

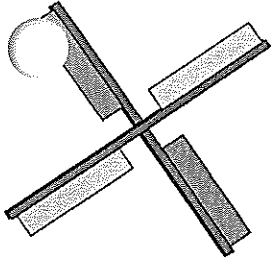
# My Design Portfolio

Engineer's Name

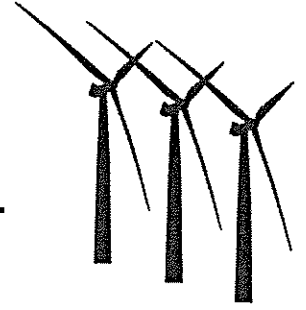
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## WINDMILL DESIGN CHALLENGE #1



Help William test the ability for the windmill to use mechanical energy to lift a bucket. The windmill must be sturdy. It must have at least two blades and no more than six blades. You must use the materials provided. You have 20 minutes to complete this challenge. You have a \$15.00 budget. You must use the materials provided. You may not alter any blade original design for this first challenge. Good Luck!





# DESIGN PORTFOLIO

**Group Name:** \_\_\_\_\_

**Individual Engineer's Name:** \_\_\_\_\_

**Occupations:**

- Accountant \_\_\_\_\_
- Sketcher \_\_\_\_\_
- Recorder \_\_\_\_\_
- Organizer \_\_\_\_\_
- Researcher \_\_\_\_\_
- Materials Specialist \_\_\_\_\_

**Problem Statement:**

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

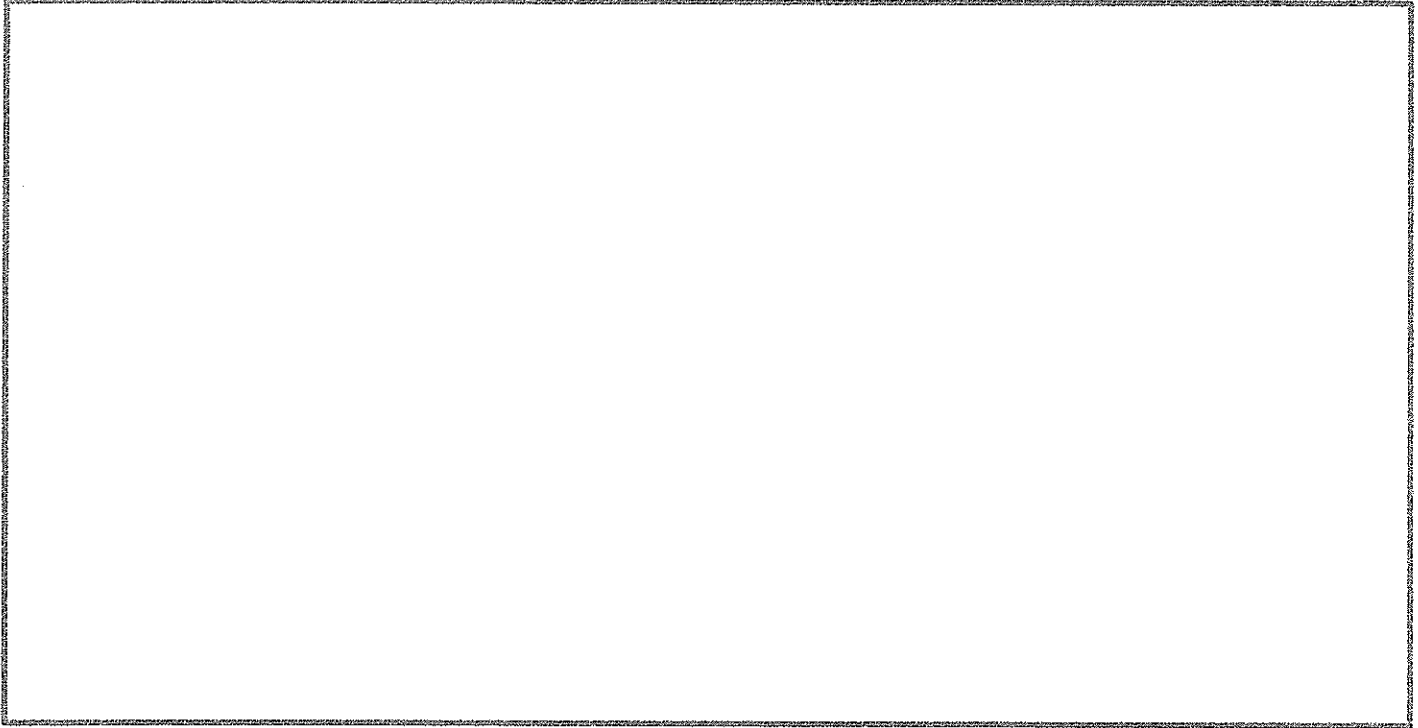
**Specifications**

**Constraints**

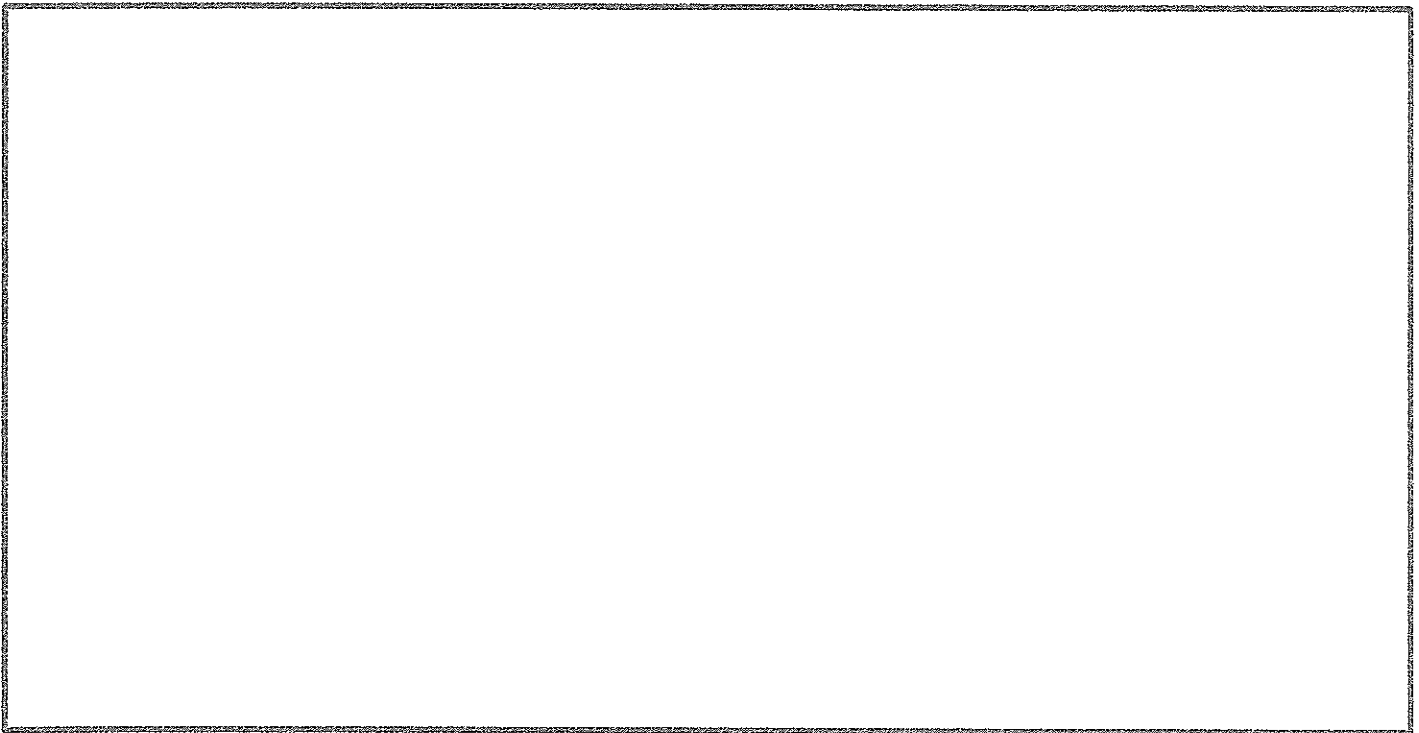
Specifications	Constraints
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Sketch your idea of the windmill. Make sure to label the following: shape of blade, blade material, hub, rotor, driveshaft, where the force is, where any friction may occur, the string attachment and length, the cup, & the amount of "water" beads.

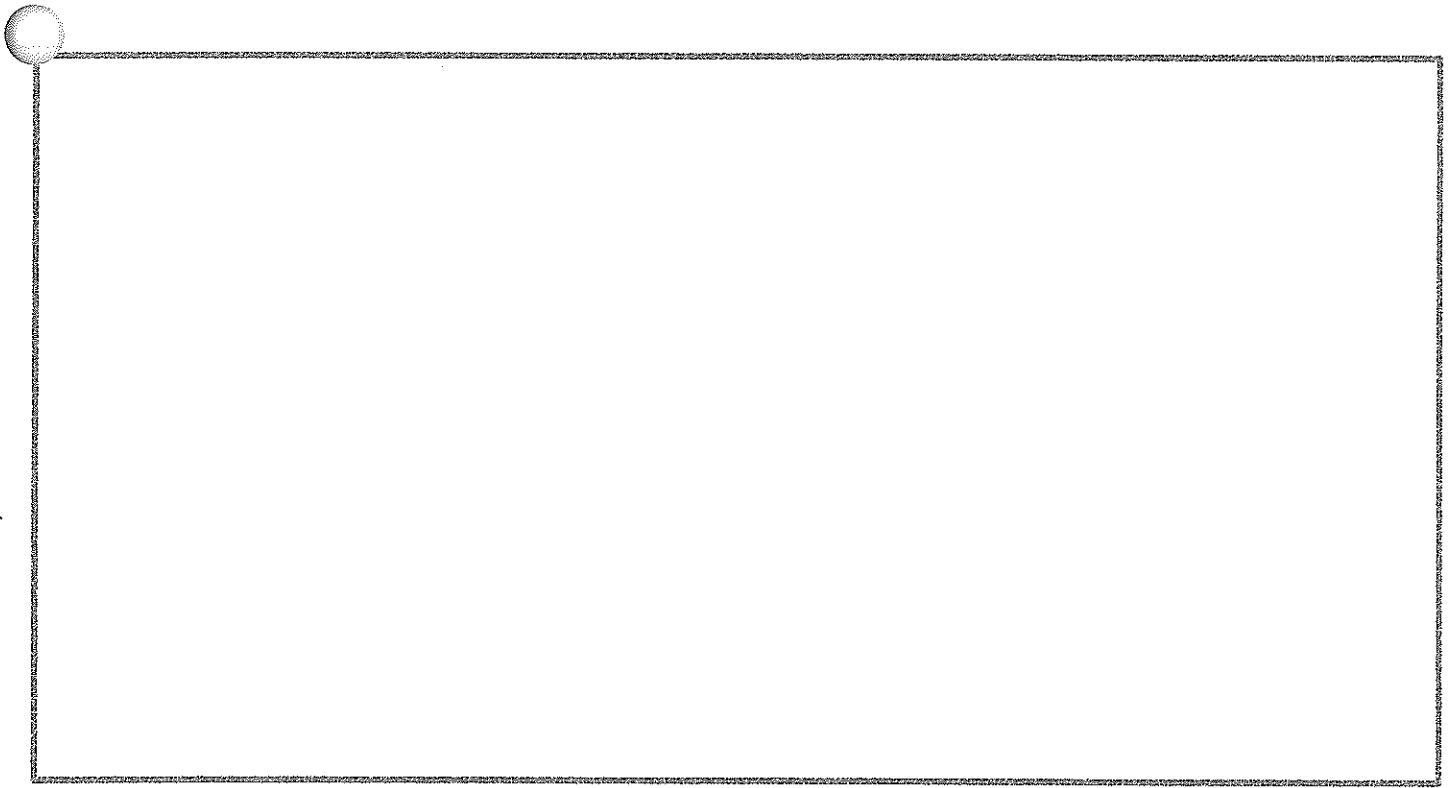
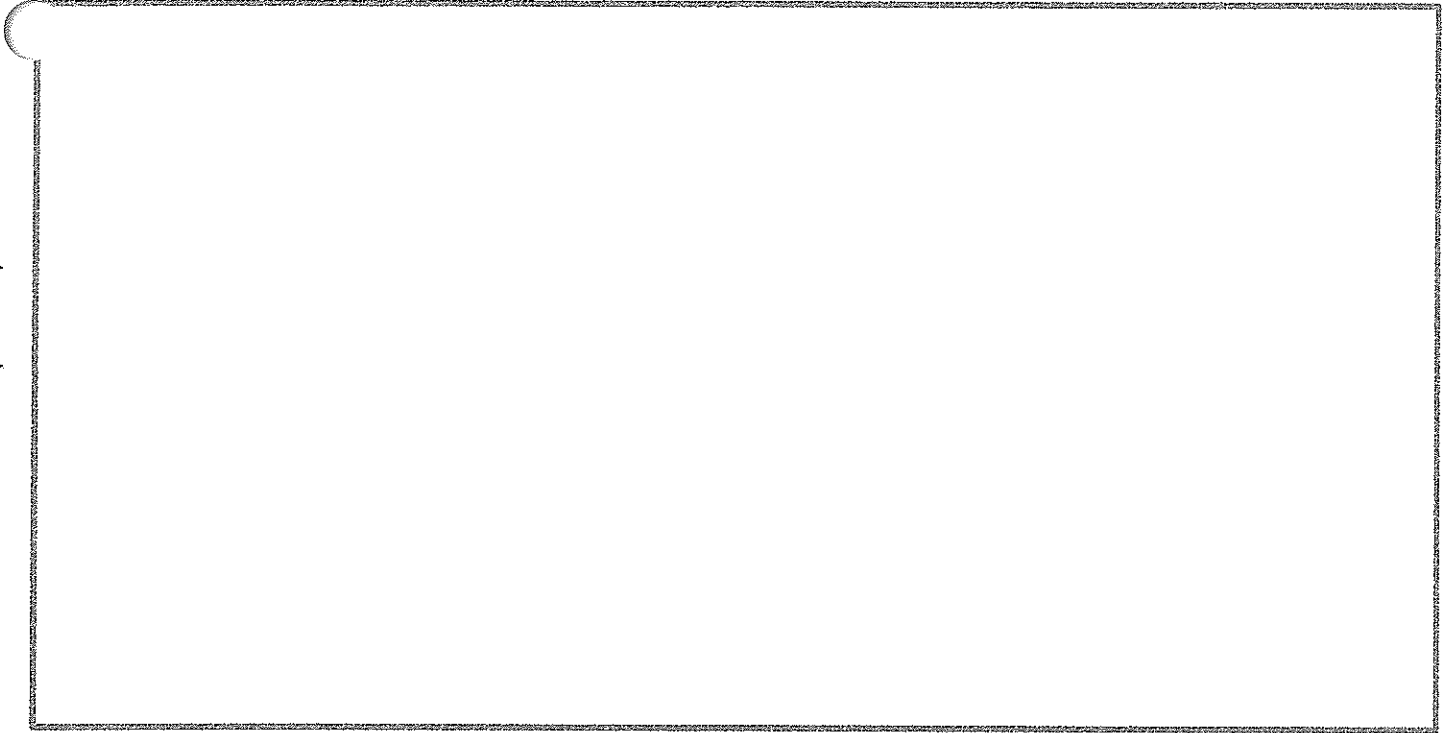
### Individual Sketch



### Group Sketch



# Additional Sketch Space



**Day 1:**

**Materials Needed:**

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**Why our sketch will work:**

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**Our problem for the day: (We are testing for...)**

✓ Turn of our blades and lift of the empty cup

**After our test we will make the following modification:** Choose 1! (blade material, blade shape, number of blades, pitch/angle)

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**We made this modification because:**

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**After our test, we found the following weaknesses with our windmill design:**

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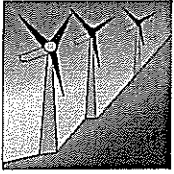
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**After our test, we found the following strengths with our windmill design:**

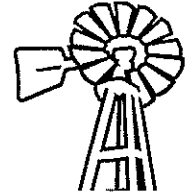
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## WINDMILL DESIGN CHALLENGE #2



You will develop a wind-powered device to vertically lift a load of 8 cubic centimeters in a rectangular carton. (Each cube represents a quantity of water). After finding success from one lift, you must use the jar and “water” beads instead for your load. However, you must prove that the weight of the load is at least triple the original load in your rectangular carton. Your windmill must be sturdy enough to operate for 90 seconds. There are many people in the village who need the ‘water’ for their crops. The more lifts in 90 seconds, the more water will be available for the village and the more points you will receive. The load must go up and down a determined distance of centimeters without the contents spilling out. Like William, resources are limited so use your materials wisely. You will have a budget of \$25.00. You must have \$1.00 remaining to enter the windmill competition. Time is limited, so you only have one class period to complete the windmill design. Good Luck!

Your team can earn windmill competition points in the following ways:

- ✓ Research & Recording: Design Portfolio & Windmill Investigations Booklet  
5 points each (10 Points total)
- ✓ Intact rectangular solid container – 3 points
- ✓ Operative windmill for full 90 seconds – 3 points
- ✓ Number of loads lifted (1 point per load)

### Occupations:

Accountant \_\_\_\_\_

Sketcher \_\_\_\_\_

Recorder/Organizer \_\_\_\_\_

Researcher \_\_\_\_\_

Measurer \_\_\_\_\_

Materials Specialist \_\_\_\_\_

**Problem Statement:**

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**Specifications**

**Constraints**


**What are the roles of the specifications?**

✓

✓

**What are the roles of the constraints?**

✓

✓

**How do these help/hinder you solving the problem?**

**Day 2:**

**Materials Needed:**

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**Why our sketch will work:**

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**Our first problem of the day: (We are testing for...) (Choose one)**

✓ blade material, blade shape, number of blades, pitch/angle

**After our test we will make the following modification: (One at a time!)**

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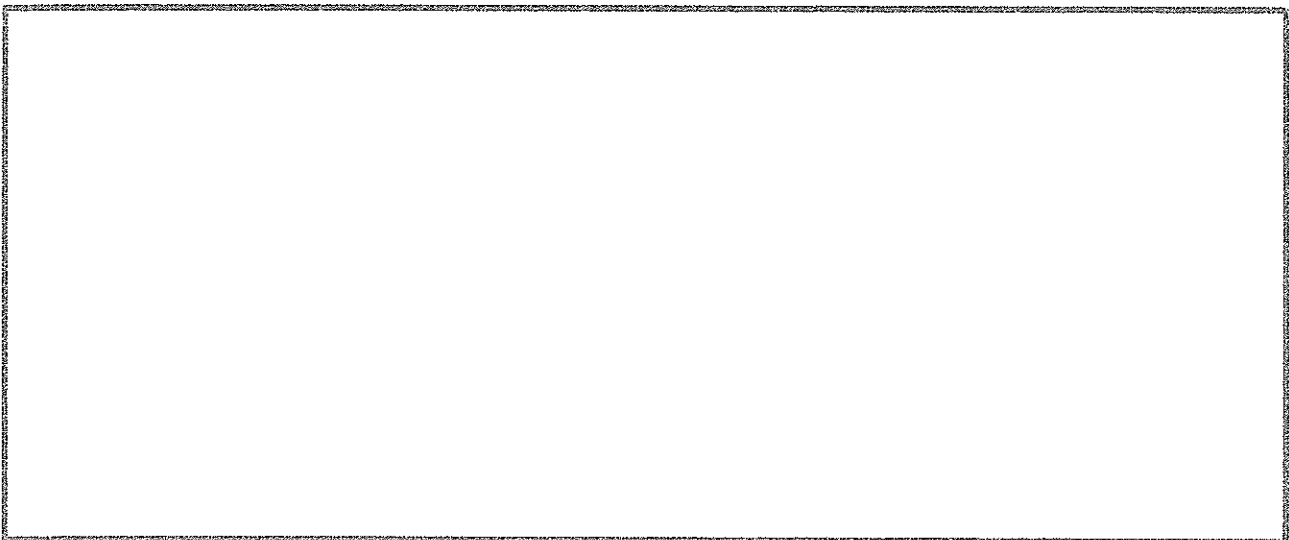
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**We made this modification because:**

**Sketch with new modification:**



**After our test, we found the following weaknesses with our windmill design:**

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**After our test, we found the following strengths with our windmill design:**

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**Our third problem of the day: (We are testing for...)** (Choose One)

- ✓ blade material, blade shape, number of blades, pitch/angle

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**After our test we will make the following modification:** (One at a time!)

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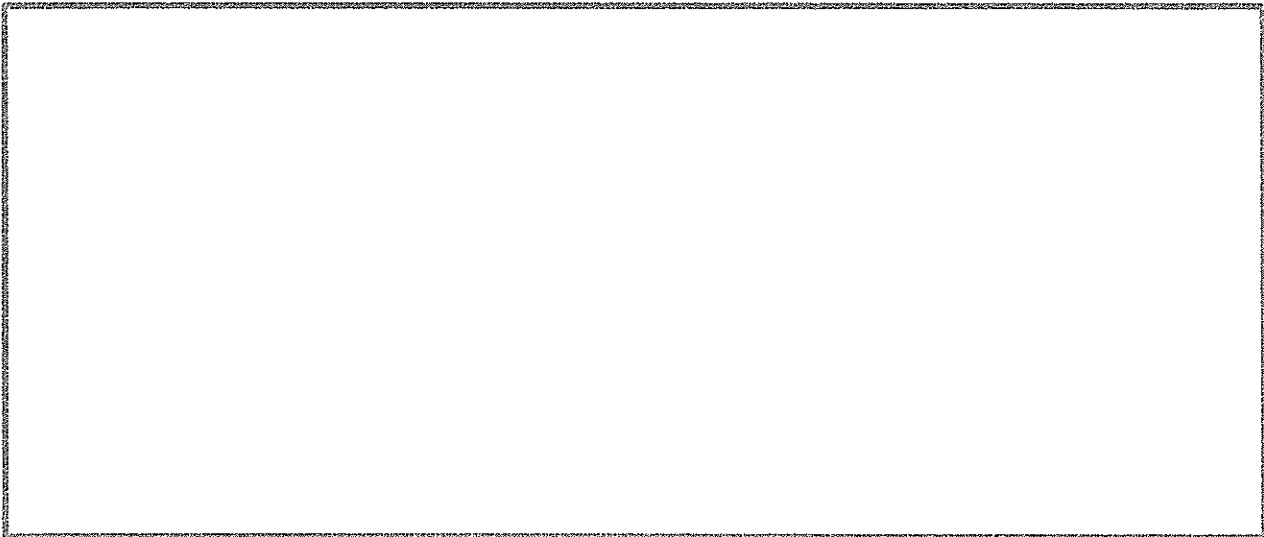
**We made this modification because:**

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**Sketch with new modification:**



TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	MASS (GRAMS)	# OF LIFTS

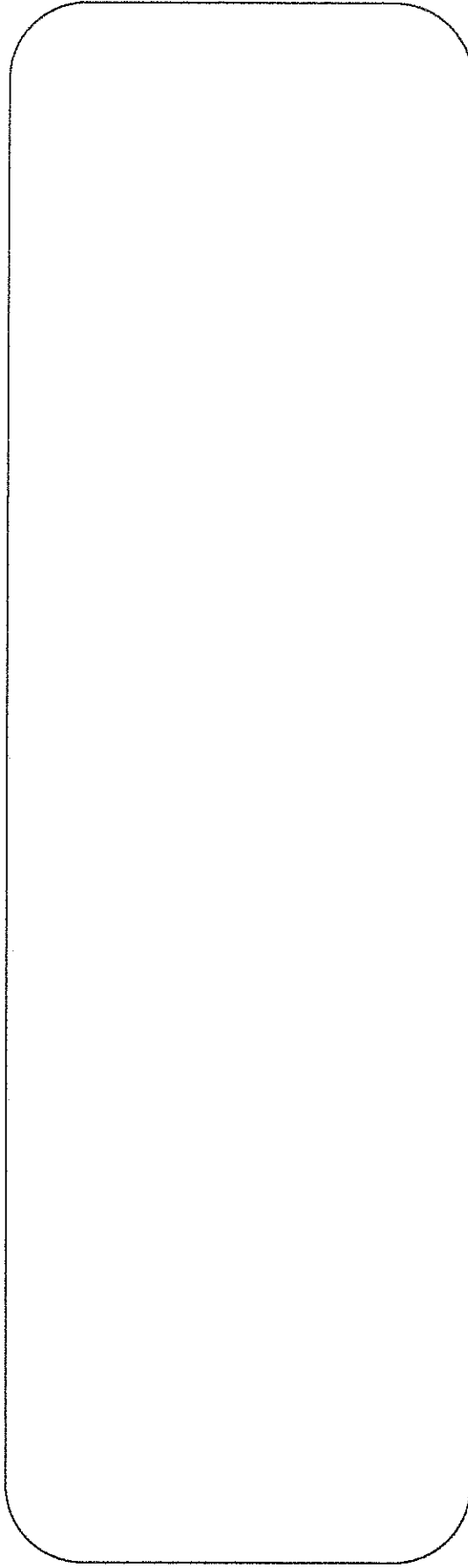
TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	MASS (GRAMS)	# OF LIFTS

TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	MASS (GRAMS)	# OF LIFTS

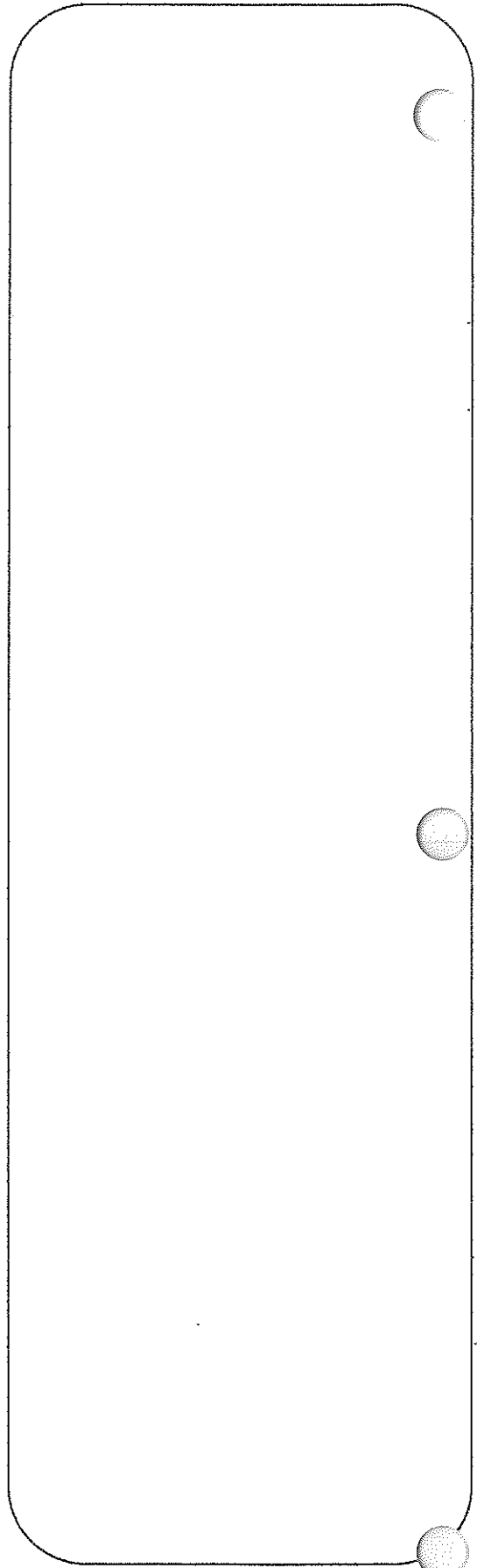
**STOP! It is "Make a Connection" time!**

For each connection you make, you get an additional point toward the challenge competition. The connection must be either math or science (you can do a combination of both), and must state how your design connects to the math/science concepts you have already learned. You must be detailed in your explanation of how the engineering design connects to the math/science. Good Luck. You have only 30 minutes to make as many connections as possible. You can only make up to four connections.

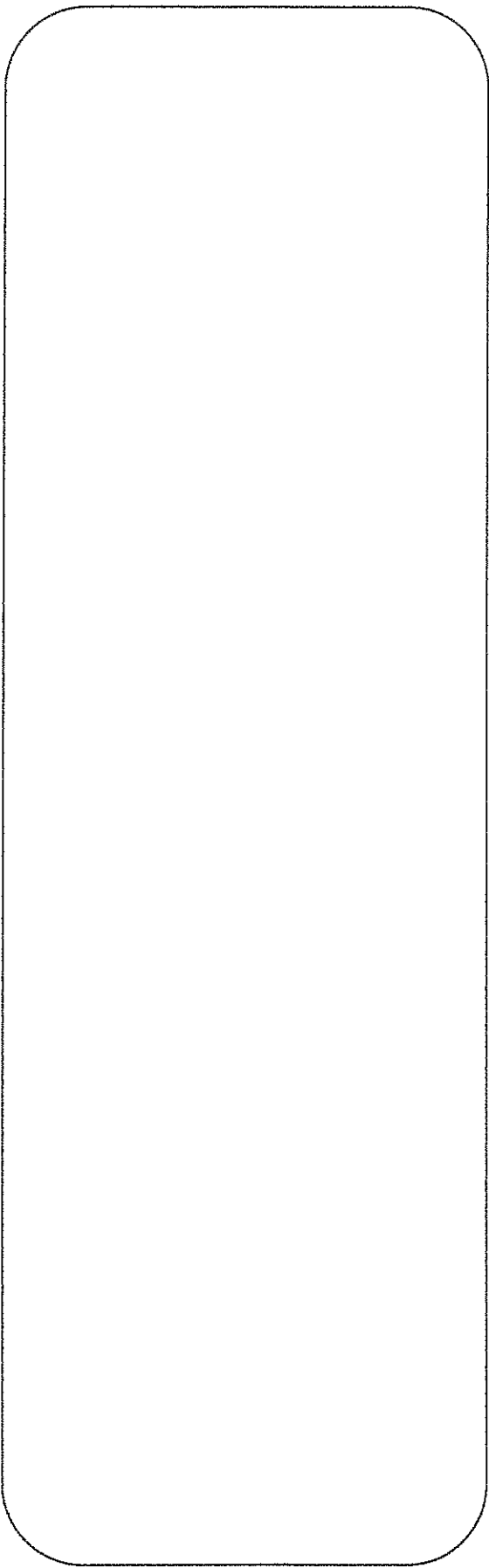
**Connection 1**



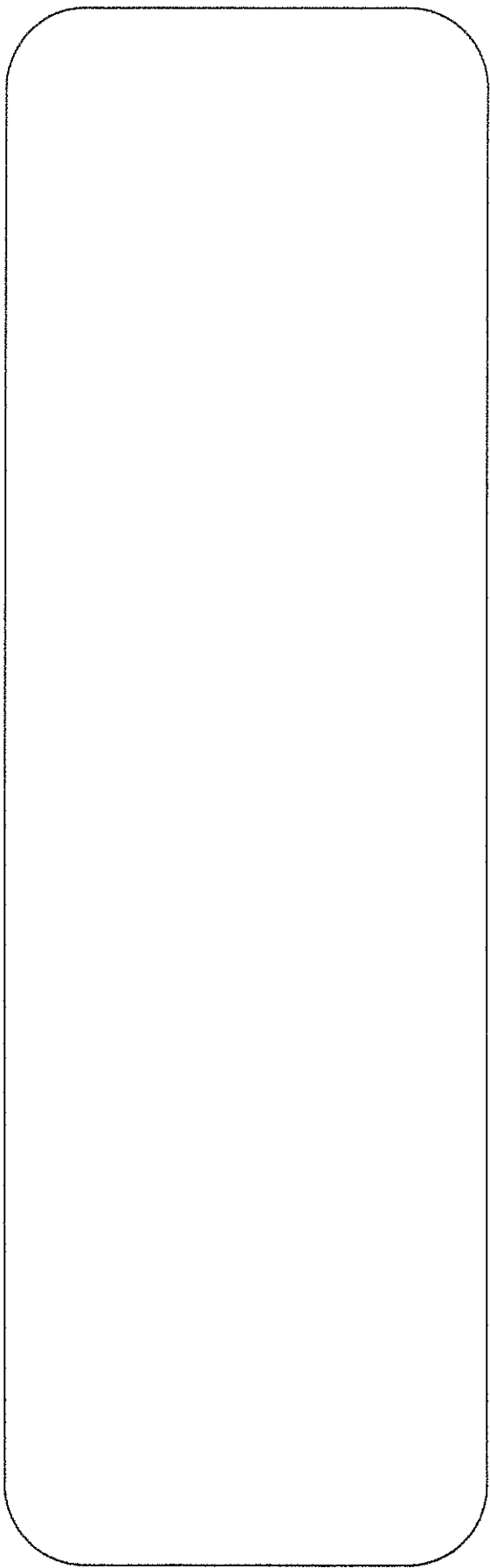
**Connection 2**







**Connection 3**



**Connection 4**

**Our fourth problem of the day: (We are testing for...)**

✓ blade material, blade shape, number of blades, pitch/angle

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**After our test we will make the following modification:**

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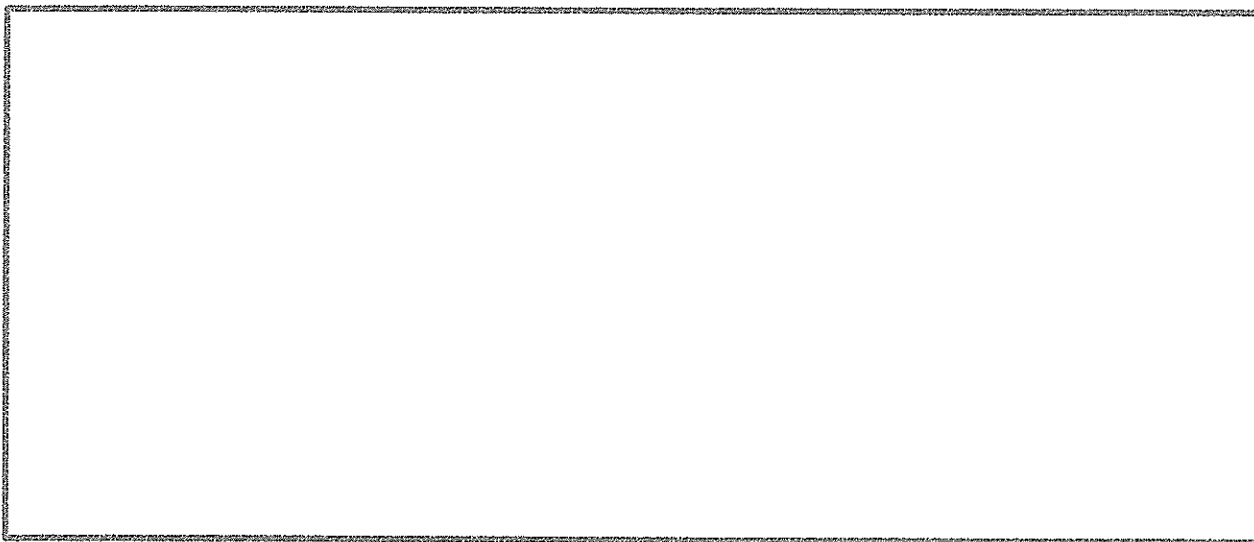
**We made this modification because:**

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**Sketch with new modification:**



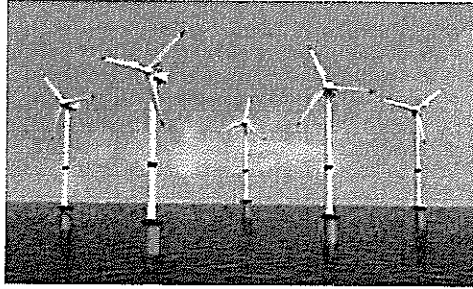
**After our test, we found the following weaknesses with our windmill design:**

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**After our test, we found the following strengths with our windmill design:**

# WIND TURBINE CHALLENGE



You have been asked to be a part of the preliminary study to utilize your knowledge of windmill design for the Long Island Offshore Windmill Project. The engineers have asked that you design a wind turbine that generates electricity. A successful wind turbine will be able to light a bulb. Amount of electricity produced will be measured by a voltmeter. The more volts generated, the more efficient the wind -turbine design. One aspect of nature's ability to efficiently "work" with the wind must be included in your design (Biomimicry). The total mass of your turbine blades must be kept under 70 grams. The model wind turbine must be sturdy enough to not sway in high winds from storms, hurricanes, etc. To keep costs low as to not raise residents' taxes, the project manager has limited materials and given you a \$50.00 budget. To enter the windmill turbine competition, you must have \$2.50 remaining in your budget. Good Luck!

Your team can earn wind turbine competition points in the following ways:

- ✓ Research & Recording: Design Portfolio – 5 pts.
- ✓ Wind Turbine Investigations Booklet – 5 points
- ✓ Lighting the bulb – 5 points
- ✓ Amount of volts produced on the voltmeter
  - 0.5 volts = 1 pt.
  - 0.6 volts = 2 pts.
  - 0.7 volts = 3 pts.
  - 0.8 volts = 4 pts.
  - 0.9 volts = 5 pts.
  - 1.0 -1.5 volts = 8 pts.

**Problem Statement:**

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**Specifications**

**Constraints**


**What are the roles of the specifications?**

✓

✓

**What are the roles of the constraints?**

✓

✓

**How do these help/hinder you solving the problem?**

**Day 3:**

**Materials Needed:**

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**Why our sketch will work:**

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**Our first problem of the day:** (We are testing for...) (Choose One)

✓ blade material, blade shape, number of blades, pitch/angle

**After our test we will make the following modification:** (One at a time!)

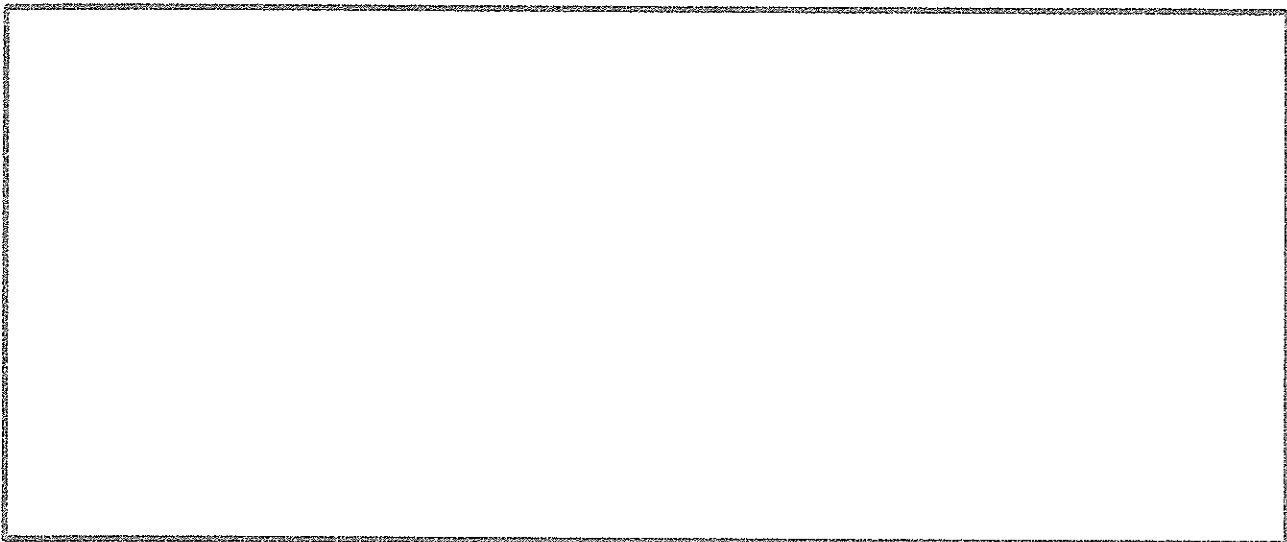
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**We made this modification because:**

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**Sketch with new modification:**



**After our test, we found the following weaknesses with our windmill design:**

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**After our test, we found the following strengths with our windmill design:**

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**Our third problem of the day: (We are testing for...)** (Choose One)

- ✓ blade material, blade shape, number of blades, pitch/angle

**After our test we will make the following modification:** (One at a time!)

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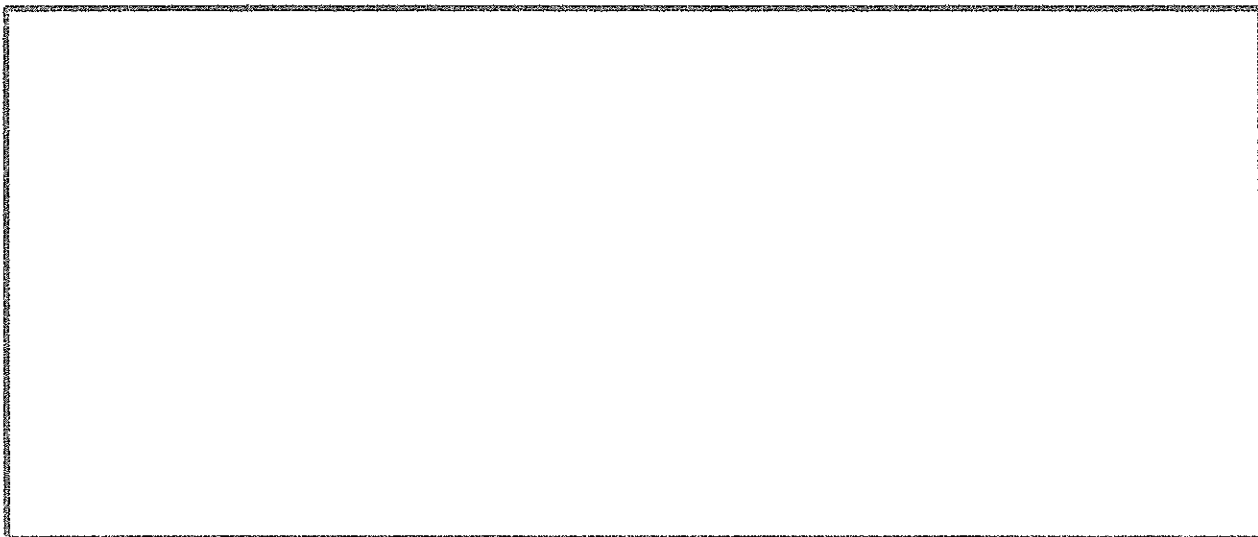
**We made this modification because:**

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**Sketch with new modification:**



TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	BULB LIGHT? Y/N	# OF VOLTS
1						
2						
3						
4						

TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	BULB LIGHT? Y/N	# OF VOLTS



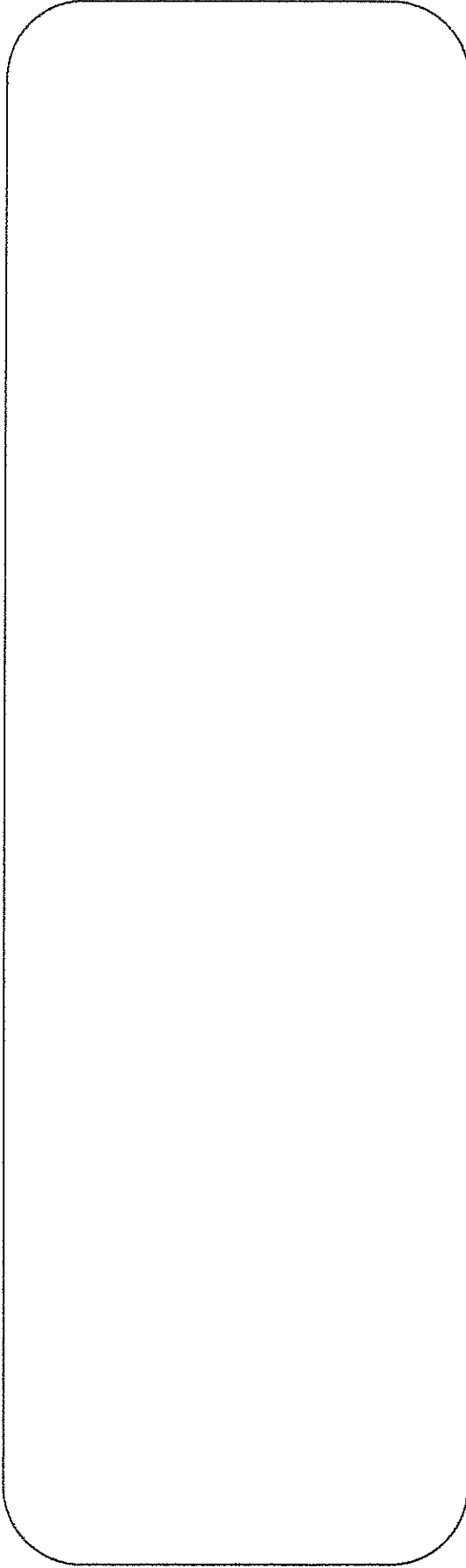
TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	BULB LIGHT? Y/N	# OF VOLTS

TRIAL #	# OF BLADES	BLADE DESIGN	BLADE MATERIAL	BLADE PITCH (DEGREES)	BULB LIGHT? Y/N	# OF VOLTS

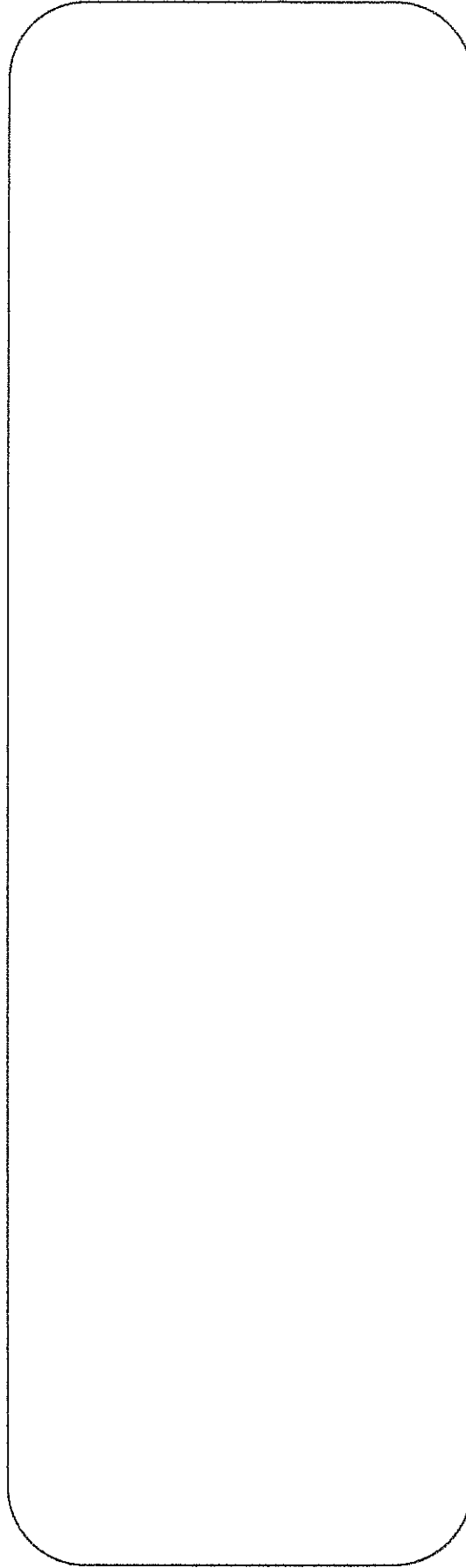
**STOP! It is "Make a Connection" time!**

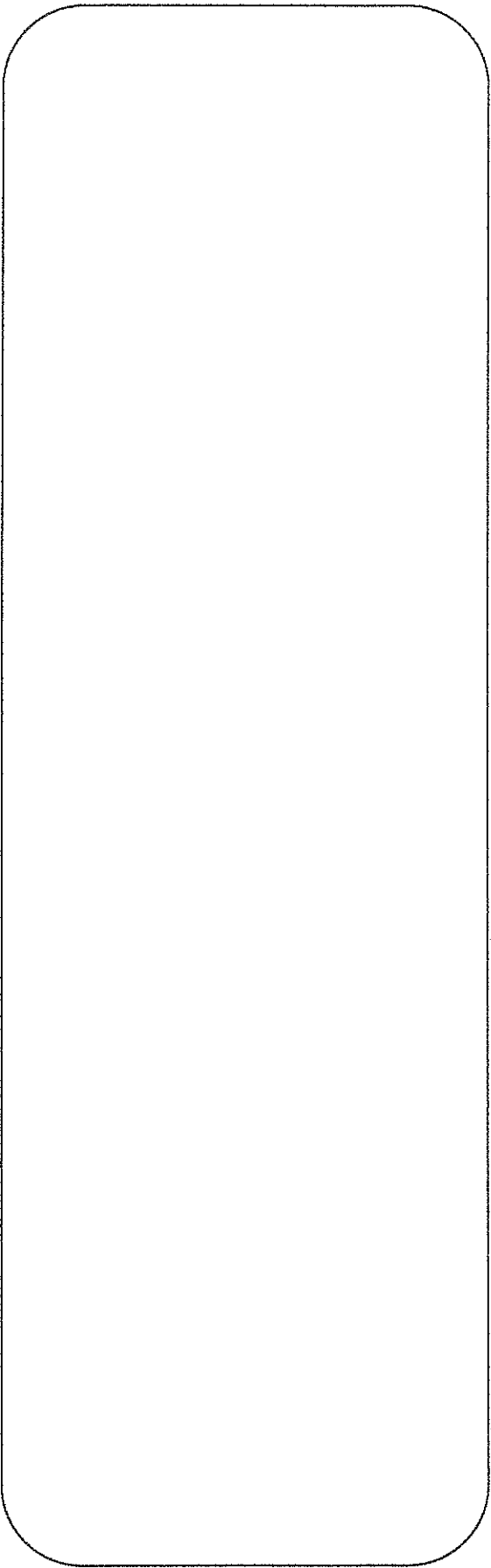
For each connection you make, you get an additional point toward the challenge competition. The connection must be either math or science (you can do a combination of both), and must state how your design connects to the math/science concepts you have already learned. You must be detailed in your explanation of how the engineering design connects to the math/science. Good Luck. You have only 30 minutes to make as many connections as possible. You can only make up to four connections.

**Connection 1**

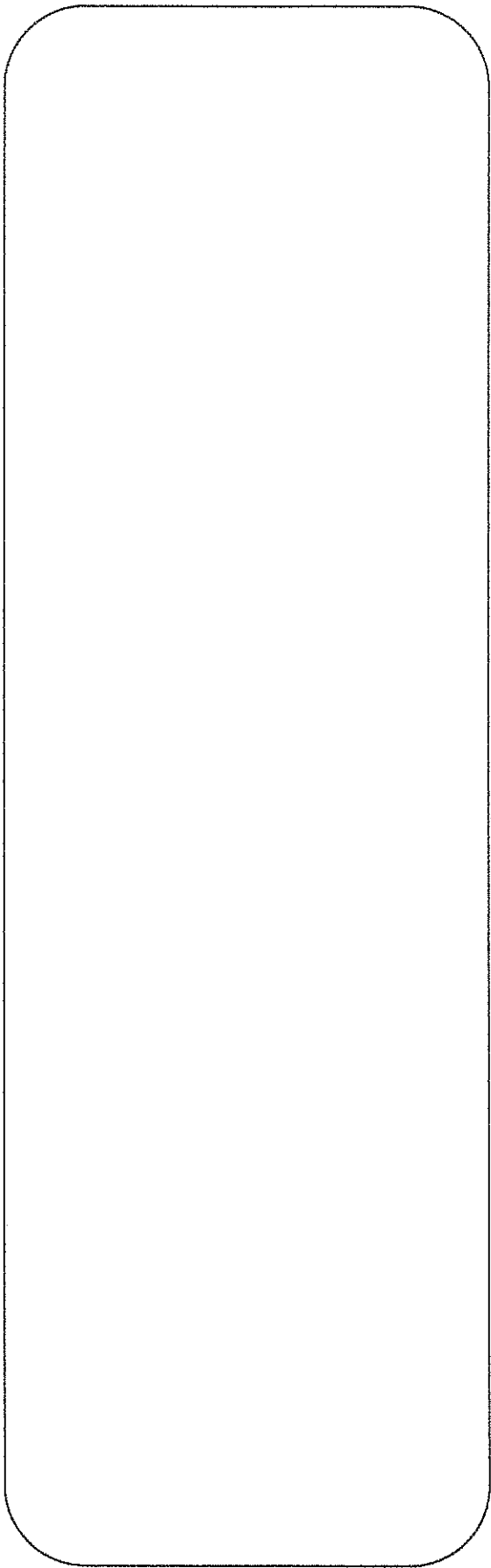


**Connection 2**





**Connection 3**



**Connection 4**

Analyzing the above chart, when did your struggles become your strengths?

Claim 1:

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Claim 2:

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Evidence from Chart:

First Piece of Evidence:

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Second Piece of Evidence:

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Using the graph paper below, graph at least five of your modification results sequentially as you tested your wind turbine transferring mechanical energy to electrical energy. Be sure to graph at least five modification results. How will you show how your modifications affected your wind turbine output? What variable will be on the x-axis? \_\_\_\_\_

What variable will be on the y-axis? \_\_\_\_\_

How will you label your graphic representation? \_\_\_\_\_

\_\_\_\_\_

You may make a line plot or line graph.

What does this graph show? Did you get closer to a desired solution?

What is the evidence from your graph to support your claim?

Graphic evidence:

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Conclusion:

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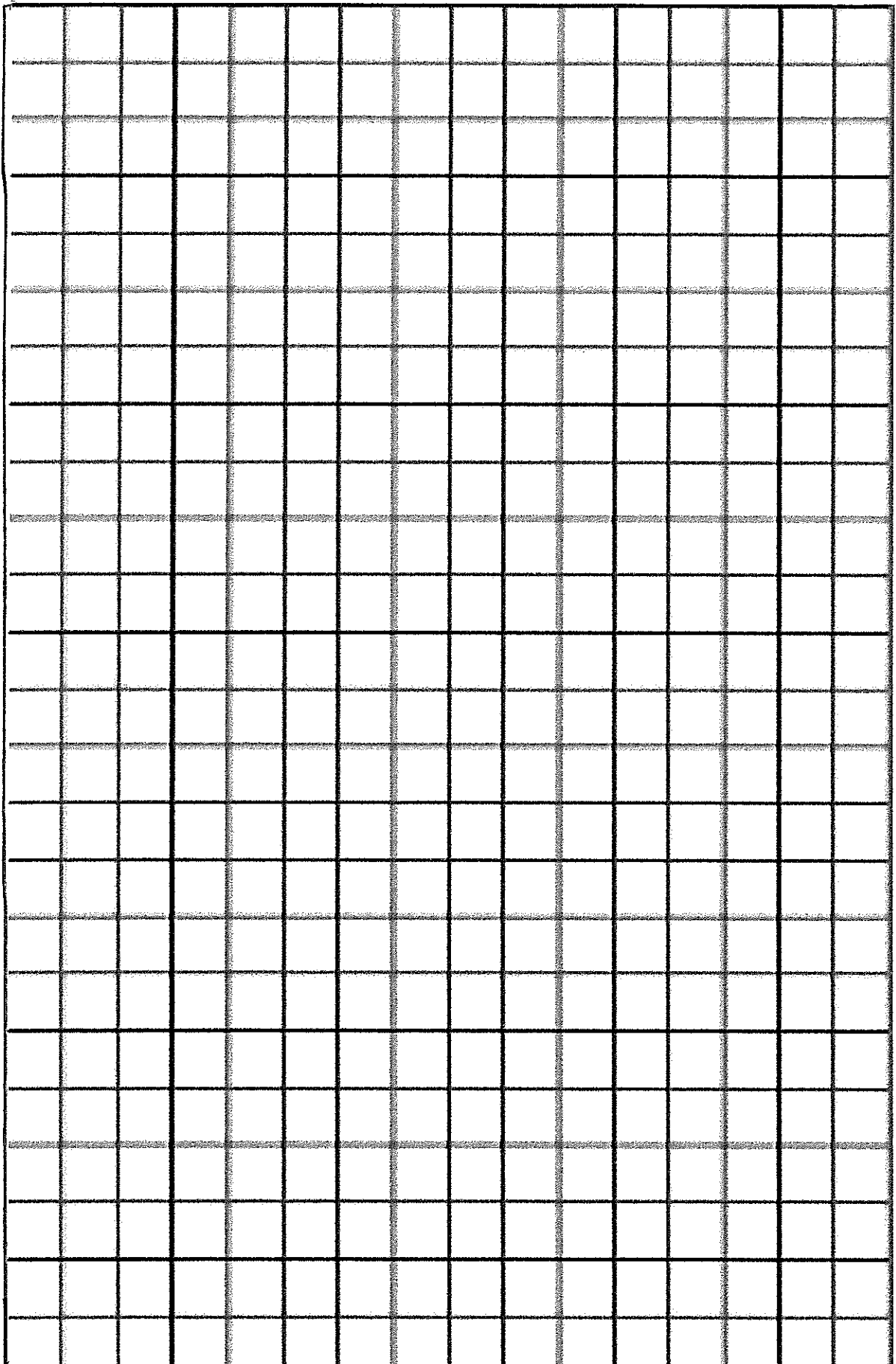
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# Harnessing the Wind Materials Sheet



## COSTS

Rentals .....	\$3.75 per day
(scissors, rulers, measuring tape, plastic lifting cups, protractors, fan, voltmeter )	
Marbles .....	Two for \$1.20
Black String .....	\$0.75 per decimeter
Duct/Masking Tape .....	\$1.00 per decimeter
Cardboard/ Oak Tag Blades .....	\$4.80 for four
Styrofoam Blades .....	\$ 3.90 for three
Plastic Blades .....	\$ 2.50 for two
Blue Hard Plastic Blades .....	\$5.25 for four
Wooden Spokes .....	\$2.00 for four
Wind Mill Stand .....	\$2.50 per day
Wind Turbine Stand.....	\$7.50 (for two days)
Foam Core Blades	\$ 2.75 for two
Miscellaneous Materials .....	

## **Ways to EARN Money**

- ✓ Team Building .....
- ✓ Evidence of making one modification at a time .....
- ✓ Research Sharing .....
- ✓ Accounting/Sketching ....
  - Estimation
  - Teaching others



# Harnessing the Wind Balance Sheet

Item	Cost	Work Shown	Balance




# STEM RUBRIC

Team Name \_\_\_\_\_ Date \_\_\_\_\_

Post evidence on next page - One piece of evidence for each category!

	OUR ACTIONS	4 ALL OF THE TIME	3 MOST OF THE TIME	2 SOME OF THE TIME
<p><b>Team Builders</b></p>	<ul style="list-style-type: none"> <li>- Every person listened to all ideas shared by group members</li> <li>- We took turns sharing our ideas.</li> <li>- We all performed our jobs.</li> <li>- Team members were always involved in thinking or doing.</li> <li>- When the observer came to us, we stopped and joined the class.</li> </ul>			
<p><b>Scientists &amp; Mathematicians</b></p>	<ul style="list-style-type: none"> <li>- We made our connection "cards" filled with thought and detail</li> <li>- When we talked about our ideas, we used science and math words</li> <li>- We used math and science to help engineer a better windmill/wind turbine</li> <li>- We referred to our science notes and learned and incorporated important facts from our researcher.</li> </ul>			
<p><b>Engineers</b></p>	<ul style="list-style-type: none"> <li>- We waited to make our modifications until our recorder posted it</li> <li>- We brainstormed possible solutions before we made our modifications</li> <li>- We tested out our modifications</li> <li>- We were aware of our trade-offs and reflected in our Design Portfolio daily</li> </ul>			

**EVIDENCE**

**Team Builders**

**Scientists &  
Mathematicians**

**Engineers**



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