

## “Solar Energy - Awareness & Action”: A communal report of developments for the 2<sup>nd</sup> year of a Comenius project.

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**Basic project information:** The “Solar Energy – Awareness & Action”[SEAA] is a Comenius I project with 5 partner schools from Portugal, Spain, Italy, Malta & Greece [(Escola Antré Soares (PT), Colexio de Educación Infantil e Primaria Froebel (ES), Scuola Secondaria di 1° Grado C.B. Cavour (IT), Stella Maris College Junior School (MT) & 9<sup>th</sup> Primary School of Rethymno (EL)]. The main aim of the project is to sensitise the pupils on issues and aspects of solar energy, within a framework of sustainable development and environmental and ecological awareness, both at conceptual and at practical-experiential level. Furthermore, the pupils are encouraged to act as conscious citizens, construct their own devices which work with solar energy and present them to local communities within open Science Fair procedures and activities, in an attempt to inform and sensitise the general public. A thematic approach to solar energy has been planned to include or even interweave formal, non-formal and informal teaching and learning approaches. These include investigations, hands-on activities and project work within formal and non-formal educational contexts, but also within a free-choice learning environment involving outside classroom activities (e.g. on site visits and science fairs). Shared project activities have been planned and undertaken by groups of children in each school, encouraging pupils to learn from the experience of working on a contributed set of ideas and projects from all participating countries.

**Keywords.** Solar energy, school partnership projects, Socrates-Comenius I project, school based projects and activities, hands-on science activities, thematic-holistic approaches.

### 1. SEAA project meetings, 2006-2007

Two meetings have been conducted during the second year of the SEAA Project. Members of the participating schools first met at the

*Colexio de Educación Infantil e Primaria Froebel*, Pontevedra, Spain in November 2006 (13<sup>th</sup>-18<sup>th</sup>) and then they met again at the *Stella Maris College Junior School*, Gzira, Malta, in May 2007 (4<sup>th</sup>-9<sup>th</sup>).



**Photo 1:** Participants of the SEAA group in front of *Colexio de Educación Infantil e Primaria Froebel* in Spain, November 2006.

In both meetings project issues have been discussed, whereas ideas and activities have been proposed and developed within a framework of prospective classroom approaches and/or applications.



**Photo 2:** Colleagues of the SEAA group at a social event in Malta, May 2007.

All partners attended several project meetings during each visit and participated lively

in the activities organized by colleagues and children of the local hosting institutions.



**Photo 3:** Meeting in progress, Spain, November 2006.



**Photo 4:** A warm welcome reception with the Brothers at Stella Maris College Junior School, Malta, May 2007.

The project meetings have always been a combination of hard work and educative enjoyment by sharing events as well as selective sight-seeing, the kind of which one rarely experiences when travelling alone. All hosting institutions have been very hospitable, welcoming the project participants in a collaborative spirit, whereas local colleagues have always been very kind to show us around and share with us their traditions and culture.

Thus, in Galicia, in November 2006 we had guided visits around Pontevedra and a welcome meeting at the City Hall. We also visited A Coruña and Santiago de Compostela. In Malta, in May 2007 we visited Marsaxlokk, the Neolithic temples of Hagar Qim and Mnajdra, Mdina, the island of Gozo and of course Valletta. In both visits, we managed to work together for the project, but also to strengthen our bonds and have some fun going out in social events.

## 2. Project work base and policy development

Throughout the second year of the project a distinct set of activities about the Sun and solar energy as well as active, passive and photovoltaic solar systems has been scheduled and worked upon, in collaboration with all partner schools. This has been feasible due to an available variety of resources, activities and designs out of which we can be selective and adaptive according to pupils' interests and the conditions of educational settings. In this sense, some of the issues approached so far are the following:

- Revision and extension of ideas about the Sun in national and local tales, legends, mythologies and histories by examining more available resources, in combination with arts, music, drama and theatre.
- Investigations about the Sun and the solar system and construction of a couple of scaled models (e.g. a 3D one and one for the school yard).
- Discussions on the potential of active solar energy systems and in some cases constructions of a solar water heater with plastic bottles and rubber tubes in a serpentine arrangement and/or a water heater with a spiral tubing arrangement to be tested in practice.
- Revision of energy crisis issues and discussions on solar energy solutions in passive solar systems and more precisely traditional and modern architecture perspectives for a sustainable and low energy efficient home living.
- Investigations on passive solar systems and construction of small and inexpensive greenhouses either ready made or out of PVC tubes and plastic glazing and experiment with the growth of plants etc.
- Construction of toys with photovoltaic cells and motors as an accessible, playful, but also valuable introduction to future photovoltaic technology.

A *thematic approach* has always been guiding the teaching and learning tasks of this project, looking at various themes that arise within a broad framework of school subjects and extracurricular activities, in a formal, non-formal

and informal mode, involving teachers and pupils as well as associated partners and the local communities.



**Photo 5:** Participants of the SEAA group attending a school assembly and a theatre play at *Colexio de Educación Infantil e Primaria Froebel* in Spain, November 2006.



**Photo 6:** A choir at *Stella Maris College Junior School, MT* welcoming the SEAA group with project songs about the Sun, May 2007.

During the two meetings in the past school year 2006-2007, collaborating teachers have exchanged ideas on experiments and investigations regarding aspects of solar energy to be treated with pupils. Information on applications and/or constructions about *passive* (e.g. solar houses and solar architecture, greenhouses, solar cookers, solar dehydrators etc.) and *active solar systems* (e.g. solar water heaters, solar heating/cooling for homes, solar power stations with reflectors etc.) as well as *photovoltaic systems* (e.g. solar cells and arrays, solar cars and solar toys with PV cells and motors etc.) has been shared and discussed. A particular set of six activities on solar energy applications has been developed and put forward as a basis for the second year of the project, regarding solar energy uses and applications. The activities have been designed as follows: (URL: <

[http://9dim-rethymn.reth.sch.gr/contents\\_en/downloads.htm](http://9dim-rethymn.reth.sch.gr/contents_en/downloads.htm)>):

1. **A portable open panel solar cooker** with a cardboard box torn apart in a particular way and aluminium foil glued on all surfaces, attempting set the scene for a study on the effects of reflected solar radiation and solar cooking.
2. **A more advanced open panel solar cooker** with the reflectors inside a cardboard box.
3. **Model greenhouses made out of cardboard boxes**, in an attempt to introduce the children to the greenhouse effect and relevant principles.
4. **Simple solar collectors with aluminium containers of various shapes and sizes** set in the sunshine to heat up water, providing the basic idea for relevant experiments and activities.
5. **A solar water heater** with a collector with a spiral tube arrangement and a plastic tank, setting the scene for an investigation on basic solar water heating without the *thermosiphon effect*.
6. **A solar catamaran with two plastic bottles, a PV cell and a motor**, as a basic arrangement to provide ideas for construction of a series of relevant solar boats with floaters and to sensitise pupils about the potential of photovoltaic systems in a rather familiar and playful way

Thus, regarding the science background of the project, activities and tasks have been developed in each participating school based on the above indicative activities for the current year; although partners have also developed their own projects within a broader thematic framework including other subjects apart from science such as language, mathematics, environmental education, theatre and drama, music, crafts and technology, geography, ICT, etc.

There has also been an attempt to actively develop a communication amongst participating pupils from different schools through an exchange of joint letters and Christmas postcards organised in groups of children and/or classes. This has proven to be a difficult task mainly due to language difficulties and adequate combination of interests and age groups, but it has been considered essential in building up a warm atmosphere of friendship amongst

participants to function as a solid basis for future joint experimentation and project development.

The electronic mailing list, established during the first project year, has continued functioning actively, involving all participating colleagues from the partner schools, providing *in vitro* communication with first hand and updated information about the developments of the project for everyone. Moreover, the web site of the project is constantly developing under the site of the coordinating school, the 9<sup>th</sup> Primary School of Rethymno. It is accessible at the URL: <[http://9dim-rethymn.reth.sch.gr/contents\\_en/Comenius.htm](http://9dim-rethymn.reth.sch.gr/contents_en/Comenius.htm)>, providing information about the project to partners and the general public.

### 3. Indicative project activities conducted during the 2<sup>nd</sup> year

Teachers and pupils have been involved in a variety of project activities throughout the 2<sup>nd</sup> year, 2006-2007. A more precise view of the numbers of pupils and teachers participating in the project is presented in the table below.

SEAA School Partners	Pupils		Teachers	
	F	M	F	M
<i>Escola Antré Soares (PT)</i>	78	62	6	2
<i>Colexio de Educación Infantil e Primaria Froebel (ES)</i>	27	22	7	1
<i>Scuola Secondaria di 1° Grado C.B. Cavour (IT)</i>	50	55	9	0
<i>Stella Maris College Junior School (MT)</i>	0	89	6	4
<i>9<sup>th</sup> Primary School of Rethymno (EL)</i>	78	72	5	5
<b>sub-total</b>	<b>233</b>	<b>300</b>	<b>33</b>	<b>12</b>
<b>Total</b>	<b>533</b>		<b>45</b>	

**Table 1:** Numbers of pupils & teachers participating in project work per school and in total.

Nevertheless, it more likely appears that a greater number of pupils and teachers have participated explicitly or implicitly in project activities, than those initially declared.

It appears that as the SEAA project is progressing we tend to develop a rather long list of conducted activities and/or activities to be conducted in the remaining time schedule. During the project meeting in Malta, we started putting this list together, in the form of a table, by listing the activities in one column and then ticking in relevant columns that represented the partner schools. The conducted activities were ticked with an “X” symbol, the ones to be done

in the near future with an “\*” symbol and the ones planned to be conducted in the remaining time with an “!” symbol. Thus, we all started to have a clearer picture of the developments in each partner school throughout the project years. Although this list is still uncompleted, a recent version is attached to this report as an Appendix.

Some indicative project activities have been selected and grouped in terms of subject areas involved within a thematic approach and are presented in the following sections.

#### 3.1. Language, literature, history & culture related project activities

In an initial phase of the project, all partner schools, in most cases under the coordination of the English teachers, involved pupils on some research about the participating countries, as far as cultural, geographic, mythological aspects are concerned. Children were divided in groups and each group had to study a country. They searched and selected the information from the internet, books, leaflets etc. In this way they got familiar with all countries and schools participating in the project. In some cases, this work was presented to the whole school, in an exhibition in December 2006.

Through the e-mailing list of the project, teacher participants from all schools decided the involvement of pupils in creation and exchange of collective Christmas cards. Thus, children in different classes in between participating schools were paired and they created Christmas cards with relevant material, even in electronic form in some cases, which were sent over to each other.

The revival of myths, tales and stories, which deal with the Sun in one way or another, has been conducted through classroom activities and text production, continuing a set of activities that started last year. For example, stories of the Sun from ancient civilizations like the Egyptians, the Celts, the Aztec, the Sumerian, the Greek, the Roman etc., stories of Sun Gods in various times and cultures and their relation to astronomy (cf. URL:<<http://www.windows.ucar.edu/tour/link=/mythology/planets/sun.html>>), as well as Sun monuments such as the Stonehenge etc.

The colleague *Esperança Fernandes*, teacher of English at the *Escola Antré Soares, PT*, motivated her pupils to participate in this project through a Power Point presentation with music and lyrics of the song “*New Days*” by *Asher Lane*. Words like “Sun”, “Universe”, etc. were

skipped from the lyrics and the pupils had to listen to the song and fill them in. During the comprehension phase of the lyrics, the teacher and the pupils had a short discussion about the influence of the sunny days in people's lives.

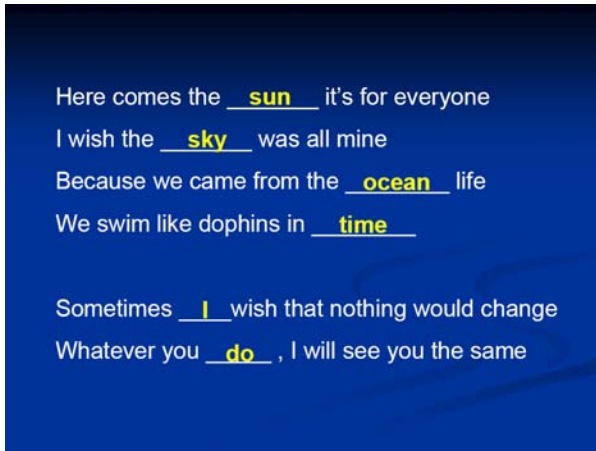


Figure 1: The beginning of the “New days” song in a synchronized “.ppt” file with the relevant background music (Escola Antré Soares, PT).

Through e-mail communication amongst partner teachers, an agreement has been reached about developing thematic projects in each school on healthy diet and nutrition as well as Mediterranean nutritional habits, common dishes and local recipes.



Photo 7: Colleagues of the SEAA group exchanging the nutrition-recipe booklets during the project meeting in Malta, May 2007.

The projects were expected to take the form of short booklets and/or diaries, to be developed within a framework of pupils' information research in various accessible resources and collaborative team work. The final product was to be composed in a unified document with text, photos, decoration etc. and finally take the form of a collective booklet to be exchanged amongst partner schools. In this way, we would all share these valuable pieces of elaborated information

presented by pupils and colleagues with all members of partner schools and local communities. It appears that we have managed to fulfil this objective, with a smile of success!



Photo 8: Konstantina Papaioannou & Claudia Anastasi, English teachers in Greece and Malta respectively, exchanging the recipe books, Malta, May 2007.

The text language of the booklets has been either English and/or national languages (see sample pages below).

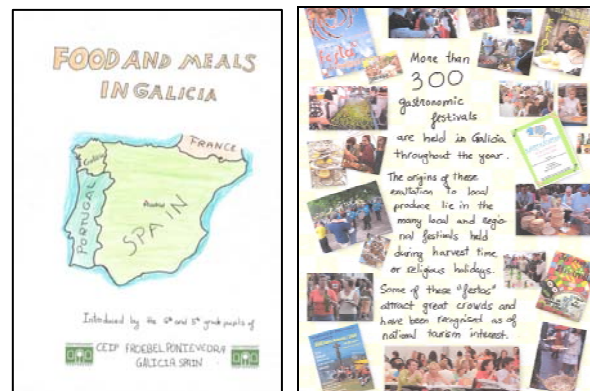


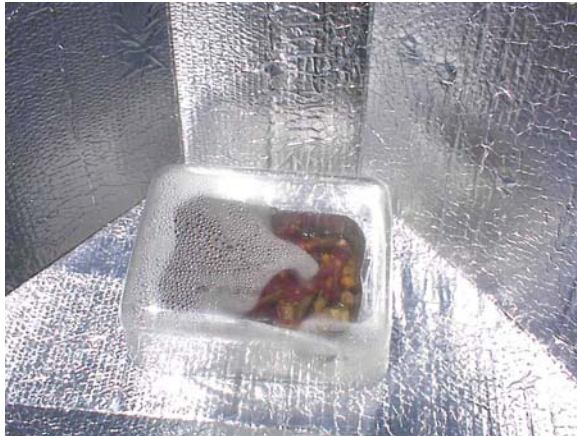
Figure 2: Two introductory pages from the booklet from the Colexio de Educación Infantil e Primaria Froebel, ES, informing us about the 300 gastronomic festivals of Galicia [under the supervision of colleague Carmiña Noya].



Figure 3: Two recipe pages from Scuola Secondaria di 1° Grado C.B. Cavour, IT, with a group of 3 boys preparing a local dish “fusilli all trapanese” [under the supervision of colleagues Ketty Bufardeci & Antonella Piccin].

Moreover, anticipated links were to be drawn with solar energy applications in action, i.e. drying fruits, vegetables and herbs in solar dehydrators, whereas some of them could be grown in school gardens and/or greenhouses (see following section).

Additionally, children could cook some delightful dishes in solar cookers at the final event of a science fair etc. In fact, some partner schools have constructed a simple solar dehydrator out of one or two cardboard boxes (collector & dryer) and plastic or glass glazing, which have been tested when weather conditions permitted it with very interesting results, linking language and science issues in a thematic approach (see examples below).



**Photo 9:** Okras with tomato sauce in an open panel solar cooker at a science fair (9<sup>th</sup> Primary School of Rethymno, Crete, EL).



**Photo 10:** A “solar dehydrator” (Sun dryer) out of a cardboard box, for drying out fruits and vegetables (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

In some cases, during the process of production of the nutrition-recipe booklets, several other forms of text production have taken place, such as poems for instance. Below, there is a poem which was written collectively with children of a 6<sup>th</sup> Grade of the 9<sup>th</sup> Primary School

of Rethymno, Crete and their English teacher Konstantina Papaioannou.

*Ladies and gentlemen welcome on board!  
Let's take a trip to the nutrition world.  
We'll get to know what we should eat,  
so take a look at our diet in Crete.*

*To keep ourselves healthy we must eat  
fruit, vegetables, pulses and meat.  
Lots of fish, some cheese and bread,  
all we need to do is use our head.*

*Say 'no' to burgers, the so called 'junk food'  
start eating things that do you real good.  
So many colours for you to choose,  
red apples, green salads and orange juice.*

*Biscuits and crisps, chocolate and sweets  
are the kind of food we should not eat.  
If we stick to these rules, we'll feel great  
and won't have any problems with our weight.*

**Figure 4:** A class poem inspired by 6<sup>th</sup> Grade children on healthy nutrition and Cretan diet (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

Text production in the forms of: a) creative writing (personal letter writing) and persuasive writing e.g. newspaper articles and leaflets, b) argumentative writing in the form of pro and cons analysis etc. have been developed in schools and especially by language teachers like the colleague *Claudia Caruana Anastasi* from the *Stella Maris College* in Malta. Some hints were provided in the form of questions to be tackled and structure the paragraphs of the article text as the following example.

#### **Newspaper article Plan:**

**Paragraph 1:** What is the environmental problem and what is causing it?

**Paragraph 2:** Why is energy so important? How is it used in our daily life?

**Paragraph 3:** What is energy conservation? What can we do to use less energy?

**Paragraph 4:** What are photovoltaic cells? How could they be used in our daily life?

**Paragraph 5:** What are the disadvantages of continuing to rely on fossil fuels (coal, oil and natural gas)?

**Paragraph 6:** What are the advantages of using solar energy?

**Paragraph 7:** What are the drawbacks of using solar energy?

**Figure 4:** Sample paragraph-questions for the structure of a newspaper article (*Stella Maris College Junior School, MT*).

Several newspaper articles as well as relevant leaflets and poems have been produced with similar techniques and were presented in a final exhibition event at the *Stella Maris College Junior School*, which all colleagues attending the

Malta meeting had the opportunity to admire (see sample photos below).



**Photo 11:** Exhibition of leaflets and “sunny poems” at *Stella Maris College Junior School, MT.*



**Photo 12:** Exhibition of newspaper articles at *Stella Maris College Junior School, MT.*

The colleague *Maria Merisoglou*, who has been teaching children of the 1<sup>st</sup> Grade at the 9<sup>th</sup> Primary School of Rethymno, Crete has also worked on leaflets with her class. Initially the children’s ideas were collected and put down on paper and then the leaflet was either put together in a collage mode and/or redesigned using computer software. The children have been very creative, even at this young age and they managed to point out a variety of issues concerning the harmful effects of sunshine (see a sample leaflet that follows).



**Figures 5 & 6:** A sample leaflet inspired by 1<sup>st</sup> Grade in Greece and designed by their teacher with the title “*I can make the Sun a kite, if I know how to protect myself*” (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

After having constructed the leaflets they were very keen in communicating their ideas to the rest of the school, so they decided to visit all classes and sensitize the children about their topic by distributing them their leaflets!



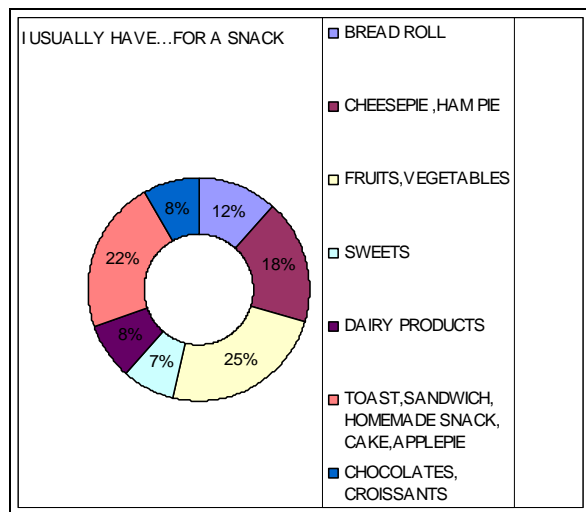
**Photo 13:** Distributing the leaflets to the other classes of the school, having a chat with the children (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

An interesting survey was designed and carried out by a class of 6<sup>th</sup> Grade pupils and their English teacher *Maria Stagaki* at the 9<sup>th</sup> Primary School of Rethymno, Crete. The children administered a short questionnaire to

102 out of 108 pupils of the 5<sup>th</sup> and 6<sup>th</sup> Grades of the school, with ten questions investigating their nutritional habits. The results were discussed in English in class and some charts were produced, linking foreign language teaching and learning with Mathematics, within an investigation of a theme project. Some of the children's finding inspired them to construct nutritional posters depicting the preferences of their classmates.



**Photo 14:** A group of Children of the 6<sup>th</sup> grade constructing their poster (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

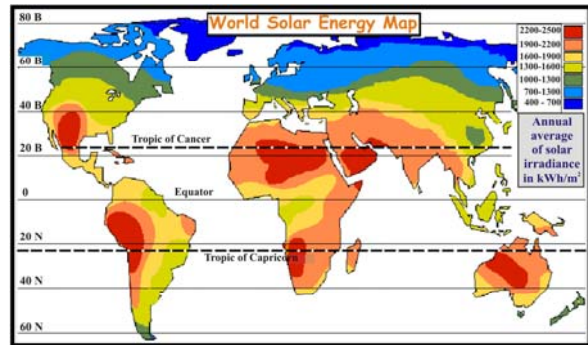


**Figure 7:** A pie chart presenting the nutritional habits for snacks. It appears rather interesting that the sandwiches and cakes nearly have an equal preference with fruits and vegetables! (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

### 3.2. Science and environmental education related project activities

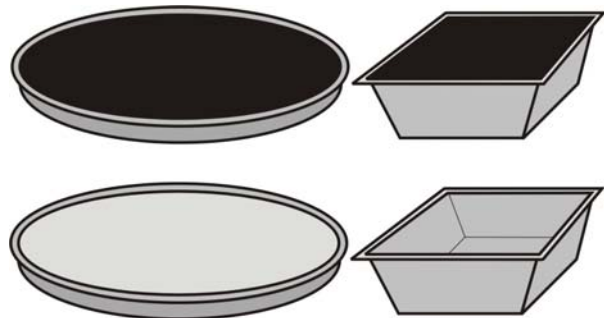
A world solar energy map has been presented to children in order to trigger their interest for discussions about the over all distribution of solar irradiance to the surface of the earth (cf. fig. 8). The discussions that usually follow tackle some sensitive issues like which countries have greater access to solar energy and why they do not take advantage of it, the extent to which their financial status allows them to

take advantage of modern solar energy technologies, but also of low solar technologies like solar cookers etc.

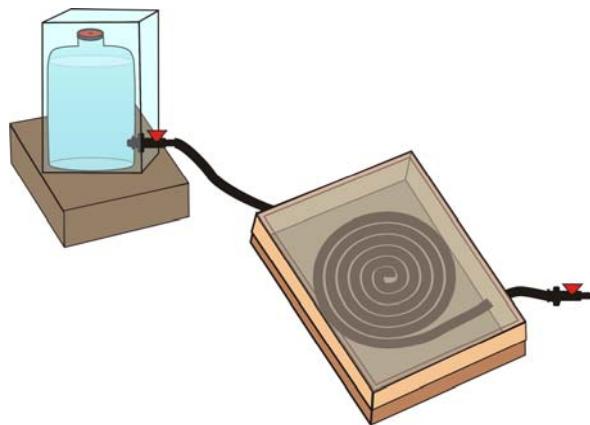


**Figure 8:** A world Solar Energy map depicting the annual average of solar irradiance in kWh/m<sup>2</sup>.

All partner schools have set up **experiments and investigations on solar thermal energy and active solar systems**, such as: a) solar water heating in various aluminium containers (see fig. 9) and/or plastic bags, b) construct a solar water heater out of a spiral arrangement of black tube in a collector box with a plastic tank (see fig. 10).



**Figure 9:** An experiment with a “simple solar collectors” to heat up water. They are made out of aluminium containers of various shapes and sizes, painted black inside or not. They are filled with an equal quantity of water and then set in the sunshine. They can even be covered with plastic film or not, extending the experimental framework.



**Figure 10:** A drawing of a solar water heater out of a spiral tube arrangement in a box and a plastic container used as a tank. This solar water heater, heats up water as it passes through the collector. So, the water in the tank has to be refilled frequently (9<sup>th</sup> Primary School of Rethymno, Crete).



This spiral solar water heater might not be suitable to investigate the “*thermosiphon effect*” as the *serpentine solar water heater* constructed last year by most school partners, but it still has an educational value in the sense that it can heat up the water passing through the tube really fast.



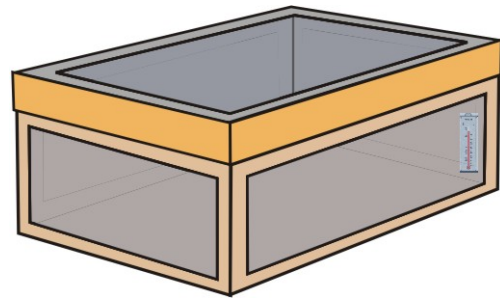
**Photo 15:** The tube arrangement of a spiral solar water heater (Stella Maris College Junior School, MT).



**Photos 16:** A serpentine solar water heater with its tank (Colegio de Educación Infantil e Primaria Froebel, ES).

All participating schools have also set up **experiments and investigations on solar thermal energy and passive solar systems**, such as: a) make greenhouse models out of boxes with plastic glazing (see fig.11), b) simple open panel solar cookers (see fig.12). These are easy made constructions with a rich scientific background which can stimulate a series of experiments and

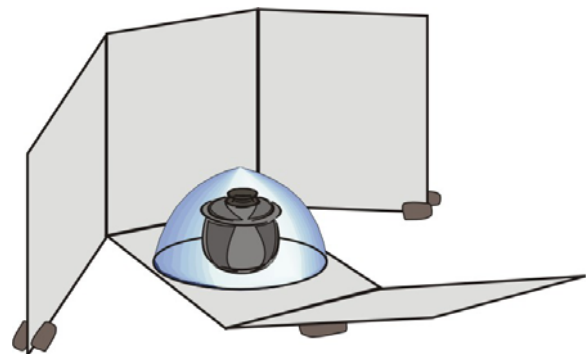
investigations. The pupils and teachers have been encouraged to record measurements and exchange data and information with each other at all times.



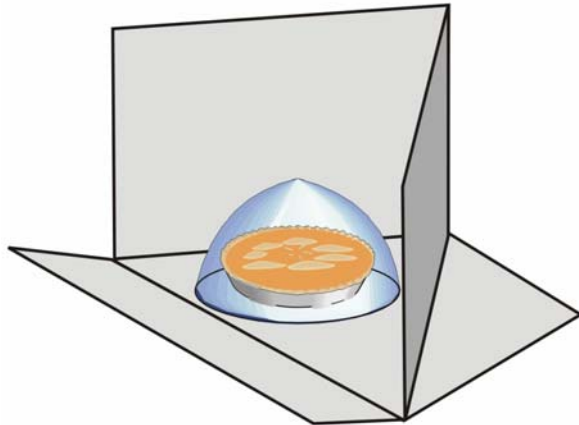
**Figure 11:** A drawing of a simple greenhouse model out of a cardboard box where parts of the surrounding and top surfaces have been cut out and replaced with plastic film or Plexiglas (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

Model greenhouses provide an interesting device to discuss the “*greenhouse effect*” and project it later to “real”, large scale greenhouses. Discussion can go even further pointing out similarities and differences with the global greenhouse effect and climate changes.

After that, the pupils undertook project work and constructed *open panel solar cookers* of two designs. The first can easily be constructed by adequately tearing apart a cardboard box in its sides and bottom and by sticking aluminium foil on all of its surfaces, turning them into reflectors (see fig. 12). The second open panel solar cooker is a portable one, constituting of two pieces of cardboard adequately folded and arranged as shown in fig. 13. In both of the solar cooker designs, the *technical greenhouse effect* that was created inside the box space of the *box solar cookers* designed last year is now created inside the upside down salad bowl covering our cooking utensil. Alternatively, a plastic oven bag can be used. Open panel solar cookers appear to be more convenient to emphasize on the role of reflectors in the relevant phenomena.



**Figure 12:** A drawing of a simple open panel solar cooker out of a torn cardboard box (9<sup>th</sup> Primary School of Rethymno, Crete, EL).



**Figure 13:** A drawing of a simple open panel cooker out of two pieces of cardboard covered with aluminium foil (9<sup>th</sup> Primary School of Rethymno, Crete, EL).



**Photo 17:** An open panel solar cooker at an exhibition (Escola Antré Soares, PT).



**Photo 18:** An open panel solar cooker out of a torn box ... in action at a science fair (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

An interesting set of activities have focused on the *growth and development of plants within greenhouses and open garden settings* or even with comparisons of the two approaches. As Sanders (2007) contends “*plants are essential to life on Earth and yet are often deemed invisible by the human populace*”. Nevertheless, botanic and school gardens are an under-researched educational context and, as such, have occupied

a peripheral arena in biology and science education discussions. A combination of formal and informal approaches in teaching and learning environments, such as school gardens, greenhouses and homes, tends to make public the private life of plants and their role in sustaining life on Earth. Within the framework of the SEAA project several greenhouses and school garden projects have been developed throughout the current year. Some of these examples are briefly described below.

The Italian colleagues *Ketty Bufardeci & Antonella Piccin* and their pupils at the *Scuola Secondaria di 1° Grado C.B. Cavour*, had worked last year on the construction of a “*greenhouse-tunnel*”, where they grew seeds and plants. This year they reconstructed their greenhouse, since it suffered from some damage in its iron skeleton. So, they renovated the structure, cleared the weeds and made 10 small raised beds out of the ground soil to put their plants (see photos 19 & 20). They planted mostly salad plants like cos lettuce, collards, butterhead lettuce, mild cultivated rocket (*Eruca vesicaria sativa*), garden cress, dandelion, corn salad, leaf lettuce, curly endive, escarole, belleville leaf sorrel (*Rumex acetosa*), etc. They labeled their plants using plastic yellow tags and they took care of them quite often, walking along the narrow paths in between the raised soil beds. They watered them frequently, fertilized them with organic compost and recorded their growth. They studied the conditions in which the plants were growing inside the greenhouse, taking care of ventilation and air flow as well as heat control over time. After 6-8 weeks they started collecting their salad plants with joy and happiness (see photo 21). Then, they organized a “*salad party*” to share their food with classmates, while informing them about the value of salads in healthy nutrition.





**Photos 19, 20 & 21:** Pupils renovating the “greenhouse-tunnel”, planting the plants inside on 10 raised soil beds with narrow corridors in between and alongside and in the end proudly showing their salad crop (*Scuola Secondaria di 1° Grado C.B. Cavour, IT*).

Moreover, the Spanish colleagues *Teresa Couto*, *Manuel Carpintero Vázquez*, *Ana Lorenzo Bello*, collaborating teachers and pupils of the *Colegio de Educación Infantil e Primaria Froebel* have worked on the growing of plants and conducted experiments in their back yard where they created a small greenhouse. They closed the area in between two walls with plastic film and polycarbonate plates (see photo 22). They used wooden boxes as soil containers and they grew their plants inside them, labeling each box accordingly (see photos 23 & 24).



**Photos 22, 23 & 24:** Young pupils growing plants in raised wooden containers and in pots (*Colegio de Educación Infantil e Primaria Froebel, ES*).

They have looked at plants as self feeding organisms and they have discussed the process of photosynthesis and the role of solar energy in the growth of plants etc. (cf. Bartholomew, 2005 & Matthews, 2005)

The colleague *Avelino Garrido* from the *Escola Antré Soares, PT*, with children of the 5<sup>th</sup> Grade has managed to build a greenhouse in the backyard of the school with simple materials, such as plastic tubes bent and bond together and then fixed to the ground with bases of concrete. The greenhouse was covered with adequate plastic film all around and it was held at the sides with stones and log wood (see photos 25 & 26). During science courses the children have studied some important topics of botany and the greenhouse effect. The students selected some seeds of vegetables and flowers and planted them on the ground inside the greenhouse and also in small pots (see photo 27). They designed “fair experiments” by planting the same seeds outside on the ground and in similar pots in order to observe the behaviour of the plants in both environments, inside and outside the greenhouse. They have taken photos to record the growth of the plants, which were later presented in an evolutionary mode depicting the stages of growth of the plants inside and out side the greenhouse.

They concluded that in most cases the plants growing under the greenhouse conditions developed faster and showed better health.



**Photos 25, 26 & 27:** Pupils building their greenhouse out of plastic tubes affixed to bases of concrete and with plastic film all around (*Escola Antré Soares, PT*).

The colleagues and the children from the 4<sup>th</sup> and 5<sup>th</sup> Grade of the 9<sup>th</sup> Primary School of Rethymno, Crete have worked on cultivating seeds and plants in raised beds, a rather not famous technique albeit very ancient, but with great educational potential (cf. Bird, 2001). After a lot of thought and several trials it was decided to build those raised beds out of *Ytong* blocks, an alternative, long known building material made

from light-weight “Aerated Autoclaved Concrete” (AAC), which is non-toxic, environmentally friendly and easy to build, with outstanding thermal insulation. The building of the blocks in particular dimensions and designs, to construct the raised beds, has taken quite a work load and a lot of personal labour.



**Photo 28:** Building the raised beds out of *Ytong* blocks at the school garden (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

In the end of May 2007, the first plants have been established by children of the 4<sup>th</sup> Grade and later of the 5<sup>th</sup> Grade (see photos 29 & 30).



**Photos 29 & 30:** Children planting tomatoes and courgettes at the raised beds in the school garden (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

The children studied the growth of their plants under the particular conditions and filled in short diaries describing the various phases of development. Unfortunately, the schools closed a few weeks later for summer holidays, so they saw their plants again in September, tasting the juicy tomatoes etc. Having built most of the raised beds already it is planned to start earlier for the 3<sup>rd</sup> project year in order to complete a more holistic plant study.

All school partners have also dealt with a **third set of solar energy experiments and constructions using photovoltaic cells** such as: a) shading the photovoltaic cells partly and/or totally in order to study their performance with a toy, i.e. a solar boat, functioning with a motor b) visiting the city and/or particular photovoltaic parks and study them more closely (see photos 31 and 32, 33), c) project work in constructing solar toys with photovoltaic cells and motors (e.g. toy boats, model houses etc.).



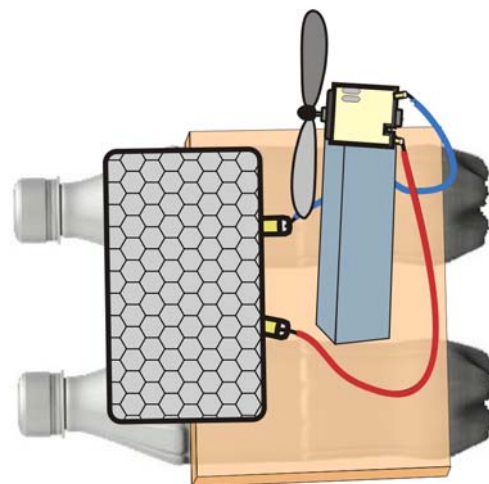
**Photo 31:** Pupils walking around *Braga* investigating the town buildings trying to spot elements of solar architecture. Here, they stopped to look more closely these traffic lights working with photovoltaic cells (*Escola Antré Soares, PT*).



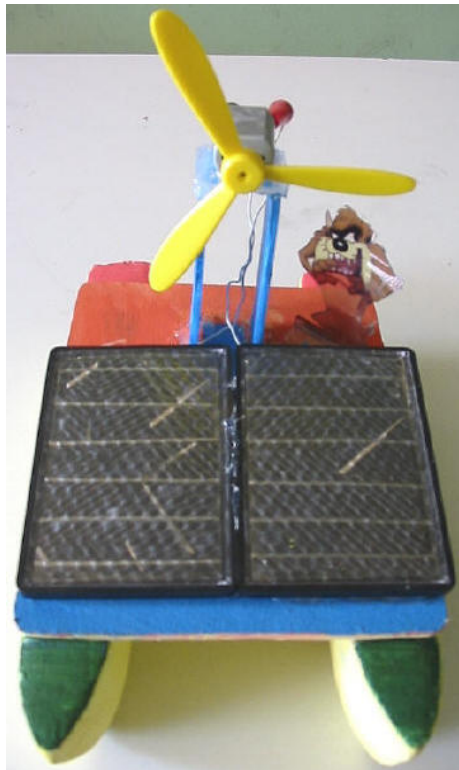
**Photos 32 & 33:** Pupils of the 5<sup>th</sup> and 6<sup>th</sup> Grade of the 9<sup>th</sup> Primary School of Rethymno, Crete, EL visited the “Photovoltaic Park” of the Technological Institute of Crete. They were quite astonished by the batteries supporting the PV systems as energy storage devices.

Furthermore, all schools worked on the solar energy projects with photovoltaic cells etc. and prepared the set up of *science fairs and/or final exhibitions*, which have in most cases been incorporated in the final events of the school year.

A basic idea for a series of constructions on *solar catamarans* is one made out of two plastic bottles bond together with a piece of plastic or light wood. The motor is placed higher on that base and a helix is attached to its shaft. The motor is then connected to the photovoltaic cell, balanced in the front part of the construction and the solar catamaran moves forward by propelling air in the opposite direction (see figure 14). An excellent toy to discuss mechanical and solar energy all together!



**Figure 14:** A drawing of a simple solar catamaran out of two plastic bottles a PV cell and a motor (9<sup>th</sup> Primary School of Rethymno, Crete, EL).



**Photo 34:** Solar catamaran with two polystyrene floaters, built on a similar idea previously described (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

The colleague *Ivan Mifsud Bons* with pupils from the *Stella Maris College Junior School, MT* have constructed a variety of solar toys, which were exhibited to the SEAA project partners at the meeting in Malta. The pupils have used the parts and pieces out of readymade sets bought from the market and they creatively improvised their constructions adding originality, inspiration and inventiveness. They constructed many different designs of “solar houses” with electricity circuits, bulbs and buzzers, as well as music boxes and motors that moved various parts of these houses (see photos 35 and 36, 37).



**Photo 35:** Pupils of *Stella Maris College Junior School, MT*. exhibiting their constructions and toys powered by photovoltaic cells and motors out at the school yard.



**Photos 36 & 37** A solar home and a solar lighthouse, just two of the many creative constructions (*Stella Maris College Junior School, MT*, under the supervision of *Ivan Mifsud Bons* & collaborating teachers).

The colleagues and pupils of the *Escola Antré Soares, PT* have been very inventive once again this year. Last year they had constructed a “big toy car” which became very popular in the school. But, this year, they managed to construct a “solar tricycle” made out of a tricycle, a powerful photovoltaic cell and a motor attached to the back axis of the two wheels (see photo below).



**Photo 38:** The solar tricycle!!! (*Escola Antré Soares, PT*).

## André Soares mostra trabalhos a energia solar

A Escola André Soares, em Braga, tem patente uma exposição intitulada "Solar Energy Awareness & Action" que reúne trabalhos realizados por alunos durante o presente ano lectivo, no âmbito do projecto Comenius I. Os alunos construíram formas solares de diferentes tipos, aquecedores de água, relógios e brinquedos solares, e uma estufa onde puderam observar o desenvolvimento de diferentes plantas. O Clube de Artes Visuais da Escola motivou os alunos para o tema levando-os a



Trabalhos foram realizados durante o ano lectivo

criar pinturas que também se encontram expostas. Na disciplina de Inglês os alunos tra-

balharam receitas tradicionais desta região que compilaram num livro, para um intercâmbio de receitas entre os diferentes países envolvidos neste projecto. Com este projecto, a Escola André Soares pretende sensibilizar os alunos para o uso das energias renováveis e, concretamente, para as vantagens da energia solar, promovendo o desenvolvimento sustentável bem como a consciência ecológica, levando-os a agir de forma consciente e a criar os seus próprios trabalhos nos quais se podem observar as vantagens da energia solar. Os trabalhos estão expostos no Polivalente da Escola.

**Figure 15:** The solar tricycle hit the news and the local press (*Escola Antré Soares, Braga, PT*).

The teachers and pupils of the *Scuola Secondaria di 1° Grado C.B. Cavour, IT* also worked on the study and construction of *sundials*. In the *initial phase* of the project the pupils undertook a great deal of research using Internet, textbooks and the newspapers available to them. Working in mixed groups, the boys and girls gradually selected the most appropriate material and made a summary of the content, accessible to younger pupils. In the *second phase*, the pupils devoted themselves to collecting visuals and slogans connected with sundials and they gradually refined their choice of materials and decided on the number of visuals to be used in the finished work. Obtaining information of their territory and culture as a starting point, the pupils looked for and photographed the sundials present in their city and surrounding area. Many of the students who had acquired conceptions of construction during the first phase of the project, used them to produce and test the reliability of sundials they made, albeit simple ones.

Sundials were also constructed by teachers and pupils at the *Escola Antré Soares, PT*, who visited the "*Centro Multimeios de Espinho*", where they attended a Planetarium session called "*Camping with the stars*". They also had the opportunity to participate in a follow-up workshop about sundials and learn some basic issues in the construction of a sundial. After that, each of them constructed his sundial to try out in the sunshine (see photos 39 & 40).

Similarly, pupils from the *Stella Maris College Junior School, MT* constructed sundials under the supervision of their Mathematic teacher *Sharon Cilia*. They made some calculations and charts and the managed to

construct a simple sundial with a straw as a gnomon.



**Photos 39 & 40:** Pupils attending a workshop on sundials at the "*Centro Multimeios de Espinho*" and a sample sundial they constructed (*Escola Antré Soares, PT*).



**Photo 41:** Sundials constructed by pupils at *Stella Maris College Junior School, MT*.

Finally the *9<sup>th</sup> Primary School of Rethymno, Crete, EL* attended the *2<sup>nd</sup> Panhellenic Contest* for primary schools on science experiments with simple materials organized by *Ellinogermaniki Agogi* and the *National Physics Teachers Association*. The school received the *3<sup>rd</sup> prize* presenting a serpentine solar water heater and an experimental arrangement of simple solar collectors with plastic bags resting on cartons of various colors (see photo 42).



**Photo 42:** Prof. Stella Vosniadou, member of the judging committee is presenting the pupils and teacher with their award (9<sup>th</sup> Primary School of Rethymno, Crete, EL).

### 3.3. Crafts, music and theatre related project activities

Some groups of pupils have worked to present other project related activities such as: theatrical plays, songs, craft work and happenings as well as paintings etc.

The colleague *Maria Merisoglou* from the 9<sup>th</sup> Primary School of Rethymno has worked with children of the 1<sup>st</sup> grade on a theatrical play with the title “*How, where, when and why the girl married the Sun*”, which gave a performance with puppets during the final event of the school year. The story says that there was an old man who was very poor, had three daughters but he could not raise them. He often went to the forest in order to bring wood and herbs to sell to provide some food for them. One day when he was crying and sighing a man with black skin heard him. This man was working for the sun as a servant and asked the old man about his problems. The old man told him everything and then he transferred the words of the old man to his master, the Sun. The Sun ordered his servant to offer some money to the old man, but ask him to give one of his daughters as wife to the servant. Only the youngest daughter agreed to marry the servant. The truth is that the husband of the girl was eventually going to be the Sun and not the servant. Unfortunately, she didn't realize it since every night the servant forced her to drink a sleeping draught. She discovered the truth only when her sisters gave her a sponge which she hid under her chest, spilled the sleeping draught on to it and managed to stay awake all night to finally see the Sun. But the Sun saw her when she opened her eyes to look at him and he kicked her out of the house immediately! The problem was that the girl was

pregnant and she needed a house to bear her child. The only person who welcomed her was the youngest sister of the Sun. Finally, when the Sun heard the news, he got angry with all the other people who did not provide hospitality and shelter to his wife. He went to his sister's home and took back to the palace his wife and son, who by the way had the sign of the sun on his forehead. They all lived happily thereafter.



**Photo 43:** Pupils of the school watching the above play with puppets at the school yard in June 2007 (9<sup>th</sup> Primary School of Rethymno, Crete, EL)

Pupils and teachers have sung and danced several songs like the relating to the Sun, but our favorite tends to be one from *Stella Maris College* in Malta, the “*Solar Ay-Ye*” song (Music & Lyrics by *Frank O'Neill*).

*When the sun shines, I am happy  
 For the sunshine is my friend  
 I can use its awesome power  
 It's the best you understand.*

*Heats the water, turns the engine  
 Rolls the motor drives my toys  
 What a joy it is to have you  
 You're my one and only choice.*

*May all the world go solar  
 For it is safer and free  
 May all the world go solar  
 Safer for you and for me*

*Solar ay-ye  
 Solar ay-yo [x 3]*

**Figure 16:** The “*Solar ay-ye*” song (*Stella Maris College Junior School, MT*).

Pupils have worked with simple, common materials and have constructed several pieces of craftwork and paintings. They have been constructed either individually and/or collectively in whole class activities.





**Photo 44:** Children of the 1<sup>st</sup> Grade are preparing collective posters on solar energy to be distributed to partner schools (9<sup>th</sup> Primary School of Rethymno, Crete, EL.).



**Photo 47:** A wall painting exhibited at the final event of the *Escola Antré Soares, PT.*

A large and very artistic exhibition was organized by *Stella Maris College Junior School*, when the project meeting took place in Malta (see photos below).



**Photo 45:** A long paper painting at the final event of the school year with the topic "Holidays with the Sun" (9<sup>th</sup> Primary School of Rethymno, Crete, EL.).



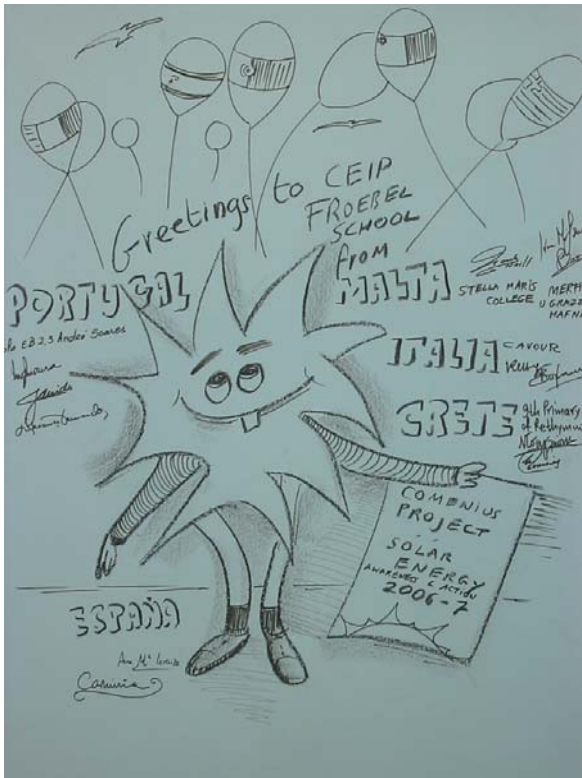
Wall painting and posters with messages have also been produced this year.



**Photo 46:** Posters drawn by pupils and teachers at *Stella Maris College Junior School, MT.*



**Photos 48 & 49:** Photos from the project work exhibition at *Stella Maris College Junior School, MT*, May 2007.



**Figure 17:** A project poster designed by the colleague Frank O'Neill from the Stella Maris College Junior School, MT, which was signed by all participating colleagues at the meeting in Pontevedra, Spain, November 2006.

Several pupils have also prepared power point presentations to share their work with other fellow pupils and teachers. Those presentations deal with a variety of topics related to solar energy, alternative forms of energy, energy crisis, the solar system, the sundials etc. They are to be uploaded on the project web site soon (cf. URL: [http://9dim-rethymn.reth.sch.gr/contents\\_en/downloads.htm](http://9dim-rethymn.reth.sch.gr/contents_en/downloads.htm)).

#### 4. Concluding remarks

It appears that quite a variety of solar energy activities, solar applications and constructions, have also taken place during the second year of the SEAA Comenius project. It seems that the initial idea to create a *core set* of basic activities for all and a *peripheral set* of activities to be developed independently and/or in collaboration with partner schools, is a rather feasible one and leaves us with a potential for the third and last year of the project.

Moreover, in terms of professional development as teachers, we obtain useful insights on how schools operate in different countries and systems, which help us to improve our daily practice and become wiser. It is interesting to see similar activities conducted by pupils in different countries and be able to identify similarities in approaches and general spirit.

Finally, we would like to thank all pupils and teachers participating in the SEAA project for their time and efforts, only under the anticipation that somewhere in all this they receive a valuable feedback for their lives.



**Photo 50:** Happy faces saying goodbye ... till next year! (Colegio de Educación Infantil e Primaria Froebel, ES).

#### 5. References

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**Appendix: List of SEAA project activities conducted or to be conducted by the partner schools**

No	Activity and/or construction	9 <sup>th</sup> Primar	St. Maris	Froebel	A. Soares	Cavour
	Hot boxes	X				
	Pizza box solar cooker, single	X	X	X	X	X
	Pizza box solar cooker, double	X				
	Pizza box solar cooker, in another box	X			X	
	Box solar cookers with 1 reflector + lid	X	X	X	X	X
	Box solar cookers with 1 reflector no lid	X	X			
	Box solar cooker with 4 reflectors	X				
	Open panel solar cooker out of a box	X	X	X	*	*
	Open panel solar cooker in a box	X		X	*	!
	Open panel solar cooker with design	X				
	Pringles solar cooker	X				X
	Semi-cylinder solar cooker	X				
	Parabolic solar cooker	X				
	Simple solar collectors with cartons and plastic bags	X	*	*	*	*
	Simple solar collectors with aluminum containers	X	*	*	*	*
	Solar water heater with "S" tube arrangement	X	X	X	X	X
	Solar water heater with "spiral" tube arrangement	X	X	*	X	!
	Solar water heater with vertical and horizontal tube arrangement	X				
	Model solar water heaters	X				
	Photovoltaic cell experiments with transparent, semi-transparent and non-transparent material (cards) covers	X	*	X	X	X
	Solar toy cars of various kinds	X	X	X	X	
	Solar toy cars with a ready made kit	!	X	X	X	X
	Transformation of a toy car to a solar one		X	!	X	!
	Solar boats	X	X	X	X	!
	Solar catamarans out of plastic bottles, with a helix	X	!	X	!	!
	Solar catamarans out of polystyrene floaters, with a helix	X	!	!	!	!
	Solar river boats with water wheels	X				
	Solar toys (honey bee around a flower)	X				
	Solar toys (carousel)	X	X	X		
	Solar lift		X	X		
	Solar music rooms-houses		X			
	Solar instruments		X			
	Solar windmills		X	X	X	
	Solar toys (solar cutter)		X			
	Models of houses with PV cells on roofs	X	X	!	X	!
	Greenhouse models out of boxes with surrounding plastic frames	X	!	!	!	!
	Greenhouse models with wooden or other material construction	X	X	*	*	*
	Real greenhouses ready made	*		X		X
	Real greenhouses with PVC tubes designs	!	!		X	
	Real greenhouses within a raised bed gardening construction	!	!			

Solar dehydrator out of 1 box	x	!	!	!	!
Solar dehydrator out of 2 boxes (collector and dryer)	x	!	x	!	!
Wooden constructions of solar dehydrators	*		x		
Songs	!	4	3	*	
Poems	x	x	x	x	x
Leaflets	x	x			x
Newspaper articles by children	*	x x			x
Presenting an argument	*	x			
Stories combining text and drawings	x	!	x		
Stories combining poems and drawings		x			x
Mythology, stories, legends	x	x !	x	x	x
Solar concepts (models)		x	x		x
Solar system models	x	x	*	*	x
Posters	x	x		x	
Drawings	x	x	x	x	x
Paintings	x	x	x	x	x
Power point presentations	*	x	*	x	x
Charts	x	x			x
Solar systems models	x	x			x
Sundials	x	x !	*	x	x
Wall paintings	x	x			
Recipes and healthy nutrition + book or booklet	x	x	x	x	x
Solar cooking delights	x	!	!	!	!
Post cards exchange	x	x	x	x	x
Theatre play ( <i>The Sun-dropped Lady</i> )	x				
Theatre play ( <i>How, where, when and why the girl married the Sun</i> )	x				
Theatre play					
Theatre play					
Theatre play					
Theatre play					
Theatre play					
Drama episode ...					

### Activities Code

The conducted activities are ticked with an “x” symbol, the ones to be done in the near future with an “\*” symbol and the ones planned to be conducted in the remaining time with an “!” symbol.