

ADDITIONAL DOCUMENTS

Teacher's Guide to Windmill Experiments

This information should help you guide students, deal with the range of materials that may be available, and ensure that experimental results are reasonably consistent:

- Bottles collected for windmill towers can vary in size and shape; note that half-liter bottles may be too short (for the provided pinwheel template) and two-liter bottles may be too stout (for the length of the straw pinwheel shafts).
- The two-straw shaft design takes into account that holes students cut in the bottles are typically too rough for a straw-shaft to spin smoothly. Alternatives include the teacher using an electric drill to make all the holes in advance, and making slightly over-sized holes and using masking tape to create smooth edges.
- Heavy thread is best. String or yarn creates too much bulk as it winds around the shaft.
- Heavy paper (such as Astrobright paper) or light cover stock is superior to lightweight bond. Fans can be used in lieu of blow dryers, but you will need to experiment yourself with the specific fan(s) available and establish the distance at which students should place their windmills. (Too much "wind" will allow the windmill to lift 10 pennies as easily as one.) Actual wind outside will vary too much.
- If you have a blow dryer for each team of students, there is no need to weight the windmill towers/bottles with water or sand. Instead, masking tape can be used to secure them to the edge of the working surface.
- If students are taking turns with blow dryers, be sure any given team always uses the same dryer. Differences between dryers would interfere with consistent results.
- If the thread tends to wind toward and slip off the end of the straw as pennies are lifted, students may not have made the slits through which the string is tied deep enough. Also, students can gently and briefly tap the string with a finger to start it winding back toward the bottle. Alternately, they can affix a brass paper fastener to the end of the straw, with each prong through a tiny slit and the prongs splayed out.
- If you wish, students can experiment with lifting other objects. A hand-held hole-punch can be used to make holes in a small polystyrene cup, which can then be tied to the string as a carrying basket. Note, for comparing the time required to lift a variety of objects, a bar graph is more appropriate than a line graph.