
# ACTIVITY 8

## Design a Windmill

***RANCH LIFE SERIES | BOOK 2 | COWBOYS AND HORSES***
Chapter 7

**Content Area**
Science

**Topic**
Physical Properties Engineering Challenge

**Objective**
Students will design blades for a windmill that will turn in the wind and lift a load.

**Texas Essential Knowledge and Skills (TEKS):**
3.6A, 4.6A, 5.6A

# Design a Windmill

**CONTENT AREA:** Social Studies

**TOPIC:** Physical Properties Engineering Challenge

## ACTIVITY MATERIALS:

### WINDMILL BASE

*Each student group will need one base/load. The following list builds one base/load:*

- Large plastic 32 to 64 oz. fruit juice bottle with circular base
- 3" foam ball
- 10 to 12" long 1/8"wide dowel rod or bamboo skewer
- 12" piece of string
- 3 oz. paper cup
- Hole punch/drill
- 10 pennies (load)

### WINDMILL BLADE DESIGNS

*Each student group will be provided with the following materials, in addition to the windmill base:*

- Aluminum foil
- Cardstock
- Tissue paper
- Popsicle sticks
- Foam sheets
- Index cards
- Tape and/or glue
- Scissors
- Stapler

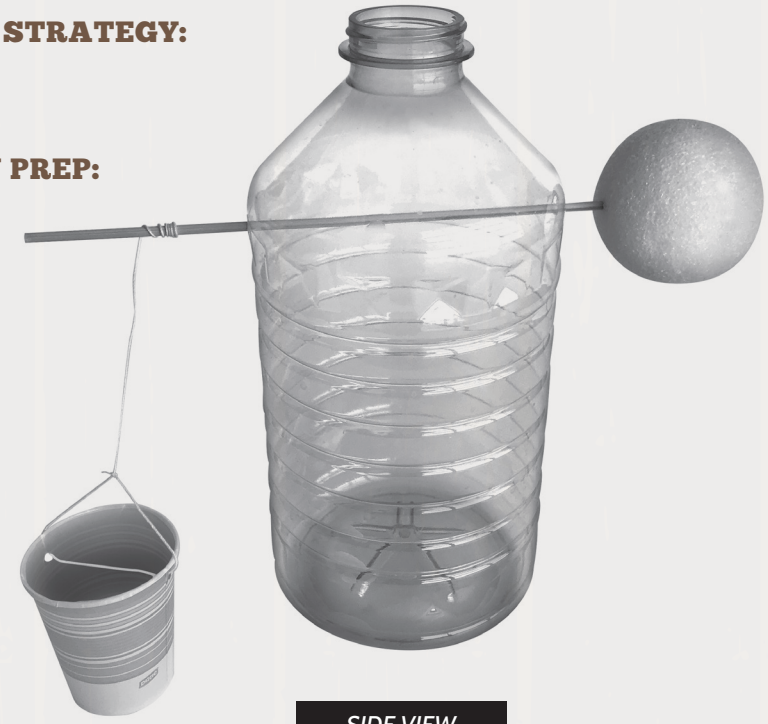
- Electric fan
- SECURITY BRIEFING *(page A8-3):* 1 per student or student group
- DESIGN A WINDMILL - PLAN SHEET *(page A8-4):* 1 sheet per student
- THE BOTTOM LINE (*page A8-5):* 1 per student or student group

## READING STRATEGY:

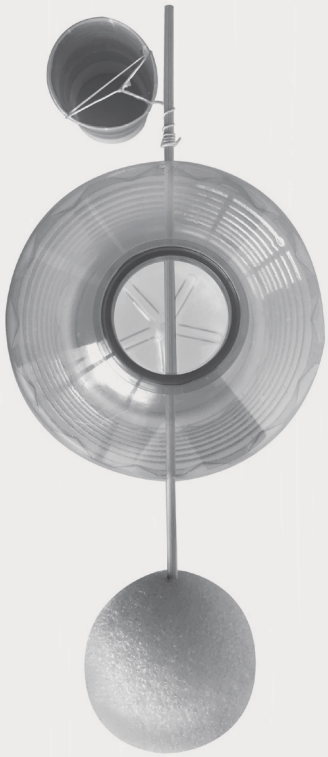
N/A

## ACTIVITY PREP:

Teachers will build one WINDMILL BASE per student group according to the diagram before the student activity.



*SIDE VIEW*



*TOP DOWN VIEW*

# Design a Windmill

## ACTIVITY INSTRUCTIONS:

### WINDMILL BLADE DESIGN CHALLENGE

Students will design WINDMILL BLADES capable of turning in the wind and lifting a load from the ground to the top of the windmill.

### PLANNING PHASE

1. Students will be given one minute to individually plan and draw a WINDMILL BLADE design on the DESIGN A WINDMILL - PLAN SHEET. (*Students should not be collaborating during this individual planning time.)*
2. After the minute is up, members of the group will share their ideas with one another. Students must decide which elements of each group member's design they would like to include in the group's blade design. The group's blade design MUST include one design element from each group member.
3. Each group will plan and create their final design on the PLAN SHEET.
4. Students will present their group's blade design to the teacher, noting which elements in the design belong to each group member. (No plan is approved that does not include a design element from each team member.)
5. After the group's blade design has been approved by the teacher, students can begin creating their blades with the provided materials.

### CREATING PHASE

Each group will receive the same windmill base. Team members will gather materials from the table and begin making their blades and assembling their windmill.

### TESTING PHASE

Each group can test their windmill blades with the fan anytime during their build. The speed of the fan does not matter if the blades turn and can lift a cup with 10 pennies.

### REDESIGNING PHASE:

If the windmill does not spin and lift the cup of 10 pennies, then the team will go redesign and retest.

## STUDENT SKILLS ASSESSMENT:

Have students (or student groups) complete THE BOTTOM LINE worksheet at the end of the game.

# Design a Windmill

## SECURITY BRIEFING –

### WORDS OF WISDOM FROM HANK THE COWDOG:

*Living on a ranch requires a lot of careful planning by the humans. Loper must think about meeting the basic needs of his animals, which includes water. On our ranch, Loper installed a windmill to pump water for us to drink, but during a Texas wind storm the windmill blades were damaged. Now, Loper needs to repair the old windmill fast because every day without water is dangerous! He is looking at redesigning his windmill to run more efficiently using wind energy. Loper needs ideas and he put me, Hank the Cowdog, in charge of rounding up some more ideas. It makes sense, I round up his cattle... but I am not real good at designing stuff, so I need your help!*

*I rounded up some materials you can use in your blade design:*

- *Aluminum Foil*
- *Cardstock*
- *Copy Paper*
- *Tissue Paper*
- *Popsicle Sticks*
- *Foam Sheet*
- *Tape*
- *Glue*
- *Stapler*

### ACTIVITY INSTRUCTIONS:

*Your challenge is to design WINDMILL BLADES capable of turning in the wind and lifting a load from the ground to the top of the windmill.*

1. *First, each student is given 1 minute to plan and draw a WINDMILL BLADE design on a blank sheet of paper.*
2. *After time is up, group members will share their WINDMILL BLADE designs with one another.*
3. *Together, your group will decide which elements from each member's design will be used to create a final WINDMILL BLADE group design. (All members of your group must have a design contribution to the final blade design to have your plan approved by your teacher.)*
4. *After your plan has been approved, retrieve your windmill base and begin creating your WINDMILL BLADES out of the provided materials. Assemble your windmill to test your BLADES.*
5. *Test your WINDMILL BLADES with the electric fan. Use THE BOTTOM LINE worksheet to record data on different materials used in your design or redesign.*
6. *If your design isn't successful in turning or lifting the load, you must work together as a group to troubleshoot where the problem may be. A redesign may be necessary.*
7. *Refine and test your group's WINDMILL BLADE design until it successfully turns and lifts the load.*

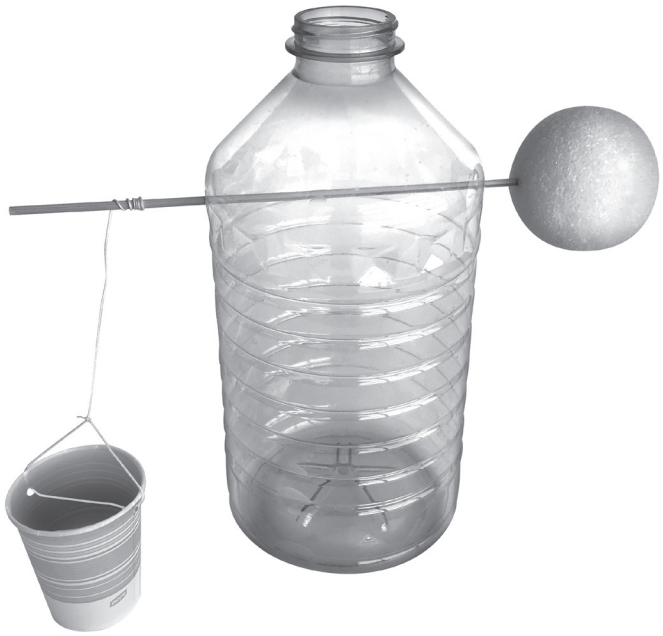
### WRAP UP:

*Fill out THE BOTTOM LINE worksheet after you have completed the activity.*

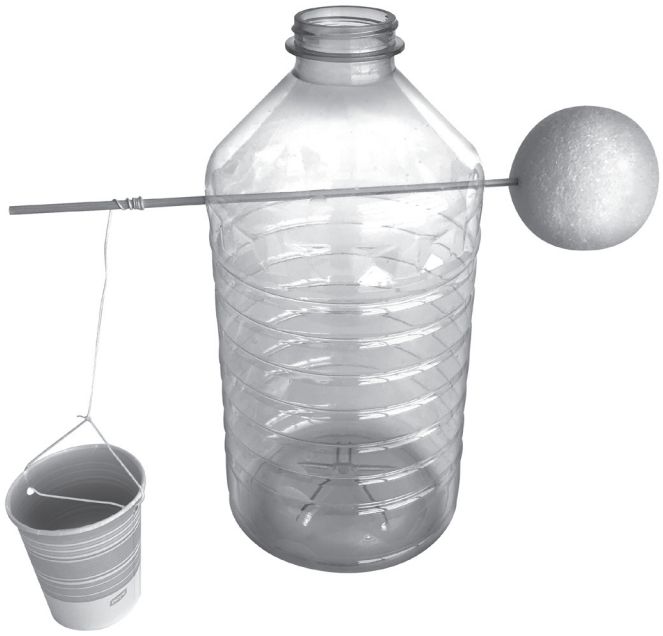
# Design a Windmill

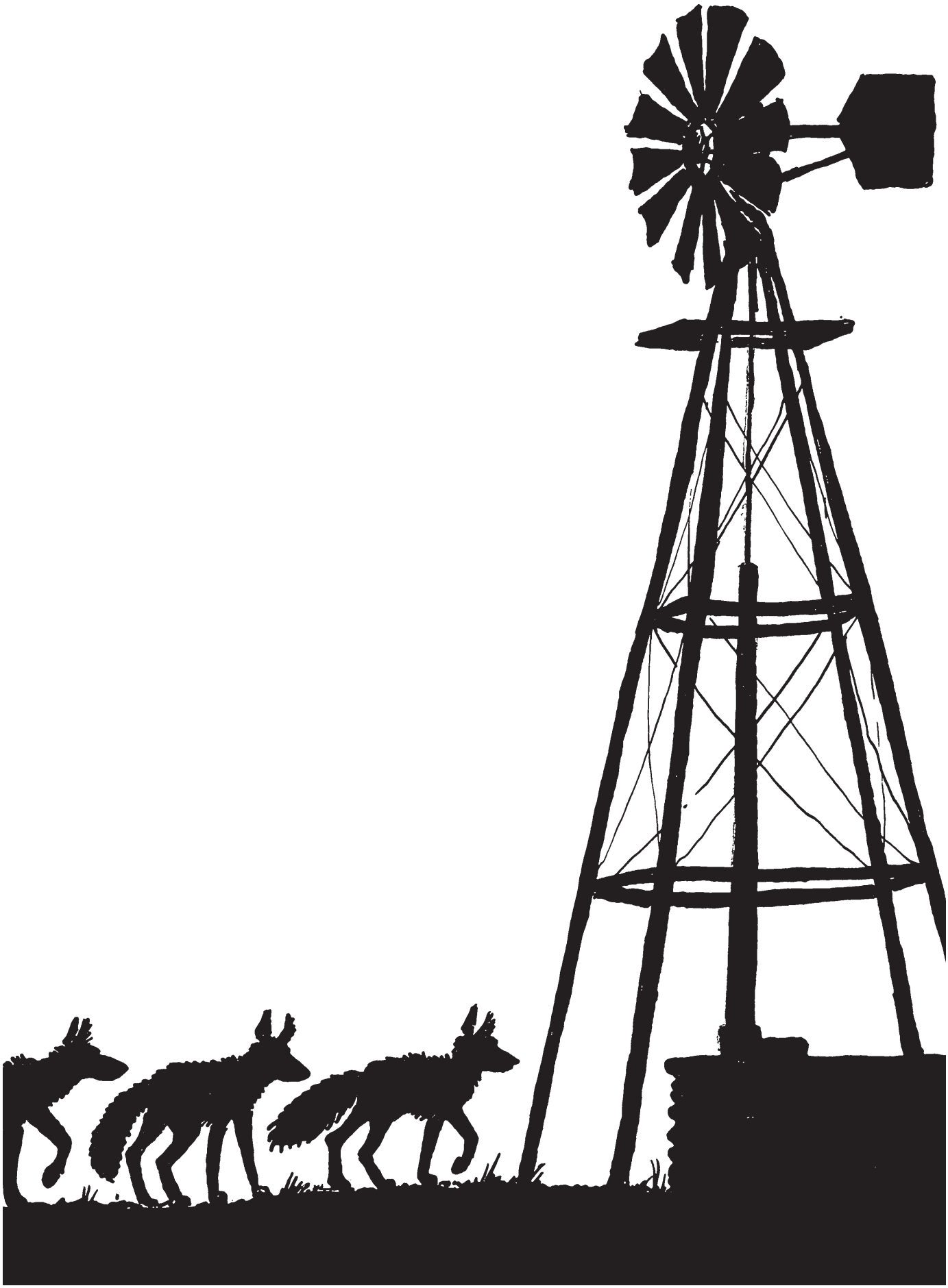
Your challenge is to design WINDMILL BLADES capable of turning in the wind and lifting a load from the ground to the top of the windmill.

**WINDMILL BLADE DESIGN** *(Individual):*



**WINDMILL BLADE DESIGN** *(Group):*





# Design a Windmill

NAME: _____ DATE: _____

## THE BOTTOM LINE

Now that your group has completed the WINDMILL BLADE design for your windmill, it is time to put your design to the test. Complete the chart below with information about your windmill blades. Remember, for your design to be successful, it must be able to lift a load to the top of the windmill so Loper can throw his tools in the bucket when making repairs.

*Enter the data in the chart. Answer the questions below.*

| WINDMILL BLADE DESIGN - DATA COLLECTION CHART | | | |
|---|---|---|---|
| Materials | Physical Properties | | Successful? |
| | BENEFIT(S) | DRAWBACK(S) | |
| | | | ❑ Yes ❑ No |
| | | | ❑ Yes ❑ No |
| | | | ❑ Yes ❑ No |
| | | | ❑ Yes ❑ No |

1. What problems did your group encounter during the design process and how did you work through your issues?

2. What would be the benefit of using wind power on a ranch?

3. What limiations might a ranch have in using wind power?