

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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Popguns A Rock-it Science Lesson Filmed January 2010

Rock-it Science

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Intro Quick Recap:

- Lightning heats the air to 50,000 degrees. This makes the air expand very fast.
- The expansion creates a shock wave and a sound wave. When the wave goes through the air, that's when you hear thunder.
- You can make a sound wave similar to it by clapping your hands.
- Do you know where corks come from? From tree bark.
- Does cork burn? Hold one end of a cork and light the other end on fire.
- In the 1960's, they used cork in the first spaceships to protect the astronauts from the heat of re-entry.
- When the spaceship re-entered the atmosphere at 20,000 miles per hour, the outside of the ship was covered in flames. But the astronaut inside was okay because, even though the cork was burning hot on one side, it was still cool on the other side. (Show how you can hold the burning cork without getting burnt.)
- The cork puffs up when you burn it. It also gets very black, so you can use it if you're a commando and want to black out your face at night.



Light cork on fire.

Experiment Quick Recap: "Popguns"

- Tell students that the objective is to make a cork fly straight up and come straight down.
- At first, just give students a piece of PVC pipe and a cork. Tell them to see if they can make a sound with the pipe.
- Then pass out a wooden dowel, a screw, a leather disk with a hole in it, and a washer. Also set up glue guns and make some screw drivers available.
- Do not give students instructions to assemble the popgun; let them figure it out for themselves.
- Have students write their names or some other mark on the cork so they don't lose it.
- After students have assembled their popguns and have been experimenting with them for awhile, set out some cups of water so students can wet the leather disc and see if that makes a difference.
- Later, give them a piece of string so they can attach one end to the cork and the other end to the gun so they don't lose the cork.
- If anyone's gun doesn't work, make sure they have the washer under the leather disc and not on top of it. Also make sure they've wet the leather.



Equipment List: "Popguns" Items needed for Instructor:

Consumables:

• Cork, size #7 to fit 1/2" PVC pipe

Other:

- Butane Lighter
- Propane Torch
- Power Strips

Items needed for Students:

Consumables (per student):

- PVC Pipe, 1/2" diameter, about 6" long
- Cork, size #7 to fit PVC pipe
- 1/4" wooden dowel, about 8" long, with 1/8" diameter hole drilled in one end
- Phillips Screw, #6 x 1/2"
- 1/2" Washer
- Leather Disc, .685" diameter with 1/8" hole in center. Thickness at least .08"
- String (about 2 ft)

Other (per group of 2 or 3 students):

- Glue Guns
- Phillips Screwdriver
- 12-oz Clear Plastic Cup
- Water (about 8 oz)

Prep Work:

- Cut PVC Pipe to 6" lengths
- Insert corks into pipes
- Cut 1/4" wooden dowels to 8" length
- Drill hole in end of dowels
- Cut leather into discs with special leather punch (.685" ID tubing)
- Drill hole in leather discs
- (See Prep video for tips.)



Cork and PVC Pipe



Leather discs



Phillips screws



Wooden wheels



PVC Pipes with Corks inserted

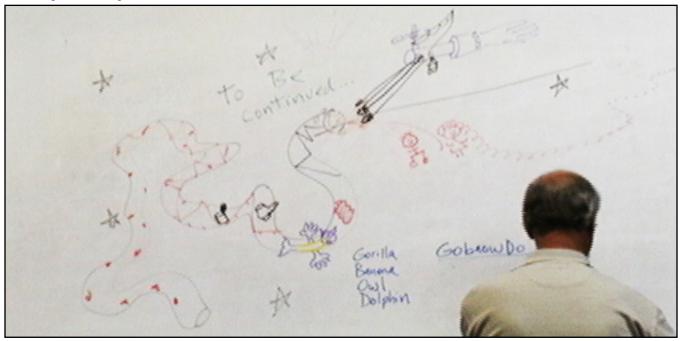


Dowel

String

Phillips screwdrivers

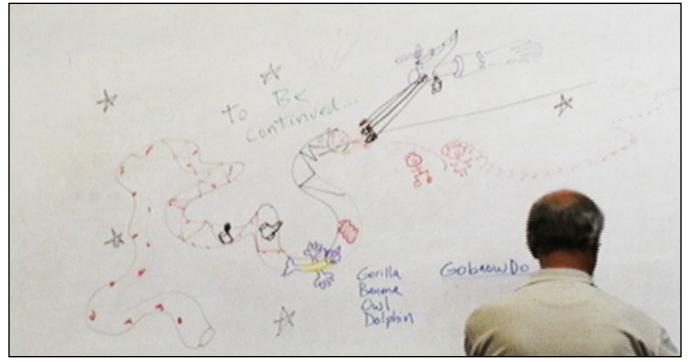
Story Recap: "Jack & Jill and the Wormhole Aliens"



Part 1:

- Jack and Jill are floating in space. Their spaceship, made by Evil Mister Fred Industries, has evaporated.
- How long can people live in space with nothing around them? Not long.
- A giant wormhole spaceship was warping from one place to another, and it happened to appear just at the moment Jack and Jill's ship disappeared, and it sucked Jack and Jill inside.
- Ask students for suggestions of creatures. Instructor combines them to make the alien that lives in the wormhole spaceship. In this class, the students suggested Gorilla, Banana, Owl, and Dolphin. So the creature was called a Gobaowdo.
- The Gobaowdos could go anywhere in the universe just by thinking about it. Wherever they went, they would collect pieces of junk, which they thought were valuable treasures.
- Red rocks were scattered everywhere. Jack ate one and started bouncing around at seven hundred miles an hour. Then Jill ate some, too, so she could keep up with Jack. They realized the rocks were a valuable source of energy and didn't want anyone to steal them.
- Evil Mister Fred had converted his castle into a rocket ship, and he had come by to see Jack and Jill die, because he knew their ship would evaporate. When he didn't see them, he lowered a minion on a fishing pole to see if they were inside the wormhole ship.
- The minion went inside and ate one of the rocks and bounced out of the wormhole. When he told Evil Mister Fred about the red rocks, he decided to try to steal them.
- Jack and Jill ordered a giant cork from the Acme Store of Everything to block the opening, but Evil Mister Fred lowered a bunch of minions on lines to bite on the cork and try to pull it out.

Story Recap (cont.):



Ending:

- (Same picture as Part 1 -- no additional drawings.)
- Evil Mister Fred's minions were biting on the cork, trying to get it out of the wormhole.
- Jack and Jill told the Gobaowdos to eat a bunch of the red rocks and point themselves toward the cork.
- When Gobaowdos eat the red rocks, it affects them differently than humans. It makes them burp. Just before they burped, they got so big, they sealed off the end of the wormhole where the cork was, and all the pressure of their burping went against the bottom of the cork.
- The cork popped out at incredible speed, almost the speed of light, and hit Evil Mister Fred's spaceship. It knocked the ship into another space-time continuum.

Transcript: Intro

Ever seen lightning? What happens after lightning? [Students: Thunder!] Thunder. Why does thunder happen? [Students offer various explanations.] It turns out that lightning -- if you go over to a lightning bolt and say, "Hi, lightning bolt, how ya doing?" and stick a thermometer in its mouth, the thermometer will say 50,000 degrees. It would probably explode your thermometer. Well, when you heat air to 50,000 degrees, it expands really fast. And the expansion is like an explosion which creates a shock wave and a sound wave. And the sound wave goes through the air, and that's when you hear the thunder [claps hands], like that. You can make a shock wave similar to it by clapping your hands. In our experiment today, we're going to be using some sound waves. We're going to be compressing some air, just like you do when you trap it in your hands, and we'll suddenly release it.

Now, you've probably seen corks before, right? Do you know where you get corks? You get them from wine bottles. They grow in wine bottles. No? Where do corks come from? [Students offer answers.] It comes from tree bark. They still make some of them -- I think this one is the mashed-up kind they glued back together again, because it doesn't have all the lines and things that look like regular tree bark. Does cork burn? No? Yes? Maybe?

If you're going to have a fire, you need a -- [Students: Water!] -- fire extinguisher [places a cup of water on the table]. Let's see if this is a real cork or a fake cork. [Lights the end of the cork with a barbeque lighter.] Oh, it's burning. [After several seconds, flame starts to go out.] Let's try it with a bigger flame [re-lights cork with a propane torch].

Now, they used a cork a lot like this in the 1960's on one of the first spaceships. It was called the Mercury program, and there were astronauts inside the spaceship, which is nothing more than a big tin can flying up in the air. And they said, "Don't worry. When your spaceship comes back into the atmosphere, it'll look like it's on fire, but you won't burn up. Trust us." And they sent the guys up there in the spaceship.



One end of the cork burns while the other end stays cool.

And it was time for them to come back down again. There they are, going about 20,000 miles an hour through the atmosphere. They had a little window they could look out. And all they saw were flames. They said, "Houston, we've got a problem! This spaceship is on fire." But nobody in Houston could hear them because there were so many flames around, the radio stopped working. Uh-oh. And it burned and burned and burned, and the guy didn't die because the cork, even though it's burning hot on this side -- on that side where I'm holding it, it's still cool. And it kind of puffs up. You see how fat it got? It puffs up as it burns. And it was about four inches thick.

So cork has the useful property that you can cork a wine bottle with it, and you can protect spaceships with it, it burns, and if you're a commando and you're invading some bad guy's territory, and you need to black out your face so that they can't see you at night, you can take the burnt charcoal *[cork]* and rub it all over your face. It's really black. *[Dips cork in water to extinguish it.]* Today we're going to be using some cork as well in our experiment. But first, we need a crazy story.

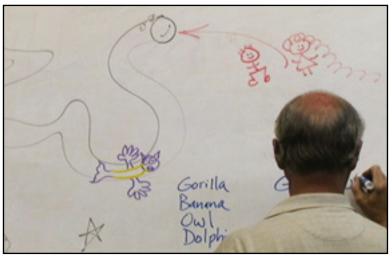
Story: "Jack & Jill and the Wormhole Aliens"

Once upon a time, floating out in space, were Jack and Jill. There's Jack and here's Jill. And Jill has infinitely long hair. Is there any air in space? [Students: No.] I know there's hair in space, but is there any air? No? Well, there they are. How long are they going to live before they run out of oxygen and die? [Students offer answers.] Not very long at all. Yeah, the water evaporates off your skin really fast, you get super, super cold, and your body starts to bulge outward because there's no pressure inside. You'd have serious problems real fast.

So Jack and Jill are floating out there. Their spaceship, which was made by the Evil Mister Fred Industries, has evaporated -- poof! And now they're flying through space with nothing around them. Now, what are the odds that at that very instant, another spaceship should immediately appear from warping from one place to another, and use its tractor to suck them inside? Yeah, at least a million to one. But that is exactly what happened. A giant wormhole spaceship happened to appear out of nowhere and suck Jack and Jill inside. And they didn't die because this particular wormhole spaceship had air inside, and it was nice and warm. So Jack and Jill are now living inside.

And there are creatures living inside this spaceship. The creatures -- what would be an odd-looking creature? Name one creature that it should have. *[Students make suggestions.]* So it has a dolphin shape. Let's give it a dolphin tail. What other features should it have? Gorilla hands. What else should it have? An owl head, okay. And a banana-shaped body. And so we're going to call it -- let's see, it's a gorilla, a banana, an owl, and a dolphin. So we call it a Gobaowdo.

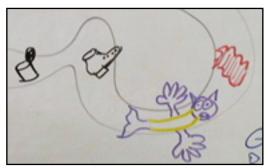
And Jack and Jill met the Gobaowdos in there, and they discovered that these



The alien in the wormhole is part gorilla, banana, owl, and dolphin.

Gobaowdos lived inside this wormhole that could go anywhere in the universe just by thinking wherever they wanted to be. If they wanted to be in Disneyland -- poof! -- they would be there instantly. If they

wanted to go to Pluto and visit whatever cartoon characters are living on Pluto, they could be there instantly. Anywhere they wanted to be. And they ate stuff and they collected stuff. Wherever they went, they collected the most valuable things they could find. They found a piece of wrinkled-up newspaper in Hong Kong, and they thought this was the most valuable thing they'd ever seen. They found an old boot when they went to Mars. They found a tin can on Venus. And they valued all these things very highly, and they kept all those in treasured spots inside of their wormhole.



The alien with his junk.

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There also was a bunch of red rocks inside of the wormhole. and they just threw them all around. Occasionally they ate them. And Jack and Jill said, "Wow! Why do you have so much junk lying around in here? Why don't you clean this place up?" And they said, "Junk?? What do you mean, junk? These are our treasures. We've been all over the universe collecting these things." And Jack picked up one of the rocks and said, "Wow, look at this. It's a rock. Smells like strawberry." He ate a piece of rock. He said, "It tastes good, too." Then all of a sudden, Jack started talking really fast, and he took off and bounced around inside of the wormhole -- boing, boing, boing, boing. He reached speeds of seven hundred miles an hour, like that. And Jill said, "Jack! Where are you?" Jack said, "I don't know, I'm lost!" So Jill ate some of the rock, too. And she went boing, boing, boing, boing, boing, and found

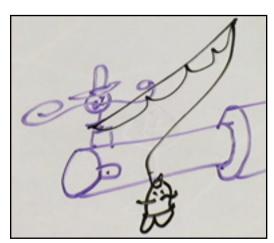
Jack. And she said, 'Wow! This is incredible stuff! This rock is amazing! We could use this to save all kinds of oil. We don't need to burn oil anymore. This rock has energy in it. It's like pure energy." And they thought, "Well, we'd better protect this stuff, too, because if certain people find it, they could use it for evil."

Now, no sooner did they mention that than who should show up but Evil Mister Fred. Evil Mister Fred had converted his castle tower into a rocket ship, and he's flying through space. It was his spaceship that Jack and Jill were riding on that evaporated right out from under them, and he wanted to be there to watch them die. So there he was. And all of a sudden, here comes this wormhole and poof! -- Jack and Jill were

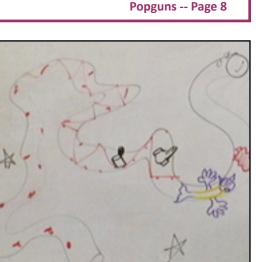
gone. And he said, "Oh, man, I planned that out for years. And it looks like they just disappeared. They may not even be dead. They're inside that wormy-looking thing." He said, "Okay, minions, somebody's got to go down there and find out if Jack and Jill are still alive."

So he grabbed a minion and he put a fishing hook on his head. They have hard heads, it doesn't hurt. And then he cast the minion out, and the wormhole thing ate the minion. And now there's a minion inside. And Jack and Jill hear this boing, boing, boing, boing inside the wormhole, and they ran over to see what it was, and there was a minion. They said, "Oh, no. A minion. That means Evil Mister Fred's got to be somewhere near here." And the minion said, "Oooh, candy!" And it ate one of the rocks. Next thing you know, the minion went boing, boing, boing, boing and bounced right back out the mouth. Now Evil Mister Fred's got the fishing pole with a minion on the end, and the minion's going seven hundred miles an hour. And he reeled out lots and lots and lots of line,

Evil Mister Fred's castle spaceship.



Minion on a fishing pole.



The red rocks were scattered all around,

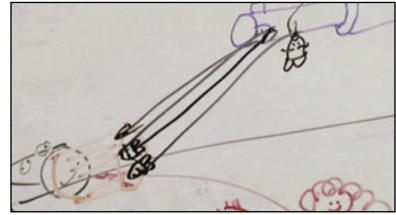
and Jack bounced around after he ate one.

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and finally the minion slowed down and he reeled him back in and said, "What were you doing?" The minion said, "Nothing." And Evil Mister Fred said, "Well, what did you find out? Are Jack and Jill still alive?" The minion said, "Yup! And they've got candy in there. If you eat it, you go really fast." And Evil Mister Fred said, "Oh, all right! I'm going in. Whatever it is, if they want it, I'm going to steal it."

Jack and Jill now realized Evil Mister Fred was going to come and get them, so they had to do something fast. So they called the Acme Store of Everything, because they have everything and they deliver it instantly, and they ordered a giant cork and they put it in the wormhole's mouth to keep Evil Mister Fred from coming in. Now, Evil Mister Fred isn't going to wait for that too long. He's got a few more minions, and he hooked lines to them and tied the lines to his spaceship, and he told the minions, "Go bite the cork." So now there



Minions biting at the cork.

are minions biting on this cork to grip it. So there's minions, minions, minions, all hanging onto this cork, and all the lines are attached to the spaceship. And he says, "Okay, full reverse!" Rrrrrr -- and he's going like that, trying to pull out that cork. Jack and Jill are in trouble. If you were Jack and Jill, 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.)

We'll leave this "To be Continued . . ."

Experiment: "Popguns"

We have tubes with corks in them [blows across top of tube to make a musical sound] that can do things. And I'm going to be giving you some stuff that I'll be putting on the table, and the objective is to make the cork fly straight up and come straight down. The objective is not to make the cork fly over that wall or into those boxes, because you only get one cork. If you lose the cork, then you have to sit there and say, "Awwww, I lost my cork." You have to say that the whole rest of the time.



Cork and PVC Pipe.

The stuff you're going to be getting is the tube with a cork, and a stick.

The stick has some features that are desirable. And a screw, and a piece of leather with a little hole in it, and a washer with a hole in it, and a piece of string. And you might need a glue gun, so I'll set up some glue guns while you're looking at the parts. *[Instructor passes out the pipes and corks to students.]* See if you can make a sound with it.



Assembling pieces with a screwdriver: washer on the bottom, leather on top, and the screw goes into the hole in the stick.

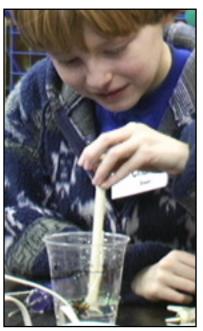
[Instructor passes out the rest of the parts, but does not give students any instructions for assembly. They get to put it together by trial and error and see what works.] Ah, some people have discovered the screw fits someplace. [Passes out screwdrivers.]

You might put something on the screw before you stick the screw into the stick, but that's up to you. I'm going to pass out some pens so you can put your name or a mark on your cork so you know which cork is yours. *[Instructor sets up glue guns on table.]*

Try it first without the string. [Students practice shooting corks with the items they've assembled.] There's one more thing that I didn't give you. Some people have gotten theirs to fire without the thing that I didn't give you. That's pretty good. But the thing I'm going to give you will help it work better.

[Instructor sets cups of water on the table. Some students figure out that they can dip the end of the stick into the water to get the leather wet. Then they resume shooting and see if it works better.]

Dip the leather in water.



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[Student: Do we tie the string to the cork?] I glue the string to the cork. Sooner or later, to keep you from losing your cork, glue a string onto the cork and onto somewhere on the body of the tube.

If you want to put a wheel on the end of the stick, we've got wheels *[passes out wooden wheels to glue on the bottom of the stick]*. I put one on the end of the stick so it doesn't hurt my hand when I hit it.

[Student: Mine won't fly.] Oh, that's because you've got the washer on top of the leather instead of under the leather.

[After several minutes] Okay, everybody put your cork guns down for a minute. If you get a good airtight seal on the bottom of the cork, it should be able to fly. But we need to stop now and make an ending for our story.



Glue a wooden wheel to end of stick.



Glue a string to the cork and the shooter.



Almost finished attaching the string.

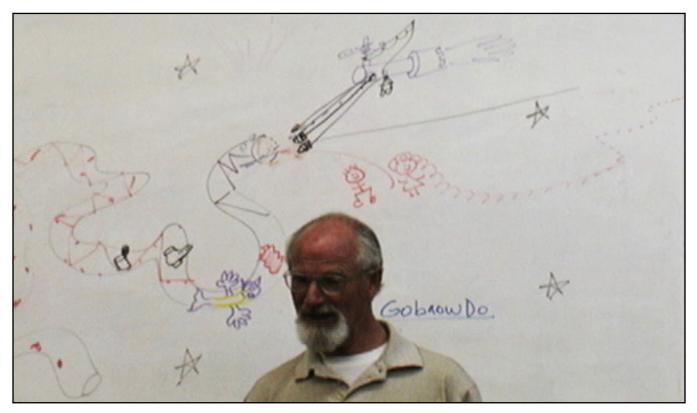


Ready to fire.

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

Jack and Jill are inside the wormhole. There are extremely energetic red rocks in there that if you eat them, you can go up to seven hundred miles an hour. There are Gobaowdos inside as well, and Evil Mister Fred is on the outside with his spaceship, and minions are biting onto the cork, and he's trying to pull the cork out of the wormhole. And Jack and Jill say, "Hey, Gobaowdos! We need some help here. We need about, oh, forty of your guys to eat some of those red rocks. And just before you eat it, make sure you're pointing towards the cork. And the Gobaowdos said, "All right. This'll be great."

So they collected a bunch of red rocks, and Jack and Jill said, "Ready? One, two, three, go!" And they ate the red rocks. Well, when Gobaowdo's eat red rocks, it doesn't work the same as with people. With people, they zoom all over the place. With Gobaowdos, they eat them, and a few seconds later they burp. And the Gobaowdos all went, "Oh, ohhh, braaaaaaaaaaappppp!!" And they got so big before they burped, they sealed off that end of the wormhole, and all the pressure from their burping went against the bottom of the cork. It was an incredible amount of pressure, and the cork all of a sudden, because Evil Mister Fred was wiggling it, popped out. But it popped out at an incredible speed, almost the speed of light, and hit Evil Mister Fred's spaceship. And knocked Evil Mister Fred and his spaceship into another space-time continuum. And they all lived happily ever after, except Evil Mister Fred.



End of Lesson If you have questions about this lesson, please ask them through the online <u>Teacher</u> <u>Support Forum</u> on our web site.