



Teacher's Guide for:
Marshmallow Cannons

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.

Title Page of Video

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

[00:03;09]

Marshmallow Cannons
filmed June 23, 2009

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Introduction

[No introduction. This lesson begins with the story.]

Story: "Jack & Jill and the Magic Marshmallows"

[01:00:11;02] Once upon a time, there was a horizon. And the horizon took a bend, and came around this way, like that. And above that horizon there was another one, like that. And where this one took a bend, it was actually a tall, tall cliff, like that. And on top of the cliff there were some trees that grew marshmallows. Some of the marshmallow trees were blue, some of them were red, some of them were green, some of them were yellow, and some of them were brown.



Marshmallow Trees on Cliff with Caves near the Ocean

The brown marshmallow trees grew chocolate marshmallows, the green marshmallow trees grew grape marshmallows, the blue ones grew blueberry marshmallows, the red ones grew blood marshmallows, and the yellow ones grew banana marshmallows.

And out here was ocean, this is all ocean. And in the cliff there was lots of caves. These are the caves. The caves all connected to each other. And one day Jack and were walking, having a nice walk on the

bottom of the ocean. Here's Jack, walking along, having a good time. And here's Jill, like that. And they brought with them their friends, the Kick-Mes.

The Kick-Mes are little creatures that look like this. The Kick-Mes are always sad. They're such sad creatures, unless you kick them. And if you kick them on their target, they go "Woo-hoo," and they're happy. The harder you kick them, the happier they are. If you kick a Kick-Me into a fire, he'll burn up, and the smoke will form in the air, and the smoke will condense back into a Kick-Me, he'll bounce on the ground and say, "Do it again! Do it again!"



Jack & Jill and a Kick-Me

If you kick him into a garbage disposal, he'll get all chewed up and go down the sewer. Next thing you know -- boomp, boomp, boomp, he comes back out again, because you can't really hurt a Kick-Me.

Jack and Jill have all these Kick-Mes. And the Kick-Mes want something to do under the ocean. And Jill can talk to the animals. So she goes (whistles), and a shark comes along. And Jack and Jill say, "All right," and they go bang, bang, they kick the Kick-Mes right into the shark's mouth. He chews them all up. He doesn't like them because they're rubbery, so he spits them out, and they form themselves back into Kick-Mes again.

And Jack and Jill said, "We've got to find something better to do with these Kick-Mes." So, as they're walking along the bottom of the ocean, they come to the shore where the waves are. Huge waves are crashing against the rocks, sharp pointy rocks out here. And they kick the Kick-Mes into the rocks. And the big waves would come along and crash onto the rocks and smash the Kick-Mes. And the Kick-Mes said, "Woo-hoo!" They liked that. So there's Kick-Mes all over the place. Then the Kick-Mes would re-form themselves, and another wave would come in and go smash! -- and break them all to pieces.



Waves Crashing on Sharp Pointy Rocks

And they played with that for awhile, but then they said, "This isn't good enough. We want to do something better." Then Jack and Jill saw those caves, and they said, "Ooh, fun!"

So they stuck some Kick-Mes into the caves. They didn't fit very well; they had to stick them in pretty tight. Then a wave would come along, hit the cave, and the Kick-Me would go ka-boop! down inside. And they'd get stuck even harder in there. So a really big wave would come along, and sometimes the Kick-Me would go ka-pow!! like a cannon shot. Ping! -- out that way. He got shot out of the cave.



A Kick-Me getting Shot Out of the Cave

And inside one of the caves, there was a box that looked like a treasure chest. But it didn't have treasure in it. It had dynamite. And one of the Kick-Mes said, "Oh, licorice!" And he ate the dynamite stick. And then the wave came along and hit the Kick-Me, and the Kick-Me exploded. So they had exploding Kick-Mes, flying Kick-Mes, Kick-Mes everywhere, having a great time. And they were laughing. Whenever Kick-Mes laugh, somebody hears them, and the person that heard them was The Evil Mister Fred.

And Evil Mister Fred was flying over in his flying vacuum cleaner, and he heard all these laughing Kick-Mes. He said, "What's up with those guys? What are they doing down there? I don't like them having fun. I'll show them!"

So called the Acme Store of Everything and he ordered a monster. A regular monster. And he had his minions dig a hole in the ground that connected to these caves, and he stuck the monster down the hole. And the monster looked like a bunny rabbit, with a little fluffy tail, big eyes, ears -- but he had snakes growing out of the top of his head. And the cool thing about this monster is, if you looked right at the monster, you would turn into stone. And he put the monster down there so if any Kick-Me went down there into this cave and saw the monster, the Kick-Me would turn into stone, and they couldn't have fun anymore, and they'd be sad, because they'd be all rocks. And Evil Mister Fred said, "Yeah, this is gonna be great!"

Well, some Kick-Mes went in there and sure enough, they turned into stone. And they didn't come back out again. So Jack and Jill were watching the Kick-Mes get more and more stuck in there, and they weren't coming back out, they weren't exploding, they weren't being beat up on the waves, and they wondered, "What's going on?"

And one of the little ants was sitting on the cliff -- here's a little ant. And Jack and Jill said, "Ant! Can you go in there and see what's going on?" And the ant ran inside, and he ran back out, and he said, "Oh, it's horrible. You wouldn't believe it. The Kick-Mes are all turned into rocks." And Jack and Jill said, "Rocks? How did that happen?" And the ant said, "There's a monster in there, a horrible, terrible, nasty monster." And Jack and Jill said, "Oh, what does it look like?" And the ant said, "It looks like a bunny rabbit." And Jack and Jill said, "How could that be a monster?" And the ant said, "I don't know. But it didn't do anything to me, maybe because I'm an ant." And Jack and Jill said, "Well, what can we do?"



Evil Mister Fred on his Flying Vacuum Cleaner



Bunny Rabbit Monster with Snakes on its Head



The Little Ant

And the ant said, "Oh, there's a fable, an ancient story that tells what to do if you get turned into stone by the bunny rabbit with snakes in his head monster." And Jack and Jill said, "Well, what did they do?"

And the ant said, "They've got to eat marshmallows from the marshmallows trees." And Jack and Jill said, "Oh, any marshmallow?" And the ant said, "Well, no, you have to find the Magic Marshmallow. And if you eat that one, then you'll get turned right back into whatever you were before."

So Jack and Jill said, "Okay." So they ran up there to start harvesting marshmallows. But they didn't know which ones were the magic ones and which were not. And they were going to stuff the marshmallows into the caves, and hopefully the Kick-Mes would see the marshmallows coming by, and maybe the marshmallow would touch them and turn them back into Kick-Mes again. But it wasn't working. Jack was eating all the marshmallows. He likes marshmallows.

Now, if you were Jack and Jill, and you wanted to rescue all those Kick-Mes that are frozen into stone, down inside this cave, what would you do?

Imagination and Brainstorming Time

[01:06:09;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 . . .

Experiment: "Marshmallow Cannons"

Items needed for Instructor:

- 1/2" PVC Pipe: 1@ 6", 2@ 3", 1 elbow, 1 T-connector
- Mini-marshmallows (a few)
- Rolling cart to bring supplies outside
- Large Marshmallow Cannon
- Air Compressor to power large cannon
- Large Marshmallows

Prep Work:

- Cut 1/2" PVC Pipe to 3" and 6" lengths
- Wash goggles

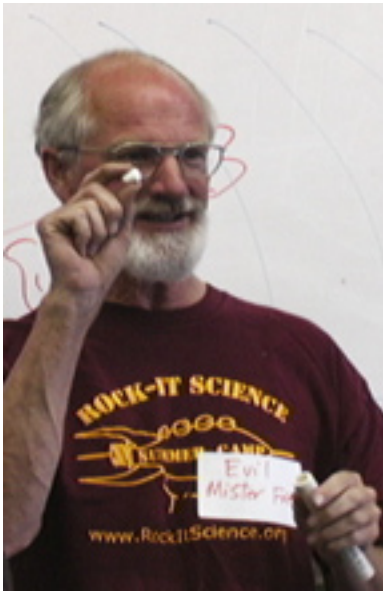
Items needed for Students:

Consumables (per student):

- 1/2" PVC Pipe: Approx 2 pcs @ 6", 5 pcs @ 3", 2 elbows, 2 T-connectors per student
- Small Marshmallows (one bag per class)

Other (per student):

- Goggles



Mini-Marshmallow fits the Pipe

[01:13:55;13] During the experiment, if you find marshmallows on the floor, don't eat them. Luckily, ordinary plumbing pipe plastic tubing is made to fit marshmallows! They fit in there perfectly. And you can -- *[points pipe upward and blows into it, expelling the marshmallow]*.

Now, suppose you wanted to commit suicide by marshmallows *[assembles three pipes and two elbows, so that the end of the pipe points back at himself]*. Okay? *[Inserts a marshmallow.]* Will it make its way through? Okay, are you ready? One, two, three -- *[blows into pipe and marshmallow is expelled, hitting him in the forehead]*.

Okay, what if we made one like that *[replaces one of the elbows with a T-connector, so there are two ways the marshmallow could go]*. Will it go that way or that way? Okay, we'll load it up. Okay, are you ready? *[Blows into pipe and marshmallow hits him in the forehead again, instead of going out through the forward opening.]*

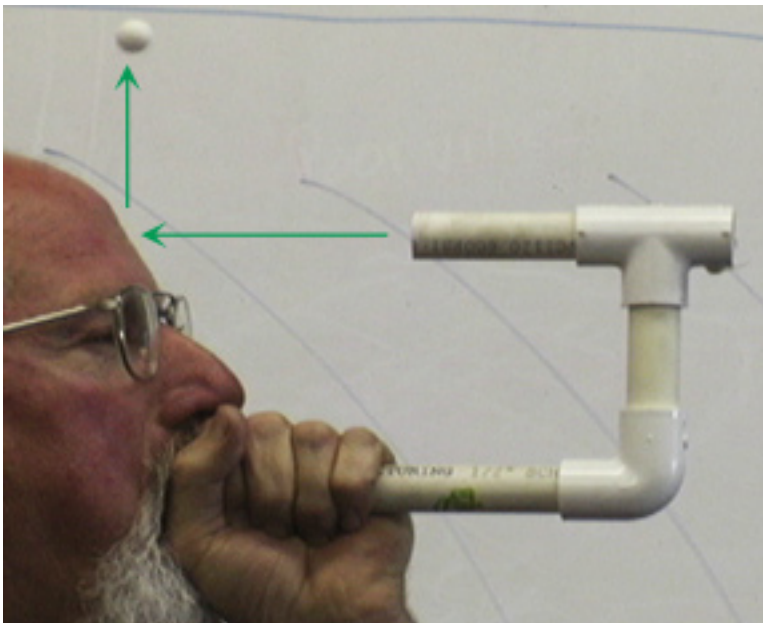
Now, why did it go that way?



Three Pipes and Two Elbows

In our experiments, you're going to get some pieces of pipe. These things are called "T's" because they look like the letter "T". These things are called elbows, because they look like elbows. And there are short pieces, pipes, and there are long pipes. And you'll get up to -- well, I'll tell you when we get out there how many you get.

There are some rules about shooting the marshmallows. You don't shoot them at other people at all. When we go outside, you're going to be



Even with a T-Connector, the Marshmallow hits the Forehead and Bounces off.

wearing goggles -- on your eyes, even if you wear glasses. Goggles are not to be on your forehead, because your eyes are not on your forehead. They are not to be on your necks, because there are no eyes on your necks. Goggles are not to be on the ground, because there are no eyes on the ground. If you're out there and your goggles are not on your eyes, and someone taps you on the shoulder, you have to go sit down in the shade for five minutes, because we don't want a marshmallow stuck in your eye.

You don't get to shoot anything other than marshmallows. If you find a cherry bomb out there and put it in there, you don't get to shoot the cherry bomb.

When you're out there, you're going to start out with one long tube. You can shoot the marshmallow more than one time. We don't care if you pick one up off the ground and shoot it again. Just don't pick one up off the ground and eat it again.

At the end, when we're all done shooting, it's not our parking lot. It's the American Legion's parking lot. These are veterans of war. They're old guys, they've been beat up, they've been shot, they've been hit by hand grenades, they can't see too well, they can't walk too well, but they don't like marshmallows all over their parking lot. So when we're done, we have to pick up the marshmallows.

As we go along, we're going to say, "New piece!" And you'll come over to the cart and we'll hand you each a new piece. We don't know what it's going to be. It might be an elbow, might be a T, might be a tube, you never know. It might also be a cork.

Now, there is a slight exception to the rule. If somebody else says, "I WANT you to shoot at me," then you can chase them all over the place and shoot at them. If they fall down and scuff their knees and come back all bleeding and torn up and everything and say, "Mr. Mac, he knocked me down," I'll say, "Oh, he was chasing you?" And you'll say, "Yeah!" And then I'll say, "Did you say he could shoot you?" And you'll say, "Yeah." Then I'll say, "Okay, go wash off all your wounds and put bandages on them. It's your own fault!" Evil Mister Fred's Rules of Unfairness. Okay, let's go outside.

[Outside, students receive a 6" tube and a few mini-marshmallows to begin with. Then other pieces of pipe and connectors are added, one at a time, and the students configure them any way they like.]



1. Start with One 6" Pipe



2. Add One Elbow



3. Add One 3" Pipe



4. Add a Second Elbow



5. Add a Second 3" Pipe



6. Add One "T"



7. Add a Third 3" Pipe



8. Add a Second "T"



Mr. Mac's "standard" Configuration

[After all the pieces have been distributed to the students and they've had a chance to shoot marshmallows with each configuration, the Instructor brings out a large cannon made from much larger pieces of PVC pipe. Using this as a demo, he shoots full-size marshmallows, using an air compressor for power. Students position themselves at the opposite end of the parking lot so they can try to catch the marshmallows.]



Air Compressor to power Large Cannon



Large Marshmallow Cannon

End of Story

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

[01:48:26;14] Evil Mister Fred hid the evil bunny rabbit monster inside the cave. And the Kick-Mes were turned into stone. Jack and Jill heard about it from a little ant. And the ant said if they had magic marshmallows and had them bounce off of the Kick-Mes, then the Kick-Mes would return back into Kick-Mes again. And Jack and Jill were searching for the Magic Marshmallows, and there were all these chocolate ones, and grape flavored ones, and blueberry- and blood- and banana-flavored marshmallows. And Jack kept eating them.

And Jack accidentally ate one of the Magic Marshmallows. And Jack started to glow really bright, so Jill couldn't even look at him. She had to cover her eyes. And Jack was glowing like crazy, and Jack said, "Woo!" And Jack began to float over the ground. And Jill said, "Cool!" And Jill went "Shhhh!" And Jack blew away. Then Jack started to flap his arms, and he could fly really fast. And Jill said, "This is great, Jack! Go down into those caves and take a whole bunch of whatever you ate, and give them to the Kick-Mes." And Jack said, "All right." So Jack flew down into the caves, and Jill didn't hear anything. She couldn't tell what was going on. Something was going on in that cave, but she didn't know what.



Jack Began to Float and Flapped his Arms Really Fast

And while Jill was waiting outside, she turned around and looked, because she just had this second feeling that something was not right. So she turned around, and there was a

huge wave coming. And Jill said, "Tidal wave!!" And Jill ran into one of the caves.

And the wave went ka-sploosh! against the cliff, into all the openings of those caves at the same time. And all the air that was in the caves got blasted out. And the Kick-Mes, Jack, Jill, and a whole bunch of marshmallows all shot out of this cave at once.

Evil Mister Fred was up in the air. And some of the Kick-Mes were still stone. And, smash! the Kick-Mes hit Evil Mister Fred and knocked him off of his vacuum cleaner. And the wave washed over him and washed him clear to China. And as the Kick-Mes were coming back down again, all these marshmallows were hitting them, and they turned back into Kick-Mes.

And everybody lived happily ever after, except Evil Mister Fred.

End of Lesson



The Tidal Wave



The Marshmallows Shot out of All the Caves at once.