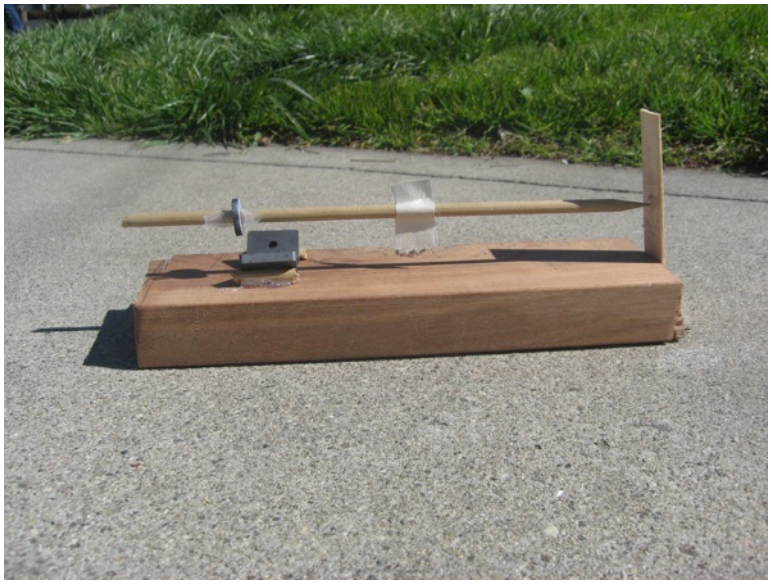
Magnetic Spinner

Category: Physics: Electricity & Magnetism

Type: Make & Take



Rough Parts List:

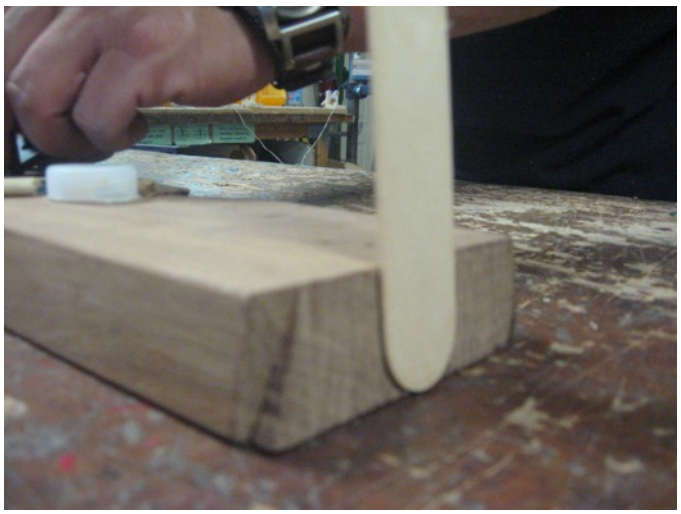
1	Baseboard
1	Dowel
2	Magnets
1	Magnet with a hole in the center large enough for the dowel to slide through
1	Large craft stick or paint paddle
1	Small piece of straw or piece of paper
	Masking tape

Tools List:

Hot glue gun
Needle nose pliers or something to cut the dowel
Pencil sharpener

Video: https://youtu.be/tuI10q47fw8

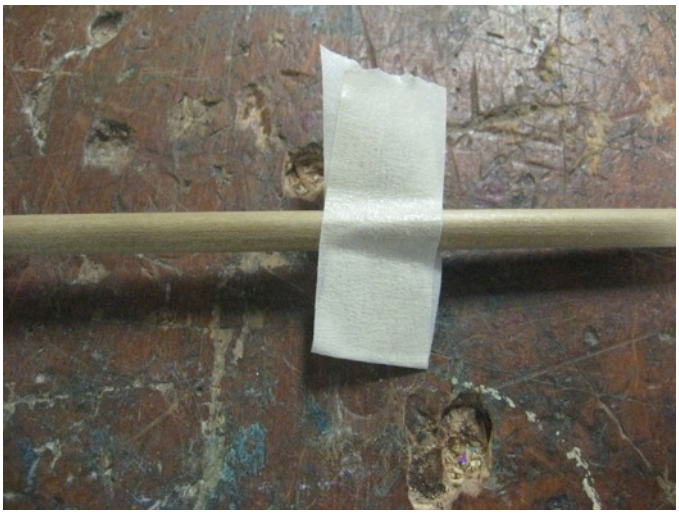
How To:



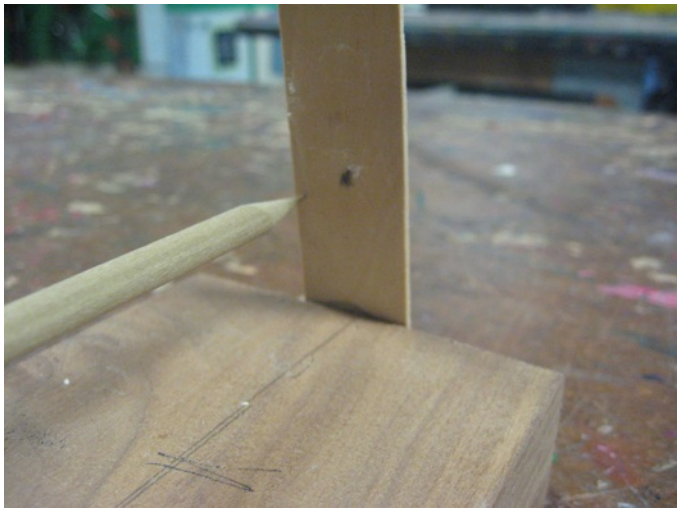
Cut about 4" of a craft stick or paint paddle. Hot glue the paint paddle to the baseboard.

Cut two 1" pieces of a dowel. Glue magnets onto the dowels. Glue the dowels to the baseboard. *Important: the magnets' faces (opposite the dowels) must push on each other. If they don't, take off one dowel and put it on the other side of the magnet then check it again.*

Cut a dowel at least 1” longer than your baseboard. Sharpen it to a fine point. Cut 1” of a straw. Insert the straw into the ring magnet then insert the sharpened dowel. The straw should hold the magnet firmly.



Decorate the dowel with a piece of masking tape.



Put the sharp point of the dowel up against the paint paddle and begin experimenting with the stick to get it to float horizontally.

Fine Points:

→ The magnet must slide up and down the dowel, but only when you push on it

→ To get the donut magnet in exactly the right spot on the dowel is quite a trick. Further, you must have the donut magnet with the right side toward the post, and you can only determine this by trying it. If you try for a while and it’s not working, remove the ring magnet, flip it around, thread it back on and try again.

Concepts Involved:

- Magnets can exert force on iron and other magnets without touching them. This is called a magnetic field.
- Magnets have two sides called north and south. Like sides push on each other, opposites sides pull on each other and both sides pull on iron.
- When something is supported by magnetic repulsion, there is very little friction. This is the way magnetic levitation trains work.

Focus Questions:

1. How can you make the magnetic spinner float higher?
2. What happens if you tip it up vertically?
3. Why do you think we had to put a point on the tip of the dowel?

Elaboration:

The shaft of the magnetic spinner is not really levitating: the sharpened point is touching the post, and spinning with very little friction. But if one were to try to replace that point of contact with another magnet or array of magnets, it would be impossible to make it levitate. (Don't take our word for it – give it a try!) This is simply the way magnetic fields behave. It can be compared to trying to balance a basketball on a racket ball. In both cases stable equilibrium is not possible.

Magnetic levitation trains and other systems that float on magnetic fields need not have a point of contact, because the magnets they use are electromagnets controlled by computers that use rapid feedback circuits to maintain balance. You can balance a basketball on a racket ball if you are holding the racket ball and changing its position fast enough to stay under the basketball.

If a magnet had only one pole, it would be called a magnetic monopole and have very different properties. No one has ever discovered such a magnet though, despite decades of searching. All known magnets, from atoms to stars, have a north pole and a south pole. The names "North" and "South" are arbitrary – the important thing to understand is that the two poles are fundamentally different. The only way to determine which pole you are dealing with is to expose it to a known pole of the same type and witness it repel. If it attracts a known pole, you may have the opposite pole of a magnet, or you may have a bit of iron. If you have two identical objects that attract each other all from all sides – not repelling at all – it is impossible to know which one is the magnet without bringing in another magnet.

Stronger magnets will make the spinner float higher. If you tip it towards vertical, it should work until it falls over. If you stick the shaft in a cup and put magnets all around the rim, it works fine vertically. The point on the tip of the stick minimizes friction as it spins.

Links to k-12 CA Content Standards:

<u>Grades k-8 Standard Set Investigation and Experimentation:</u>
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.

<u>Grades k-12 Mathematical Reasoning:</u>

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:
1.1 Use estimation to verify the reasonableness of calculated results.
1.2 2.2 Apply strategies and results from simpler problems to more complex problems.
1.3 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.