Designing and Testing Turbines

Air Pressure, Current, Volts, Circuits, Material Properties, Friction

DISCOVERY PLACE
SCIENCE

Description

Creating turbines can be a fun way to explore the relationship of naturally occurring energy sources like wind. Using everyday materials students can create a variety of turbines that can be tested with LED's and voltmeters to determine their effectiveness and start meaningful conversations around design improvements, energy conservation and a sustainable energy plan for the United States.

In education, there are now a great number of schools that have 3D printers and are typically looking for ways to integrate this technology into their curriculum. So for his particular design I have incorporated 3D designed and printed parts using a resource like Tinkercad that is free and available online at www.tinkercad.com. These parts serve several functions; connecting and retaining the various parts of the turbine as well as a gear system designed to increase the output/current of the generator (motor). These design elements are very simple and easily created by students but you can also download the files that I generated for my prototypes from this shared folder http://bit.ly/Harbor3D.

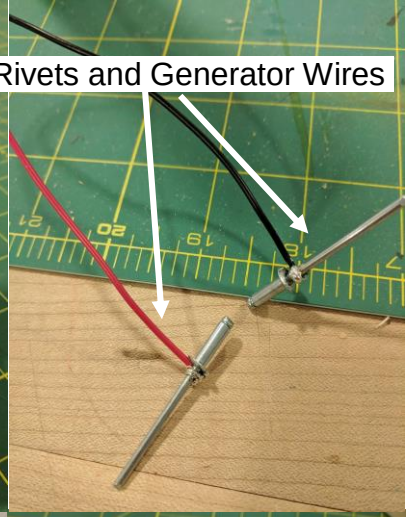
Aside from the 3D designed parts, students will also need to design and develop the blades of their turbine. This can be done using 3D design tools but can also be achieved using everyday household items like cups and slightly rigid paper like cardstock or notecards. The blade design is a great opportunity to explore the concept of air pressure and wind, as the blades will need to move in relationship to the direction and force applied by wind (fan).

Suggest Materials

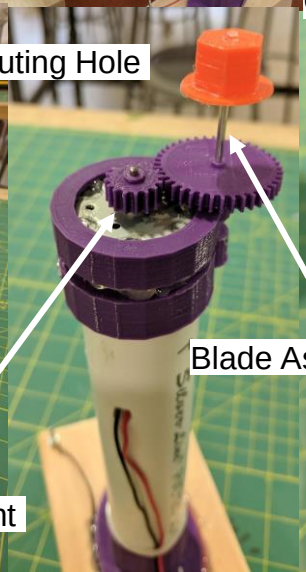
1. PVC Pipe
2. 2” x 4”
3. Wire
4. Rivets
5. DC Low Friction Motor- https://www.vernier.com/products/kidwind/wind-energy/kw-gen/
6. Rivets
7. Materials for the blades (cups, paper, tape, glue, etc)
8. 3D Designed Files for printing- http://bit.ly/Harbor3D

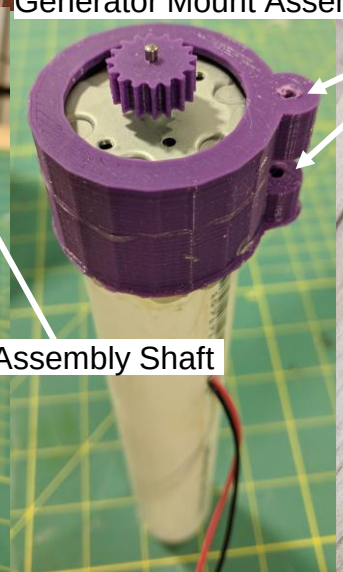
Assembly Process (see pictures for assistance)

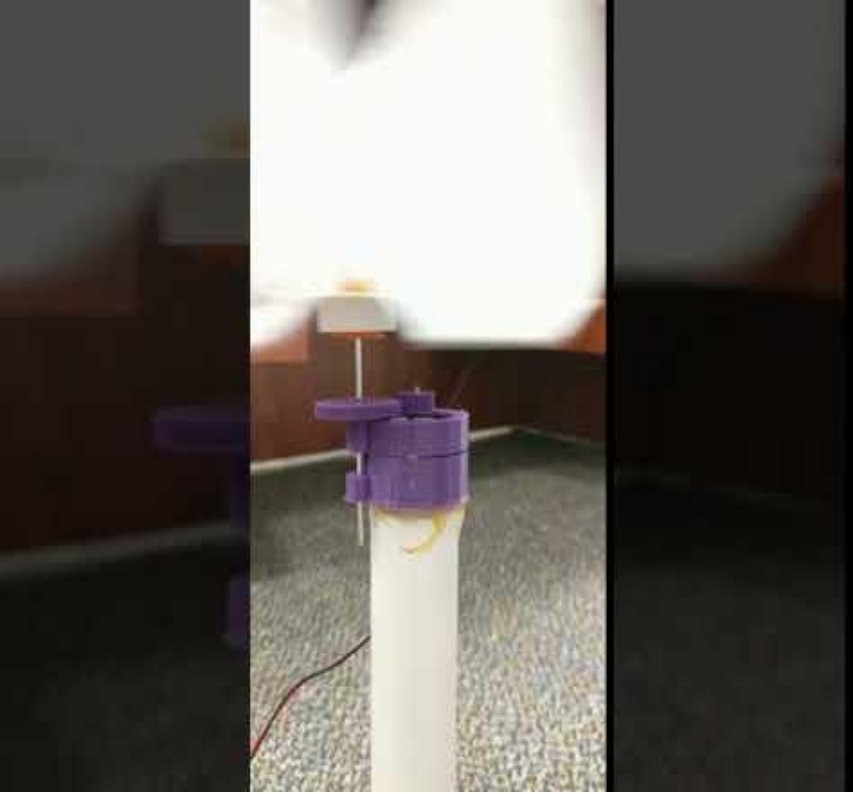
1. Cut 2”x4” blocks of wood to length, prototype was cut to 6” in length.
2. Cut PVC pipe to length, prototype was cut to 10” in length.
3. Drill holes for rivets into the wood base.
4. Assemble 3D Printed parts to connect the following pieces together.
    a. Wood base to PVC pipe using printed coupler part and two basic wood screws.
    b. Drill wire routing hole into the side of the PVC pipe.
    c. Attach wires to generator leads, this may not be required based upon the source of purchase.
    d. Run wires through the PVC pipe out of the wire routing hole.
    e. Hot glue motor assembly to the PVC pipe, and top (spinning axle end) of the generator. Be sure the holes align for the blade assembly shaft.
    f. Connect generator wires to rivet posts (soldering is not required but helpful). Hot glue rivet posts into the wood base holes.
    g. Add gears to the generator axle and blade assembly shaft. Test for function and fit.
    h. Add blade design to the blade assembly shaft. Test with fan for function.



Generator Mount Assembly and Hole Alignment







Sample Function Test Videos
https://youtu.be/ymv6HjnAUFA
https://youtu.be/DGI4rtu-7Dg

Without Gears
0.4-0.6 Volts
https://youtu.be/4vNkn2Vco-0

With Gears
1.7-1.9 Volts
https://youtu.be/1hzm9aJzxUc