

Real Cool Futures Science Lesson Plan

Subject Area: Science (Physics)

Age group: KS4

Lesson Title: Why do most wind turbines have 3 blades?

Timer: 50 mins

Aims: To understand how energy can be transformed using a renewable source.
To know how to test a hypothesis.
To be able to use real life examples to explain the design of wind turbines.

Why do this:

STEM subjects are absolutely central to tackling environmental challenges such as climate change. This lesson links an investigation based on a renewable technology (wind power) to the case study of someone working in the industry - demonstrating a real world application of science. The case study of Dan Hammond can be used as a starter, giving students an overview of what Dan's job entails and a general introduction to the website www.realcoolfutures.com.

Hypothesis to test:

The greater the number of blades, the greater the output of the wind turbine (i.e. the faster the mass will be raised).

Background information:

Wind turbines that have been developed over the last 50 years have used either 2 or 3 blades. It has been shown that efficiency increases with the number of blades, but with diminishing return. Increasing the number of blades from 1 to 2 yields a small increase in efficiency, whereas increasing the blade count from 2 to 3 yields an even smaller increase in efficiency. Further increases in the blade count yield minimal improvements in efficiency and too much is lost in terms of blade stiffness as the blades become thinner.

Resources:

Access to the website www.realcoolfutures.com, photocopies of Worksheets 1&2 and the Template Sheet (below) plus the following per group:

Compasses

Ruler

A4 card

Scissors

Plastic straw

Cotton thread, 1.5m

2 paper clips/5-10g masses

2 wooden cocktail sticks

2 wooden clothes pegs

Plasticine

Hairdryer

Stopwatch



Starter (10 minutes):

Log on to the Real Cool Futures website www.realcoolfutures.com and show on the whiteboard. Click on the Energy & Water category. Scroll down and find Dan Hammond [or click to follow link], a wind energy technical project manager.

URL: <http://www.realcoolfutures.com/case-study.php/dan-hammond-wind-energy-technical-project-manager>

Use Dan as an example for explaining to students that what they study is relevant to the world beyond the school gate, and that there are people who work in industries like this. Ask students what other jobs they can think of that are connected to renewable technologies.

Main section (30 minutes):**Overview:**

Working in pairs or small groups, students are tasked with making model wind turbines. They should follow the instructions given (Worksheet 1) to make 2 turbines per group. These can then be tested and a written Results Table can be completed (Worksheet 2).

Tell each group the number of the blades that they will be testing (ensure that all options from 2 to 6 blades are covered). The decision about which group has what number of blades could be based on ability - this will allow for some differentiation.

Before they start their experiments, ask each group to write a prediction (Worksheet 2) about what number of blades will raise the mass the fastest and why - e.g. "I predict that the 6-blade turbine will raise the mass the fastest because it has the most blades to catch the wind."

For the Method:

Provide each group with Worksheet 1 which contains the method and a picture guide. They will also need a Template Sheet.

For the Results:

Also provide each group with Worksheet 2. Ask them to write their prediction in the space before starting their experiments and filling in the Results Table. Each group will need to repeat each experiment 3 times before calculating a mean time. Groups should later share their results so that everyone has data for each number of blades.



Plenary (10 minutes):

A one sentence summary – in their groups students are asked to sum up and share with the class, in one sentence, the findings of their research.

Students are then asked to answer the question: “Why do most wind turbines have 3 blades?”

Do their results enable them to answer this question?

If not, what further investigation or research could be done to find out? This could be a home-work task or an extended piece of work.

