course ½ day workshops
FR	HES	Inspecteurs de l'éducation nationale Conseillers pédagogiques de circonscription	½ day workshops
HU	REC	Energy Club ECKE/Isosolar	Face to face training
CZ	REC/SEVEN	Philips Lighting	1 day workshop
EE	REC	Association of Wind Energy Heat Pump Union Estonian Fund for Nature Futuren Estonian Foundation for Rural Development	½ day workshop
SK	REC	Teacher Association	1 day workshop
IT	EAA CDB		

10. Links to national curriculum

It is clear from these training sessions that teachers enjoy the idea of exploring with their class or students the challenge of thinking globally and acting locally. However interested and motivated they may be, in all schools, teachers or a team of teachers are expected to teach the national curriculum in which concepts like generation and use of energy, resource depletion of fossil fuels, the linkage between energy use, environmental pollution and climate change and the potential of renewable energy sources are taught at different times often in different disciplines.

One solution is simply to provide a table listing in one column the curriculum requirements and in the second suitable KITH activities which can be used to illustrate the topic.

There are four age ranges in the UK up to age 16 years. These are designated key stages (KS) with two being of primary school age – KS1 (6-8 years old), KS2 (9-11 years old) – and two for secondary school – KS3 (11-13 years old) and KS4 (14-16 years old). The majority of the activities in this handbook cover KS3 and KS4, but some are also suitable for KS2. The appropriate stage is indicated for each activity.

The relevant national curriculum subjects are listed for each KITH activity. The use of energy and its environmental impact leading to climate change can be taught as part of citizenship or geography, or as a science subject like biology, physics or chemistry. The conversion of renewable energy sources into useful heat or electricity is always related to what can be done at the micro level that is to the home.

Trials in Cornish primary schools have targeted key stage 2 of the UK national curriculum. CEP have produced appropriate support material and liaised with the local educational authority to agree the potential and protocol for training workshop

The other solution which is more difficult to achieve in practice is for the authorities to provide time within the curricula to consider topics within education for sustainable development of which climate change is a priority issue.

11. Selecting activities and lesson plans

The activities are listed in the KITH handbook table of contents under various topics. These can be given in any class which seems appropriate including languages and in any type or size of school. Activities can be selected either to study one specific topic or a number of activities can be selected to study various subjects over a period of time. A typical lesson plan is given below.

Before starting the activities, the key concepts need to be introduced to and discussed with the students. The KITH resources provided can be used as introductory material.

When the activities have been chosen, it will be necessary to copy the worksheets which can be modified. Notes to help teachers are appended to each activity.

As the resource book is also available electronically in the form of a CD, it is possible to print directly from the computer or to adapt the material should this be more appropriate. The CD also contains additional resources such as PowerPoint presentations which have been found useful in introducing some of the topics.

Completing the activities requires various skills:

- Listening, reading and interpretation of the themes;
- Observation, data collection, comparison and analysis;
- Working both individually and as a group member;
- Communication and presentation skills; and
- Simple mathematical skills.

For more information see Annex 1

12. Central and Eastern Europe

The KITH resources and the revised Green Pack were introduced in the in-service training programme of the REC countries (CZ, HU, EE, PL, SK).

Structure of the Green Pack related to the KITH resources

The Green Pack includes 22 topics related to environmental protection and sustainable development, divided into five chapters:

- **Environmental components:** air, water, soil and biodiversity
- **Threats to the environment:** urbanisation, noise, waste and chemicals
- **Human activities and impacts:** energy, transport, industry, agriculture, forestry and tourism
- **Global challenges:** climate change, ozone depletion, acidification, and issues affecting seas and oceans
- **Values:** ethics and values related to consumerism, human health and the environment, citizens' rights, and responsibility for the Earth's future

KITH has been a valuable resource for integration into several GP topics, especially to the chapters: Human activities and impacts, Global challenges and Values.

The new Green Pack chapters

1. We can not do without energy
2. Renewable energy
3. Energy efficiency
4. Climate change and consumption

Using KITH resources and integration of KITH chapters to the Green Pack Teachers' handbook

The GP handbook is intended primarily for European teachers and their students. Its core elements are the lesson plans, which can be combined with the other components of the Green Pack, the video cassettes, CD-ROM and dilemma game. Each of the environmental topics is covered by one or more of the lesson scenarios. The scenarios are structured so as to provide users with information about the major concept, relevant subjects, materials needed, time and place, objectives and methodology. The introduction presents basic information on the issue and users are advised to look for more information in the relevant section of the CD-ROM. Before an activity begins, teachers can find various fact sheets and schemes at the end of each lesson plan to be photocopied and distributed. A table presenting schematic information on environmental topics, lesson scenarios and their appropriateness to the different school subjects, as well as the recommended video films and clips, is enclosed at the end of the handbook.

The activities described in the handbook have a guiding, rather than compulsory character. They are intended to stoke the teacher's imagination and lead to the organisation of events similar to the ones suggested, but meeting the particular needs and abilities of the students.

There were three chapters of the KITH that were integrated into the GP, sustainable energy, EE and the RES based on the above described school curriculum.

The REC countries organised teacher training days (1-2 days) on the use of the KITH resource and these were implemented in 2007/2008. Some selected schools tried the four GP chapters in the Czech Republic, Estonia, Hungary, Poland and Slovakia. The teachers who were ready to try the new GP chapters participated in one day training in September 2008. The questionnaire shown at the end of this section was used for the evaluation of the KITH and the GP chapters.

Example of the teachers training for the trial of the GP chapters

Chapter1: WE CAN'T DO WITHOUT ENERGY	
Major concept	People today are reliant on variety of power sources, whose primarily origin is the sun power. Any kind of energy production has its own specific impact on the environment.
Duration	4 independent activities, 1-2 class periods each
Time of year	Any
Place	Classroom
Materials	Posters, Green Pack film collection
Subjects	Physics, chemistry, environment protection, sustainable development
Aims	<ul style="list-style-type: none">- discover how present life depends on energy;- demonstrate that the origin of all power sources is the energy of sun;- trace the changes in energy usage within our civilization evolution;- present general data on different types of power sources and the basic concept of non-renewable resources
Methods	Discussion, brainstorming, group working, video presentation

Activity:

I part - Living without energy?

1/ Explain to the class that energy is part of all human activities: it heats homes, makes cars move, cultivates land and makes machines do work.

2/ Ask students whether they are able to imagine one morning without energy by answering the following questions:

- Try to describe some of the activities accompanying you since you wake up until you arrive in school;
- What kind of appliances and energy are used by you?
- Are there any alternatives and do they require energy?

3/ Hand out copies of the fact sheet "What kind of energy do I use at home?" and ask students to work individually on it. Add some missing activities.

13. Manufacture of scale model RES

RES only become meaningful if these can be investigated. If there is sufficient time then such scale models can be built in lessons involving craft, design or technology. EAF have undertaken this type of activity successfully in Romania.

The UK trials have shown that it is desirable for schools to invest in some simple kits which will allow students to make measurements which will characterise the outputs of RES. Such measurements can illustrate the uncertainty in measurement and also the variability of the output of such sources. Wind turbines and solar water heaters have been designed and tested as part of the UK trials and are illustrated in Figures 1 and 2.

These designs are inexpensive to reproduce and so plans will be drawn up to enable schools to use their technicians to make such kits.

Figure 1 model wind turbine

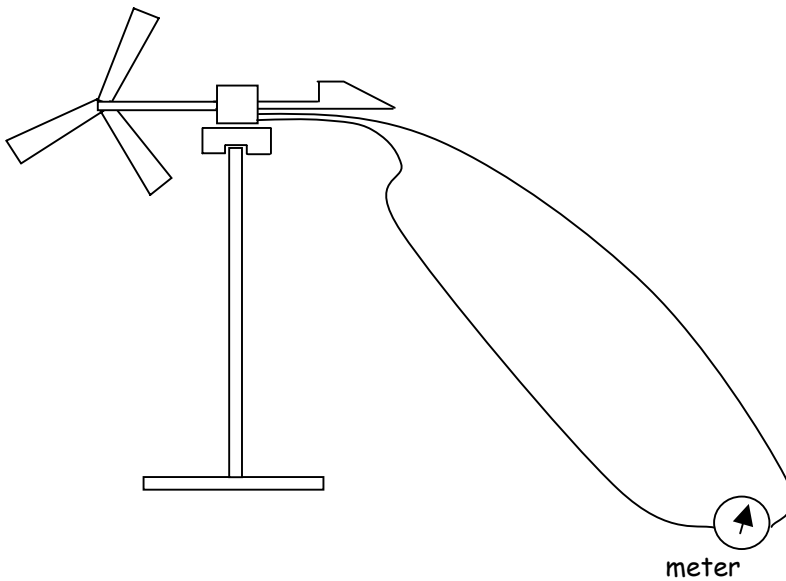
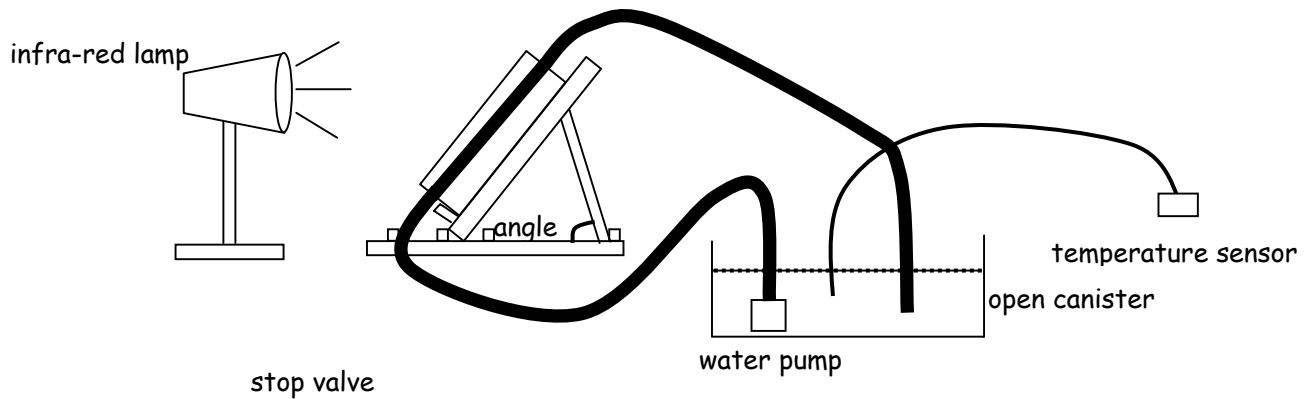


Figure 2 model solar water heater



14. Conclusions

The resources are comprehensive and useful and are a level which enables them to be used by both teachers and students. Experience to date is that the information makes science more meaningful as it relates phenomena to societal problems associated with a more sustainable way of life. These experiences in the schools with teachers and students have been used to improve both the resources and the methods.

The holistic approach KITH has adopted to energy use provides not only an interesting science topic but also reinforces many of the concepts that students will have learnt but yet applied such as energy conversion and the generation of electricity and the production of hot water by non polluting means.

The integration of energy efficiency, renewable energies and climate change in the curriculum requires a systematic planning at the beginning of the school semester. Chemistry, physics, geography, biology (science) and history teachers were involved in the planning and integration in the school curriculum in Hungary for example. There some schools teaching ecology and sustainable development. They found the integration of energy efficiency, renewable energies and climate change is easier when the school teach more overarching topics such as sustainable development.

The success to the use of these resources are the interest of the teachers, their willingness to find time to provide a set of lessons, the ability to discuss rationally how we maintain an acceptable standard of living whilst transforming our energy dependence from fossil fuels to renewables.

Annex 1: Lesson plans

The emphasis in science teaching is changing from learning facts to investigating, discovering and analysing information in order to create *understanding*. The phenomenon of global warming and the options for limiting climate change can not only make science more interesting, but also more relevant to everyday life.

The *uncertainty* posed by climate change indicates to students the limits to which science can contribute towards making global decisions and it is within this context that the KITH resources should be presented and used by teachers and students.

This provides the syllabus which teachers are expected to teach during the school year. As UK schools are regularly inspected, teachers have to produce written evidence of what has been taught and how this knowledge has been tested. This leaves little time for teachers to explore science topics like climate change even if they have a personal interest.

In addition UK teachers are required to develop and document every single lesson starting with learning objectives and ending with learning outcomes. Teachers are therefore expected to spend 2 or 3 hours a day documenting outcomes and planning lessons

The only practical solution to help teachers is to formulate such lesson plans for them based on a preceding discussion as to how they might use such resources. An example of an individual plan follows together with a plan for a set of lessons (the activities refer to those in the KITH handbook).

Lesson 1 Characteristics of renewable energy sources (RES)

	<i>Learning objectives</i>	<i>Learning outcomes</i>
	<ul style="list-style-type: none"> origins of energy sources characteristics of energy sources greenhouse gases 	<ul style="list-style-type: none"> understanding how fossil fuels and renewable energy sources differ knowledge of the advantages of RES understanding global warming
<i>Basic concepts</i>		
starter	Agree definition for fossil fuels and renewable energy sources after reading source text. (Activity 1.1)	
main	Characteristics of energy sources and why RES are likely to become more important. (Activity 1.2)	
plenary	Which RES are most suitable for Reading? (Activity 1.3)	
out of lesson learning	Find examples in newspapers, magazines or the internet of renewable energy sources being used by families or communities and bring to class.	
<p>Notes for teachers</p> <p>The characteristics of fossil fuel and renewable energy sources are very different; so too is their abundance and environmental impact. These activities will enable the students to identify the differences between these two sets of energy sources.</p> <p>Activities should always be done in small groups; groups then present their work to the other groups and discuss any differences. The source texts are taken from the Kyoto in the home modules (www.kyotoinhome.info).</p> <p>Equipment Pencil, paper, worksheet</p>		

Student worksheet: Characteristics of renewable energy sources

Activity 1.1: Definitions

Discuss within your group and agree definitions for fossil fuel and renewable energy sources. Use background text to help you.

Be prepared to discuss your answers with the other groups and explain your decisions.

Activity 1.2: Energy source characteristics

Tasks

Complete the following table about fossil fuels and renewable energy characteristics; consult background text as necessary. Be prepared to discuss your answers with the other groups and explain your decisions. Answer with either yes or no.

characteristics	oil	gas	coal	solar hot water	Photo voltaic	wind	Bio-mass	heat pump
Available within 100 miles of Reading								
Needs to be imported into UK								
Source limited								
Conversion to electricity by burning								
Conversion to heat by burning								
Results in greenhouse gases								
Variation day/night								
Variation summer to winter								

Activity 1.3: Renewable energy sources in Reading

Which renewable energy source is most suitable for our town? Give reasons for your choice. What do you think should be the first step for converting to the use of renewables? Discuss your answers with the other groups and explain your ideas.

Activity 1.4: Renewable sources (Out of lesson)

Look in newspapers or magazines or on the internet and identify one application of renewable energy sources as applied to the home. Bring along to the next lesson.

Lesson plan for solar water heating

DATE	LESSON1	LESSON2	LESSON3	LESSON4	LESSON5
THEME	Environmental impact of using energy	Impacts of global warming	Principles of solar heating	Application of solar heating to your home	Renewable energy heating
OBJECTIVES&AIMS	* Understanding the importance of energy * Understanding how much our lives are dependant on energy consumption	* Understanding the link between energy consumption and environmental problems * Identifying the type of problems we have today	* Understanding the principles of solar heating	* Understanding where hot water is used in the home.	* Considering the application of solar heating to the home.
DISCUSSION	Where and how do you think we use energy?	Why is there a difference in using energy in different houses?	The solar system; sun and the planets	Where is hot water used in the home?	What is passive solar heating?
ACTIVITY	Activity 1.1: change in energy use with time.	Activity 1.4: Creating a poster illustrating global warming	Activity 6.1: Solar water heating.	Activity 6.3: Hot water detective	Activity 5.4: Trombe box
HOME ACTIVITY	Activity 1.3: Collecting articles and pictures on global warming in newspapers, magazines or on the internet.			Activity 6.2: Solar water potential	
RESOURCES	*Background information *Illustrations related to energy consumption *Activity 1.1 material	Pictures, articles from newspapers Activity 1.4 material Background information	Activity 6.1 material & worksheet	Activity worksheets 6.2 & 6.3 Background information	Activity 5.1 material & worksheet Background information: