

“The effect the wind turbine’s blade size has on the amount of energy produced.”

This project was evaluated using the point scale of 0-1-2-3. The project was evaluated based on the visible information in the project photograph; some more information may have been on the additional sheets.

A. Title

Title: The effect the wind turbine’s blade size has on the amount of energy produced.

Score: 3 – *The title correctly states the independent variable and the dependent variable and is NOT worded as a QUESTION.*

Comments: The title states both the independent variable (turbine blade size) and the dependent variable (amount of energy produced).

B. Question

Question: How does the wind turbine’s blade size affect the amount of energy produced?

Score: 3 – *The question states the independent variable and the dependent variable, and is testable.*

Comments: The question correctly states the independent and dependent variable, and is measurable. However, adding units would have made the question stronger.

C. Hypothesis

Hypothesis: We believe that the larger the blade size, the more energy will be produced. The longer the turbine blades (and therefore the greater the diameter of the rotor), the more wind that can pass over the surface of the blade which can create lift. Therefore, more energy is produced. Generally speaking, doubling the rotor diameter will produce an increase in energy output. The blades of a wind turbine works similar to an airplane, it uses aerodynamic principles (lift and drag) to capture the wind most efficiently. We believe the largest blades will have the most lift. This is because the largest blades have a greater surface area for the wind to pass over it. As the lift increases, so does its opposite force: drag. Drag is like the friction of air. Newton’s third law of motion comes into play here; he said that, “For every action there is an equal and opposite reaction.” So with a greater lift comes a greater drag. The wind that passes over the top of the blade reaches the tip of the blade faster than the wind that passes through the bottom of the blade. The difference in the speed creates lift. The greater the difference, the greater the lift. Lift makes the blades spin faster and produce more energy while drag slows down the blades so that less energy is produced. The large blades have a greater lift which therefore allows them to produce a greater amount of energy. (kidwind.org).

Score: 3 – *The hypothesis (1) predicts the effect that changing the independent variable will have on the dependent variable, AND (2) explains the reason for the prediction using scientific concepts (“because...”)*

Comments: The hypothesis accurately predicts the effect that changing the independent variable (turbine blade size) will have on the dependent variable (amount of energy produced). The students also support the reasoning with scientific concepts.

D. Background Research (found throughout the project especially within the hypothesis and discussion/conclusion sections)

Score: 3 – *Background research is accurate, containing MANY relevant, well-chosen facts, definitions, concrete details, quotations, scientific concepts, or other information and examples that (1) provide information on the IV & DV AND (2) attempts to support the “because” portion of the hypothesis AND (3) attempts to support the “scientific reasoning” of the discussion/conclusion.*

Comments: The background information presented accurately supports the investigation.

E. Investigation Design (ID)

Score: 2 – Four of the 5 components of the ID are stated correctly, OR more than one IV is changing at a time or there are not multiple trials.

Comments: The dependent variable only states that the students will be measuring energy output, but does not include units. Additionally there seems to be some confusion with the levels of independent variable because the blade dimensions do not match with the descriptions of “small”, “medium”, and “large” (“small” are 31.68cm x 10cm, “medium” are 36cm x 8.8cm, and “large” are 31cm x 7.74cm).

F. Procedure

Score: 3 – The Procedure is a step-by-step description of how the investigation was done AND uses precise language and scientific vocabulary to describe both the sequence of actions taken and materials used AND is sufficiently detailed to enable the reader to replicate the investigation AND is consistent with the Investigation Design Diagram (IDD) and is an appropriate test of the hypothesis.

Comments: The procedure is very detailed and does allow for replication. However, pictures could help clarify the steps in their procedure.

G. Data/Results

Score: 3 – Data table(s) and graph(s) are accurate and include labels (titles, axes with units of measure) AND address the hypothesis and have been chose to clearly address the original question AND data analysis identifies and accurately summarizes trends or patterns in the data.

Comments: Graphs, tables and analysis are included, accurate, and clear. All components of the graphs are included.

Ha. Discussion/Conclusion: Scientific Explanation

Score: 3 – A scientific explanation consisting of a statement that makes an overall claim addressing the original investigation question AND supports the claim with evidence and relevant, accurate data from the investigation AND contains relevant scientific concepts AND uses words, phrases and clauses that clarify and connect the relationships between claim, evidence and science concepts AND demonstrates an understanding of the topic.

Comments: The scientific explanation contains all five parts and is well cited.

Hb. Discussion/Conclusion: Reflection

Score: 3 – Conclusion contains thoughtful, relevant, and reasonable reflections including states whether the hypothesis was or was not supported AND a description of possible sources of error AND suggested solutions to these sources of error AND “Next Steps” determined as a result of this investigation.

Comments: All four parts of the reflection are present and accurate.

I. Literature Cited

Score: 3 – A sufficient number of credible sources are listed in the bibliography in an appropriate format that allows the reader to locate the resource AND are cited in the text of the hypothesis, background research, conclusion, and other sections as appropriate AND include books, articles, scholarly websites, or personal communication with knowledgeable experts/scientists.

Comments: There are a good number of resources listed. This part would be even stronger if there was a mix of books, and articles in addition to websites.

Project Section	Score (0-3)	Weight	Weighted Score
A. Title	3	x 1	= 3
B. Question	3	x 1	= 3
C. Hypothesis	3	x 2	= 6
D. Background Research	3	x 2	= 6
E. Investigation Design (ID)	2	x 2	= 4
F. Procedure	3	x 2	= 6
G. Data/Results	3	x 3	= 9
Ha. Discussion/Conclusion: Scientific Explanation	3	x 2	= 6
Hb. Discussion/Conclusion: Reflections	3	x 1	= 3
I. Literature Cited	3	x 2	= 6
		Total weighted score	= 52 (54 max)
	Final Score (%) =	=Total weighted score/54 x 100	= 96%