

## PBL- Wind Turbine Project

Much of engineering and technology depends upon the basic laws of physics and their many applications. These laws include Newton's, Faraday's, Lenz's, Ohm's and Betz's. All of the lessons and labs in this program allow students to gain a practical understanding of these laws by employing with problem bases learning. The overarching problem is wind energy and its electrical generation application. Students will be challenged understand related technologies, and to build, measure, test, and improve miniature wind turbines.

Wind energy lessons and projects will produce the following student learning outcomes:

- Apply several laws of physics
- Perform lab measurements
- Use electrical and mechanical models
- Compare calculated and experimental results
- Employ the engineering design principle
- Work as team
- Project planning and management
- Perform engineering estimations
- Perform Excel calculations
- Produce a project report

Module	Objectives	Activates	Links
1	Introduce wind energy HAWT vs VAWT Introduce Faraday's Law for generation Team formations	Teams exchange contact information Measure magnet strength Average data using Excel Wind energy reading homework	
2	Engineering Design Principle Subsystem concepts Magnet subsystem Coils Subsystem Structure subsystem Wind capture subsystem Right-Hand Rule Generator parameters	Wind and tape coils Measure coils areas Measure number of turns of wire Average area with Excel Mount coils on base unit Test coils direction with battery and compass	
3	Turbine Frame subsystem Ohm's Law Power calculations Power losses Shaft friction Moment of inertia Power system analysis Frame construction issues Progress report-1	Build VAWT frame Position coils and magnets Test spin magnet shaft Average shaft spin data Team meeting Status report to instructor	
4	Compare calculated and test	Use drill press as turbine prime mover	

	data Wind power equation Betz's law Wind blade options	Record no-load and load voltage vs RPM Enter data in Excel spreadsheet Determine best fit area	
5	Wind blade performance Turbine performance Wind turbine loading effect	Add wind capture blades to turbine Calculate project wind energy	
6	Lentz's Law Wind turbine efficiency Progress report-2	Test turbine in wind tunnel Record No-load and Load voltage Use Excel to analyze data	
7	Final report preparation	Turbine improvements Test improvements	