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STEM
E-CONTENT
3D VIRTUAL REALTY

The Key To Global Life,
Digital Change Of Nature

Total Duration: 4 + 2 = 6 hours
(2 hours for research)

Student's Age: 12-18 Years

Application Area:
- Electricity,
- Physics,
- Recycling of energy,
- Waste Management.

Keywords: **Wind, power, art, kinetic energy, renewable energy, energy source, transformation of energy.**

R3 - Wind Energy - Kinetic Art

Module
- Renewable Energy
- Environmental pollution
- Global Warming

R3 - English Version

Materials:
- **possible presentations to be used by the teacher :**
- **o** *presentation01_DesignFocus*
- **o** *presentation02_EnergyConversionFocus*
- **Scrap wood**
- **PVC tubes**
- **Plastic spoons**
- **Plastic cups**
- **Recycled Plastic bottles**
- **Table tennis balls**
- **Paper, cardboard, foam, pipes, duct tape, rope, straws, elastics**
- **Different devices: pliers, hammer, knives, screw driver**
- **For electronic materials (Joule Thief Circuit):**
- **DC motor (e.g. Start-up current only 12 mA, 0.45 - 5 V, Values (no load): 2 V - 2350 rpm - 0.022 ;**
- **Transistor (type: 2N2222 or 2N3904)**
- **Resistance 1KOhm**
- **Red LED**
- **Condensator 47µF 10V**
- **Terminal blog (Picture 1)**
- **2x1.5 m electric wires (2 different colors): flexible mounting thread, section 0.14mm2.**
- **Ferrite toroid core (Picture 2: minimum 16 mm outer diameter – eg. A=16 mm, B=9.6 mm, C=6.6 mm)**

Notes:
- Take precautions when using electronic devices
- Act in accordance with the learning approach DIY (Do It Yourself)
- Materials should be stored safely
- When assembling the electrical circuit, ensure that all elements are correctly connected (help students)

Introduction

The demand for more energy grows daily at a high rate. In our highly technological world, we consume electrical energy (electricity) much more than every day, we consume electricity every second through the technologies we all use (Picture 1).

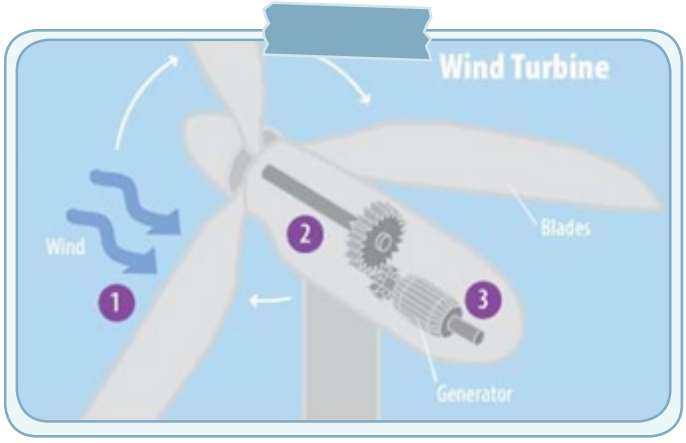
The limited availability of non-renewable energy sources (fossil fuels) and the damage to the environment are driving engineers, scientists and also policy makers to sustainable and renewable energy sources. It is mandatory that researchers and engineers research on renewable energy supplies and sustainable environments to address these major global challenges.

Picture 1. Green energy

Societal disturbance can trigger shortages in the production and distribution of non-renewable energies such as oil, coal and natural gas and these non-renewable sources are limited. They will be depleted in a finite time. Renewable energy is energy from sources that are naturally replenishing but flow-limited; renewable resources are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. They are clean, meaning that they do not release harmful emissions into our environment (Picture 2).

Picture 2. Wind Turbine

Students will build simple circuits based on the Joule thief and will integrate this device in their artistic work so that it can light a LED. The Joule Thief Circuit is a voltage booster circuit which converts a constant low voltage input into a periodic output of a higher voltage. The circuit is an arrangement of a power source, a resistor, a transistor and a ferrite toroid core wrapped with two wires coming from the positive terminal of the power source, one through a resistor (Picture 3)



Picture 3. Wind Turbine

A magnetic field is created around the ferrite toroid because of the current that passes through the wires. The extra current causes the transistor to switch off and power to the ferrite toroid is cut off. As a result, the magnetic field is converted into electrical energy which is given as output. Once the magnetic field no longer exists (the pulse ends), the transistor is switched on again and conducts electricity to create the magnetic field again. This repeated process occurs rapidly enough to provide a somewhat constant power output (Picture 4).

At the end of this activity students will be able to integrate the "Joule Thief Circuit" into their own wind trio propeller, created with different reused material.

Picture 4. Greek windmils

Picture 5. American windmils

Students are introduced to renewable energy, including its relevance and importance to our current and future world. They learn the mechanics of how wind turbines convert wind energy into electrical energy and the concepts of lift and drag (Picture 5).

Then, students create artwork to raise awareness about the power of wind and the importance of wind power as an energy source.

They have to think about art, how to integrate art in public spaces and how to make art partly functional.

They research the work of artists who create kinetic art and create their model of a kinetic artwork that generates enough energy to light up a LED by moving in the wind.

Considerations

- Take precautions when using electronic devices
- Act in accordance with the learning approach DIY (Do It Yourself)
- Materials should be stored safely
- When assembling the electrical circuit, ensure that all elements are correctly connected (help students)
- Choose the appropriate material for circuit elements used.
- Students must work with caution in the laboratory and follow all safety rules

Aim of the Activity

Students are introduced to renewable energy, including its relevance and importance to our current and future world. They will conduct research on the environmental impact of fossil fuels and on renewable energy sources, and learn the mechanics of how wind turbines convert wind energy into electrical energy and the concepts of lift and drag. At the same time, students create artwork to raise awareness about the power of wind and the importance of wind power as an energy source.

This project requires knowledge and application of technology and science to be realized, as well as an artistic mindset (Picture 6).

The students use their knowledge of basic physics and electricity to create an artistic work that uses wind power to light a LED. Materials are available for the installation of the Joule Thief circuit and students are asked to perform the wind trio propellers. This allows students to understand the working principle of the wind turbine and to study the effect of a magnetic field indirectly in the Joule Thief circuit.

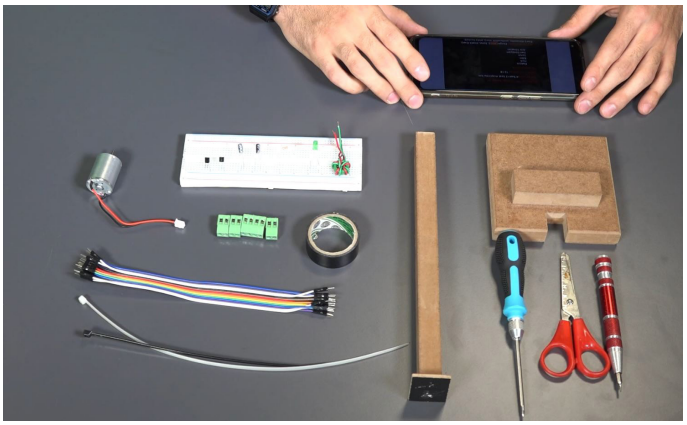
Picture 6. Working Wind Turbine

They also have to think about art, how to integrate art in public spaces, and how to make art partly functional. Students will share their research results with the peers in the classroom

- In the end of this activity, students will:
- Understand the importance of renewable resources to the environment.
- Design and build a working device, test and evaluate results, and implement an engineering design cycle to make improvements.
- Develop scientific process skills.
- Improve engagement skills

Activity Process

Before-Activity



Picture 7. Before Activity

Teachers should ask students and get answers to the following questions before the activity. Students are asked to present their research results within the classroom (Picture 7). At stage, the teacher asks the following research questions:

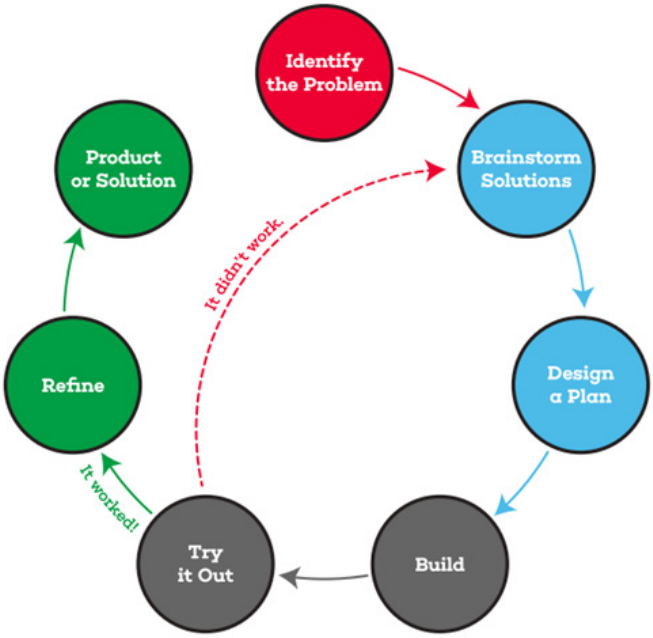
- What are the environmental dangers of fossil fuels?
- What are the types of renewable energy?
- What is the importance of renewable energy for the environment?
- How does an ancient windmill work?
- How does a wind turbine work?
- What different types of wind turbines are there to generate electricity?
- Which are the components that make up a wind turbine? What is the role of each component?
- In which household tools can similar components be found?
- How much electricity does a wind turbine generate?
- Where are wind turbines placed?
- Important Research subject: How does the Joule Thief Circuit work? How can the low voltage be converted to higher voltage in this circuit?

Let's Start

1 Design Steps:

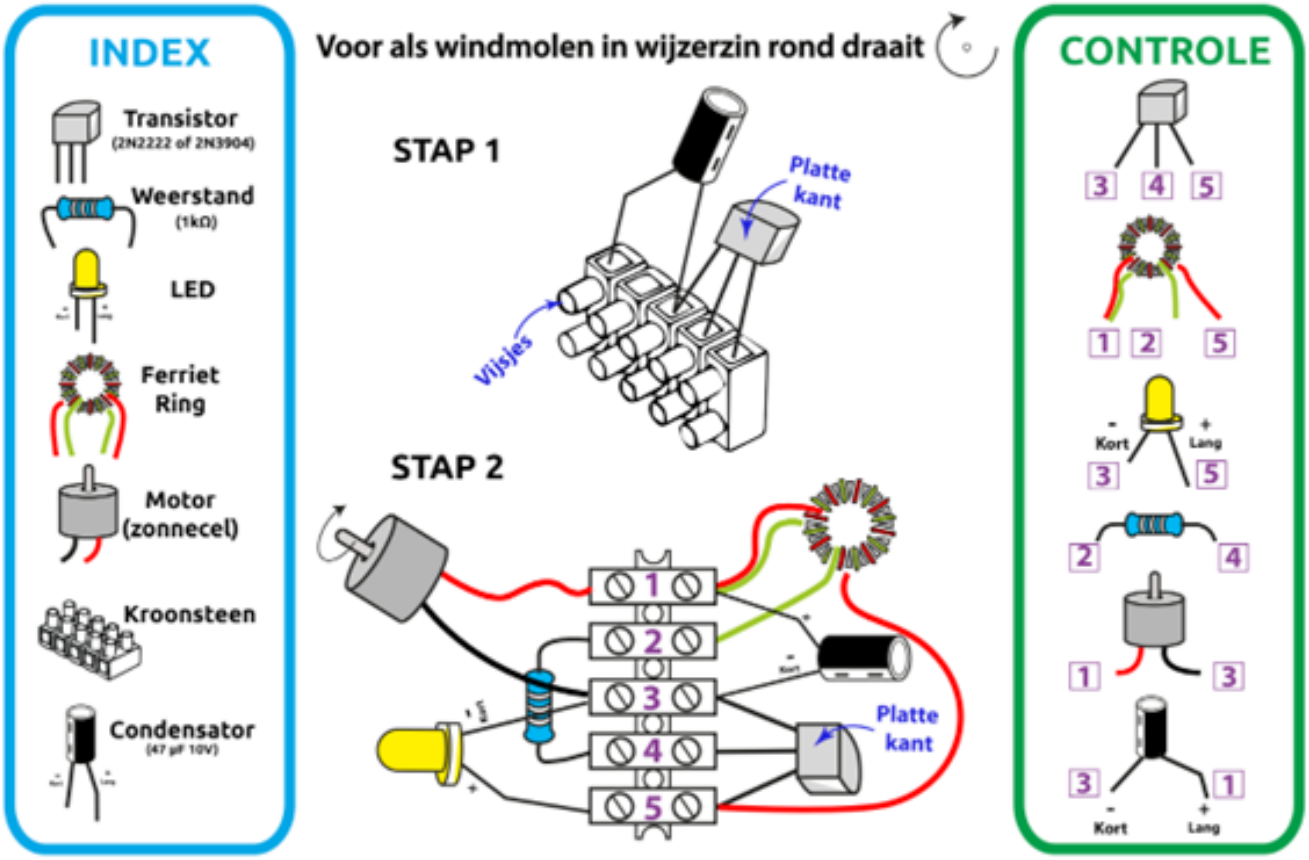
The students' task is to create artwork to raise awareness about the power of wind and the importance of wind power as an energy source.

1. Possible *presentation* to be used by the teacher
2. Think as an engineer! The teacher introduces the methodology (Picture 8).



Picture 8. Search diagram

3. Teacher introduces the Joule Thief Circuit to the students.
4. Students create their own circuit by following the steps as shown in the figure (Picture 9).



Picture 9. The Joule Thief Circuit

5. Examine the examples of the wind trio propeller. Teacher can discuss with students some examples on (Picture 10).

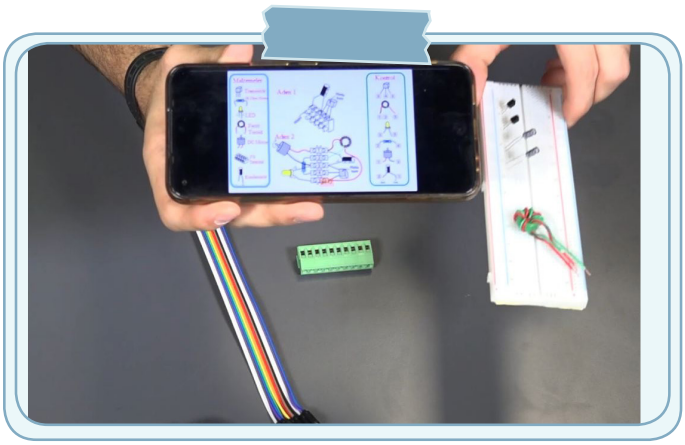
Picture 10. Examples

6. Students are asked to integrate the propellers they designed into the Joule Thief circuit previously assembled (Picture 11).

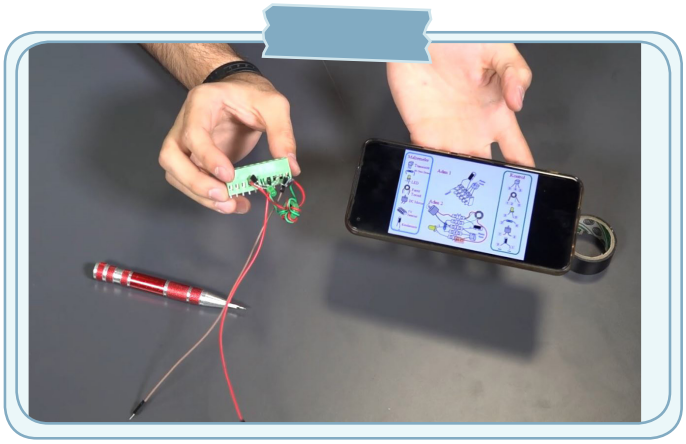
7. At the end, the teacher controls whether the LED lights up, by turning the propeller (Picture 12).

8. Have the students research what would be a good place to place their artistic model structures once they are built

9. Optional: Student teams build model anemometers to better understand and measure wind speed.



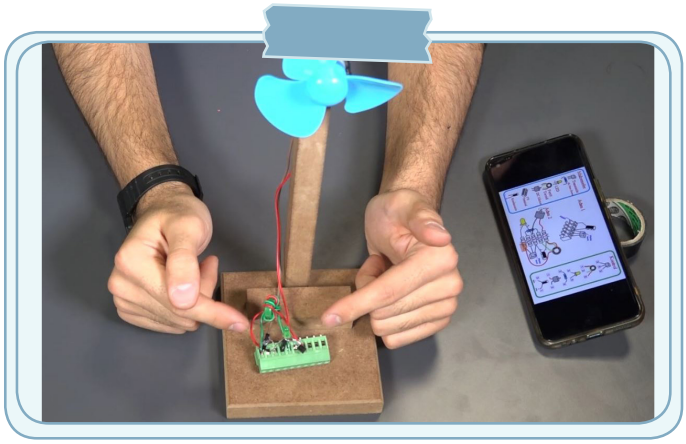
Picture 11. The Joule Thief circuit



Picture 12. The Joule Thief circuit

Closure

- At the end of the study, these outputs could be obtained. Here is example for you (Picture 13).



Picture 13. Example

Assesment

Evaluation

- The design of students can be displayed within the school. Different products can be created by diversifying waste materials used.

Goals	Must be Improved (1)	Medium (2)	Good (3)	Very Good (4)
Understanding the effect of fossil fuels on environment	(.....)	(.....)	(.....)	(.....)
Understanding renewable energy effect on environment	(.....)	(.....)	(.....)	(.....)
Self expression	(.....)	(.....)	(.....)	(.....)
Join discussion	(.....)	(.....)	(.....)	(.....)
Appropriate circuit installation	(.....)	(.....)	(.....)	(.....)
Development of the design project	(.....)	(.....)	(.....)	(.....)
Appropriate design to the function	(.....)	(.....)	(.....)	(.....)
Effectiveness of the presentation	(.....)	(.....)	(.....)	(.....)
Total				

Links

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- Design for motion lesson: https://www.youtube.com/watch?v=qs88aC0k0yI
- Activity building a mini wind turbine where a Joule Thief Circuit is used: https://www.instructables.com/Junior-Wind-Turbine/