117, Ebute Meta, Apapa,
off Costain, Lagos, Nigeria
www.waawfoundation.org
info@waawfoundation.org
Phone: (972)763 5924
Fax: (888) 519 4269

# WIND ENERGY: BUILD A WIND TURBINE

*Written by Lucy Ikpesu*

**Class Description**

In this class, students will explore how the sun generates wind energy, and how engineers have succeeded in transferring this energy into mechanical work. Students will participate in the design process and build their own wind turbines out of scrap materials that will power a LED bulb, Sound and light board.

**Total class time**: 120 minutes.

**Class Outcomes**

- ✓ Students will understand the basic components of a wind turbine and how it can be converted to other forms of energy (into usable mechanical energy).
- ✓ Students will learn about blade design.
- ✓ Students will construct a basic wind turbine of their own design out of basic craft/local materials.
- ✓ Students will learn about the various factors that can affect the efficiency of a wind turbine.

## INTRODUCTION

Wind power is one of the fastest- growing energy sources in the world. Renewable energy is the wind beneath the turbine blade. Wind is a form of **solar energy**. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when "harvested" by modern **wind turbines**, can be used to generate **electricity**.

**Wind energy** describes the process by which the wind is used to generate **mechanical power or electricity**. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as pumping water) or a generator can convert this mechanical power into electricity.

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Wind turbines turn in the moving air and power an **electric generator** that supplies an electric current. The wind turns the turbine blades, which spin a shaft, which connects to a generator and makes electricity.

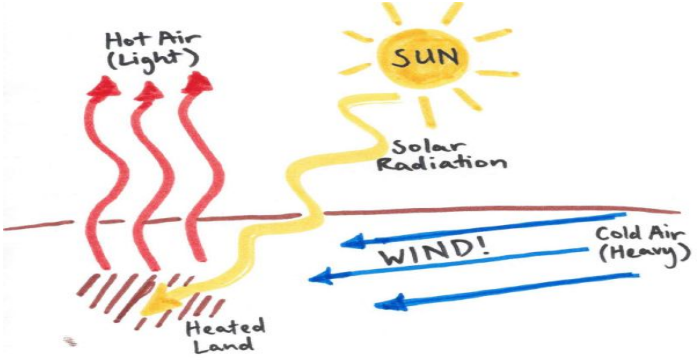
## MATERIALS NEEDED

The kit to teach this class will include:

- ✓ Large standing or box fans (1 per every 6-8 students)
- ✓ One 1-inch-diameter PVC 46M - long Pipes
- ✓ Five-seven 1-inch-diameter PVC 13M - short Pipe
- ✓ Three-four 1-inch-diameter PVC tee fitting (Tee joint)
- ✓ Four-five 1-inch-diameter PVC 90-degree fitting (Bend joint)
- ✓ DC rotor with wires
- ✓ LED bulb
- ✓ Two alligator clips
- ✓ Hub with sticks OR a Blade
- ✓ Multimeter
- ✓ Carton
- ✓ Masking tape or cellotape
- ✓ Alarm board (Optional)

## PRE-CLASS PREPARATION

Preparing to teach this class, Teacher should take time to go through the activities and build the wind turbine to get familiar with what the students will be doing. Amounts and types of materials to collect can be tricky! Allow plenty of time to gather what the students will need. Lay out turbine materials in a neutral place where all students will be able to access them. Pair the class in groups of 3s and 4s.




***How Wind Energy comes from the sun***

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First review with your students: Wind is **air in motion**. Wind forms when the sun heats one part of the atmosphere differently than another part. This causes expansion of warmer air, making less pressure where it is warm than where it is cooler. Air always moves from high pressure to lower pressure, and this movement of air is wind. During the day at a **coast**, the sun heats the air above the land more quickly than the air above water. The warm air over the land expands and rises. Cooler air from the ocean moves toward the land to take the place of the rising air, and makes a "sea breeze" that cools beachgoers in the summer.

NOTE: You could discuss the various forms of energy and how they could be converted from one form to another. Wind energy can be converted into electrical energy and mechanical energy.


**Blades** - When the wind hits the blades the force pushes on the blades, causing them to move. Blades can be made from many different materials and designed in many different ways to provide the best results.

**Crimping Hub**- The blades are all connected to the hub which holds them in place.

**Rotor** - The blades and the hub combine to create the rotor.

**Tower** - The tower holds all these elements up where the wind will reach them.

**Base -** The base consists of the legs/stands (can be 3 – 4 stands) on which the tower and other parts sit on.

**Tee and Bend Joints -** The joints holds all the parts of the pipe together

## PROCEDURES

Allow students to assemble the equipment without instructions. It is fun when they play with them, make mistakes and correct themselves. This is an experimental learning, students

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understand and learn more during this process. The final result should always be that the wind turbine worked.

Here are the steps to assembly the wind turbine:

1. Assemble the base of the turbine.
2. Attach the tower to the base
3. Attach the DC rotor
4. Attach the LED bulb
5. Fix the blade (Hub + Sticks and carton)
6. Extend the turbine to the wind or standing fan to rotate blade and LED bulb lights

Other steps

7. Use multimeter to measure the voltage produced
8. Experiment with alarm board

See pictures of steps below:

*Base of the turbine*

*Attach tower to the base*

*Attach the DC rotor*

*Attach the LED bulb*

*Fix the blade*

*Blade rotates, LED bulb lights*

**Note: That the base of the turbine can be of different design (e.g with 4 stands) and the blades can be designed using the hub, Sticks (skewers) and carton.**

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## DISCUSSION/OBSERVATION

After they are done building wind turbine and after checking blade designs, It is important to stop every once in a while to evaluate their work and see if they are headed in the right direction. Facilitate a discussion (about 10 minutes) to help the students evaluate and criticize their designs and the designs of other students. Some questions to ask:

- Was it tough to get started?
- What component did your group focus on at the beginning?
- What problems did you run into as you began to work? Did you and your teammates have different ideas about how to design things? If so, how did you decide between different options?
- Where could your design improve? There is no shame in using another's idea as a springboard for your own, as long as you ask and give credit where it is due. We're all learning together.
- As you make changes to your design, how are you judging if the changes were an improvement? Did anyone find themselves making too many changes at once? Usually, a design process of trial changes one variable, then conducts another test to see which trial works best.

## CONCLUSION

Wrap up should be a final discussion about the student's turbines and what they encountered while going through the design process. Some questions from the first discussion can be repeated; have some answers changed? Have students record the highlights of the conversation in their notebooks. Some additional questions:

- Which factor seemed to be the most important? (Blade pitch, length, driveshaft friction…)?
- How did you and your teammates work together?
- Were there ever any disputes about your design?
- What are some similarities between the process we used today and the process you would use for a large scale project?