

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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Ropes and Pulleys A Rock-it Science Lesson Filmed February, 2012

Rock-it Science

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Intro Quick Recap:



- You have a giant cheeseburger in space and an invalid monster who wants to eat it.
- The monster can't reach the cheeseburger, and he can't move. There's also a mountain in space.
- You call the Acme Store of Everything, order a long pole, and place it on top of the mountain and under the cheeseburger.
- If you can find a way to make your end of the pole go down, the cheeseburger will go up and fall into the monster's mouth.

Demo One: Seesaw

- Instructor sets up a balanced seesaw on the table. The Assistant sits on one end, representing the cheeseburger.
- A lightweight student sits on the other end, representing the person in the space suit.
- The student isn't heavy enough to lift the cheeseburger. Ask students what can be changed to make that happen.
- The student and Assistant get off and the Instructor moves the fulcrum closer to the cheeseburger end. When they get back on, the student's weight makes the Assistant rise.



Intro Quick Recap, cont.: <u>Demo Two: Ramp</u>

- You can also use a ramp to move things. If the cheeseburger in the drawing had stubby legs and wanted to move up the pole, you could tie a rope to one of its teeth and pull it up the ramp.
- Show students a large sheet of paper in the shape of an inclined plane. Roll it up into a tube so the inclined edge looks like a spiral.



• Tell students this is a simple machine, and ask them if it looks like something you could use to twist into wood.

Experiment Quick Recap: "Ropes and Pulleys" Part One: Pulleys

- In Los Angeles, they have canals that run through the city from the hills to the ocean.
- During flash floods, water rushes down the canals and can sweep away kids playing there.
- If a firefighter tries to grab a kid out of the canal, the force of the rushing water pulls him in.
- To avoid this, they installed beams overhanging the canals, with a large ring attached to a rope.
- If someone is caught in the water, they can grab the ring and the firefighters can use the rope to pull them out without getting pulled in themselves.
- In the first part of the experiment, there is a large ring with a pulley on it attached to a rope hanging from two overhead beams. One student holds onto the ring while the other students pull on the rope to make her rise off the ground, then let her down gently. Each student takes a turn on the ring.
- Then the students switch to another rope which is just draped over the beam, with no pulley. So when the students pull the rope, they have to overcome the resistance of the rope's friction against the beam. Each student takes a turn on the ring.



- Then they switch to a rope with one pulley on it, and each student takes a turn on the ring.
- Then they switch to a rope connected to four pulleys, two at the top near the beam, and two at the bottom near the ring. If you pull with one hundred pounds of force, you can lift four hundred pounds. Students pair up with a partner of similar weight. One student pulls the rope while his partner holds the ring; then they switch. Each pair takes a turn.

Part Two: Tug of War

- All students line up on one end of the rope for a tugof-war. The Instructor is on the other side and wraps the rope once around a post between himself and the students. The students pull on the rope and try to move the Instructor.
- Explain that wrapping the rope around the post creates friction, making the rope harder to pull.
- Then each student takes a turn in the Instructor's place while the rest of the students pull on the other end of the rope.



Experiment Quick Recap, cont.: "Ropes and Pulleys"

Part Three: How to Move a Giant Boat

• Once there was a king who built a huge boat that was too big and too tall, and it was too full of gold. So it got stuck in the mud just off-shore.



- The king got three thousand soldiers who tied a bunch of ropes to the ship and tried to pull it out of the mud. They failed.
- Archimedes claimed he could free the boat with just one hand, even though he was an old man.
- The king accepted his offer and threatened to kill him if he failed.
- Archimedes stuck a long telephone pole-like rod to the front of the ship and another to a strong tree on the shore. Then he attached many pulleys to each of the poles and connected them with ropes.
- Archimedes held the end of the rope with one hand, and every time the wind or the waves made
- the ship move a little bit, he took up the slack in the rope. After a few hours the ship was free.
- Set up two pulleys connected by a rope. The Assistant holds one pulley and represents the tree onshore, and a student holds the other one and represents the ship. The Instructor holds the end of the rope and represents Archimedes.
- As the Instructor moves, the students is pulled closer to the tree. The pulley arrangement has three lengths of rope, so the Instructor has to move three times the distance that the student moves.



Alternate Experiment: "Mountain Rescue"

You can simplify the apparatus by using a tree, a slide, or other objects available in the schoolyard. Set up several stations and have the students rotate through them. Make signs similar to the ones below and place one at each station. *This version of the experiment does not appear on the video*.

Pulley Take Urns Pull victim up The slide. Take Turns being the Everyone Take one Victim. turn as victim. Victims ... watch your See how many it Takes Lift Victim hands near the top! to lift victim 2 fee 2 feet high. NO HIGHERI DON'T WRAP HANDS WITH ROPE lift sitting of the 044 With one turn of rope around pole one person tries to hold back every: until rope One rescuer lift ground straight. is victim then ONE one else. switch places. TAKE TURNS turns. Take

Equipment List: "Ropes and Pulleys"

Items needed for Instructor:

- Climbing ropes
- Carabiners
- Pulleys, 4 single, 2 double
- Bicycle wheel with spokes cut off, wrapped with cloth tape (see prep video)
- 1/2" PVC pipe, about 12" long, 4 pieces
- Duct tape to wrap PVC pipe
- Long pole with hook to move ropes
- Wrestling/gymnastic mats
- Pole for tug-of-war
- Paper "ramp" shape, approx. 9' x 3'
- Black marker to outline ramp shape

Items needed for Students:

• None

Prep Work (see prep video):

- Build ring: Remove spokes from bicycle wheel, wrap with cloth tape.
- Set up ropes and pulleys.
- Add PVC pipe where needed to keep ropes from tangling.
- Set out mats.
- Cut out ramp, outline in black.



Double pulley with PVC pipe slipped over the ropes to prevent tangling.



Floor mat.



Single pulley attached to beam.



Modified bicycle wheel attached to pulley with carabiner.

Story Recap: "Jack & Jill's Wagon Train"



Part 1:

- Evil Mister Fred liked cowboy movies, and he wanted to be like the indians. He glued feathers onto his minions and gave them bats that had a bulge on the end like a tomahawk.
- He disguised his castle to make it look more like a teepee. He leaned sticks against it and had the minions wrap it with paper. He stood on top with feathers on his hat so he looked like a chief.
- He also had a bow and arrows with poisoned tips. When he shot the minions with the arrows, it made them go crazy. They'd run faster and farther and yell a lot.
- Jack and Jill were leading a wagon train headed west, along with their friends and Kick-mees.
- They didn't have any oxen, so the wagons were pulled by hundreds of mice who could mold themselves into the shape of an ox.
- The minions started clubbing the mice. So the mice transformed themselves into a kangaroo, and the kangaroo kept the minions away. But it was slowing down the wagon train.
- Then Evil Mister Fred called the Acme Store of Everything and ordered a river of hot lava.
- Jack and Jill ordered some sky hooks so they could hoist their wagons up on the hooks and float over the lava. But they weren't strong enough to get their wagons up onto the hooks.

Story Recap (cont.): "Jack & Jill's Wagon Train"



Ending:

- Jack and Jill ordered some pulleys from the Acme Store of Everything and hoisted their wagons onto the sky hooks.
- The wagons acted like sails, and the wagons started floating towards the castle.
- Evil Mister Fred got on his flying vacuum cleaner and took out his pocket knife so he could cut the ropes on the pulleys.
- The mice, who had turned themselves into a kangaroo, put boxing gloves on. Then they put some pepper on the kangaroo's nose. When he sneezed, he jumped high into the air, right in front of Evil Mister Fred.
- Evil Mister Fred tried to chop the kangaroo with his knife, but the boxing gloves were too strong.
- The kangaroo punched Evil Mister Fred and made him fall off his vacuum cleaner and into the hot lava.

Transcript: Intro

Let's suppose you have a giant cheeseburger in space. Here's a cheeseburger in space. And you have an invalid monster that wants to eat it. There. But he can't move over to where the cheeseburger is. He's stuck there.



And you're going to help him out. And there's a space mountain there, floating out there. And here's you, floating around in your spacesuit. There. And you want to get the cheeseburger into the monster's mouth.

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So you call the Acme Store of Everything and you order a great big pole. There. And you figure it's like a seesaw. If you can pull on your end of the pole and lift the cheeseburger up, it'll fall into the monster's mouth.

So you could put a rope on it if you wanted to, and pull down. Or you could get on top of it and jump up and down. And you might be able to make it go into his mouth. Well, let's take something like that.

Demo One: Seesaw

Hang on rope or stand on top.

[Instructor sets up a

balanced seesaw on the table.] We can kind of balance it like that. Now we need a giant cheeseburger. There's one! The cheeseburger's going to sit on the seesaw. [Assistant sits crosslegged on one end of the seesaw.] Now we need a lightweight person. [Selects a student.] You're pretty light. You go sit on the other end. There.





Balanced seesaw.

Uh-oh. She's not heavy enough to move the cheeseburger. What shall we do? [Students offer suggestions.] If I want to make it easier for her to lift the cheeseburger, what should I do? There's something you could change to make it so she can lift the cheeseburger. What can you do? There's something you can move. What could you move?

Student isn't heavy enough to lift the Assistant.



Mountain, cheeseburger, and monster.



Pole on top of mountain, under cheeseburger.

Transcript: Intro, cont.



Move fulcrum toward cheeseburger.

Well, step off for a second. [Student and Assistant move off seesaw.] Let's move that. [Slides fulcrum closer to the Assistant's end.] Would that make it better or worse?

[Student and Assistant get back on seesaw, and the Assistant is lifted up.] Aha! She can now lift the cheeseburger. Now walk forward. Oh, look at that. Now you're perfectly balanced.

So that's leverage. You can do all sorts of things with leverage. Okay, let's step down

now. Let's give a hand to our cheeseburger and to our bouncer person. *[Puts away seesaw.]* So that's one kind of leverage.



Cheeseburger is lifted up.

Demo Two: Ramp

Another kind of thing you can use to help you move stuff is a ramp. If the cheeseburger had really stubby legs and wanted to move up the stick, it might not be able to do it itself, but you could take a rope and tie it to one of his teeth and help him go up the ramp.



Ramp-shaped sheet of paper.

And our Assistant has a ramp here. [Instructor and Assistant unroll a large sheet of paper in the shape of a right triangle with a long base. The hypotenuse is out-

lined in black so it shows up against the white paper.] Does that look rampish? Yeah, it looks like a ramp. And then she's going to roll it

up. [While Instructor holds the pointed end, the Assistant rolls up the triangle from the other end, so the black outline is visible as a spiral on the outside of the tube.]

And it'll turn into another kind of machine, a simple machine. It looks like a unicorn horn. But it also looks like something else that you can twist and it goes into wood. Does this look like anything that you could twist into wood? [Student: A drill] A drill, yeah. It looks like a drill. You could drill through wood. [Student: A screw.] And it looks like a screw. It's another form of simple machine. Well, today we're going to be working with simple machines. And one kind of simple machine we're going to use involves ropes and pulleys. But first, we need a crazy story.



Rolled-up ramp.

Story: "Jack & Jill's Wagon Train"



Minion with feathers And tomahawk club.

Once upon a time, Evil Mister Fred had watched a cowboy movie. And he liked the indians because the indians had bows and arrows and they could ride really good on horses and stuff. So he glued feathers on his minions. So every minion got his own feather. And instead of just ordinary baseball bats, he gave them a baseball bat -- he couldn't give them a sharp end because they'd chop each other to bits -- he just put a big wump on the end like that. So they'd look more like an indian's tomahawk.

And so the minions thought this was cool, too. They could run around, their feathers would make some noise in the air as they ran. And they had a bigger lump at the end to hit each other with. And,

you know, the minions didn't like his castle because his castle didn't look like a teepee. So he had to disguise his castle so it would look more like a teepee. So he just took a bunch of sticks and leaned some sticks on it, like that. And then he has the minions wrap paper around it. And then



Evil Mister Fred on top.

Evil Mister Fred would stand on the top, like that. He'd be the big chief.

On top of his sombrero, he had one of those things with lots of feathers. There, headpiece, like that. And he got to have the bow and arrow. And he put poison on the tip of his arrow. And he'd shoot the minions with it. And the poison made them go crazy. They'd run faster and farther and yell a lot.



Teepee castle.

Now, he didn't do this for no reason. Of course, he's going to do this for some purpose. He knew that Jack and Jill were on a wagon train heading west. And the wagon trains in those days had a wooden wagon with some wheels. Wooden wheels with steel on the outside. And they put animal fat on the axles. And they had a framework like that. And they put some tarps over it. So then they had this wagon.



Mice pulling wagon.



Jack & Jill's cowboy hats.

And they'd pull it with mice. Oh, they didn't use horses because horses got tired too easily. They usually used oxen. But Jack and Jill didn't have any oxen, so they got a bunch of mice. Probably four or five hundred mice. They can be molded into the shape of a cow kind of thing.

And Jack and Jill could stand up here. And they were headed west. Jack's got a cowboy hat. And, wonder if Jill's going to wear a cowboy hat. Jill could mold her hair into a cowboy hat. There. That's Jill's hat.

And Jack and Jill were out there with all of their friends and their kick-mees. So there was a few hundred wagons, all heading west. And there, right in front of them was Evil Mister Fred's castle disguised as a teepee, and a whole bunch of minions with clubs.

And the minions came out and started clubbing their little mice. And the mice didn't like that. And the mice, since they could form themselves into an ox, they could form themselves into something like a kangaroo and chase the minions, because they could jump really far. So this is a mouse kangaroo. It's made up of hundreds of mice. There. So they could modify themselves. So there were great battles going on between the minions and the mice. But it was slowing down the wagon train, and Jack and Jill didn't like that.

And Evil Mister Fred added another feature. He called the Acme Store of Everything and he ordered a river of hot lava. And Jack and Jill said, "Uh-oh. How are we going to cross the hot lava? It's two thousand degrees."

So Jack and Jill ordered some sky hooks. And you can buy different levels of sky hooks. You can buy the five-hundred-foot sky hook, which holds you up five hundred feet, or the thousand-foot sky hook, or the three-thousand-foot sky hook. And they hang up there in the air. And they figured they'd just hoist their wagons up on the sky hooks. There are sky hooks way up high, like that. And then they'd fly with their sky hooks right over the top of Evil Mister Fred and escape the hot lava and the minions with their clubs.

Problem was, they weren't strong to get their wagons and hook them onto the sky hooks. And they said, "Darn! What are we going to do?" If you were Jack and Jill, what would you do?



Mouse kangaroo.



River of hot lava.



Sky hooks.

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: "Mountain Rescue" Part One: Ropes and Pulleys



1. End of rope goes over beam.



 Rope passes through pulley with ring hanging on it. Assistant holds safety cord attached to ring.



3. Rope passes through second pulley on another beam.



4. Students pull on other end.

Line up behind that line. In Los Angeles, they have canals that run through the city. The canals come from the hills and go into the ocean. Sometimes there are storms up in the hills but not in the city. It's raining up there, but not down here. Then there's a flash flood. Water comes swooping down through the canals, all the little kids on their bicycles who are riding up and down the walls in the canals get washed away, and they scream and yell. And the fire department comes out. And a two-hundred-pound man sees a forty-pound kid screaming and yelling, reaches down to pick him up out of the fast water, the kid is going by so fast that the two-hundred-pound fireman goes ka-sploosh in the water, and they both drown.

So they came up with a better idea. They put places along the canal, like that big four-by-four sticking out up there. They have a rope go across it, and then on this side they put a bunch of firemen. And the kid's coming along and sees that ring and grabs it. And then the firemen can go like this and pick him up out of the water. And he's on a pulley, so they can slide him one way or the other and get him out of the canal.

First Rope: So we need a victim to hang onto the ring. What we're going to do is, each person that wants to can be a victim. First person goes first, and then when she's done she goes to the end of the line.

Now, there's a problem with this. If you guys all grab on the rope and pull, somebody ends up getting squished against the wall. So instead of doing one row, we're going to do two rows of people facing each other.

[To first student] So you go over there and sit down. You're the victim. [Student goes to the mat and takes hold of ring. Instructor directs remaining students to stand facing each other in two lines, on either side of the rope.] So everybody grab the rope. And then you're going to pull sideways so you don't do the dominoes thing. You want to keep yourself facing your partner. [Students pull on the rope, and the student holding the ring lifts off the ground. The Assistant holds onto a cord attached to the ring to keep it from going too high.] And she goes up. Now you walk forwards and put her down, or just let the rope go down slowly. You let them



5. Up she goes.

Ropes and Pulleys -- Page 15

down slowly, because they don't like to crash so much. [Students take turns being lifted up on the ring.] Okay, you can drop that rope and we'll move on to the next one.

Second Rope: [This rope is draped over the beam, with the ring on one end and the students pulling on the other end.] There. This one you just hang onto the ring, and there's no pulley up there. You have to deal with the friction of the rope over that board. Again, you want to make sure you're standing sideways while you're pulling because sometimes they drop off, and you don't want to do the dominoes thing. [Sends first student up to grab the ring.] Pull him up. Stop when that silver thing hits the pole, or if he yells stop. [Students pull up the first student.] Okay, bring him down. [Students take turns being lifted.] Okay, we're going to move on to the next one.



Third rope has one pulley on it.

Third Rope: [Instructor and Assistant change ropes again.] This time we get to use one pulley. Okay, now we're getting rid of the friction of the beam. Same deal, line up behind the tape. [Students take turns being lifted.]

Fourth Rope: Now we're going to be doing the one with four pulleys. You choose a victim, someone to work with, someone about your weight. Go stand by your victim. This has got four pul-

leys, so if you pull with a hundred pounds, you can lift four hundred pounds. [Students pair up, and the first pair comes forward. One holds onto the ring while the other one holds the rope.]

One of you hang onto this and the other one will be the puller. You're the puller and you're the pullee. You're going to try to lift her all by yourself. Okay, pull. We're not going to go all the way to the top. We'll just go a little ways. Okay, now bring her down slowly. Just let the rope down a little bit at a time so it doesn't burn your hands. Okay, now you switch places. [Each pair of students takes their turn.] Okay, now we're going to go outside.



Second rope is just draped over the beam.



top, two at bottom.



With four pulleys, one person can lift alone.

Part Two: Tug of War

[Students line up several feet away from a post.] You're going to be playing tug-of-war with just one person against everybody else. [Instructor gives one end of the rope to the line of students and wraps the other end once around the post.] Okay, now first, I'm going to play tug-of-war against all of you so you can see what it's like. When I say go, you're all going to pull for just three seconds and then stop. Ready, get set, pull!

[Instructor pulls on the short end of the rope while the students pull on the other end.] One, two, three, stop! See, I didn't die. I wrapped the rope around this pole one time

around, and we're going to see

a turn on the short end of the rope.]



One person pulling against all the rest.

how much friction we can get from this pole. And when you're pulling, remember to keep one foot behind you in case they let go. [First student takes hold of the short end of the rope and starts to wrap the rope around his hand.] Don't wrap it around your hand in case they pull you all the way through. Ready, get set, go! Okay, stop. [Each student takes



Rope wrapped once around pole.

Part Three: How to Move a Giant Boat

There was a king who made a ship that was way too big and too tall and too full of junk, like gold. And the ship got stuck in the mud, which was very embarrassing for the king because it was his first trial. And there it sat, stuck in the mud, and it was a problem. So they got three thousand soldiers, tied a bunch of ropes to the ship, and played tug-of-war. So there's three thousand soldiers out here trying to get it unstuck.

And Archimedes was an old man at the time, and he was standing out there, and he watched them. And they couldn't get it free. And Archimedes said, "Ha! Weaklings! I could do that by myself, with one hand." And the king heard this. And the king said, "All right, wiseguy, come here." So Archimedes went over to the king. The king says, "We're going to give you a chance to unstuck that ship with one hand. And if you fail, we'll all watch while you get your head cut off." And Archimedes said, " Sounds good to me!"

So they went and stuck a long telephone pole-like rod on the front of the ship and another one on the shore, attached to a



Big ship.



Poles with pulleys attached to ship and tree.



Ropes attached to pulleys.

very strong tree, like that. And then they put a pulley here, and a pulley there, and a pulley there.

there, and a pulley there. And pulleys over here. And then they ran the rope over that one, under that one, over that one, under that one, over that one, under that one, all the way around until all the pulleys had a rope over it. And Archimedes held the other end.

And he just kept some tension on that end. And every time the wind blew a little bit, the ship would go rrrrr-rrrrr *[leaning side to side]*. Every time a wave hit it, it would go wuh-wuh *[lifting and dropping slightly]*. He'd always keep taking up the slack, and taking up the slack, and taking up the slack. And after a few hours, the ship was free with the pulleys.

So we're going to show you a very simple pulley set so you can see how it works. [Assistant represents the tree and holds a pulley with a rope attached to it. Instructor takes a second pulley and runs the rope through it.] Now we'll go around. Pretend this is the one that's on the ship. [Hands the second pulley to a student.] There, you can be our ship. And then we'll go through this one. [Passes the rope through the first pulley again.] Okay, then we go back to our ship again. [Ties

rope to the second pulley.]

Okay, and then here is Archimedes [Instructor holds the end of the rope.] And Archimedes can pull on this and pull [the student] forwards, just by taking up the slack.

Now, to see what it's like, you can stand up [student holding the pulley stands], and we can pull you closer to the tree. And I'm going to go clear out here [Instructor moves about thirty feet away]. All right, now I'm just going to hold the rope right here. And [student], start moving backwards, and we'll see how far she moves compared to how far I move.





Assistant is the "tree" and Instructor is Archimedes.



Instructor moves farther than student.

[Student holding the pulley moves slowly backwards as the Instructor moves forwards.] So now she's moving a short distance and I'm moving a long distance. And you can see that I moved [thirty feet] back here, and she only moved about ten feet that way. And that's the leverage you get from pulleys. There's a three to one ratio, three ropes here to the one that I have. Three to one ratio, so I only have to pull one-third of what she has to pull. And Archimedes knew all about that, and that's how he was able to get the ship off and save his own head.

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



Wagon on sky hook.

So Evil Mister Fred has laid an ambush for Jack and Jill with hot lava, and minions with feathers and tomahawks. And Jack and Jill have to figure out how to get around it. They ordered some sky hooks, but they weren't strong enough to lift up their wagons.

And Jill said, "Yeah, pulleys. We can do that." So they got some pulleys from the Acme Store of Everything and hung some pulleys here. And they started hoisting their wagons up on these pul-



Wagons floating away.

leys. So now there's a wagon up in the sky. There, like that. Wagons floating in the sky.

And Evil Mister Fred said, "You can't do that! That's not fair." And Jack and Jill said, "But we're doing it." And the wagons acted like sails, and the sky hooks started floating over everything. And Evil Mister Fred said, "I'll show you!"



Evil Mister Fred with vacuum cleaner and pocket knife.

So he got on his flying vacuum cleaner, and he put some minions in the vacuum cleaner bag. And he's got his bow and arrow, but he's also got his pocket knife. He'd probably be better off with a pocket knife. And Evil Mister Fred said, "I'll show you! You guys are up in the air. I'm going to fly right over there and cut your ropes, and you're going to plummet to your deaths. Life is good!"

And Jack and Jill said, "Uh-oh. We're in trouble. Evil Mister Fred's got his knife." And he started zooming towards the highest conestoga wagon flying in the sky. And all the mice were down there because they didn't want to drag the mice up in the air like that. And the mice said, "We've got to stop him! What are we going to do?" And they already made a kangaroo. And they said, "I wonder how high our kangaroo can jump?"

So they put some pepper on his nose, and the kangaroo sneezed and jumped into the air. And they also gave it some

boxing gloves, because I think kangaroos can box. There. So the kangaroo jumped up into the air, Evil Mister Fred was coming that way, the kangaroo was coming that way. They met right in front of the conestoga wagon, and Evil Mister Fred tried to chop the kangaroo with his pocket knife.



Kangaroo with boxing gloves.

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

The kangaroo's boxing gloves were made out of uncuttable leather, and the kangaroo managed to box Evil Mister Fred, and Evil Mister Fred fell off his flying vacuum cleaner and fell into the hot lava -- pssssshhhhhhh! A little piece of mustache came flying out on fire. And they all lived happily ever after, except Evil Mister Fred.



Kangaroo knocks Evil Mister Fred Into the hot lava, and a little piece of mustache flies out of the fire.

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.