Teacher's Guide for:

Balloon Rockets

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.

NOTE: *This is the transcript of a lesson that was videotaped during an actual Rock-it Science class with real students, not actors. The students' brainstorming comments are included on the video but are not transcribed here because they're not part of the lesson presentation.*

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Balloon Rockets
A Rock-it Science Lesson
Filmed July, 2011

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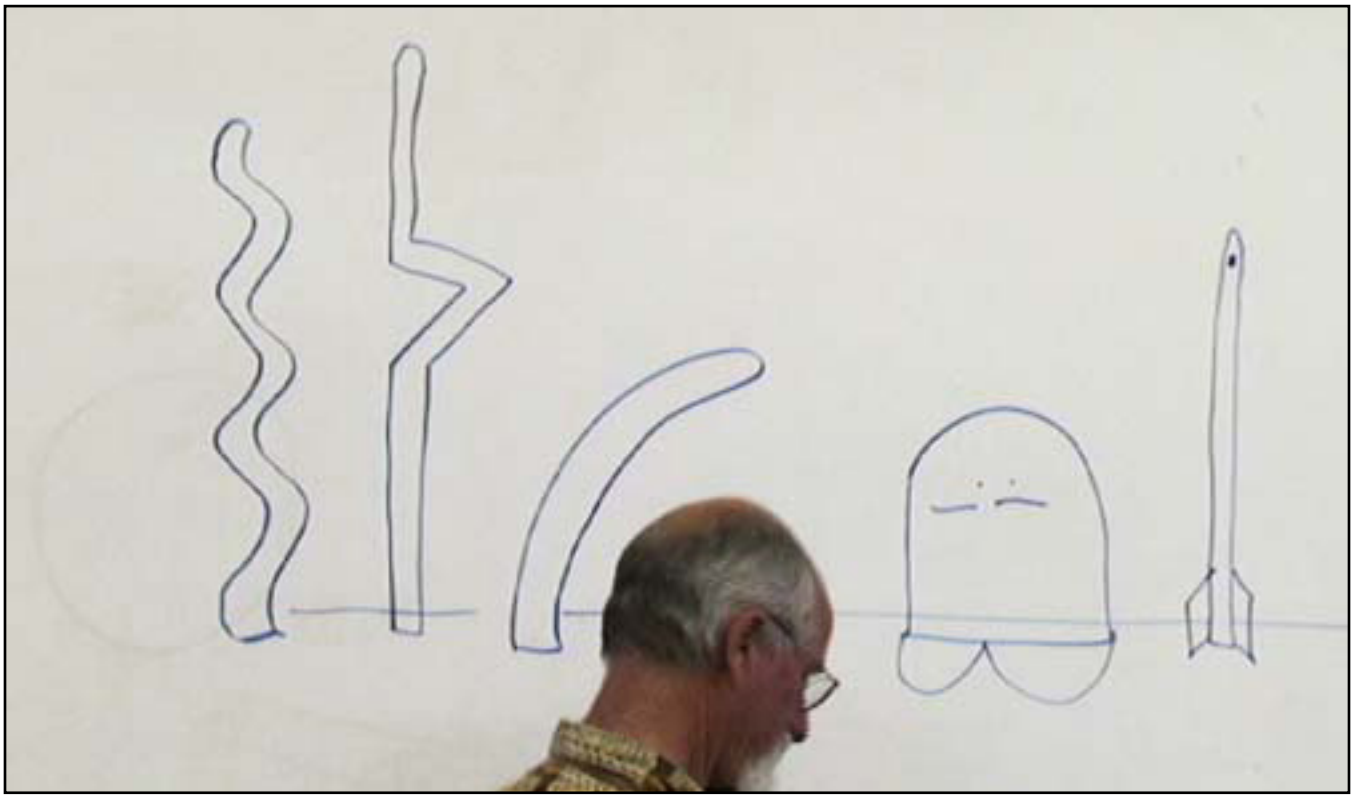
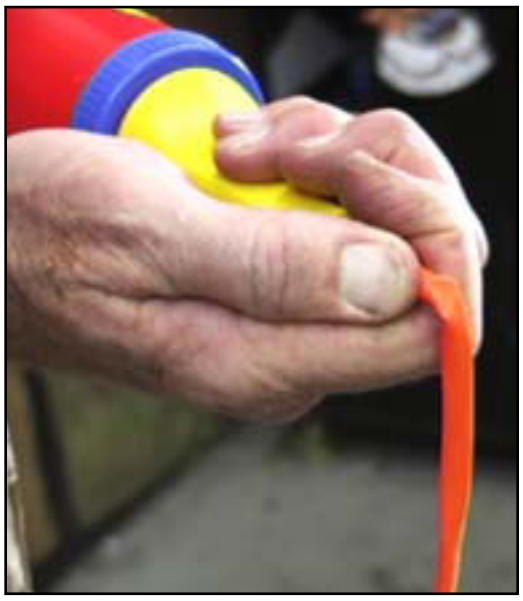
Intro Quick Recap:



- If you want to build a missile and shoot it, it should look like this, right? (Draw a long curved shape.)
- Draw a wiggly shape, a zig-zag shape, a stubby rounded shape, and ask the students whether any of them would make good missiles.
- Draw a missile that's long and straight, with fins at the bottom for drag and some weight at the top.
- Most missiles, or bows and arrows, are shaped like this so they'll go straight.
- In today's experiment, we'll try to make some arrows go, but in a weird way.

Experiment Quick Recap: *"Balloon Rockets"*

- Instructor shows students how to use an air pump to blow up a long skinny balloon. The balloon hole is smaller than the pump nozzle, so they have to roll the balloon opening onto the nozzle and hold it in place while they pump.
- Inflating a balloon with air is one way to store energy in it. Another way is to stretch the balloon.
- Instructor stretches the balloon, then lets go of one end and then the other, to make the balloon fly through the air.
- You could also lay it across your head and pull both ends down, but if you let go of it like that, it would hurt.
- You can hold both ends of the balloon in one hand and stretch it at the middle with one finger, then let go of the ends to make the balloon shoot through the air.



Hold balloon on pump nozzle.

- When you blow up a long skinny balloon, there's a trick to tying a knot in it. Inflate the balloon so that the last few inches at the tip are uninflated. Then squeeze the air from the bottom up into the balloon so it goes into the tip. That leaves a few inches of uninflated balloon at the bottom. This is the part you can use to tie a knot.
- Once it's knotted, you can push the knot up inside the balloon with your finger. When you let go, it flies off.
- Tables are set up in a semicircle facing a model pirate ship that's hanging from the ceiling.
- Students get balloon pumps and long skinny balloons.
- The objective is use any method they want to shoot a balloon and get it to land on the pirate ship.
- If they're successful, the Instructor lowers the pirate ship so the student can retrieve the balloon.
- After several minutes, Instructor hands out Balloon Rockets, which are larger and bumpier, and students try shooting these at the pirate ship.

Blowing up balloons to shoot at the pirate ship.

Equipment List: "Balloon Rockets"

Items needed for Instructor:

- Model pirate ship (or other target item)
- String, about 20 ft
- Spring clamp (to secure string)

Items needed for Students:

Consumables (per student):

- Balloon, long and skinny
- Balloon, rocket

Other (per group of 2 students:

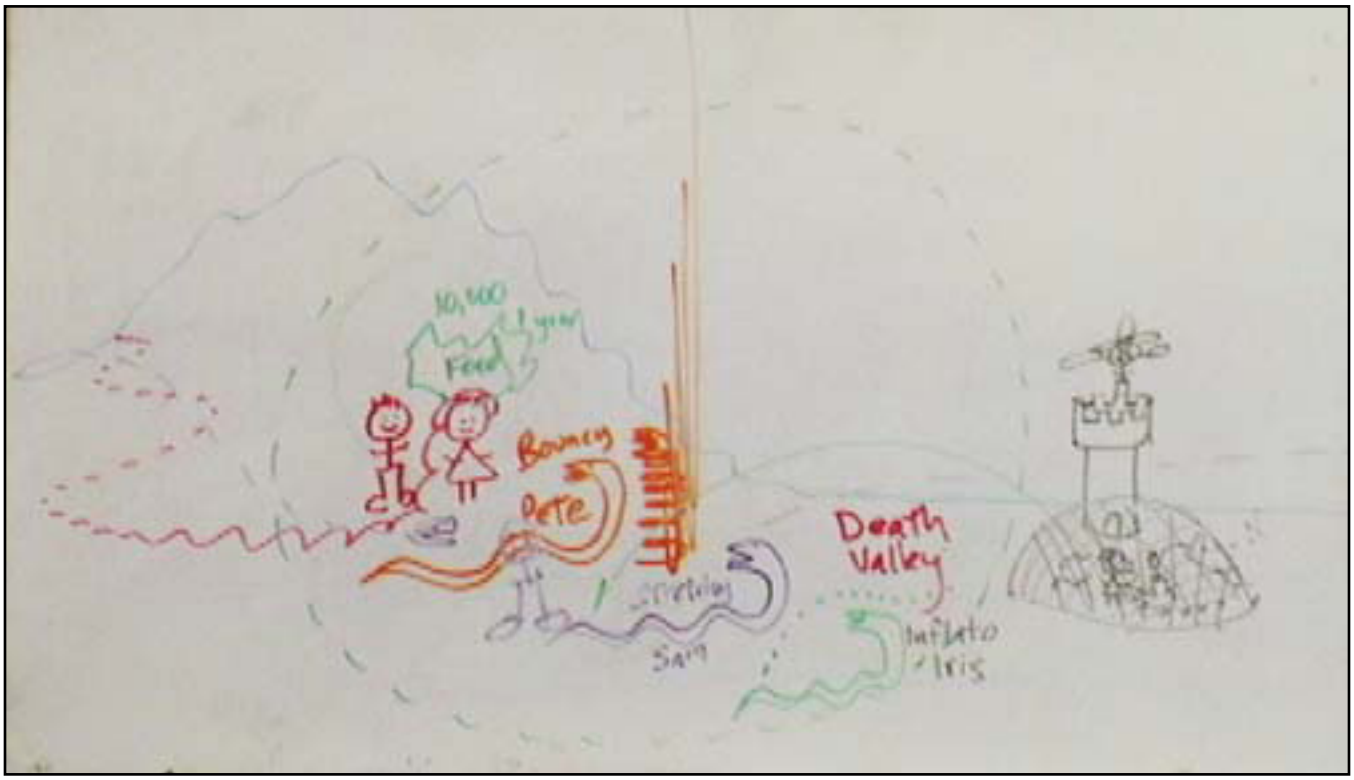
- Balloon pump

Prep Work:

- Suspend pirate ship by looping the string over a bar near the ceiling. Tie other end of string to a spring clamp so it can be released easily, then raised and lowered.

End of string is tied to spring clamp so pirate ship can be released easily.

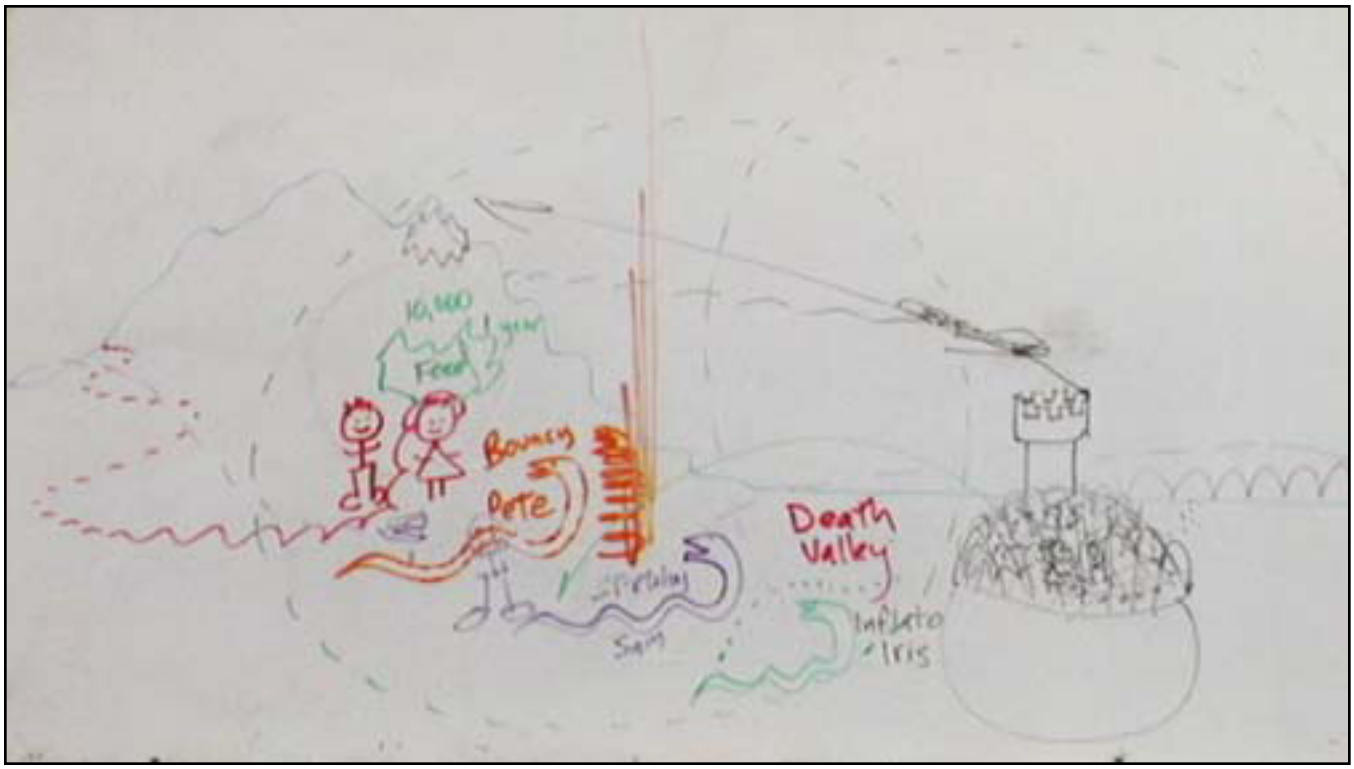
Story Recap: "*Jack & Jill and the Magic Snakes*"



Part 1:

- Jack and Jill were walking through the magic forest, carrying food for the poor. They had enough to feed ten thousand people for a year, and Jill was carrying it on her head.
- After coming out of the forest, they had to cross Death Valley, where Evil Mister Fred had built a castle.
- As Jack and Jill were walking, they met a talking snake. This snake could coil up like a spring and bounce clear up to the top of the sky. Jack and Jill invited him to come along. They called him Bouncy Pete.
- Further on, they met another snake named Stretchy Sam, who could stretch himself clear around the planet. And he also went along with Jack and Jill.
- Then they met Inflato Iris, a snake who could inflate herself until she was bigger than the planet. And she went along with Jack and Jill.
- Death Valley is really hot, so to save time, they got on top of Bouncy Pete. He took one bounce, and they landed on the other side of Death Valley, where Evil Mister Fred's castle was.
- Evil Mister Fred dropped a big net over Jack and Jill and the snakes and trapped them.

Story Recap (cont.)

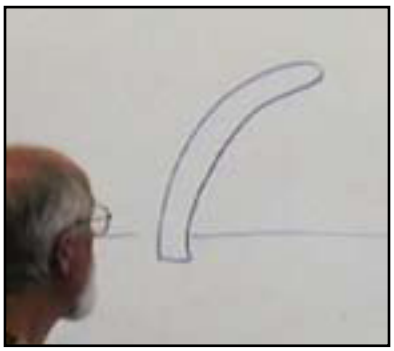


Ending:

- Jack and Jill and the snakes were trapped in a net, and Evil Mister Fred told his minions to jump on top of the net and hit them with their baseball bats.
- Jack and Jill told Stretchy Sam to stretch himself all over the net to create a protective barrier between them and the baseball bats.
- Then Bouncy Pete started bouncing and making the minions fly off.
- Then Inflato Iris started to inflate herself, so she lifted Jack and Jill way up in the air.
- Then everybody got on top of Bouncy Pete and jumped off. Then they bounced over to where the poor people lived to deliver the free food.
- Inflato Iris was still back at the castle. Evil Mister Fred told the minions to attack her, but Inflato Iris started letting the air out of herself, towards Evil Mister Fred.
- The wind was so strong, Evil Mister Fred's mustache blew straight back, his hat blew off, and he was lying almost flat back, just hanging on by his toes.
- When the wind reached a thousand miles an hour, he couldn't hold on any longer. He went flying through the air and left a splat mark on the side of the mountain.

Transcript: Intro

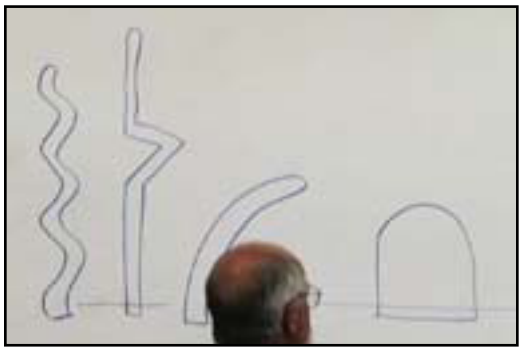
If you want to build a missile and shoot it, you probably should make it look like that, right? *[Draws a curved shape.] [Students: No.]* Wouldn't that be a perfect missile? No? Why? What's wrong with it? It's curved? It can't fly straight if it's curved?



Curved missile.

Well, what if I made it look like this *[draws a wiggly shape]*? How about that? Would that shoot straight? *[Students: No.]*

How about if I make it look like that *[draws a zig-zag shape]*? Will that go straight? No? Darn.



Other shapes of missiles

So it would have to be straight to go straight? How about if I make it look like that *[draws a stubby rounded shape]*? Will it go straight then? *[Students: Yes. No. It's not a missile, it's a minion!]* Oh, it's a minion *[draws a face and feet on the shape to make it look like a minion]*.

Straight missile with fins.

Yeah, missiles usually need to be long and straight and skinny to go well. Same like bow and arrows. And arrows usually have fins on the back. They call that drag. And they have a little bit of weight on the front, which is the tip. And they'll go nice and straight.

Now, we're going to try to make some arrows go, but we're going to do it in a really weird sort of way. *[Student: How?]* You'll find out when we do the experiment. There's lots of weird ways. But first we need a crazy story.

Story: *"Jack & Jill and the Magic Snakes"*

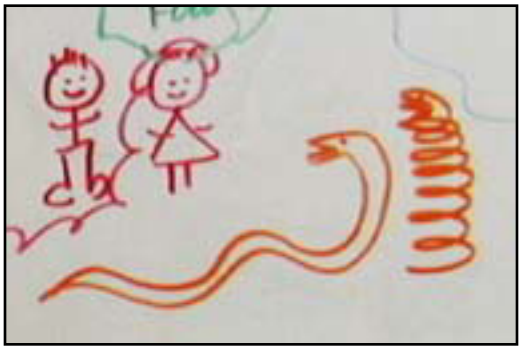
Once upon a time, Jack and Jill were walking through the magic forest. They were carrying food for the poor. They had enough food to feed 10,000 poor people for one year. There's Jack, there's Jill. How much do you think ten thousand people's food for a year would weigh? *[Student: A million pounds.]* A million pounds. Well, Jill was carrying it in her hat. Food. She had enough food to feed ten thousand people for one year.

Jack & Jill carrying food.

Evil Mister Fred's Castle

And they were going to carry this food through the magic forest across the deadly plains. Oh, Death Valley, how about that? And through Evil Mister Fred's territory. And of course, Evil Mister Fred wants to take the food from them, because he'd like to have food for a year for ten thousand people, for free, if he could take it. For his minions.

And while Jack and Jill were walking along, they came across a snake. Let's see, an orange snake. And the snake said, "Hi, whatcha doin?" And Jack and Jill said, "Hey, a talking snake. That's pretty good. Can you do anything, Talking Snake?" And the snake said, "Of course I can do things. I'm a snake. Snakes are very clever. Snakes are very smart. Snakes can do anything they want to do." And Jack and Jill said, "Well, what can you do?" The snake said, " I can coil up like a spring and bounce clear up to the top of the sky." And Jack and Jill said, "No, you can't!" And the snake said, "Yes, I can!" And he coiled himself up into a spring and started going boing, boing, boing, boing, and disappeared clear up in the sky. And Jack and Jill said, "Wow, that was really good!" And pretty soon -- boing!! -- he came back down.


Bouncy Pete, the snake.

They said, "Hey, snake. Maybe we could use you. Would you go along with us?" And the snake said, "Sure." So now that snake is going to go with them. What should we call that snake? *[Student: Pete!]* Pete. He's Pete. He's the bouncing Pete. We'll call him the Bouncing Pete.

Pretty soon they came across another snake, a purple snake. And that snake also said, "Hi, how are you doing?" And Jack and Jill said, "Look -- another talking snake. Well, snake, can you do anything?" And the snake said, "Well, of course I can do things. I'm a snake. I'm very clever. I can do anything I want." And he said, "I can stretch myself out clear around the entire planet." And they said, "No, you can't." And the snake said, "Yes, I can. Just step on my tail." So Jack stepped on his tail, and the snake started to stretch himself out. And sure enough, he stretched himself from one side of the world, clear around and back to

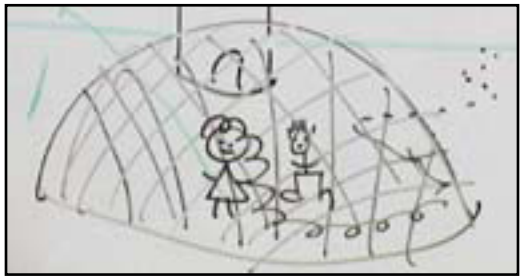

Stretchy Sam could stretch around the world.

the other side. "Hi! How are you doing?" And then he unstretched himself, back where he started from. And Jack and Jill said, "Whoa, that's really cool! Will you come along with us?" And the snake said, "Sure!" *[Student: What's his name?]* Oh, his name is Stretchy. Stretchy Sam.

And then they came across a third snake. And they said, "Uh-oh, there's another snake." And the snake said, "Hi! Yup, I'm another snake." And they said, "Can you do anything?" The snake said, "Of course I can do things." And Jack and Jill said, "Well, what can you do?" And the snake said, "I can blow myself up so huge, I'm bigger than the whole planet." And Jack and Jill said, "No, you can't!" And the snake said, "Yes, I can." And he started to breathe in. And he was sucking in so much air, he became huge. And Jack and Jill said, "Please stop sucking in all the air. We can't breathe." And the snake let the air all back out again -- whoosh! And Jack said, "Thank you very much. That's good."

Inflato Iris could puff up really big.

And Jack and Jill and the three snakes headed across Death Valley. Well, Death Valley is really hot. Luckily, they all got on top of Bouncy Pete, and Bouncy Pete took one bounce -- boinggg -- and landed over here by Evil Mister Fred's place. And all three of them were there.


Evil Mister Fred trapped them in a net.

And Evil Mister Fred said, "Mwah-ha-ha! Snakes! You're dumb. You can't do anything." And the snakes said, "Oh, yeah, we can." And Evil Mister Fred said, "Too bad for you." And he dropped a big old net on all the snakes and Jack and Jill.

Now Jack and Jill are inside this big net. *[Student: What's the other snake's name?]* Oh, the one that fills up really big? He needs a name, doesn't he? What shall we call him? Inflato Irwin. Maybe he could be a girl. Inflato Iris. There you go. And the snakes are all in there, too. Now, if you were Jack and Jill, and you've been trapped by Evil Mister Fred under a great big net with three snakes, what would you do?

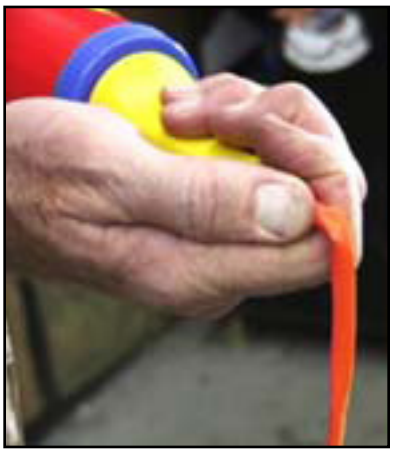
Imagination and Brainstorming Time

[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.)

And we're going to leave this "To be continued . . ."

Experiment: *"Balloon Rockets"*

In our experiment, we're going to be using air pumps. They blow air on the outward puff, and they blow air on the inward puff. Isn't that weird? Out, in, out, in *[pumps]*. Does it work that way? *[Directs puff of air at students.]* You can test one when you get it.



Hold balloon onto nozzle.

And we can use them to puff up things if we want to. Here's a balloon. The balloons have a little small hole. The pump has a hole that's a little bit bigger than the balloon is. It doesn't fit on. But if you put the balloon right against it and kind of roll it, it'll go on. Then you have to hold it. And then what do you do? *[Students: Puff it!]* Puff. Okay. *[Starts pumping air into a long thin balloon.]* And you have to puff hard to get it started. There.

Now you have a balloon. *[Student: It's like a Bouncy Pete.]* Yeah, like a Bouncy Pete. There we go. Now, it has energy inside. The energy is there because the rubber is stretched. So if you let go *[releases balloon]* it takes off. Okay? That's one way to store energy in a balloon.

Another way to store energy in a balloon is to stretch it. *[Stretches out a balloon.]* St-r-e-t-ch. Now, if I just let go of it, I could try to make it go somewhere. If I let go of this end and get it accelerating forward, and just before it reaches my hand, let go of the other end, the balloon should keep going, right? What are the odds of that? *[Stretches out balloon, then releases it to make it fly through the air.]* It goes a little bit.

Stretch the balloon.

Hold both ends in one hand and stretch with other hand.

Is there any way to make it go forward faster by stretching it? What if you put it over your head and let go of both ends at once? *[Lays center of balloon on top of head and stretches the ends downward on each side.]* That could hurt.

Rather than your head, how about if you put it over your finger and let go of both ends at once? *[Holds both ends of balloon in one hand so it's folded in half and puts a finger of the other hand in the fold to stretch it out.]* Would anything happen? You think so? We'll try. *[Lets go of just one end, so the balloon doesn't go anywhere.]* Wow, it went so high, I can't even see it! *[Student: You have to let go!]* You have to let go. *[Lets go of both ends and the balloon shoots upward.]* So it's possible to launch it that way.

Now, do you guys know how to tie a knot in a balloon? *[Students: No.]* Well I'll show you. There's a trick to it. It's easy. You guys could do it. You puff it up, but you don't puff it up all the way. *[Inflates a long thin balloon, leaving a few inches uninflated at the tip.]* See? You leave some in there. And then you take this end


Squeeze air up from bottom to leave a few inches for a knot.

and go -- *[squeezes bottom end hand over hand to force the air into the tip, leaving a few inches uninflated at the bottom end]*. I'm trying to push it so his tail gets shorter. Now look at that. Okay. You wrap it around two fingers *[demonstrates how to tie a knot in the uninflated lower end of the balloon]*, and then you can put his head right through the wrapping part. And you take your fingers out. Boink -- knot. Pretty good, huh?


Stick finger inside.

Then, if it survives -- chances are it won't survive -- then you can use your finger and stick it in here *[pushes knot into lower end of balloon with finger]*. I have a finger inside. Can you see my finger in there? See my finger in the balloon *[brings it closer to the students so they can see it]?* Look carefully, watch it. Do you see my finger? *[Releases balloon and it shoots upward.]* Where'd it go?

So you can put your finger in -- you could try putting your whole foot in there, but I don't think it would fit too well. And you can shoot a balloon that way.

Okay, those are just three ways to do it. There are lots of other ways to make a balloon fly. We're going to go *[into the next room]* and we'll tell you what we're going to do when we get over there.

[Tables are set up in a semicircle facing a model pirate ship, which is suspended from the ceiling on a string. One end of the string is attached to a clamp that can be released to raise or lower the ship.]

Go around to the other side of the table. You're going to be sharing pumps. There's not enough pumps for everyone. *[Passes out pumps.]* We're going to be starting out with long skinny balloons. The idea is to make the balloons hit the pirate ship.


Balloon pumps.


Pirate ship suspended on a string.

If you get it stuck in one of the strings on the pirate ship, or on the swirly thing, you get one point. If you get it stuck in the sails, you get five points. If you can land it into the boat part, you get ten points. *[Student: But if we shoot our balloon in there, then we're going to lose it.]* Not really, because *[releases clamp to show how ship can be lowered to put it in reach]* we can bring the pirate ship down and you can take it back out. Okay?

Inflating a long skinny balloon.

Stretching a skinny balloon to shoot it.

After you shoot yours, you can go get it, of course, and bring it back. All the shooting needs to be done from behind the tables. If you want balloons, you have to ask the assistant.

[Students use various techniques to propel their long thin balloons toward the pirate ship. If one successfully lands on the ship, the Instructor lowers it so the student can retrieve it.] [A balloon pops, and a student complains about the loud noise.] If you don't like the sound of popping balloons, you can put on earmuffs.

[After several minutes, the Instructor passes out Rocket Balloons, which are long but larger and bumpy, and students try shooting those at the pirate ship.]

Here are different balloons.

Trying out rocket balloons.

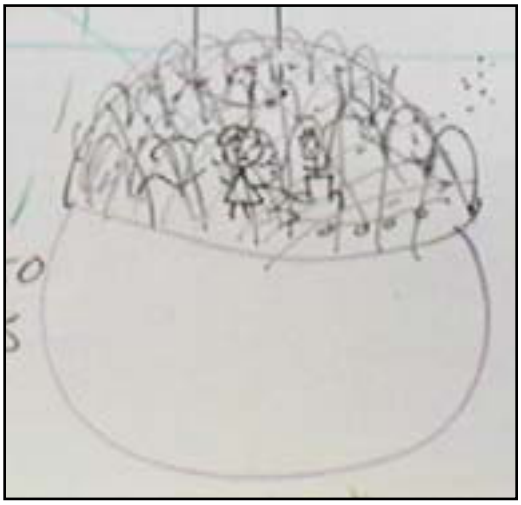
End of Story

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

So Jack and Jill are trapped, and Evil Mister Fred says, "Minions! Jump on them!" And so about a thousand minions jump on top of the net. Minions, minions, minions, minions, minions, minions, minions, minions. And Evil Mister Fred said, "Hit them with your baseball bats!

Minions jumped all over the net.

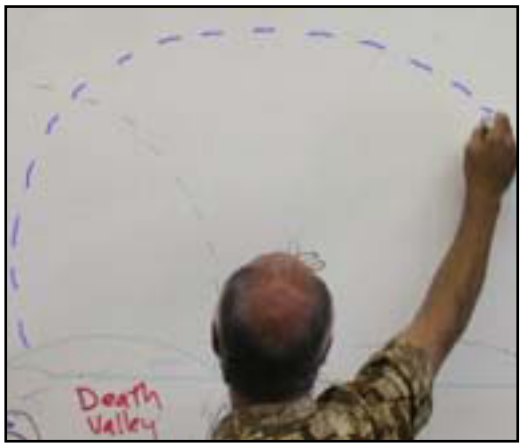
And the minions started banging on Jack and Jill and everybody in the net. And Jack and Jill said, "Stretchy Sam! Stretch yourself out all over the place and try and stretch the net off of us." And Stretchy Sam tries to stretch the net out, off of all of them. And he stretched himself all over it and created a protective barrier between them and the baseball bats.



Inflato Iris started to get big.

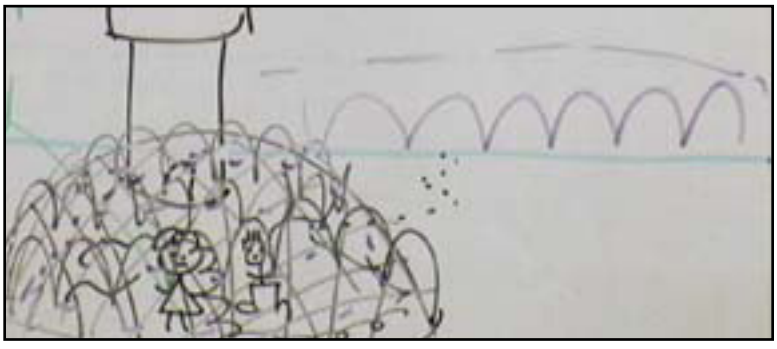
They said, "Bouncy Pete! Try bouncing those minions off!" So Bouncy Pete went boingity, boingity, boingity, boingity. Now there are minions flying all over the place.

And then they had Inflato Iris start to inflate. And Inflato Iris got to be just a little tiny for Inflato Iris.



Then Inflato Iris got really big.

And she started to get bigger and bigger and bigger. And Jack and Jill said, "Now we're talking! Go, Inflato!!" So Inflato inflated so big that she lifted Jack and Jill way up in the air. And Jack and Jill and everybody else that was with them got on top of Bouncy Pete, and they jumped off -- boinggg! And they bounced off to give away the free food.

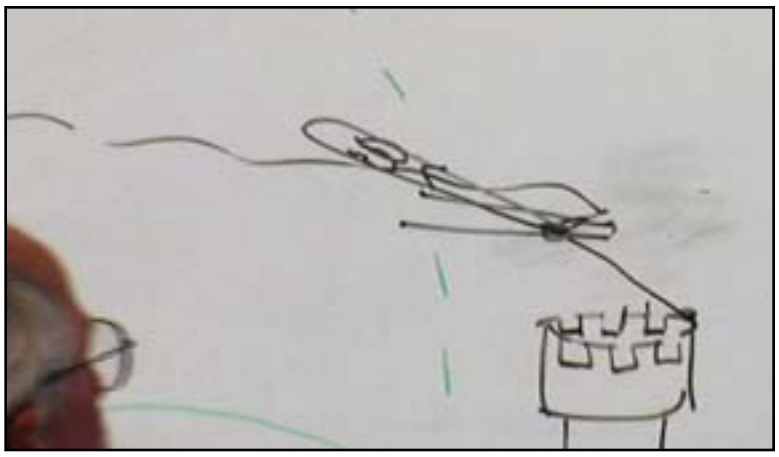


They bounced off to deliver the food to the poor.

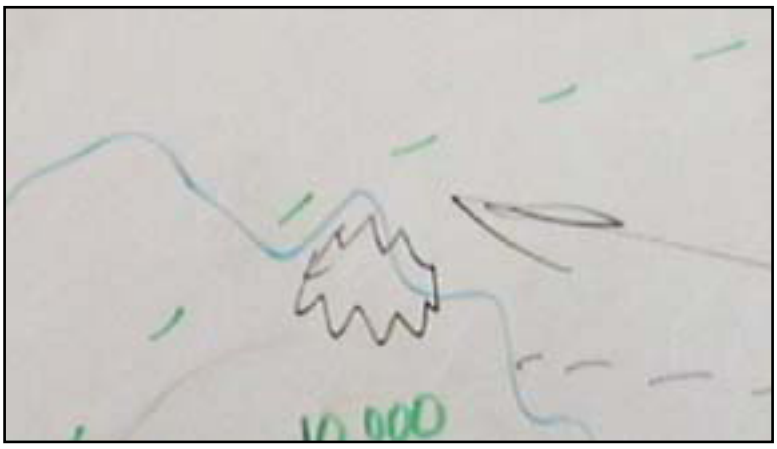
Now Evil Mister Fred is left there with an Inflato Iris. And Evil Mister Fred says, "Minions! Attack that inflatable thing!" And Inflato Iris says, "I don't think so." And she started letting the wind back out of herself, towards Evil Mister Fred.

And Evil Mister Fred's mustache went straight back because of the wind. His hat

blew off, and Evil Mister Fred got bent way back. He was hanging on by his toes. And even his head got stretched way back. There's his eyes. And he could not hold on any longer. The wind got to be over a thousand miles an hour, and Evil Mister Fred went whooooooosh -- and took off, and left an Evil Mister Fred splat mark on the side of the mountain. And they all lived happily ever after, except Evil Mister Fred.



Evil Mister Fred hanging on by his toes.



Evil Mister Fred left a splat mark on the mountain.

End of Lesson

If you have questions about this lesson, please ask them through the online Teacher Support Forum on our web site.