



## **2021 Green Energy Challenge**

**A guide to Plan, Design, Build and Evaluate your “Wind  
Turbine”!**

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Chair for 2021 Green Energy Challenge**

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## Summary

The steps in this document are provided as a guideline to help our young bright minds to successfully complete the 2021 Green Energy virtual challenge.

The link below is from PBS Kids and it is proposed as a complementary resource to help our valued teachers and students to complete the virtual challenge.

<https://pbskids.org/designsquad/parentseducators/workshop/process.html>

## **Step 1: Identify the need**

Who is the “Green Energy” challenge sponsor?

What are you trying to achieve?

What are the challenge requirement and constraints?

Requirement 1:

Requirement 2:

Constraint 1:

Constraint 2:

Constraint 3:

## **Step 2: Research possible solutions**

Search and identify other work that is related to this challenge and provide references that inspired your activities.

Reference 1:

Reference 2:

Reference 3:

### **Step 3: Brainstorm solutions**

Share ideas with other team members (if available) and consider as many solutions as possible in a few hours time. Create a 2 to 4 free-hand sketches of the possible solutions.

Solution 1:

Solution 2:

Solution 3:

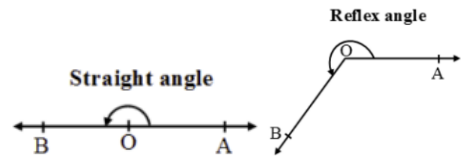
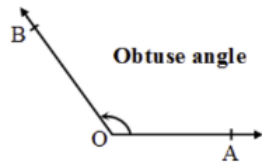
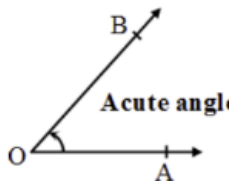
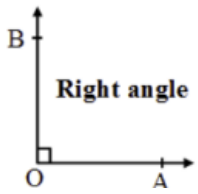
Solution 4:

#### Step 4: Select the best possible solution

Select one solution that in your opinion meets all the project requirements and constraints and helps you win the challenge, use instruction below to draw the blade design.

- 1- Start by drawing/sketching one blade shape that in your opinion is the most suitable design for use with the "Wind Turbine" propeller  
Note: there is no "right" or "wrong" shapes to choose from, it is what you believe is the best shape for the blade design. You can consider using some of the basic shapes on the right side or use your own imagination with the blade design.
- 2- Add dimensions to the blade design, how long do you want each side to be? Please refer to the Wind Turbine challenge specifications for the maximum allowed dimensions of the propeller assembly.
- 3- Identify the angles in your blade design, label and mark each angle on the blade design (please use images on the next page for your reference).





## Step 5: Construct a prototype

Build your design using the provided material,

- Cut and assemble the PVC pipes and fittings
- Assemble the gearbox, what gear ratio did you choose with your design? Why?
  
- Cut and shape the blades using the foamboard and/or balsawood
- Attach the blades to the hub, what material did you use to attach them?
  
- Measure the prototype height and width, does it meet the project specifications?
  
- What is the finished propeller diameter?
  
- How high is the centre of the hub from the table/floor?



## Step 6: Test and Evaluate the Wind Turbine

Test your Wind Turbine by placing it in front of a fan or inside the provided Airbox, does the propeller spin?

Add a resistor to the wires from the DC motor generator and measure the voltage produced by your wind turbine. Calculate the power produced using the following formula  $P = \frac{V^2}{R}$  where,

$P$  is the power produced in Watts [Watts],

$V$  is the voltage measurement across the resistor in [Volts], and

$R$  is the resistance value in [Ohms]

Change variables that affect the electrical energy from the generator, change one variable at a time and measure and plot the results each time. What are the variables that you can change with each evaluation?

- Variable 1:
- Variable 2:

Plot the result of changing each variable and

### **Step 7: Communicate the test results with your team**

Share the following information with your team member(s) and brainstorm more ideas

- How did your Wind Turbine perform?
- Is it able to turn on the provided Light Emitting Device (LED)?
- Do you need to consider other designs or variables?
- Once the design is complete, produce a 1-to-2-minute long video showing the Wind Turbine in action with the voltage (and/or) current measurements.
- Calculate the amount of power produced by the Wind Turbine and report it with your video as per the instructions by Skills Ontario, thank you.

### **Step 8: Consider a “Redesign” of the “Wind Turbine”**

If you consider a redesign to improve the Wind Turbine performance, then please repeat steps 4 to 7. Otherwise, you have completed the 2021 Green Energy Virtual Challenge by submitting the video file and power calculations, thank you.