UNIT 9: Solar Energy

This unit is comprised of 2 activities which are outlined in table 9.1. These activities have been informed by the ENERGE Energy Literacy Framework. A guide to the ENERGE Energy Literacy Framework can be found in UNIT 0. **Unit 9: Solar Energy** investigates the power of the sun as a renewable source of energy and explores the practicality and cost-effectivity of solar as a renewable source of energy to generate power in any one region. Students engage in a number of hands-on activities that describe solar energy and how to calculate the amount of solar energy available at a given location and time of day on Earth using GIS tools. Students also have the opportunity to construct and test their own model solar water heater. In particular, the energy literacy outcomes, the associated skills & competencies addressed and how the activities link to the national curricula are outlined in tables 9.2-9.4.

OVERVIEW of UNIT 9 Solar Energy

Table 9.1 Activities and titles are given, the time required to complete the activity and the ISCED classification.

		Estimated	Le	vel
	Activity Title	time	ISCED	ISCED
		(min)	2	3
Activity 9.1	Harvesting Solar Energy	45-60	Х	Х
Activity 9.2	How Efficient is Solar Energy ?	45-60	Х	Х

Activities Mapped to Subjects in National Curricula

Table 9.2 Activities are mapped to subjects in National Curricula.

	Science	Technology & Informatics	Engineering	Mathematics	Home Economics	Geography	English	Design & architecture	Civics & politics	Society & Health	Business & Economics
Activity 9.1	Х	Х	Х			Х		Х			
Activity 9.2	Х	Х	Х	Х				Х			Х

Activities Mapped to Energy Literacy Characteristics

Table 9.3 Activities are mapped to Energy literacy Characteristics.

	C1	C2	С3	C4	C5
Activity 9.1	Х		Х		
Activity 9.2	Х		Х	Х	

Skill & Competencies Addressed

Table 9.4 Activities are mapped according to Skills & Competencies addressed

	Decision Making	Problem Solving	Design/innovating	Data Analysing	Collaborating	Communicating	Research	Critical Thinking	Numeracy
Activity 9.1		Х	Х	Х					Х
Activity 9.2		Х		Х				Х	Х

In this activity, students design and construct solar energy collectors that mimic those used by residences which capture solar energy and convert it to thermal energy to heat water. Students demonstrate the radiative and adsorbtion properties of different surfaces and explore their role in solar water heater designs. Students can appreciate how solar energy is a useful alternative to fossil fuel combustion.

This activity has been developed by the Sustinable Energy Authority in Ireland (SEAI) in collaboration with CASTeL at Dublin City University as part of the The SEAI Energy in Action programme. This Energy in Action programme provides a range of inquiry based activities that support the teaching and learning of energy at post-primary level in Ireland. Permission to promote this activity as part of ENERGE project has been granted.

Dura	ation							
45-60 minutes								
Energy Literacy Characteristics addressed:								
C1	Grounded understanding of science and how energy is harnessed and used to power human activity							
C3	Sensitive to the need for energy conservation and the need to develop alternatives to fossil fuel-based energy resources							
Skill	Skills & Competencies addressed:							
• F	Creating/DesignCollaboratingProblem SolvingCommunicatingData AnalysisCommunicating							
Subj	Subject links in National Curricula:							
• 1 • [engineering • Science echnology • Geography Design & Architecture							
Leve	l							
	SCED 2 SCED 3							

Suggestions for use:

The Energy in Action programme provides a set of instructions for carrying out this activity which are made available to download in the materials section.

2	SOLAR ENERGY
Overv	
It is a go	tivity; the students leam the essentials about solar energy by making their own solar powered heate of follow up to activities students may have previously carried out in BS ACTIVITY 1 (I): WHAT t SURFACES ABSORB HEAT?
Sugge	sted approaches:
	on earlier activities from B5: HEAT ENERGY BY RADIATION.
	e students to outline the function of each of the items listed for making a solar heater before constructing i
	the students draw up a flow chart indicating the role of each of the items to be used in constructing the hear rill make the construction more interesting and easier to 'fault-find' if it malfunctions.
	atively, let students construct the heater and then assign a functional role to each item.
	the 'solar heater' is registering temperature, pose some questions:
	bes the temperature of the water in both bowls change?
	hy is this?
	hich bowl records the highest water temperature? w is the solar powered water heater helping to increase the temperature?
Resou	COS: EAI website has information on the use of Solar Energy for solar heat and solar electricity.
	an website has information on the use or solar thergy for solar heat and solar electricity, as information on other sources of renewable energy.
DEA	CTIVITY 1: SOLAR ENERGY
Backg	
	we design and make solar panels?
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Equipe • Two • Three • Wate • Cling • Tin fo • One • One • One • One • Ne • Unat 1. Paint 2. Line 1 3. When	nent required: and basins small white books thermometers fin. a mait in of black gloss paint mait in of black matt paint. to do: one book with black matt paint, the other one with black gloss paint. Leave the third unpainted. he india of each wash basin with tin full.
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Fig. 1 Activity 9.1 Energy in Action Activity Guide

Extensions to Activity:

Materials:

- A. <u>Activity 9.1 Student Handout 1</u>
- **B.** For the Solar Heater Model:
 - Two plastic wash basins
 - Three small white bowls
 - Water (1 litre)
 - 3 thermometers
- Cling film
- Aluminium foil
- One small tin of black gloss paint
- One small tin of black matt paint

In this activity, students identify and calculate how much solar energy is available for energy generation in their local region. Students then analyse the cost-effectiveness of installing solar panels on their school roof. This is important for determining the practicality of solar energy in that region as well as maximising the efficiency of solar energy technology. This activity has been developed by CASTEL as part of the ENERGE Project. The European Commission Solar Radiation GIS tool included in this activity is available under the Creative Commons license (CC BY 4.0).

Dui	Duration							
45-	45-60 minutes							
Ene	Energy Literacy Characteristics addressed:							
C1		-						
	how energy is harness	ed and used to						
	power human activity.							
C3		0,						
	conservation and the r	•						
	alternatives to fossil fu resources.	ei-based energy						
C4		act of personal						
	energy-related decision	s and actions on						
	the global community.							
Skil	IIs & Competencies addre	essed:						
•	Problem Solving •	Data Analysis						
•	Research •	Collaborating						
•	Critical Thinking							
Sub	Subject links in National Curricula:							
•	Science •	Geography						
•	Engineering •	Technology						
Lev	Level							
•	ISCED 2							
•	ISCED 3							

Suggestions for Use:

 Solar radiation data can be retrieved using the Solar Radiation GIS tool available by the European Commission at: <u>http://re.jrc.ec.europa.eu/pvg tools#MR</u>. A set of instructions on how to access and retrieve data from the Solar Radiation GIS tool is provided below in the materials section.

- 2. The teacher should then provide student groups with information from the utility bills for the school in particular, they should be given the monthly electricity costs in kWh.
 - Once the solar radiation and utility bill data has been obtained, students should organise this data into a table. A sample table has been provided. Students can then use their data table to answer the following questions:
 - Compare the number of kWh per month your school uses with the number of kWh/m²/day that can be generated by the sample solar panel in the previous question.
 - A commercial solar panel has dimensions of 1.686 x 1.016 x 0.4 m and a power output of 300-350 W per 1 panel. Calculate how many square meters (m²) of panels would be required to generate all the electricity needed to power your school for a month? Consideralso that commercial solar panels are generally accepted to be between 15 and 20% efficient.

Extensions to Activity:

Materials:

- Activity 9.2 Instructions for GIS tool
- Activity 9.2 Sample table

