Magnetic Marble Run

Category: Physics: Force & Motion

Type: Exhibit

Rough Parts List:

1	Magnetic chalk board or white board, refrigerator or file cabinet
	Magnets, many small ceramic ones
	PVC pipe, cardboard tube, or plastic tubing
	Plastic bottles, cups, or jars
	Marbles
	Tacks
	Masking tape

Tools List:

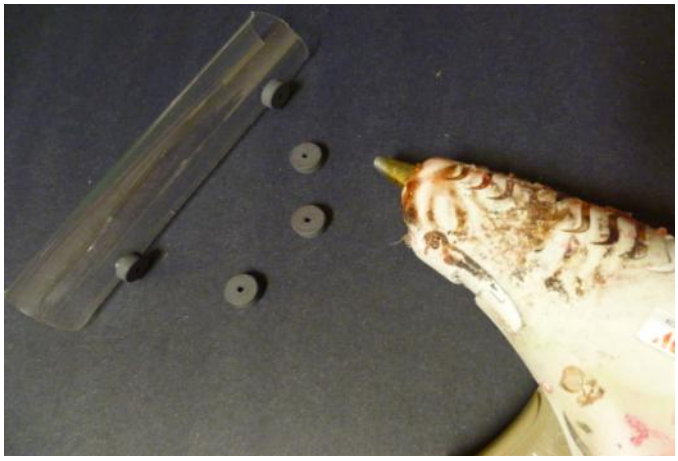
Scissors
Hot glue gun
Nail
Small saw or shears

Video: www.youtube.com/user/OaklandCSW

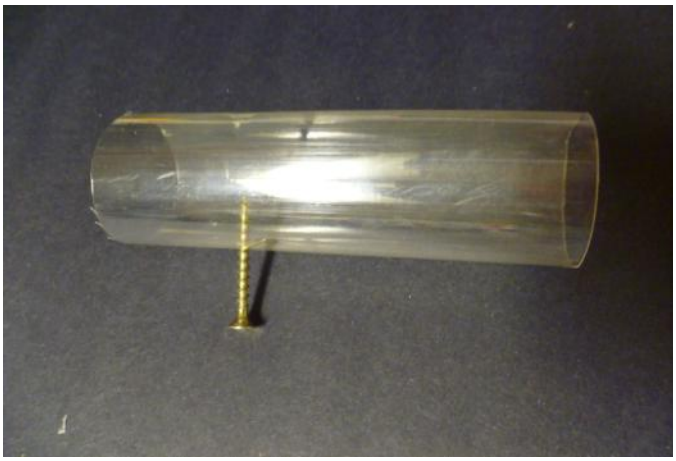
Blog Link: www.oaklanddiscovery.blogspot.com

How To:

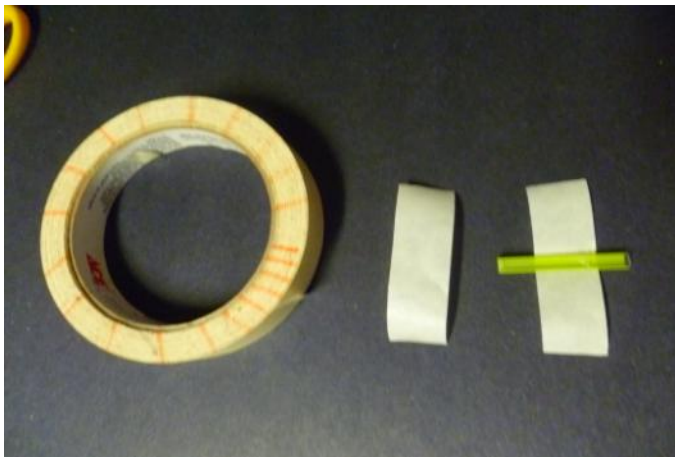
Use sheers or scissors to cut plastic or cardboard tubing in half lengthwise to create basic ramps.



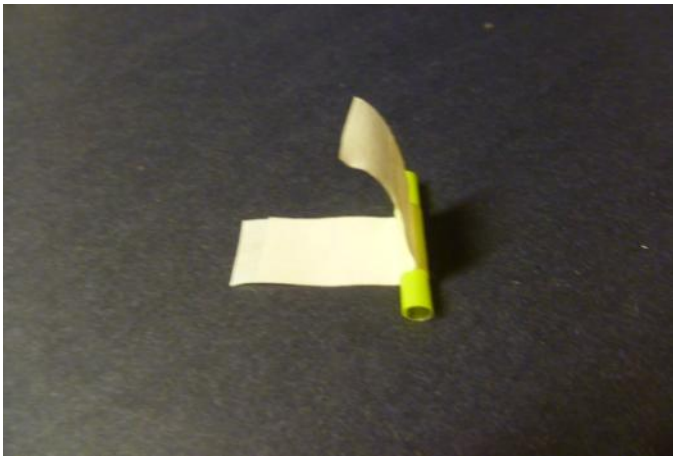
Hot glue magnets to the back of the marble ramps so they will stick to the board.



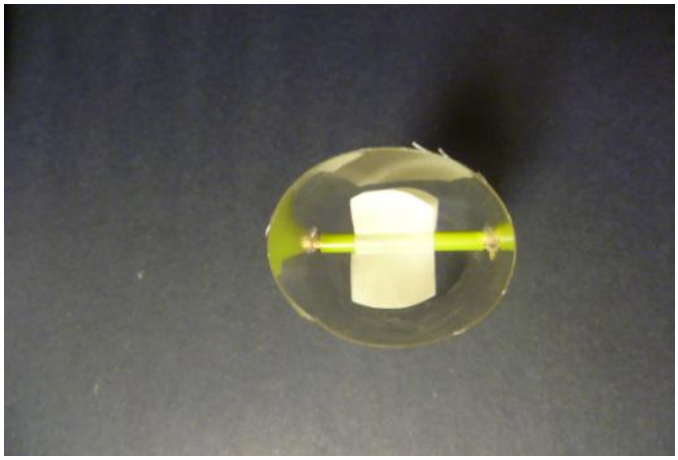
To make a pinwheel tube, use a nail to poke two small holes opposite each other in a complete tube.



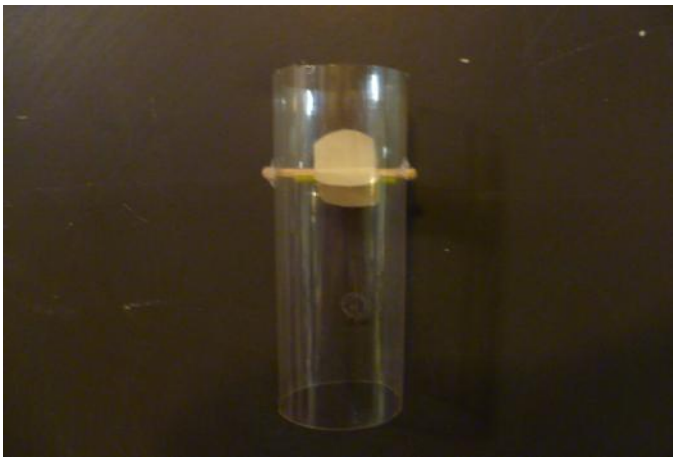
Cut a drinking straw to a length slightly smaller than the diameter of the tube. Cut out short strips of masking tape.



Fold and press the masking tape pieces into spokes around the straw. Trim them with scissors

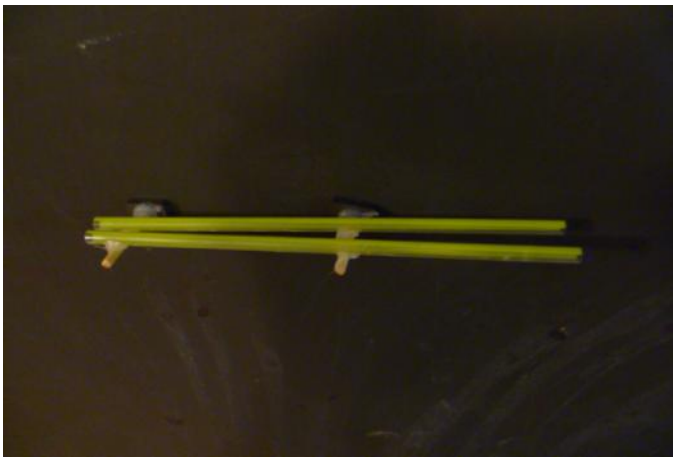


Hold the pinwheel inside the tube using a small piece of skewer through the holes.

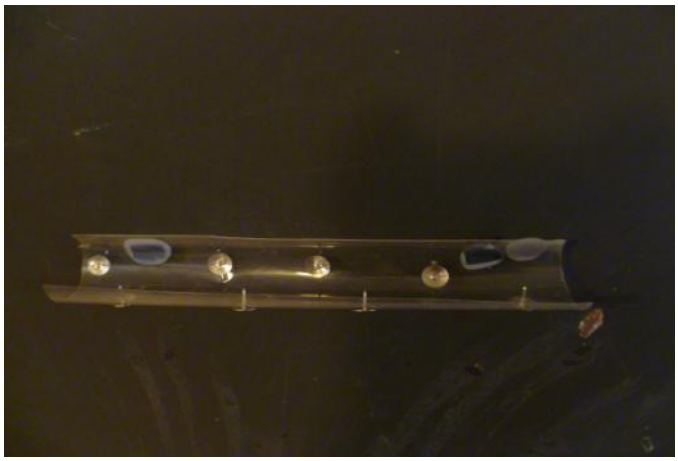


Glue magnets to the back and use this piece vertically.

Glue magnets to cups and containers to create marble traps.

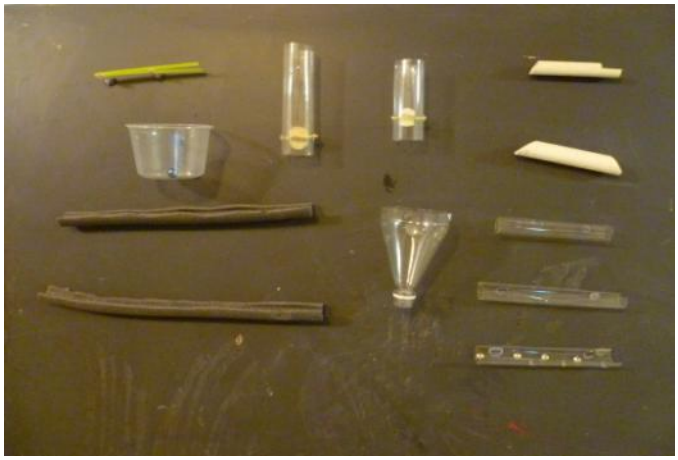


Two straws in a V shape will move a marble along even when it is parallel.



Add tacks, sandpaper, or even streaks of hot glue to a plain ramp to create obstacles for the marble.

An upside down top of a soda bottle can make the marble spiral downwards.



The more pieces you make, the more complex the run can be. Arrange and rearrange the pieces to create different marble runs!

Fine Points:

→ Be creative! How many different pathways and obstacles can you make? What items can you reuse as building materials?

→ Keep in mind that the marble runs down the course much faster than you think! Keep angles low on ramps and tubes; otherwise the marble will fly right off the track.

→ Make sure to use magnets strong enough to not only hold up the object, but also to withstand the force of a marble falling onto it.

Concepts Involved:

- Gravity is the attractive force between two objects.
- Friction is a force in the direction opposite to movement.
- Motion is a change in position over time.
- Momentum refers to how much mass is moving and quickly it is moving.

Focus Questions:

1. On which surfaces do you think the marbles will move the fastest? The slowest?

2. If you were to add different textures – like sandpaper, bubble wrap, foil, and plastic wrap – to some of the tubes and ramps, how do you think it would affect the motion?
3. What do you think causes the marble to roll down a ramp?

Elaboration:

The marble is pulled down the ramp by gravity. Gravitational force is an attraction between the marble and the earth. The marble wants to get as close as possible to the earth. Since the earth is much more massive than the marble, you don't notice the earth moving toward it. If you drop a marble out of your hand, it falls straight down to the earth. In the magnetic marble run, the marble has to go through different sections and obstacles to get as close as it can to the earth.

The marble will speed up or slow down depending on the characteristics of the section it is on. Pipes and tubes that are nearly flat, that is, with gentle slopes, and ones with higher friction will slow down the marbles. Steep sections with low friction will speed up the marble. When an object is sitting on a flat surface, the only force acting on it is gravity, which is always downward. The object cannot move any further down on a flat surface since gravity is not strong enough to push it through the surface. When an object is sitting on an incline, or ramp, the downward force of gravity pulls it against the surface, which in turn delivers a side-ways force on the marble sending it rolling downhill.

Once a marble is rolling, it has momentum. In simple terms, the more momentum it has, the harder it will be to stop. Momentum depends on mass and velocity. Since the marbles all have nearly the same mass, the faster ones will have more momentum.

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:
1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1. Physical Sciences:

2.b Students know an object's motion can be described as recording the change in position of the object over time.

2.e Students know objects fall to the ground unless something holds them up.

Grade 8 Standard Set 1. Physical Sciences: Motion and Forces

1.e Students know changes in velocity may be due to changes in speed, direction, or both.

2.a Students know a force has both direction and magnitude.

2.b Students know when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.

2.d Students know how to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.