

Mini Marble Run

It's all downhill!

Introduction:

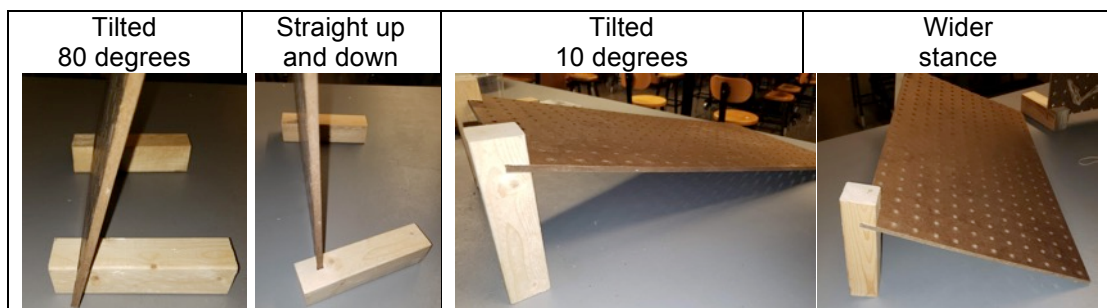
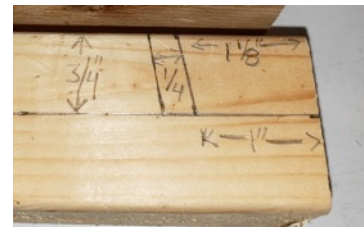
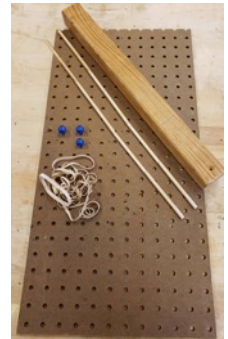
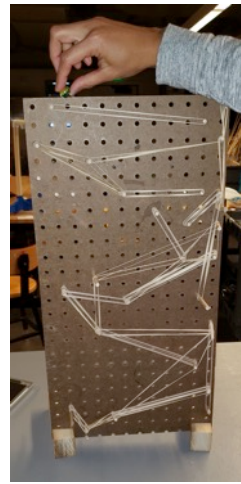
Build a mini marble run that is cheap and easy to assemble as well as easy to store. Hours of fun!

Tools and Materials:

- 1 foot x 2 feet x $\frac{1}{4}$ inch piece of tempered pegboard with $\frac{1}{4}$ inch holes (might be cheaper if bought in a 4 feetx8 feet sheet)
- Total of eight feet of $\frac{1}{4}$ inch wooden round dowels
- Two 6 inch long pieces of 2 inch by 2 inch wood
- A large assortment of rubber bands
- Saw (hand saw, band saw or table saw)
- Ruler
- Marbles (3 or more - you will lose some!)
- Electric pencil sharpener

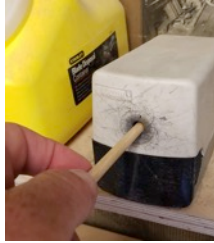
Assembly:

1. Cut your pegboard into a rectangle of 1 foot x 2 feet.
2. Make support legs from the 2 inch x 2 inch pieces. These legs will also allow your pegboard to stand in multiple ways.
 - a. You will need to make a $\frac{1}{4}$ inch wide, $\frac{3}{4}$ inch deep groove (dado) in each wooden block.
 - b. The grooves will need to be cut at an angle of 10 degrees (One way to make this angle is to off-set the cut by $\frac{1}{8}$ inch (or about 3.3mm).
 - c. The toe of the groove should be about 1 inch back from the end of the wooden block
 - d. Make sure the grooves in each block are wide enough, but also snug enough to firmly hold the pegboard.
 - e. Once cut, there are many ways to support the pegboard.



3. Cut dowels to produce a minimum of 24 shorter length pieces

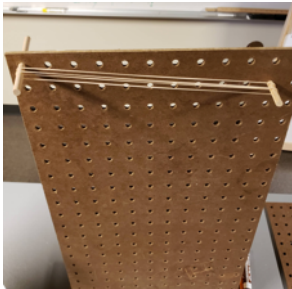
- a. Cut dowels in a variety of lengths, from 2 inch to 4 inch.
- b. Taper and clean off the ends of the dowels by briefly inserting them into an electric pencil sharpener. This will make insertion into the pegboard easier.



To do and notice:

The basic goal is to make your marble travel down your device in an interesting way. Many other goals, rules or challenges can be added.

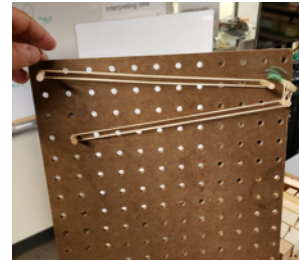
To begin, insert two pegs into the pegboard several columns apart. One peg should be situated in a row lower than the other.



Connect these pegs to each other with two parallel rubber bands. The rubber bands will act as rails that guide your marble downward. They should be roughly $\frac{1}{4}$ inch to $\frac{1}{2}$ inch apart. At the bottom of this run of parallel rubber band, try adding another rail system that will allow the marble to continue its journey downward.

This next rail system might entail having the marble change direction or speed. Bouncing the marble off of another rubber band might

help it continue its travels. Just make sure the marble or marbles stay on the device. By trial and error, experiment and redesign your device to create an interesting path for your marble to run.



What's going on?

Lifting the marbles up to the top of the run (against gravity) gives them potential energy. Releasing the marbles and allowing them to roll downhill, hopefully with some interesting twists and turns, makes your device fun to watch. However, in the end, your marbles are just converting potential energy into kinetic energy (and heat).

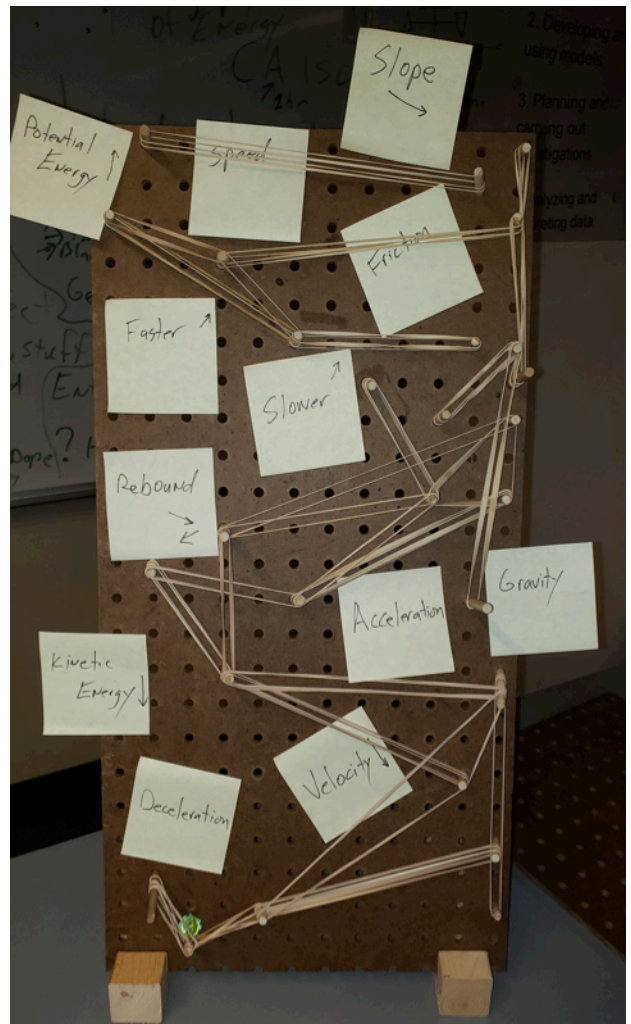
Going further:

- Try other materials to make your marble run. Go beyond pegs and rubber bands. Be creative.
- Make this into an engineering challenge:

- Can you make a run that takes a long time for the marble to reach the bottom?
- How slow can it go?
- Do some kinematics
 - What's the average velocity of your marbles?
 - Did they accelerate or decelerate?
 - Can you come up with a set-up that will store and release energy as the marbles journey downward?
 - Can you make marbles travel upward?
- Is there a way to make multiple balls roll in various ways and at various times?

Teacher Tips:

- This activity can be used as anchoring phenomena to begin a unit on forces and motion.
- Try annotating your Mini-Marble Run to get interest in topics. Have students use vocabulary words or concepts that they've heard and can investigate.



This project is adapted from:

<https://www.eliwhitney.org/7/workshop/projects/rube-goldberg-challenge>