

Wind Can Do Work

Question

- What is the maximum load that can be lifted all of the way to the top of the windmill shaft?

Materials

- 4-Blade Windmill Template
- 1 Extra-long straw
- 1 Small straw
- Masking tape
- 50 cm String or thread
- Paper clips
- Large foam cup
- 2 Straight pins
- Binder clip
- Fan
- Ruler
- Hole punch
- Marker
- Scissors

Procedure

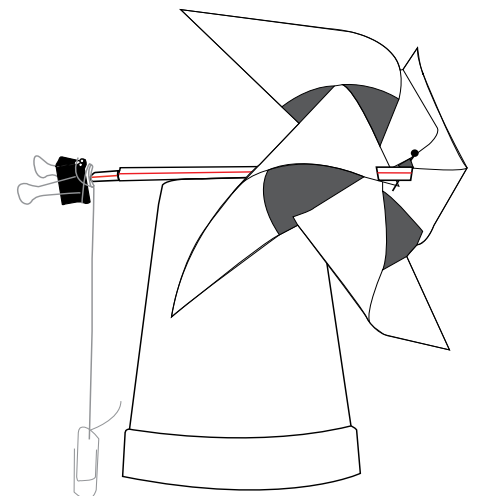
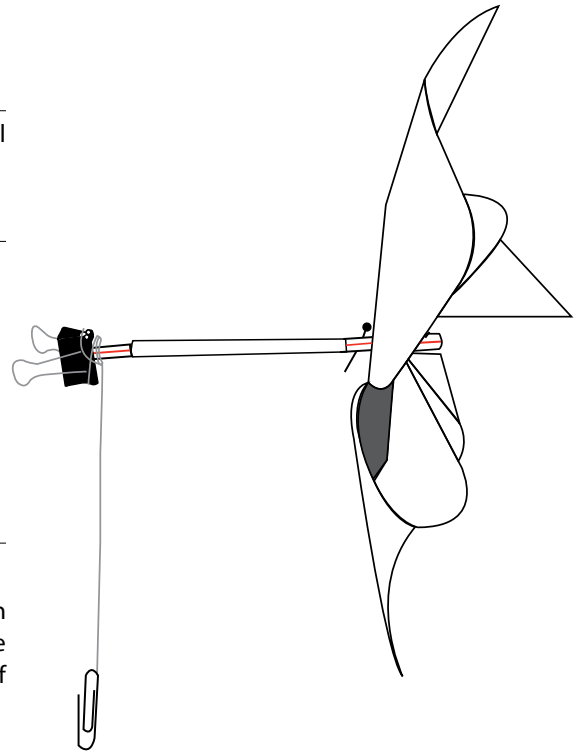
1. Turn the cup upside down.
2. Cut the longer straw so that you have an 8 cm length. Share the other portion with another student or group, or discard it. Tape this straw horizontally to the bottom of the cup (which is now the top) so that there is an equal amount of straw on both ends. Set this aside.
3. Prepare the windmill blades using the *4-Blade Windmill Template*.
4. Measure 1.0 cm from the end of the small straw and make a mark. Insert a pin through the small straw at this mark. This is the front of the straw.
5. Slide the small straw through the windmill blades until the back of the blades rest against the pin. Gently slide each blade over the end of the straw. Secure the blades to the straw using tape, or another pin.
6. Insert the small straw into the larger straw on the cup.
7. Tape the string to the end of the small straw. Tie the other end of the string to a paper clip. Make sure you have 30 cm of string from the straw to the top of the paper clip.
8. On the very end of the small straw near where the string is attached, fasten a binder clip in place for balance and to keep the string winding around the straw.
9. Slide the small straw forward to bring the binder clip next to the larger straw. Place a second straight pin through the small straw at the other end of the larger straw. This will keep the blades away from the cup while still allowing them to move and spin.
10. Place your windmill in front of the fan and observe. Record observations in your science notebooks.
11. Investigate: Keep adding paper clips one at a time to determine the maximum load that can be lifted all of the way to the top. Record your data.

Conclusion

Draw a diagram of the system. Label the energy transformations that occurred in order for work to take place.

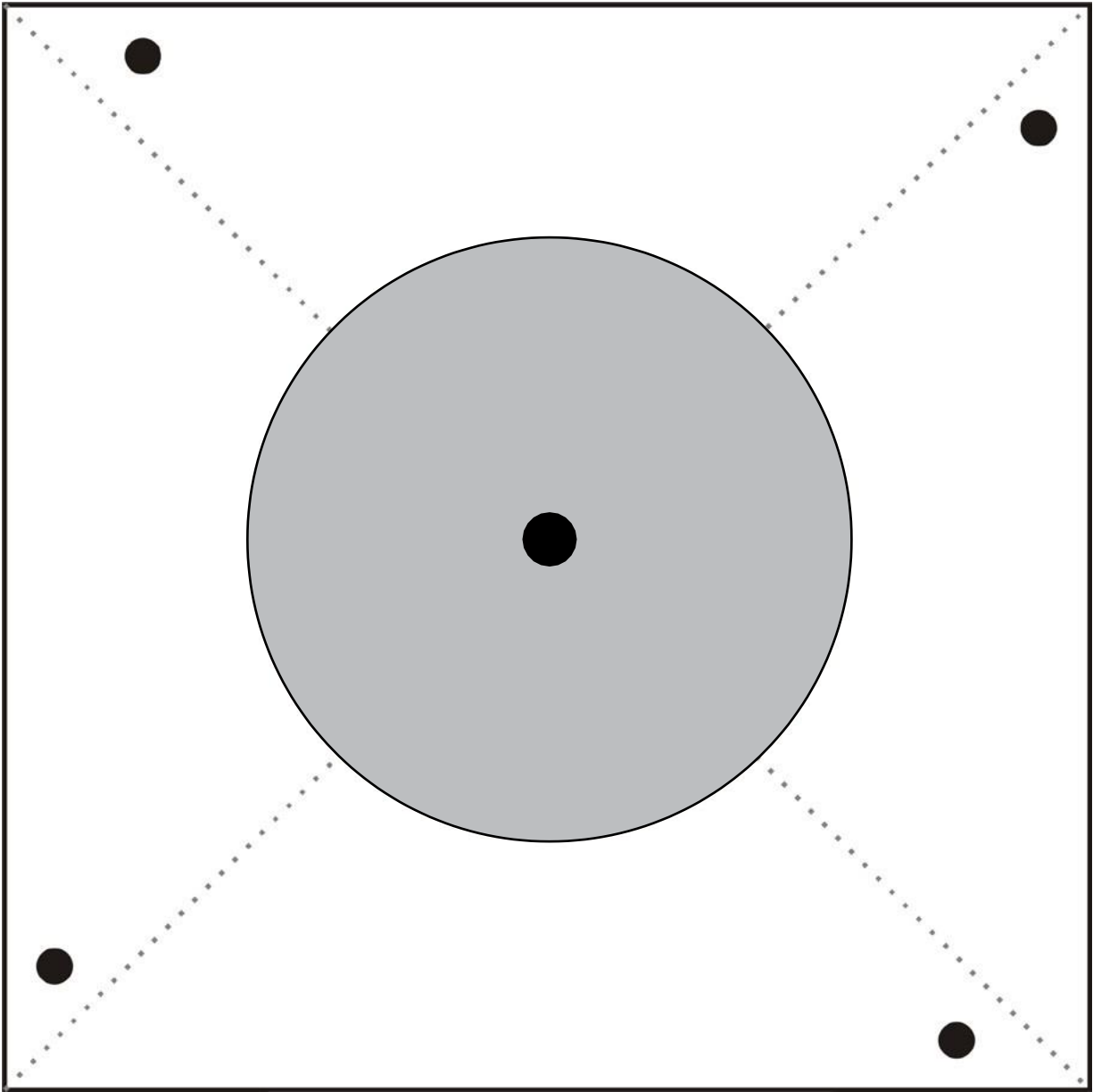
Extensions

- How could you change the design of your windmill to produce more work from the system?
- What variables can you change in this investigation? Create a new investigation changing one variable at a time.



4-Blade Windmill Template

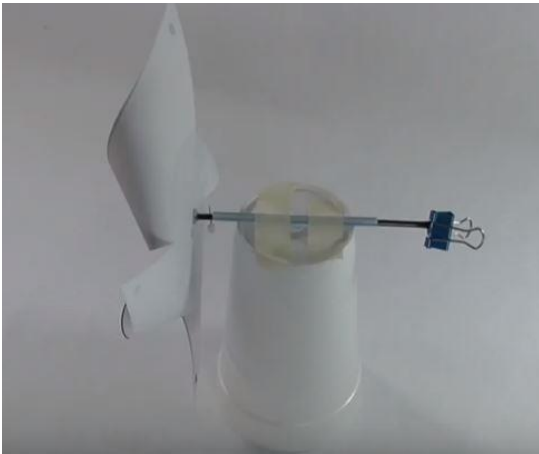
✓



Don't have all the prescribed materials? Did you complete the activity as-is and think your kids are up for an added engineering & design challenge? Create a Wind Weightlifter design challenge using only the prompt (attachment 9) and *removing the step-by-step instructions!* Sample "teacher's cheats" and suggestions of alternative materials are provided!

Check out NEED Educator Rob's Wind Can Do Work Challenge EdPuzzle video on [YouTube](https://www.youtube.com/watch?v=7eNmu08A7-Y&feature=youtu.be). His video gives a brief intro to wind, and a video step-by-step of the project. For older and more math-capable learners, stick around to the end of the video to learn how to calculate how much power (in watts) your paper-based turbine is capable of providing! Students can determine the actual power rating of their model, much like power ratings of the giant, wind turbine generators they see outside!

<https://www.youtube.com/watch?v=7eNmu08A7-Y&feature=youtu.be>



Click image for step by step tutorial