



Title: Solar energy potential and insolation

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Subject title: Renewable Energy Sources

Grade: 3rd or 4th grade

Level of performance complexity: medium

Research method: WebQuest

Stages of the research method: determining the initial and known state, asking problem questions, choosing the way to solve the problem, finding the necessary data, presentation of research results

Key words:

renewable energy sources, solar energy, insolation or irradiation

Correlations, interdisciplinarity and cross-curricular topics (CCT):

Power Electronics, Power Engineering, CCT: Learning to Learn, Personal and Social Development, Use of ICT and Sustainable Development

Learning outcomes:

- recognize the potential of the Sun as a source of energy (A, B, C)
- determine the benefits of solar energy as a renewable source (A)
- define the basic concepts, quantities and parameters around solar radiation and irradiation in own country and Europe (B, C)
- process the data obtained by the research (B)
- interpret issues and research results (B, C)

Cross-Curricular topics expectations:

Learn how to learn:

- Information management; The student independently seeks new information from various sources, transforms it into new knowledge and successfully applies it in solving problems.

- Precisely defines the problem and all its elements, 2. Applies and tests different strategies and selects those that will effectively lead to a quality solution, 3. Critically analyses the problem-solving process and identifies opportunities to use newly acquired knowledge and skills in other situations.
- Planning; The student independently determines the learning goals, chooses the approach to learning and plans the learning.
- Self-evaluation / self-assessment; The student self-evaluates the learning process and its results, assesses the progress made and plans future learning based on that.

Personal and social development:

- He manages his educational and professional path.
- Collaborative learns and works in a team.
- Collaborates, organizes, performs its task, sets hypotheses, develops its role in the team, makes decisions.

Use of ICT:

- The student analytically decides on the selection of the appropriate digital technology.
- The student takes responsibility for their own security in the digital environment and the construction of a digital identity.
- The student independently conducts complex research with the help of ICT.
- The student independently and responsibly manages the collected information.
- The student independently or in collaboration with colleagues presents, creates and shares new ones.
- The student independently or in collaboration with others creates new content and ideas or reshapes existing digital solutions by applying different ways to encourage creativity.
- The student presents, creates and shares ideas and works on a complex topic with the help of ICT.

Sustainable development:

- It critically reflects on the impact of our actions on Earth and humanity

Evaluations:

For learning:

- questions to check and define the benefits of using solar energy as a renewable source (A)
- supervision of students by professors during work (A, B, C)
- presentation of research by students (C)

As learning:

- comparing other people's research methods with one's own (B, C)
- assessment of one's own and others' work and team work (peer evaluation and self-evaluation) (B, C)
- discussion of students with other students and the teacher (A, B, C)

Learned:

- analysis of students' research work (B, C)
- presentation skills of students (C)

Activity description:

A Solar energy

After a lesson on solar energy in which students learned about the potential of the Sun as an energy source and solar radiation, the teacher begins a discussion with students about the benefits of solar energy.

Students are divided into a number of groups and through the LINO tool (<http://en.linoit.com/>) and agree to write a minimum of three (3) benefits. After each group presents their answers, the teacher discusses with the students the benefits of using solar energy.

The teacher in collaboration with the students corrects the wrong answers (evaluation for learning).

If it is not possible to use LINO digital tools, sticky papers and boards can be used.

B Exploring the potential of solar energy and insolation

At the beginning of the activity, the teacher explains the importance of the amount and duration of daily irradiation, ie insolation. It shows them the average annual irradiation of their own country, and thus its potential for using solar energy.

Asks the following questions:

- **Which part of your country has the highest radiation, and which part has the lowest?**
- **How much solar energy does the surface of your country receive in one hour?**
- **What are the potentials of using solar energy in your own country?**
- **What is the annual exposure in other European countries?**
- **To what extent do some European countries use the potential of solar energy in relation to your own?**
- **How do different substrates affect the different distribution of solar radiation?**
- **How does insolation depend on the angle of incidence of the sun's rays?**

Research method steps:

1. Creating a problem situation (CA)

Students are divided into teams of three to four students and are given one research question to explore.

2. Source research (CA)

The teacher provides students with the following websites and materials to help with the research:

- https://re.jrc.ec.europa.eu/pvg_tools/en/#MR
- <https://susdesign.com/sunposition/>

- https://en.wikipedia.org/wiki/Solar_energy_in_the_European_Union
- <https://www.solarpowereurope.org/solar-map-of-eu-countries/>

Students can use other sources in the process of research work, while the teacher guides them to the correct solutions and answers.

3. Research planning (CA)

Determining the purpose, goals of the research or research question, planning steps 4 and 5.

Students receive a WORK PLAN from the teacher as an aid in the realization of research work. Students will fulfil their work plan in different stages and agree on the course of work.

WORK PLAN		
Research problem:		
Group members:		
1.	What do we intend to achieve?	
2.	What is our goal?	
3.	How will we organize the work?	
4.	How long will it take?	
5.	What digital tools will we use?	
6.	Who will present the results?	

4. Data collection (HA)

Students study the literature on a given topic and collect all the necessary data. They can use the online tool like OFFICE 365 (<https://office365.com>), which allows them to cooperate with each other online.

5. Data processing (HA)

Using digital tools, they can process, classify, link the collected data and interpret it.

The teacher makes the following digital tools available to them:

- photo editing (<https://pixlr.com>)
- adding multimedia and interactive content to images or videos (<https://www.thinglink.com>)
- smart Map (<https://www.popplet.com>)
- development of infographics, reports, posters and presentations (<https://piktochart.com>)

Students can also use some other digital tools in the data processing process.

3. Presentation of results (CA)

The ultimate goal of the research work is to present the results of the work of each team in the next class.

Legend: CA – class activity, HA – home activity

C Presentation of research results and discussions

The representative of each group of students presents the results of the research of his group with the help of the prepared materials. The teacher monitors the course of the presentation and, based on the presented research results, evaluates the work in communication with the students (evaluation of what has been learned).

Students in a team during and after presenting the results of other teams perform evaluation as learning: self-evaluation, peer evaluation.

The teacher gives each team a slip with different criteria according to which students will evaluate the oral presentation and the quality of the research work.

Peer evaluation:

Group/Student:	Very successful	Successful	Unsuccessful
... explained the given topic in his own words.			
... addressed the class.			
... expressed himself correctly and professionally.			
... had the presence and attention of other students.			
... encouraged discussion among students on a given topic.			
... knew how to answer students' questions.			
... made the most of his given time.			

Self-evaluation:

After presenting their research, students receive a link to a short self-assessment form via Office 365 or in paper form.

Level of success:	1.	2.	3.	4.	5.
How successfully did the group complete the set task?					
To what level did each member of the group participate in the execution of the task?					

How satisfied are you with your contribution to the group?					
How much did the members of the group respect each other's opinions?					
How much do you like this way of learning and teaching?					
Write your suggestion for improvement.					

Additional literature, content and links:

Students can be introduced to links with which they can learn more about how to successfully present their presentation, which include the following links:

- <https://www.skillsyouneed.com/present/presentation-tips.html>
- <https://hbr.org/2013/06/how-to-give-a-killer-presentation>
- <https://thinkscience.co.jp/en/articles/effective-presentations>
- <https://www.skillsyouneed.com/present/presentation-tips.html>

Support procedures

Before performing the activity, teacher will check students with disabilities if they understand and explain it again if it's necessary. With the agreement, students are provided with enough time to complete the task and are not limited in time in the presentation. Each student with disabilities gets on the team a gifted student who will have the role of mentor.

Gifted students who need less time for a given topic can be given an additional question to research, mentor role, and are presenting their results among the first. Such students can receive an additional grade in the activity for their effort and engagement.