# Lesson Plan for "Wind Turbines: Energy Conversion"

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**Introduction/Background Info**

America has a large wind resource, particularly in places like Texas, but only a fraction of it is being used to produce wind energy. Wind turbines can convert the kinetic energy from wind into electricity to power homes and businesses. Large commercial wind turbines can create electrical power between 500 kilowatts to over a megawatt (roughly 200,000 homes). Harvesting energy from the wind is also cleaner than traditional coal-fired power plants, because wind turbines don't emit greenhouse gases like carbon dioxide during their operation. This lesson plan explores how wind turbines convert kinetic energy into useful energy that can be used to power devices in our homes that do "work."

**Student Objectives**

Learn the concepts of energy, work, and power.

Understand the difference between different types of energy: potential, kinetic, electrical, chemical, etc.

Be able to describe how one type of energy can be converted into another type of energy.

**Topic(s)**

Energy, work, power, energy conversion, greenhouse gases, green technology/energy production

**Overview of Lesson Process**

1. Describe the concept of energy, and its different types.
2. Show how energy is equivalent to work = force x distance.
3. Describe the concept of power = work/time.
4. Rebuild wind turbine rotors, as described in the previous lesson on wind turbine blade designs.
5. Test the power output of each student's rotor by using different weights and measuring how long it takes for the rotor to raise the weights to a given height.

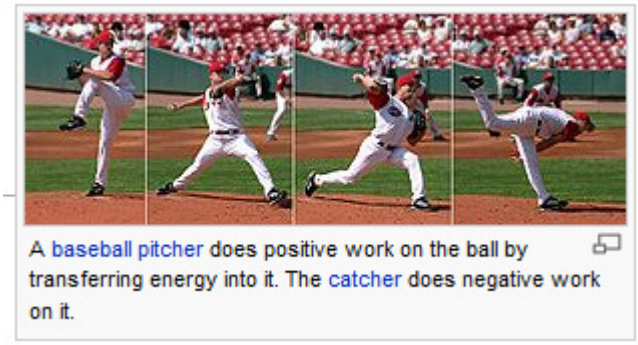
**Materials**

Cardboard, scissors, strong tape, fan, string, various coins, scale (optional), stopwatch, calculators

**Procedures**

1. Force: something that can cause an object to change its velocity (e.g., move)

2. Work: the amount of energy transferred by a force acting through a distance



A baseball pitcher does positive work on the ball by transferring energy into it. The catcher does negative work on it.

3. Energy: the amount of work that can be performed by a force
4. Potential energy (air pressure) → Kinetic energy (wind) → Electrical energy → Kinetic energy = useful work (e.g., washing machine)
5. Power: the amount of work that can be done over a certain time
6. [Re]build wind turbine rotors.
7. Test the power output by recording measurements in the sample table below:

| Test # | Weight | String Distance | Fan Speed (Low, Med, High) | Time to lift weight to rotor shaft | Work done = weight x string distance | Power output = work done / time to lift |
|---|---|---|---|---|---|---|
| 1 | Dime | | | | | |
| 2 | Penny | | | | | |
| 3 | Nickel | | | | | |
| 4 | Quarter | | | | | |
| 5 | | | | | | |

8. Discuss results: did power output change for different weights, different fan speeds? Why?

**Resources**


1. www.infinitepower.org/newfact/96-818-No8.pdf
2. http://re-energy.ca/pdf/wind-turbine.pdf
3. http://en.wikipedia.org/wiki/Energy
4. http://en.wikipedia.org/wiki/Force
5. http://en.wikipedia.org/wiki/Mechanical_work