

**The Messy Meter**

Recommended Grades:  
**Pre K - 2**

Estimated Time:  
**30 minutes**

Subject:  
**Mechanical Engineering**

## WHAT YOU'LL NEED

### PANTRY STAPLES:

- Cardstock or construction paper (thicker is better)
- String (cotton or poly is best)
- Paper Clips
- Rubber bands
- Scissors
- Tape
- Large disposable cups (Rec 16oz) or Round Oatmeal container
- Small disposable cups (Rec 6oz)

### SPECIALTY SUPPLIES:

- Large Straws
- Small Straws (not bendable preferred, wood skewer or a pencil can also be used)

### Optional Add-Ons:

- Hole punch
- Box fan or blow dryer
- Crayons, markers or other materials to decorate their windmill
- Stopwatch or timing device
- Pennies

## How Can We Use Wind to Lift a Load?

This experiment introduces youth to mechanical engineering and wind power. They will learn how wind can be converted into energy. In this activity youth will build a simple windmill and use it to power a pulley system to lift a bucket.

### STEPS

There are lots of different ways to engineer your windmill machine. The Steps for the basic pinwheel machine are below. For older youth let them try reverse engineering their designs from the picture and experiment with their own ideas:

1. Use the attached windmill pattern or cut out a 6.5" by 6.5" square.
2. Mark the center of your square and cut from the corners diagonally towards the center of the square, stopping about 1.5" from the center point.
3. Use scissors or a holepunch to make a hole in the center and at the end of every other one of your 8 corners. The hole should be large enough for the small straw to fit into.
4. Push the small straw through the center of your square and then bend (don't fold) each of the corners onto the straw.
5. Secure the front and back of the pinwheel with tape, a paperclip or rubber bands to keep the pinwheel together. There should be about an inch of space between the front and back of the pinwheel.
6. Cut the large straw so that it is equal in length to the bottom of your large cup and secure it there using tape.
7. Slide the end of your small straw through the large straw on your base. There should be about 1.5 inches of the small straw that extends past the base. You can trim the small straw if needed.
8. Take your small cup and cut two holes in opposite sides and tie a small piece of string between the two holes, creating a sort of bucket handle.
9. Secure one end of your string to the end of the small straw and tie the other end to the small cup handle.
10. Place tape or a binder clip on the end of the small straw to keep the pieces together.
11. Now blow on your pinwheel and watch it lift the small cup!

**Bonus Fun:** Have youth add in one penny at a time to see how much their windmills can lift.

### Questions to Engage Youth:

- What improvements or adjustments might make your design work faster or make it stronger?
- What is the maximum number of pennies your machine can lift?
- How long does it take your machine to lift the cup? What about with four pennies or eight?

### Explanation:

Wind has been used as an energy source since at least 3,000 years ago in Persia (modern day Iran) in the form of windmills. There are many modern designs but the underlying design principles haven't changed. The wind pushes against the blades and turns a center shaft. In the past, the shaft is connected to a pump or to a millstone used to grind grain. Today, the shaft is often connected to a generator that collects energy and transmits it to the local power grid, these are called wind turbines. Both the millstones and wind turbines are examples of simple, wheel and axle machines just like the machine you built! Wheel and axle machines are the foundation of many other mechanical inventions, like the bicycle.

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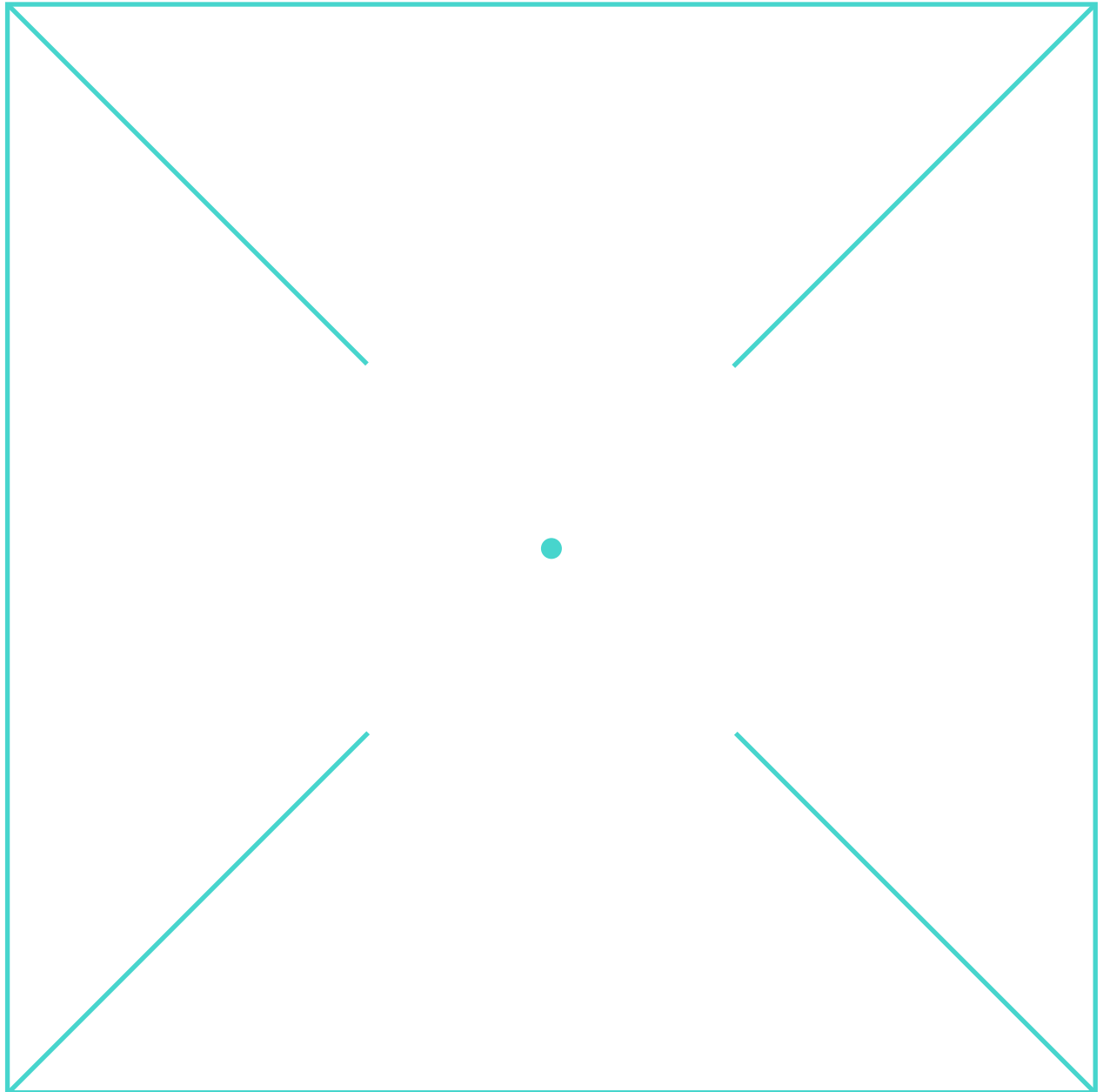


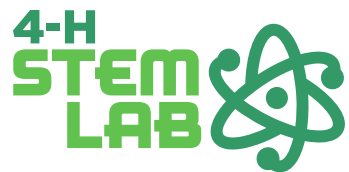
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**PINWHEEL TEMPLATE:**





# Lab Notebook

ACTIVITY NAME:

DATE:

*NOTES:*

