LIVING STEM

AGE : 10 - 14

Permaculture and Renewable Energy

Project number: KA201-050529

Activity n°4

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Educator's guide

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Duration

The total duration will depend on the tasks to be undertaken and the exact age of the students (a rough estimation is given down below)
Task 2: 30’
Task 3: 30’
Task 4: 30’
Task 5: 30’
Task 6: Suggested to be done as homework, 2-3h
Task 7 (optional): 1-2h

Gamification method(s)

A variety of tasks are given, starting as always with a task requiring research to acquire knowledge which will work as a stepping stone to more challenging tasks such as preparing a poster presentation or a PowerPoint presentation. The ultimate challenge which is optional is about organising an Engineering Fair. The Engineering fair may include both the presentation and the actual construction of the sustainable energy mechanism.

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Preparation

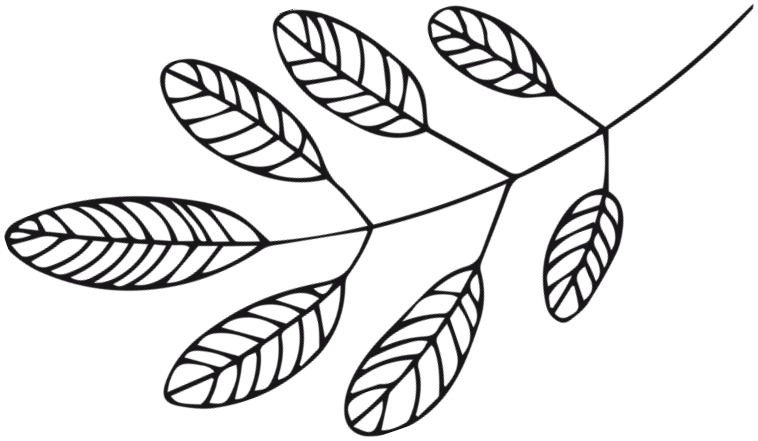
Because students are asked to undertake research to acquire knowledge, the educator should be prepared to answer students' questions, mainly evaluating if the definitions given by students on permaculture, energy and non-renewable and renewable sources of energy are correct.

Most importantly, you should guide the students on how to undertake effective research at first based on specific objectives and how to create a powerful poster or a PowerPoint presentation. Be prepared to assist students on how to build the windmill.

The idea of constructing a windmill was taken by www.tryengineering.org. Some additional useful links that will help you with most of the tasks are: National Renewable Energy Laboratory - Wind Research (www.nrel.gov/wind), Wind Europe (https://windeurope.org), Danish Wind Industry, Association (www.windpower.org), Global Wind Energy Council (www.gwec.net), Global Wind Day www.globalwindday.org).

A video which can be shown to students as an aspiration: https://www.youtube.com/watch?v=-v22HugjcJc

Based on the material given, you can try to produce the windmill yourselves before doing this with students and estimate the time needed and the additional instructions/steps your students might need to develop a more thorough lesson plan than the one given here.



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Tips for successful facilitation, supervision and organizing:

Task 7 might be best to be applied in the course of Engineering/ Technology for students age 12-14, though they can be applicable in all sectors of STEAM and from ages 8 onwards with minor modifications.

In most of the EU countries students around the age of 12-14 learn more complex engineering and technological concepts, such as properties of materials and applications, dimensioning in scale drawings, climate changes, energy saving and material viability, assembly and simulation of simple electrical circuits, design and work construction with movement, natural and artificial constructions, agricultural technology. All the aforementioned are related to a larger or smaller extent to this Living STEM Activity.

TASK 7 (optional/ challenging/ based on tasks 1-6): **Science Fair**

1. Encourage students to act as engineers and do some benchmarking via Internet how other students have made their presentation of their engineering creations.

2. Divide students into groups of 2-3 students, providing a set of materials per group (Hairdryer or Fan; small object for each team to lift (e.g: cloth pin, small toy, tea bag, pen). One set of materials for each group of students: wooden stick, wooden spoons, small wooden (balsa) pieces, bendable wire, string, paperclips, rubber bands, toothpicks, aluminium foil, tape, dowels, glue, paper, cardboard, plastic wrap, or other materials you have available)

3. Explain that students must develop their own working windmill from everyday items and that the windmill must be able to withstand a medium speed fan for one minute while winding a string to lift a small object such as a tea bag.

4. Students develop a plan for their windmill. Write or draw their plan and then present their plan to the class.

5. Student groups then execute their plans.

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Tips for successful facilitation, supervision and organizing:

6. Teams will test their windmills with the fan or hairdryer set up. (Note: you may wish to make the fan available during the building phase so they can test their windmill during the building phase.)

7. Teams then present their findings to the class.

Procedures taken with some alterations from :

https://tryengineering.org/wp-content/uploads/workingwithwind_0.pdf)

Along with the above procedures, the students can include the presentation developed as part of task 6.

In the webpage https://www.ieee.org/ you can find a list of lesson plans and worksheets. and also here: https://tryengineering.org/wp-content/uploads/TryEngineeringLessonPlanListingNov2018.pdf
relevant with Renewable resources and Permaculture such as:

1) Water Tower Challenge
2) Water fountain
3) Working with watermills
4) Design Dome
5) Here comes the Sun
6) Pipeline challenge
7) Solar structures

Thus, you can construct with your students the windmill as a sample and then give them the chance to follow similar steps in order to build other constructions (e.g 1-7 above) so as to be used in a science fair.

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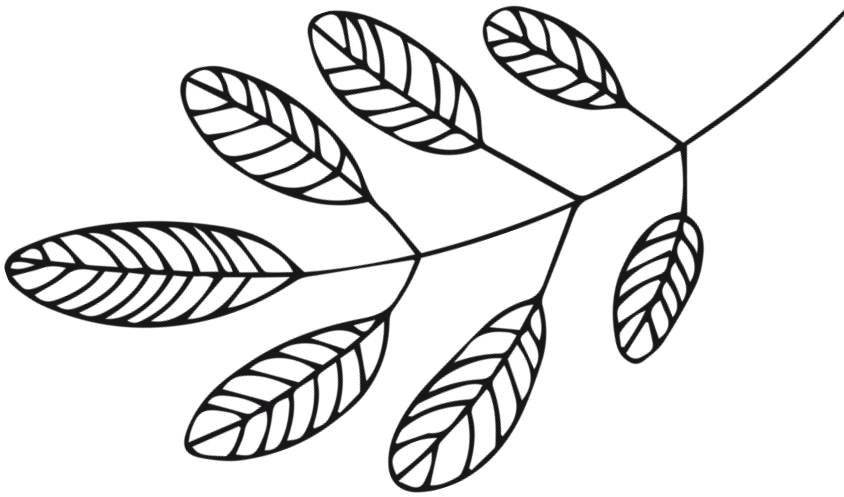
Debriefing outcomes & obtained competences:

Task 6 encourages poster presentation or Power Point presentation intending to develop their presentational skills. Tasks 2-5 is intending to develop their research skills. Ultimately, through task 7 (beyond learning the theory on energy), students can be asked to make a simple engineering design to understand through a hands on activity how engineering and sustainable energy can solve society's and agriculture's/ permaculture's challenges via teamwork and problem solving. Needless to say, that through this process they are expected to develop their critical thinking and engineering skills.



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Students' worksheet

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Related STE(A)M theory:

Permaculture is in the essence of renewable and sustainable energy as it is its mere and ultimate purpose to capture energy to increase the growth of living organisms, and develop cycles which will disseminate life.
"For example, when leaves fall from deciduous trees in autumn, they decompose, providing a nutrient and an energy source to microbes, insects and other plants. As a result, life in this system grows and multiplies. The new plants and insects will eventually reach the end of their lives, and the nutrients will go back into the soil, starting he next cycle of new life."

(Resource: https://deepgreenpermaculture.com/permaculture/permaculture-design-principles/6-energy-cycling/, Last accessed 22/04/2020)

"Permaculture design aims to make best use of renewable resources to create, manage and maintain high yielding systems, even if some non-renewable resources are needed to establish the system in the first place" (Mollison, 1988, p.14 cited in Pittaway, 2017).

These systems, fuelled by the sun, can be used not only to meet their own needs, but also the needs of the people generating them. In this way they are considered as sustainable, as they sustain both themselves and those who found them (Pittaway, 2017)

This activity is in the essence of STEAM theory combining all Sciences (but more importantly physics), Technology Engineering and of course Math should be combined in accomplishing the ultimate effort of renewable energy systems to be built as the fourth revolution of human development. "First there was the agricultural revolution, second the industrial revolution, third the information revolution ... and now the energy revolution is underway" Howard Johns, 2016, emphasis added (Resource: https://www.permaculture.co.uk/the-renewable-energy-revolution, Last accessed 21/04/2020).

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Key words

Permaculture, Sustainability, Energy, Windmill, Non-renewable resources

General aim

Learn about Permaculture, renewable and non-renewable resources. Learn about main forms of Energy and Power. Learn how to construct their own construction for producing power through sustainable energy.

Educational Objective(s)

More specifically, students age 10-14 should be able, through the activities suggested, to:

- State the general philosophy of what 'Permaculture' is, in front of an audience within 2-3 minutes.
- Name within two minutes 4 renewable and 4 non-renewable resources with no mistake.
- Name 5 main forms of energy with no mistake in 1 minute.
- State in front of the class what is a windmill, what source it uses, how it usually
- works and how it can be useful for society in general and permaculture in particular in 3-4 minutes.
- Know the precise material needed to build a self-made, home windmill making no mistake writing them down in 6 minutes.
- Construct a self-made, home windmill in 45 minutes, that can lift a light object (e.g a peg)

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Suggested Environmental Context

In normal classroom or lab class.

Necessary Equipment and Materials:

1) Material to construct a poster presentation (A3 hard paper, scissors, glue)
2) Material to produce a windmill: Hairdryer or fan; small objects for each team to lift (suggestions: cloth pin, small toy, tea bag, pen). One set of materials for each group of students: wooden stick, wooden spoons, small wooden (balsa) pieces, bendable wire, string, paperclips, rubber bands, toothpicks, aluminium foil, tape, dowels, glue, paper, cardboard, plastic wrap or other materials you have available.

Media and Resources

1) Internet access
2) Speakers might be needed if the Youtube videos suggested are going to be shown in class

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Tasks

1) Divide in groups of two or three.

2) Find at least 3 resources stating what Permaculture is (definition, main aims, what it includes), write down some main points and share it with the classroom.

3) Ask from the students to find at least 4 renewable and 4 non-renewable resources, their benefits and drawbacks and share it with the classroom.

4) a. Research and state what are forms of energy and 5 main sources.
   b. Complete the match making.

Forms of energy ...	
Wind power	1
Solar power	2
nuclear energy	3
Thermal energy	4
Geothermal energy	5
Biomass energy	6
Hydraulic energy	7
Wave energy	8

... and Resources
☐ Sun
☐ Water
☐ Wind
☐ Wave
☐ Uranium
☐ Hot water (steam)
☐ Animal waste
☐ Mazut
☐ Coal
☐ Natural Gas
☐ Vegetable Waste

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Tasks

5) What is a windmill? What source of energy does it use? How does it work? Where can we find it usually? How is it useful for society and permaculture in particular?
(make your own research with at least 4 resources which may include videos, articles, other assignments and write a paragraph of no more than 500 words)

6) Make a poster presentation or Power Point presentation with all the information taken from tasks 1-5

7) THE ULTIMATE CHALLENGE: **Science Fair**
You are working as engineers constructing a vertical or horizontal windmill. Your windmill should be able to withstand wind from a hairdryer with average strength for at least one minute. Whereas winding a string or wire to lift a light object such as a cloth pin. Your teacher is going to give you the necessary material to create your design.

- Discuss with your pair the problem you need to solve. Then develop a design for your windmill.
- Keep in mind that your design must be strong enough to withstand wind from a fan or hairdryer and the base cannot move, so it will have to be secured to a table or shelf.
- Draw your design in a box, and be sure to indicate the description and number of parts you plan to use.
- Present your design to the class. You may choose to revise your teams' plan after you receive feedback from class.
- Then build your windmill. You have 45 minutes! Each windmill will be tested using the same wind speed at a distance of three feet/1 meter. If you haven't succeeded state which were the drawbacks and how you can overcome them.
- Try as many times as possible until you succeed.

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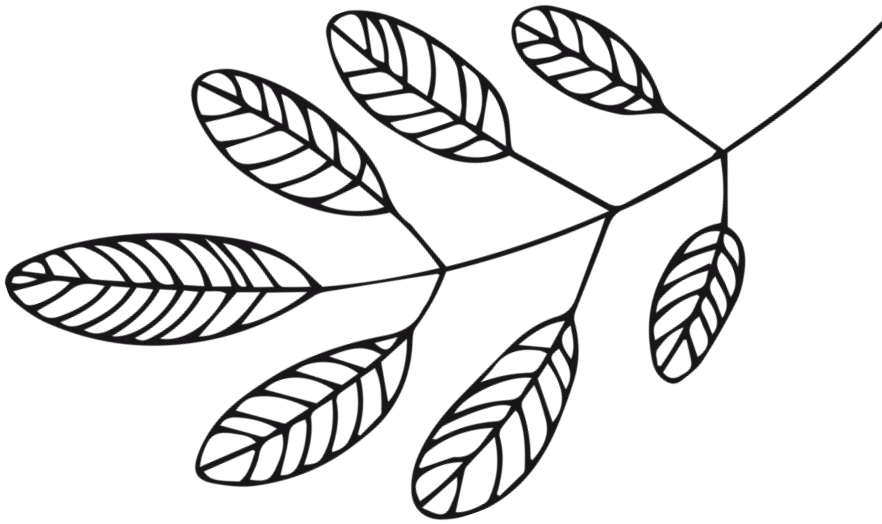
Safe and security checklist

The teacher must conduct the lesson in accordance with applicable health and safety rules, check the attendance list and assess whether some of the children need special care and / or assistance from the assistant - if any - in the classroom.

In particular, the teacher must:

- check the Legal Framework of the country
- check for people suffering from allergies in the group (for example glue allergies)
- check for people who need special help
- check the availability of an emergency box in case of injury



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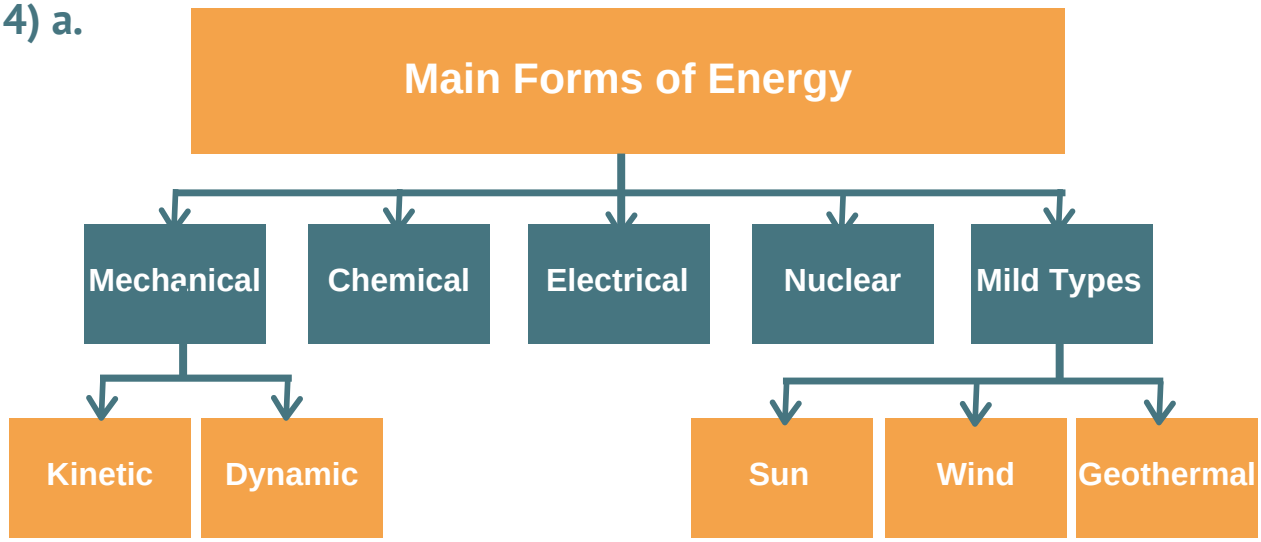
Answers to tasks

4) a.



4) b.

Forms of energy ...	
Wind power	1
Solar power	2
nuclear energy	3
Thermal energy	4
Geothermal energy	5
Biomass energy	6
Hydraulic energy	7
Wave energy	8

	... and Resources
2	Sun
7	Water
1	Wind
8	Wave
3	Uranium
5	Hot water (steam)
6	Animal waste
4	Mazut
4	Coal
4	Natural Gas
6	Vegetable Waste

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