Student Folio: Discover wind energy

Name: _____ Date: _____

As you work through your experiment of constructing a wind turbine, use the student folio to understand how to construct the wind turbine, note your predictions and record your observations.

Let's understand why you need to develop an effective wind turbine for your community.

You live in Blustery Bay, a fictional remote village in beautiful Tasmania. The bay is surrounded by a rocky plateau and you enjoy surfing, exploring the valley forests, and riding your bike in the grassy hills. You love where you live with one exception: Blustery Bay is off grid, meaning that the people of your village have no access to electricity.

You and your friends spend many hours each day gathering wood to warm your houses and heat your stoves. You'd rather spend your time doing the things you enjoy. You decide to take matters into your own hands. You need to find a way to generate electricity for the whole village. Based on available renewable energy sources near Blustery Bay, your research has determined that wind is the most reliable and readily available.

Now that you are committed to this project, you must decide what design of wind turbine will generate the most electricity so that you can present your idea to your community of Blustery Bay for their support. Today you will be engineers challenged to uncover the best design for your wind turbine.

Task

Complete the following questions:

1. **What do you think determines how much electricity a wind turbine produces?**

2. **Today, you are an engineer and your job is to design and test various wind turbines. What do you predict will be most important in the design of your turbine?**

Part One

Gather the following items:

Product	Quantity	Confirm (tick)
Cork	1	
Toothpicks	20	
Choice of card stock, aluminium foil or paper.	3 sheets	
Pencil	1	
Masking tape	1 roll	
Scissors	1	
Ruler	1	
Protractor	1	

1. Testing turbine blade angles

Draw and cut six rectangles of the same size from either card stock, aluminium foil or paper. Use your ruler to measure the rectangles first. Tape the blades onto the ends of the toothpicks as pictured below.

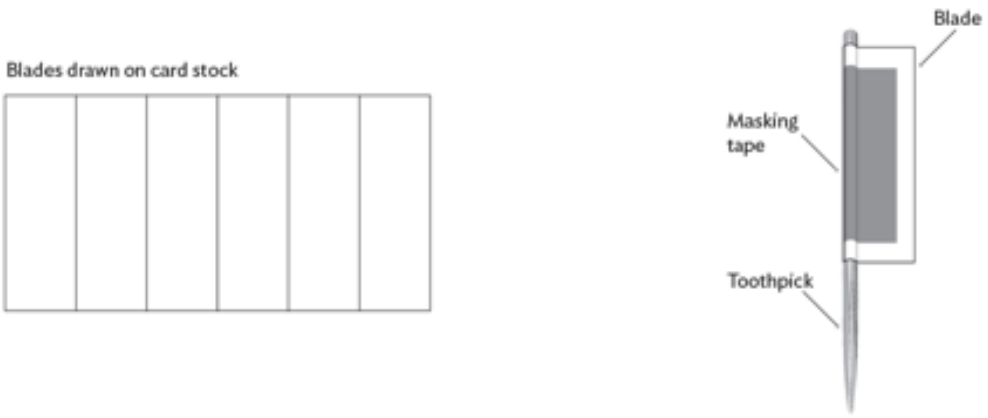

Figure 1

Press the toothpicks into the cork carefully. Try to space them evenly and keep the blades so they are parallel to the wind direction (air blowing from the fan).

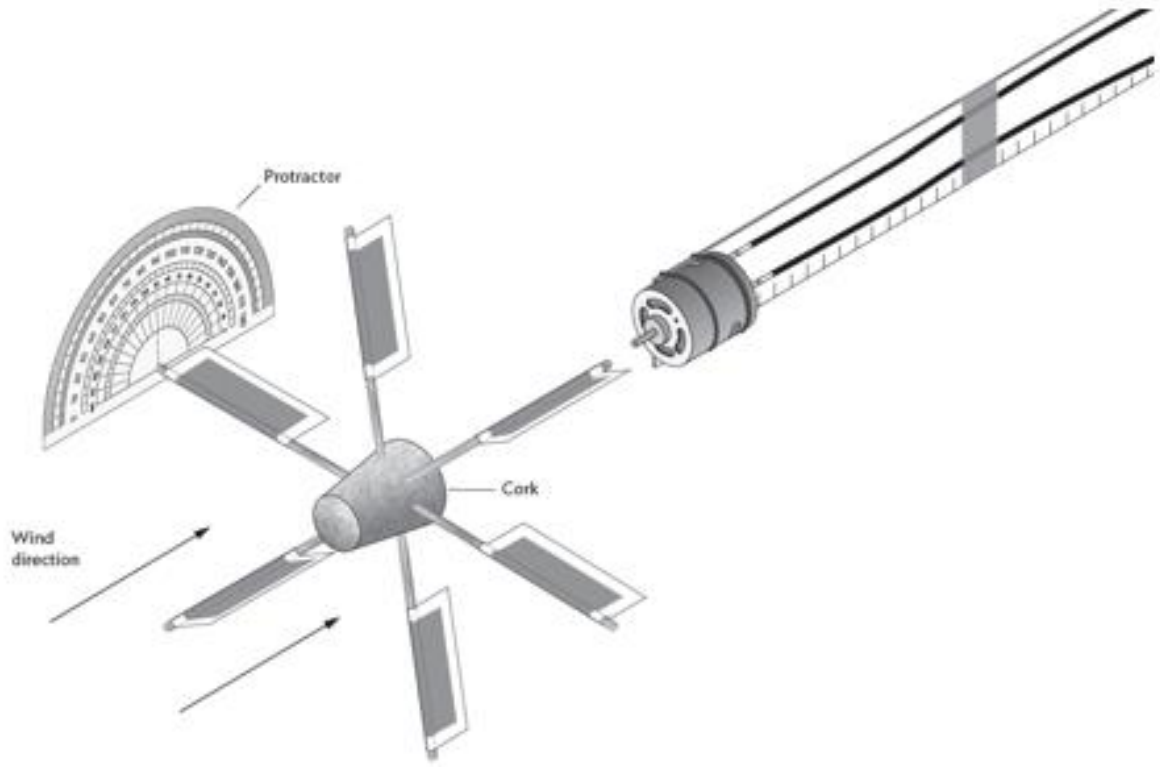

Figure 2

Take your wind turbine hub to the electric fan and hook it to the DC motor (see Figure 2). Turn the fan on and observe if the turbine spins. If it does, record the voltage to the nearest hundredths in the table below.

Gradually tilt the blades to any angle you choose (by twisting the toothpicks slightly) so they are all at the same angle and facing the same direction. Measure the approximate angle using the protractor (see Figure 2). Put your turbine in front of the fan and record voltage (in the table below) produced for each angle. Do this until you have measured the voltage while the blades are at three different angles of your choice.

Record of Measurements

Angle	Degree Measured	Voltage Measured (V)
Parallel to wind direction		
Angle 1		
Angle 2		
Angle 3		

What have you determined about how the angle of the blades impact the amount of voltage produced by your turbine?

2. Testing blade sizes

Keeping the angle of blades that produced the greatest amount of voltage from the previous test, you will now vary the sizes of the blades.

With your team, plan, draw and cut blades.

You will need 3 different sizes of your choice (6 blades each). Keep that in mind as you plan other sizes. The blades should all stay as rectangles as you will be testing shapes later.

Make sure to record the measurements of your blades and cut them out of the chosen material as you did earlier to save paper.

Note: It helps to label your blades sizes A, B, C etc

Blade Size	Dimension measured (width and length cm)		Voltage measured (V)
A			
B			
C			

What can you determine about how the size of the blades impacts the amount of voltage produced by your turbine?

3. Testing number of blades

Keeping the angle of blade that worked best in the first test and the size of blade that worked best in the second test, now you can determine what number of blades produce the most voltage.

Work with your team to determine the number of blades you want to test. Do three tests and record the results.

Number of Blades	Voltage measured (V)

What can you conclude how the number of blades impacts the amount of voltage produced by your turbine?

4. Testing shape of blades

As before, stick with the angle, blade size and number of blades that were determined in your experiment to generate the most energy. Now you and your team will test a variety of blade shapes.

Discuss this with your team and then design, draw and cut out your blades from your chosen material. You may reuse the toothpicks from the earlier tests as long as you keep your blades intact in case you need them again. Carefully cut and peel any masking tape off them.

Test the new blade shapes and record the results below. Label the shapes 1,2,3. Don't forget to compare these different shapes to the rectangular blades you started with.

Shape of Blades	Voltage measured (V)
1	
2	
3	

What can you determine about how the shape of the blades impact the amount of voltage produced by your turbine?

Part Two

Design your turbine

You need to decide what design of turbine you think will generate the most electricity given what you have learned through the trials. You might want to test your most efficient design with the different materials you chose. Put this turbine together and get ready to test it against the best designs from your classmates!

Sketch and label it in the space below. Include measurements in the sketch.

Reflection questions:

1. **How did your prediction of what factor would be most important in the efficiency of your turbine compare to the actual results?**

2. **What other factors could be altered to study the efficiency of the turbines?**

3. **How accurate do you think the tests were? Why?**

4. **How could these tests be more accurate?**

5. **Did you enjoy being a wind turbine engineer? Why or why not?**

6. **It's now time to approach the citizens of Blustery Bay with your proposal of the best wind turbine design. What should your presentation to them include?**