TEXAS 4-H
4-H District-Wide STEM Research Project

Title: Wind Turbines
Grade Level: 5th and 6th Grade
TEKS:
Science
5.1(A), 5.2 (A)(B)(C)(D)(F)(G), (5.3 A), (5.4 A), (5.7 C) (6.7 A)
Math
(5.1 A, D), (5.3 A, G, K), (5.9 A, C).

Title of Lesson: Wind Turbines

Objectives (2 to 4):
Learn the Scientific Method Steps
Learn about renewable energy
Practice the 15 SET Abilities (build, categorize, collaborate, demonstrate, describe, contrast, solve, design, evaluate, hypothesize, invent, infer, interpret, measure and learn basics of graphical representation)

Supplies:
One Pico turbine,
fan,
yardstick or measuring tape
One voltmeter,
Time Allotment: 60 minutes (A minimum of 5 trials for 10 minutes each is recommended)

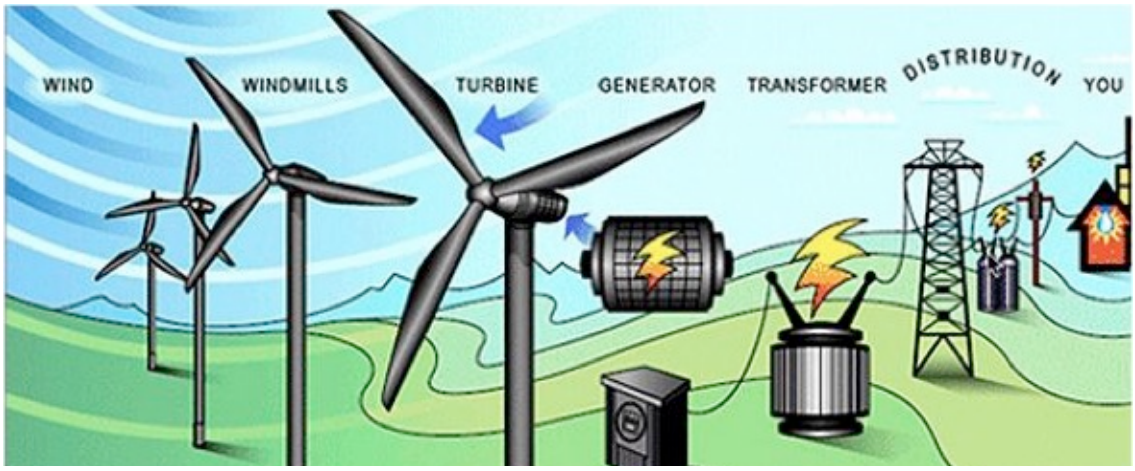
Explore the Content:
The turbine is exposed to the wind generated by the fan at different distances and with changes to the blade angles.

Vocabulary:
Renewable energy: **energy** that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.
Wind turbine: Works by generating lift due to the shape.
Blade: Shaped to generate the maximum power from the wind at the minimum cost.
Angle: Power generated by the wind turbine will vary depending on the angle at which the blades are positioned and the angle that produces the maximum power output, is 45 degrees.
Volts: electrical unit of voltage or potential difference (symbol: V). One **Volt** is defined as energy consumption of one joule per electric charge of one coulomb.

Transformer: boosts the generating output of the turbine generator.
Voltmeter: Instrument used for measuring electrical potential difference between two points in an electrical circuit.
Main Question: Is the energy produced by a wind turbine different when the blade angles and the wind power are changed?
Independent Variable**:** Fan distance (30 cm or 50 cm), blade angles (35^{o} angle or 20^{o} angle)
Dependent Variable: Volts produced by the wind turbine
Possible Hypothesis:
Wind turbine blades at 30-degree angle will produce more volts than wind turbines with blades at 20-degree angles.

Do (Activity/Experience):

Activity 1
Learn how Wind Turbines generate electricity
Wind turbines use the wind to produce energy. First the wind turns the wind turbine blades, witch spin a shaft, wich connects to a generator and makes electricity.



Activity 2
Conduct your own research project

1- Place two marks on the floor identifying the specific distance you would like to test it. (20cm, 40cm or 60cm is recommended).
2- Place your wind turbine on one of the marks and the fan on the other mark making sure you know the distance between the two objects.
3- Arrange the wind turbine's blade angle to the angle you would like to test.
4- Make sure that the voltmeter is properly connected and set to measure the volts generated.
5- After the fan and the wind turbine are separated by a specific distance (20cm, 40cm or 60cm) turn on the fan (always using the same speed) and collect the data (volts generated)

6- Change the distance (20cm, 40cm or 60cm) between the wind turbine and the fan, knowing specifically the distance between the two, collect your data (volts generated).
7- After collecting the data using the different distances between the wind turbine and the fan, change the angle of the blades and repeat the experiment

Recommendations: On each trial change only one setting at a time (distance or angle), keep the external environment controlled as much as possible by always using the same speed on the fan, keep the same doors and windows closed or open, etc.

Day	Trial Number	Distance Between Wind Turbine and Fan	Angle	Volts

Reflect:

Apply:
Report your results in a scientific manner – see handout at end for a graphic representation
Scientific Posters are commonly used to share your scientific project including the results. Typically, a Scientific Posters will have the following parts:
Abstract: The summary of the experiment which includes s the purpose of the experiment, and no more than three sentences explaining the procedure, results, and conclusion.
Introduction: Describes the problem or goal of the experiment, it offers background information about; the entity, independent variable, dependent variable and the hypothesis.
Materials and Methods: It describes the experiment's design; what materials were used, how the data was collected, how often date was collected, and how the data was analyzed. Pictures and tables can be used for this section.
Results: Describes and displays data using; tables, photographs. Remember - the figures must always have a descriptive text (figures and tables must have a title number and units of measurement).
Conclusions: The first sentence states the hypothesis or research question and the second should answer the research question with additional sentences explaining the results and procedures that influenced the results.
References: If images from the web were used, it is important to refer the website used. The common method to cite the sources is APA style (you find instructions for APA style on the internet)
Acknowledgments: A formal printed statement that recognizes individuals and institutions that contributed to the work being reported.

Example

Wind Power

J.Alexander, D.Vela, H.Rotan, S.Templeton

Abstract

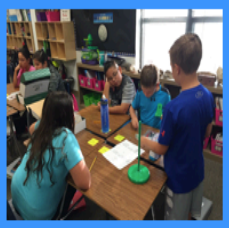
Wind energy is important because wind turbines can produce power for houses, restaurants, and businesses. The purpose of the experiment is to see how many volts the turbine produced at certain distances from a fan and at a certain angle of the blades of the turbine. The results showed that, if the fan is closer to the turbine, it will produce more volts. The results also showed that 30 cm produced more volts than 50 cm with a 35 degree angle. It was important to understand that different angles produce different results. The amount of wind speed is important; as well as, the landscape around the placement of the turbines.

Introduction

Wind turbines are important machines that produce electricity to power our houses, businesses, and schools. Wind energy is necessary to study about because it can give us electrical energy. Wind blows on the blades of a wind turbine that turns a rotor. The rotor turns the shaft that causes the generator to run and produce electricity that goes to houses. One wind turbine can power three hundred houses. Wind turbines are eco-friendly, and they also are powered by a renewable resource. Renewable resources are things that can be used again and again. Wind turbines are also loud, destroy animals' habitats, and are very expensive. However, they do produce clean electrical energy for all of us. Wind turbines can be on land or on water. Windmills used to be used to grind corn, wheat, and other plants.The purpose of the experiment is to find out how many volts are produced by the wind turbine. The independent variable is the angle of the turbine. The dependent variable is the distance of the fan from the turbine. This group hypothesized that the wind turbine, with a 35 degree angle, 30 centimeters away from the fan will produce more volts than 50 centimeters away from the fan at the same angle.

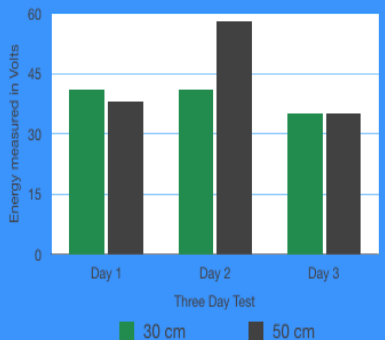
Materials and Methods

The materials used were: a pico turbine, one large fan, a yardstick, and a voltmeter. Over the three days, the angle of the blades of the turbine was tested at 35 degrees. The distances of the fan and the turbine were 30 cm and 50 cm; this was measured with a yardstick. The fan was placed at those distances. The fan was then turned on high, and the group recorded the data from the voltmeter into the data chart.



Results

Average Wind Energy Produced by Wind Turbines



Conclusion

This group hypothesized that the distance of 30 cm between the turbine and the fan would produce more volts than 50 cm when measuring the blades with a 35 degree angle. The hypothesis was correct because 30 cm away from the fan produced more volts than 50 cm away from the fan. The reason for these results is that, if the fan is closer to the turbine, the wind will blow straight onto the turbine.

References

DiSpezio, M., Frank, M., Heithaus, M., & Ogle, D. (2015). Natural Resources. In Texas Science Fusion: New Energy for Science! (pp. P. 355-361). Florida: Houghton Mifflin Harcourt.

Renewable Energy Sources. What is wind power? (2010). Retrieved August 15, 2015, from http://www.eschooltoday.com/energy/renewable-energy/wind-energy.html

Renewable Wind. (n.d.). Retrieved August 20, 2015, from http://www.eia.gov/kids/energy.cfm?page=wind_home-basics#wind_types_of_turbines-basics

Spilsbury, Richard A., & Louise (2014). Energy. Chicago, Illinois: Heinemann Library.

Wind Energy Basics. (n.d.). Retrieved August 20, 2015, from http://www.eia.gov/kids/energy.cfm?page=wind_home-basics#wind_types_of_turbines-basics

Acknowledgements

We would like to thank the following sponsors for helping us further our success with our science project sponsors were Roscoe Collegiate ISD Board of Trustees,Texas Agrilife Extension, and region 14 ESC. A special thank you to our teachers for supporting us in our project.

References:

DiSpezio, M., Frank, M., Heithaus, M., & Ogle, D. (2015). Natural Resources. In Texas Science Fusion: New Energy for Science! (pp. P. 355-361). Florida: Houghton Mifflin Harcourt.

Renewable Energy Sources. What is wind power? (2010). Retrieved August 15, 2015, from http://www.eschooltoday.com/energy/renewable-energy/wind-energy.html

Renewable Wind. (n.d.). Retrieved August 20, 2015, from http://www.eia.gov/kids/energy.cfm?page=wind_home-basics#wind_types_of_turbines-basics

Spilsbury, Richard A., & Louise (2014). Energy. Chicago, Illinois: Heinemann Library.

Wind Energy Basics. (n.d.). Retrieved August 20, 2015, from http://www.eia.gov/kids/energy.cfm?page=wind_home-basics#wind_types_of_turbines-basics

General Information:
www.gurit.com/files/documents/2aerodynamicspdf.pdf

Support Materials/Graphics (please attach all support materials, handouts, high resolution graphics that should be included or attached at the end of lesson)

Pico Turbine

http://www.picoturbine.com/

How Wind Turbines Works?

https://www.youtube.com/watch?v=qSWm_nprfqE

Renewable Energy Storage

https://www.youtube.com/watch?v=VKkWApjXCMc