

## Firefly Wind Wheel-Blade Pitch Investigation Lesson Plan (Grades 6-8)

Name: \_\_\_\_\_

Date: \_\_\_\_\_

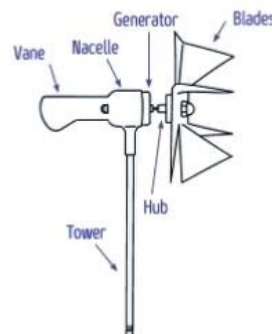
Group #: \_\_\_\_\_

### Objectives:

- Students will **observe and measure** how blade tilt affects the Firefly turbine's LED.
- Students will **explain energy transfer** from moving air to electrical energy.
- Students will **compare different blade designs** and identify which works best.
- Students will **connect their results to real-world turbines** and renewable energy.

### Materials (per group):

- Firefly template (or pre-cut circle)
- Scissors
- Push pin, small Philips, or small nail
- Pencil with eraser
- Tape
- Nacelle with generator and LED
- Fan (for testing)



### Build the Firefly:

#### Step 1 – Cut Out the Firefly Circle

- Cut along the solid outer shape of the Firefly template.

#### Step 2 – Cut Along the Inner Lines

- Carefully cut along each line toward the center, stopping at the inner circle mark.
- These cuts will form the turbine blades.

#### Step 3 – Fold the Blades

- Gently fold each blade forward along the line.
- The arrow symbol in the corner of each section indicates which corner to fold inward.
- Keep all blades bent in the same direction.



#### Step 4 – Assembled pieces

- The generator and LED should already be in your nacelles.
- You may want to add a piece of tape across the generator to keep it in place.
- Each nacelle should have a #2 pencil to put in the bottom of the nacelle piece to hold while the blades are turning.

#### Step 5 - Attach the Firefly to the Generator Shaft



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- Use the screw hub point to push through the center of the blades. Slide the hole over the screw hub.
- Twist the acorn hex nut onto the screw hub, to secure your blades to the screw hub.
- If you removed the screw hub from the rotor of the generator to attach your blades, you would need to reattach it by pushing it gently back on the rotor.

#### Step 6 – Prepare for Testing

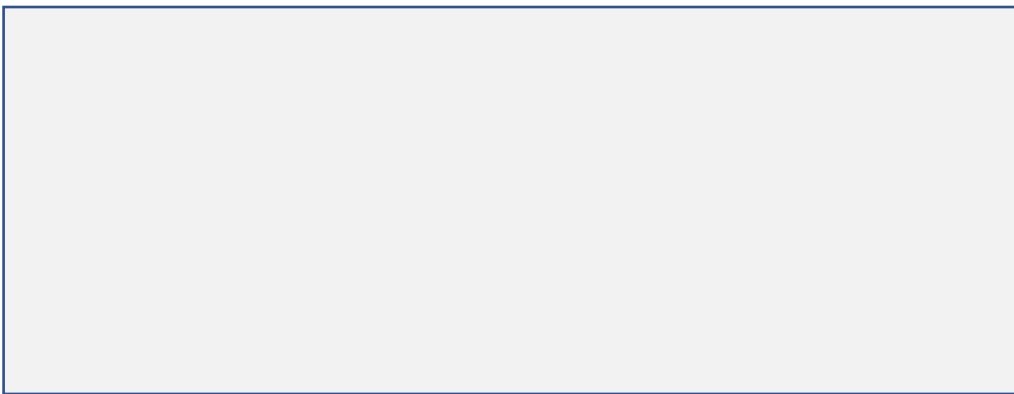
- Hold the Firefly (holding on to the pencil) in front of the fan without blocking the blades.
- Make sure the fan speed is the same for all tests.

#### Step 7 – Test Different Blade Angles

- Start with blades nearly flat ( $0^\circ$  pitch).
- Re-bend to about  $15^\circ$  and test again.
- Increase to about  $30^\circ$  and test a third time.
- Record brightness results for each.

#### Draw and Label:

- Draw a picture of your firefly.
- Match the term to the correct part of your diagram by labeling each part with the correct number:
  1. **Wind Turbine** - machine that turns wind into electricity
  2. **Blade** - catches the wind
  3. **Pitch** - tilt of the blade
  4. **Generator** - spins to make electricity
  5. **LED** - small light powered by electricity



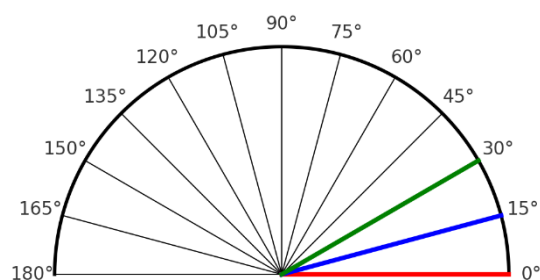
#### Measuring Pitch:

Use a protractor to measure the angle of your blade tilt.

- Flat blade = 0 degrees pitch



- Tilt forward = positive pitch
- Keep fan speed and distance the same during all tests



**Data Table:**

Trial #	Pitch Angle (°)	LED Brightness (Low / Med / High)	Spin Speed (Slow / Med / Fast)	Notes
1				
2				
3				

**CER Writing:**

Claim: Which blade pitch worked best? \_\_\_\_\_

Evidence: Use your data table and observations:

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Reasoning: Explain why that pitch made the LED brightest. Use what you know about blades catching wind, spinning the generator, and making electricity:

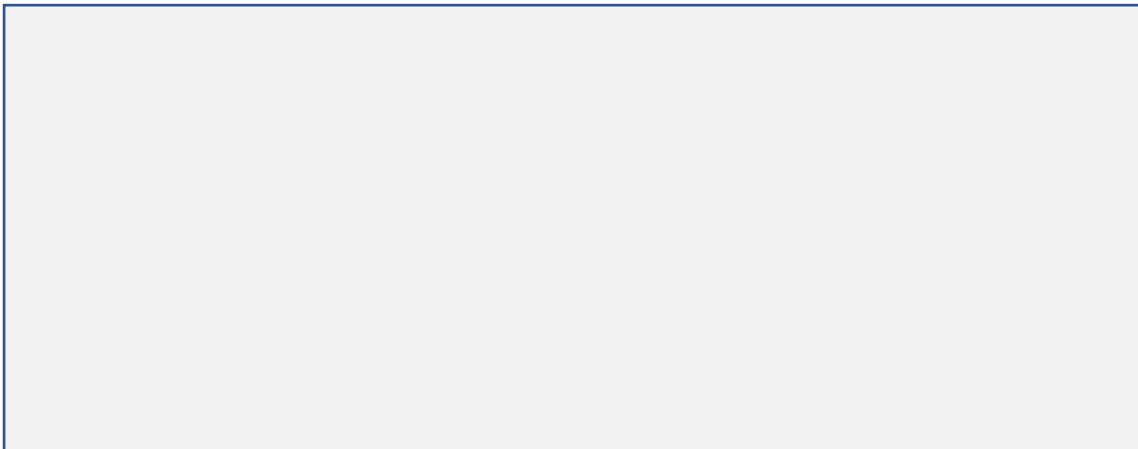
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### Draw Your Best Design:

- Draw and label your final blade pitch
- Match the term to the correct part of your diagram by labeling each part with the correct number:
  - **Wind Turbine** - machine that turns wind into electricity
  - **Blade** - catches the wind
  - **Pitch** - tilt of the blade
  - **Generator** - spins to make electricity
  - **LED** - small light powered by electricity



### Real-World Connection: *Answer the following question*

How do the tilted blades on real wind turbines help them make electricity, and why can't the blades be too flat or too tilted?

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