



Teacher's Guide for:
Magnetic Pendulums

Note: All activities in this document should be performed with adult supervision. Likewise, common sense and care are essential to the conduct of any and all activities, whether described in this document or otherwise. Parents or guardians should supervise children. Rock-it Science assumes no responsibility for any injuries or damages arising from any activities.

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Title Page of Video

(Numbers in the text are **time codes**, so you can refer back to the video.)

[00:03;09]

Magnetic Pendulums
filmed July, 2009

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Releases have been obtained for all students who appear in this video, but their images should not be used publicly unless their nametags are rendered unreadable and their names are bleeped from the audio track.

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Intro Quick Recap

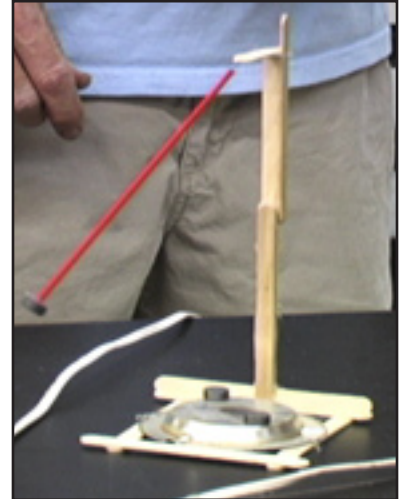
Lesson Intro:

- Show students the giant magnet and ask what the ball is made of (but don't tell them that it's steel until after testing the materials).
- Show students various materials, ask whether it will stick to the magnet, then test it.
- The only one that sticks is steel. (Stainless sample doesn't stick, but other kinds of stainless do.)

Experiment Quick Recap

Experiment: Build a Magnetic Pendulum

- Show students a sample of a magnetic pendulum. Place a few magnets on it and show them how they make it move in weird ways.
- Pass out supplies and let students build their tower any way they want.



Equipment List: "Magnetic Pendulums"

Items needed for Instructor:

- Large Horseshoe Magnet on stand (RIS item)
- Strips of different magnetic and non-magnetic materials
- Power strips for glue guns
- Scissors

Items needed for Students:

Consumables (per students):

- Magnets, 1/2" disc (4 per student)
- Straw, thin plastic
- Thread, about 1 ft.
- Ash tray, metal
- Craft sticks, about 20-30 per student
- Glue sticks

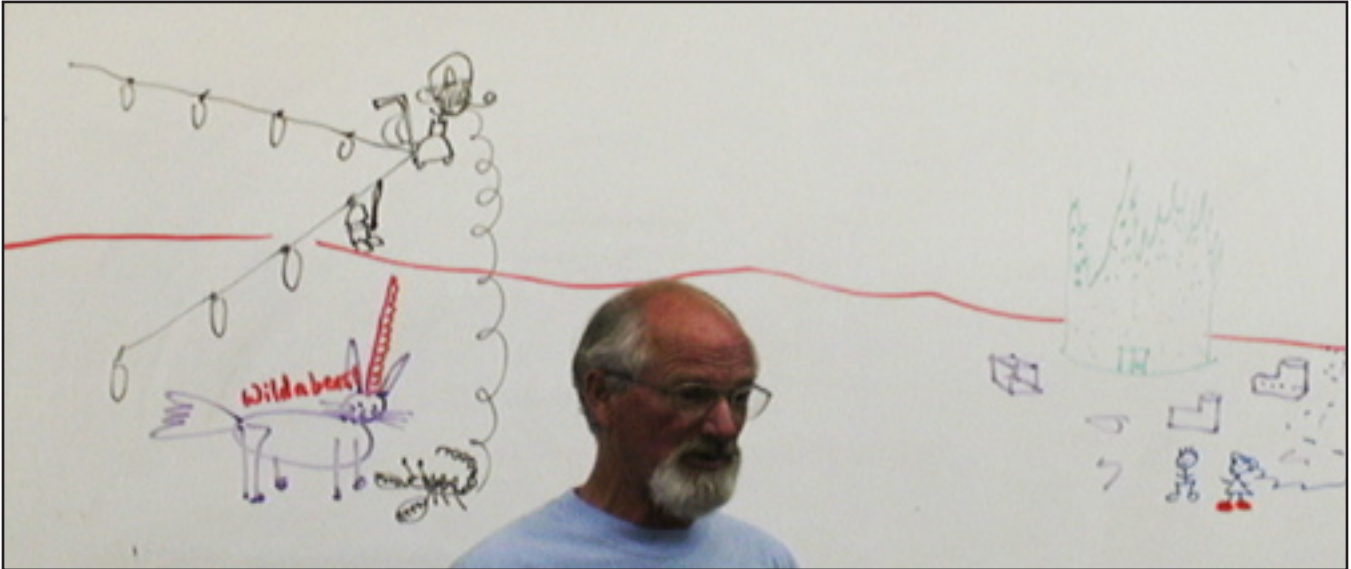
Other:

- Glue Guns
- Markers, permanent, colored

Prep Work:

- Cut thread to 1-ft lengths

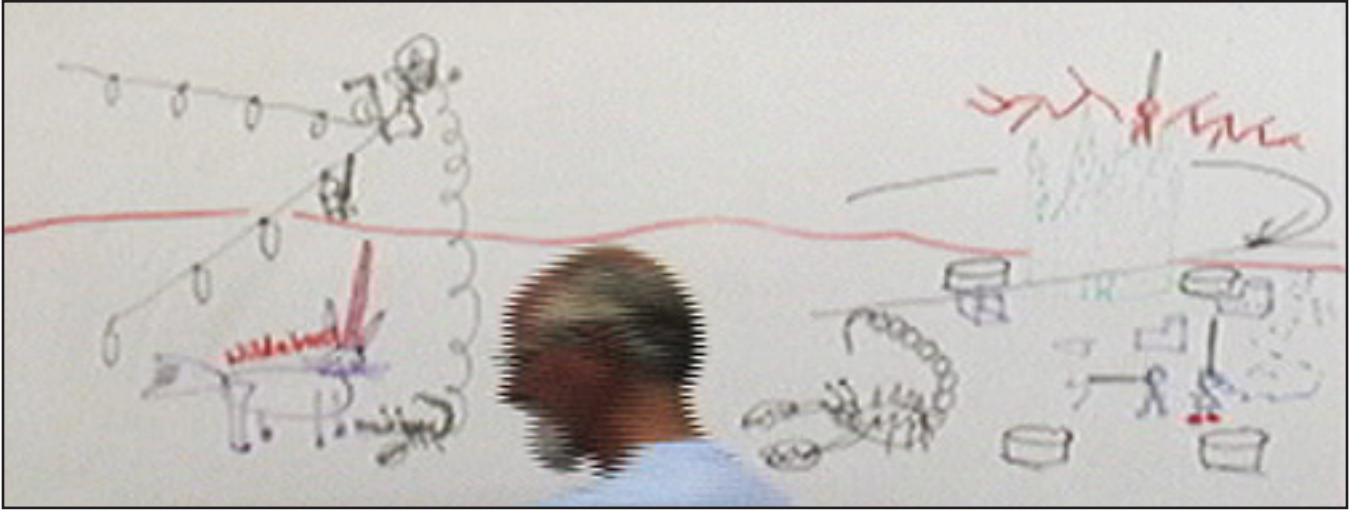
Story Quick Recap



Part 1:

- Evil Mister Fred wants to fight like the Red Baron, with other planes around him.
- He puts steel army helmets on his minions and attaches them to a pair of ropes that he pulls behind him on his flying vacuum cleaner.
- He flies over a herd of wildebeasts so the minions can practice bonking them on the head with their baseball bats as they fly over.
- The wildebeasts are eating scorpions, and when the wildebeast gets hit by a minion, it jerks its head up and the scorpion flies into the air and stings Evil Mister Fred in the face.
- Evil Mister Fred starts wearing a football helmet with a screen on the front to protect his face from scorpions.
- Then he goes to the Emerald City, where the poor people live outside the city walls in old shoes or cardboard boxes. Jack & Jill live with the poor people.
- Evil Mister Fred keeps swooping overhead with his minions, and everybody keeps getting bonked.

Story Quick Recap (cont.)



Ending:

- Jack and Jill call the Acme Store of Everything and order a giant scorpion.
- They try to train the scorpion to reach up and sting Evil Mister Fred, but he always steers clear of the scorpion when he's flying around bonking people.
- Jack and Jill call the Acme Store of Everything and order some giant magnets that they put under the ground.
- When Evil Mister Fred comes by the next time, he bonks the Wizard of Oz, who is standing on top of his castle in the Emerald City.
- The Wizard starts shooting lightning bolts, so Evil Mister Fred is distracted.
- As he flies by, the minions' steel helmets are attracted to the magnets and they get stuck.
- Evil Mister Fred keeps revving his vacuum cleaner to try to free the minions, but the rope breaks.
- Evil Mister Fred goes flying right into the path of the scorpion, who stings him.

Transcript: Introduction

[01:00:11;02] Okay, what's the ball made out of? [Student: Copper.] Copper. We have a vote for copper. Do we have a vote for any other metal? [Student: Titanium.] Titanium. How about another one? [Student: Steel.] Steel. Other metals? [Student: Iron.] Iron. Any other votes? [Student: Bronze.] Bronze. Okay, we'll find out in a minute. Let's see how far we can pull it down before it falls. So the magnet is strong about that far. It's one of the strongest magnets you can get.

We're going to take some of these. Does cardboard stick? [Students: No.] You guys are geniuses. Does wood stick? [Students: No.] There you go again -- college material. Does copper stick? [Students: No. Maybe.] Maybe no? Does it make a loud noise when it hits the table? [Students: Yes.] That's really loud. Does brass stick? [Students: No. Yes.] Yes, no, yes, no? Does it make a loud noise when it hits the table? [Students: Yes.] Does aluminum stick? [Students: No.] Does it make a loud noise? [Students: Yes.] Does stainless steel stick? [Students: No. Yes.] Okay, here goes. This was a trick question because most stainless steel that you guys are familiar with does stick. Your stainless steel spoons and pots at home, they will stick. Does it make a loud noise when it hits the table? [Students: Yes.] Oh, yeah. Does steel stick? [Students: Yes. No.] Here goes steel. So what do you think the ball is made of? [Students: Steel.] Steel. Yeah, steel is like 99+ percent iron, the rest is carbon. So the ball happens to be steel. Okay, we just wanted to check if you remembered any of that stuff.

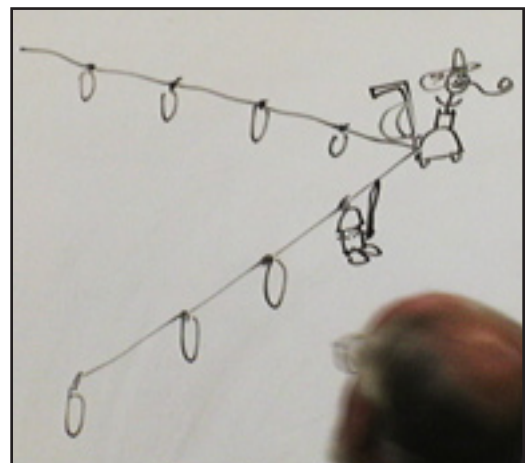


Which Metal will Stick?

Story: "Evil Mister Fred's Flying Minions"

[01:02:54;02] All right, we need a crazy story. Let's suppose that Evil Mister Fred is developing superior ways to fight wars. He studied the Red Baron. The Red Baron used to fly around in an airplane with three wings, and he'd shoot down the other guys because he was a really good flyer. The Red Baron always had other planes with him as he's flying to help protect him as he was shooting down the other guys. So Evil Mister Fred said, "Hey, I could do that."

So he took his vacuum cleaner. And he souped up his vacuum cleaner. He made it more powerful, he tied some ropes to it like this, and another rope out there, like that. So now as he's pulling it along, these ropes are trailing behind them. And he put helmets on his minions. And he's got his minions tied to the back of the the thing here, with their baseball bats. Okay, so minions there, minions, minions, minions, minions -- dangling in the air behind him as he flies. So he says, "This is a much more effective



Evil Mister Fred with Minions on the Ropes

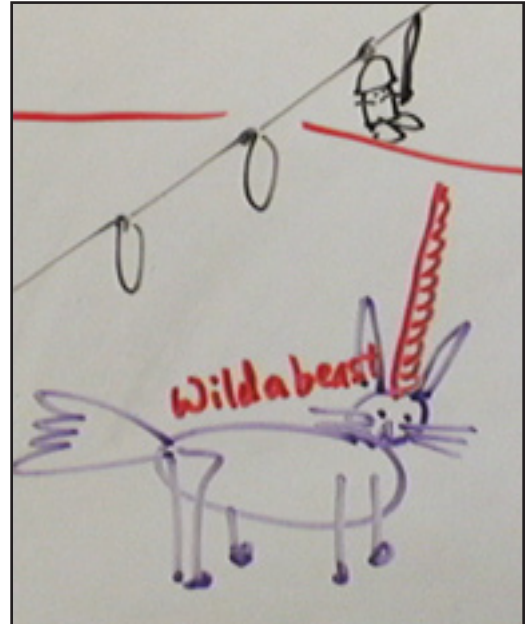
way to fight battles. Now I can swoop down with my minions right above the heads of the people and the minions can just go bang, bang, bang, bang, band, and bang on their heads as they go by.”

And he tried this out. He wanted to do it in secret, so he went out into the Serengeti Desert. And there are wildebeests out there. Know what a wildebeest is? *[Student: No.]* Good. Then I can make it be anything I want. *[Student: Something that can't fly.]* Something that can't fly, yeah. So the wildebeests are going to be wild rabbits. They have a rabbit head, they have the body of a cow, and how about the tail of a bird, and maybe they should have some horns. A unicorn horn, that would be good. There's a unicorn horn. Okay, we'll call this a wildebeast. And Evil Mister Fred said, “Now, there's a formidable enemy. He's got that sharp horn, he's got the rabbit ears, he could probably run like the wind. I'll fly over with my minions and see if they can smack him and get away without getting all tangled up.”

So he tried it out. He flew around and he came down, and the wildebeast were busy eating -- what should they eat out in Africa? *[Student: Grass. Sand. Evil Mister Fred.]* They might eat Evil Mister Fred. *[Student: Scorpions.]* Scorpions, oh! There you go. So they eat scorpions. And the scorpions have those funny tails that go up and around with a stinger on it. And they've got legs. Do scorpions have a head? Okay. Do they have antennas? *[Students: No.]* These guys have antennas. *[Student: They have claws.]* Oh, they have claws? *[Student: Pincers.]* Pincers? Okay, and they eat scorpions. So Evil Mister Fred flew right over the wildebeast. His minions were going, “Yeaayy! Go, Evil Mister Fred!” And as they flew over them, they'd just go wham, wham, wham, on the wildebeasts and would scare the wildebeasts. And a few of the wildebeasts just happened to have picked up scorpions and they went

“What”? And the scorpions flew up into the air and stuck on Evil Mister Fred's face. And now he's got stings all over his face. And he said, “Well, the experiment was a success. The minions didn't get tangled up, and they did get to hammer on the wildebeasts, but I got some scorpion stings.” So Evil Mister Fred put on his own head a football helmet with a guard on it and some screen door screens so he wouldn't get any more scorpions in his face. He says, “Now it's time to go test this out on the people.”

So he flew on further until he came to the Emerald City. There's the Emerald City. It's got a huge castle with hundreds and hundreds of apartments built into it. These are all apartment windows. And it's got an enormous door on it and a little tiny door on the front, like that. And the king of the territory lived in the Emerald City, and all the poor people lived around the outside in great big shoes. There were shoes all



A Wildebeast



A Scorpion

over the place where the poor people lived. And the poorest people of all had to live in cardboard boxes. So there are houses all over the place.

And Jack and Jill were poor. They had to live out here, like that. There's Jill. And Jill had just found brand new shoes. Jill found red shoes in the garbage, and she's got red shoes on.

And Evil Mister Fred said, "Now, for the real test. I'm going to fly my minions over the poor people out there and let them just hammer away at those guys." So Evil Mister Fred came swooping down, and his minions were all going, "Yeaaay!" And the people looked up to see what all the screaming was about, and then bang, bang, bang, bang -- they got bonked on the head. *[Student: And on the nose.]* They got bonked on the nose. So Jack has a bump on his nose. Jill's got a bump on her head, and everybody else's heads have got bumps on them. And they were all complaining, "Oh, that Evil Mister Fred -- look what he did!" And Evil Mister Fred went, "I'm not done." And he swooped around for another shot, and everyone went and hid in their boxes and their shoes until Evil Mister Fred got tired and went away.

And the next day they said, "Boy, I hope he doesn't come again." But he did. Vroommm! He bothered them all day long. Now, if you were Jack and Jill, and you wanted to stop Evil Mister Fred from doing his shenanigans, what would you do?

Imagination and Brainstorming Time

[01:10:19;27] *[Students make suggestions]* (THERE ARE NO WRONG ANSWERS! Whatever they say, you should reply: "That's a good idea," "They might do that," etc. After brainstorming, proceed with the experiments, then finish the story.)

We'll leave this To Be Continued . . .

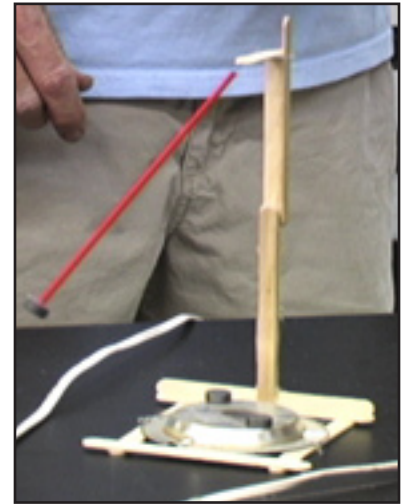


Jack & Jill at the Emerald City
with bumps on their heads.

Experiment: *Build a Magnetic Pendulum*

[[01:12:39;18] *[Instructor places a long power strip on the students' table.] [Student: More glue guns.]* Yep, we're going to do glue guns. Have you guys used glue guns? *[Students: Yes.]* Did you get extra points if you burned yourself? *[Students: No.]* *[Instructor passes out glue guns.]* When you get a glue gun, plug it into the strip.

Here's a magnetic pendulum. An ordinary magnetic pendulum just swings around, and it just swings and does what you would expect a pendulum to do. But if we put a magnet down there, it does weird stuff. If you put another magnet down there . . . *[Student: Do we get to keep it?]* Yes. *[Student: We get to keep all three magnets?]* Well, you're going to get four total, because you've got three you can put down here. Well, you can do whatever you want with the four magnets. And you can make the tower any way you want. This is just the simplest tower. You can build a rectangular tower, or a triangular tower, or whatever. We'll set that one there so you can see what it's like. While I'm passing out other stuff, we'll be giving you two magnets to goof around with while your'e waiting for the other material. You can try to make magnetic earrings, make one magnet chase the other around . . .



Sample Magnetic Pendulum



Building the Pendulums

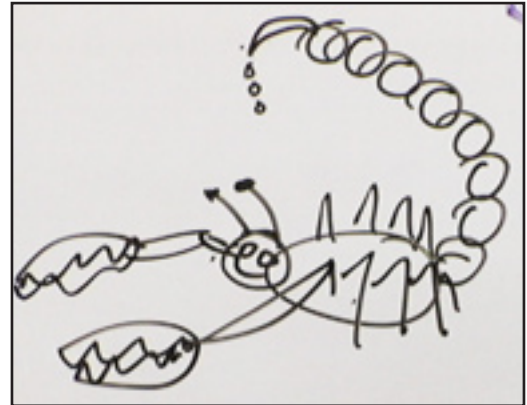
[Instructor passes out metal ashtrays, plastic straws, string, and craft sticks.] When the glue guns get warm, you can start gluing stuff together. And I should give you a red straw. Your straw is a bit longer than [the sample's] straw, so you can make your tower a little taller. It'll work better with a taller tower. And you just glue a thread to the top, and you just slide this on the thread, so it makes the thread stiffer. *[Student: And then you put a magnet on it?]* Yes. *[Students build their magnetic pendulums, experiment with the magnets in various positions, and then color them with permanent markers.]*

End of Story

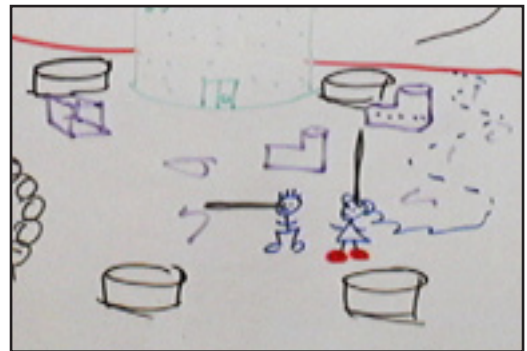
*** DO NOT * present this part of the lesson until after the experiments!**

[01:21:41;11] So Jack and Jill were trying to figure out some way to get rid of the Evil Mister Fred. And they knew he hated scorpions. And they called the Acme Store of Everything and they ordered a huge scorpion. There's a sharp spikey tail with poison dripping off of it. And I like the idea of having claws. We'll put claws on him. And he's got some legs. There -- scorpion. And they're trying to train the scorpion to reach up with his stinger and sting Evil Mister Fred when he came by. And Evil Mister Fred would fly all around and bang people on the heads and always stay away from the scorpion. So Jack and Jill said, "Ah, we have an idea." So they called the Acme Store of Everything and they ordered some huge magnets. And they put magnets under the ground. Here, there. And then, next time Evil Mister Fred came flying along, he had all his minions dragging behind him, he flew around and he was going around the city this way, like that. And the city was owned by a guy named Oz. [Student: *The Wizard of Oz.*] The Wizard of Oz. Yeah. And Oz was standing up here watching Evil Mister Fred come by, and Evil Mister Fred bonked him on the head -- bonk -- like that. And Oz says, "I'll get you, you rotten son of a gun!" And Oz pointed his finger at Evil Mister Fred and lightning shot out. But Evil Mister Fred said, "You can't hurt me. I'm in midair." Lightning bolts went pshew! pshew! -- but they couldn't hurt Evil Mister Fred.

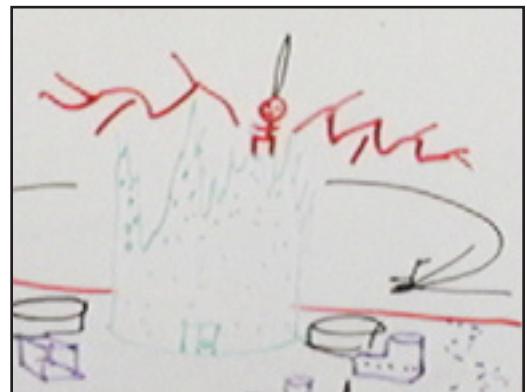
And Evil Mister Fred was trying to stay away from Oz -- lightning bolts zooming this way and that way -- and he wasn't really paying too much attention to what else was going on. He's got minions behind him and his vacuum cleaner here. And his minions were closer than he was to the ground. And they were wearing steel army helmets. And they came close, and all of a sudden Evil Mister Fred heard, "Aaahh!" Clang, clang, clang, clang, clang! His minions got stuck to the magnets. And he was pulling as hard as he could with his vacuum cleaner to try and get them off -- vrrrrrr, vrrrrrr, vrrrrr. And finally the rope broke. And Evil Mister Fred went ka-chingggg! And the scorpion said, "Oh, food!" Ka-chink! And stung him. And Evil Mister Fred did the ooh-ah-ooh-ah dance across the sky, and they didn't see him forever. And they all lived happily after, except Evil Mister Fred.



The Giant Scorpion



Magnets in the Ground



The Wizard shoots Lightning Bolts as Evil Mister Fred swoops by.

End of Lesson