

 **WIND POWER MODULE**

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***NOTE: Experiments 1 and 2 are able to be done separately or done together on the same day by separate groups. This is left to the Mentor to decide depending on class size and ability.***

**EXPERIMENT #2**

**Educational Goals**:

* Explore the Capability of Wind Power to do Actual Work
* Learn how a different number of blades can lift more weight
* See how blade count can change rotation speed at constant wind speed
* Discover the most efficient blade count for a given wind speed

**Description**: This is the Second of three experiments in the Wind Power Module. This experiment deals with the students testing the power of the wind to actually do work by lifting a bottle filled with different amounts of water with different blade counts to show how blade surface area (more blades = more surface area) is proportional to the amount of work which can be accomplished.

**Experiment #2 Content:** Students will build “machine house #2” which imitates the main section of a wind turbine where a hoist could be attached, and then do a two-part experiment to ascertain how much work can be developed from the wind, with “work” defined as a force which moves an object a distance. Thus, in the first part of the experiment, the students will attach a string to the center axle which is then tied to an empty plastic bottle with a cap (get one from the kids if you did not bring one—one liter max!) There is a matrix in the student manual to record how much weight can be lifted with 2 blades, 3 blades, and 6 blades. The bottle is filled with 2 ounces of water at a time until it can no longer be lifted by each blade configuration, with the results noted in the matrix.

In the second part of the experiment, the students will be testing the rotation velocity of the blades given a constant wind and a variable blade count. Then, a speed ratio is developed through a formula which is given in the student instructions to see which blade configuration is most efficient. You will be surprised! The three blade configuration works the best!

**Experiment #2 Time**: Approximately .5 hour for the power point if module is done simultaneously with Experiment #1. Approximately .50 hour to build the Machine House; Approximately 1 hour to do the two parts of the experiment with each of two groups doing one part of the experiment simultaneously and 1/2 hour to share results and observations. *Mentor is to work out how many sessions to allow depending on class size, ability, and willingness to work together.*

**Materials Needed**:

* Wind Power kit to assemble Motor House #2
* Box Fan for each group
* Plastic water or soda bottle
* Graduated measuring cup in ounces
* At least 20 ounces of water

**Directions**: Go through power point and have kids read most of the slides Discuss thoughts and questions about wind, wind power, the environmental and economic benefits of wind power, and the amount of electricity they use in their home (if not done simultaneously with Experiment #1). The Point of experiment #2, is to show them: 1) that the wind develops mechanical power able to produce work, and how work is increased with more blade surface area, and 2) that efficiency is as important as effectiveness.

**Topics to Discuss**:

* What is “work” and how does this equate to the Wind Turbines we see in real life? (The “work” can be understood in terms of ability to turn a shaft to run a generator—thus the more work that a turbine can develop means it can drive a larger generator. However:
* Just because 6 blades can develop more work, does not mean it is the most efficient use of cost and materials. 6 blades are a lot more expensive and heavier than 3 in real life which offsets the greater amount of work they can produce, so a balanced approach is needed to become truly efficient in the overall sense.

M**entor Notes**: Make sure that students are aware of the spinning blades. Make sure you have a fairly strong student holding the machine house as it gets heavy to hold when the bottle is full. Also, make sure they understand that they need to keep track of the parts and pieces and put them back in the appropriate bags. Assign one person in each group to be in charge of the construction and the accounting of the pieces.