Teacher's Guide for:

Foam Cutters

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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Foam Cutters
A Rock-it Science Lesson
Filmed November, 2009

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Intro Quick Recap:

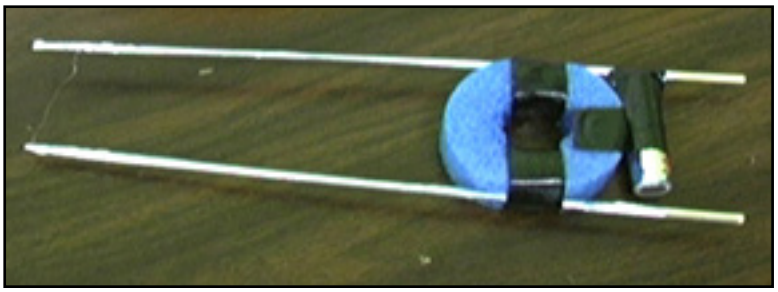
- When you stick your finger in the electrical outlet, what happens? Do you get hotter or colder?
- When electricity passes through stuff, it gets hotter, depending on how much electricity you put through it.
- Volts is like how far the electricity can jump. Amps is how much of it is flowing.
- Demonstrate a wire with six volts on it and two amps going through it.
- Hold a styrofoam tray against the wire so that the wire melts through it.
- Increase the electricity in the wire to twelve volts and four amps. Show how it cuts through the foam more quickly.
- Demonstrate the wire cutting through various objects: a block of polyethylene foam, a plastic cup, and a glue stick.

The hot wire melts through the styrofoam tray. . .

Experiment Quick Recap: *"Foam Cutters"*

Completed foam cutter

- We're going to make something using a battery to heat up a little piece of wire. The electricity needs to come out the top of the battery, through the wire, and back in the bottom of the battery.
- Demonstrate how to cover chopsticks with aluminum tape so the electricity will flow through them.
- Attach the ends of the wire to the chopsticks by placing the crimp-on studs over the pointed ends of the chopsticks.
- Place the battery between the chopsticks near the other end. Tape it to one of the chopsticks with electrical tape.
- Place a block of foam above the battery, so they're touching. Wrap tape around the foam and battery to hold them together, then tape the foam to the chopsticks.
- The foam is a little bit longer than the battery, so the battery is only in contact with one of the chopsticks. Squeezing the bottom of the chopsticks together brings them both in contact with the battery so the current flows.
- When the current flows, the wire gets hot and it can cut through a foam tray. Demonstrate how to cut shapes from the foam. It's not necessary to use force; just let the heat melt through it.
- Pass out supplies to students, starting with the chopsticks and aluminum tape, and have them build their foam cutters.
- Then pass out foam trays so students can cut shapes with the hot wire.
- NOTE: After this lesson was videotaped, we developed an alternate way of building the foam cutter. Instead of attaching crimp-on studs at each end of the wire, we used the plain wire, but made it a few inches longer than the distance between the chopsticks. Have the students wrap the ends of the wire around each chopstick, leaving it loose between them.
- After trying to cut the tray with the wire at this length, have them wrap it a few more turns around each chopstick so it becomes shorter and tighter. Then try cutting the foam tray again and see if it's harder or easier to cut as the wire becomes shorter.
- In place of the foam block, we used a slice of a large foam noodle, the kind used for swimming pool toys. This makes it easier for the students to squeeze the chopsticks together. We also used a AA battery instead of a size C battery.
- A video showing how to build this alternate foam cutter is on our web site, on the same page as the rest of the lesson video.



Alternate foam cutter design

Equipment List: "Foam Cutters"

Items needed for Instructor:

- Large foam cutter connected to amp meter
- Sample materials to cut through: foam tray, polyethylene,
  plastic cup, glue stick, etc.
- Small sample foam cutter
- Wire cutters

Items needed for Students:

Consumables (per student):

- "C" Battery
- 2 pointed wooden chopsticks
- Aluminum tape same length as chopsticks (2 pcs)
- Small block of foam
- Short wire with a #8 crimp-on stud for 18 guage wire
  at each end (pre-assembled)
- Electrical tape
- Styrofoam tray
- Ziplock bag, 1-qt size

Other:

- Scissors
- Markers, permanent, colored

For alternate (preferred) Foam Cutter design:

- "AA" Battery
- 2 pointed wooden chopsticks
- Aluminum tape same length as chopsticks (2 pcs)
- Slice of foam noodle, approx. 3/4" thick
- Steel rope, 1/16", about 6" long, separated into individual strands
- Electrical tape
- Styrofoam tray

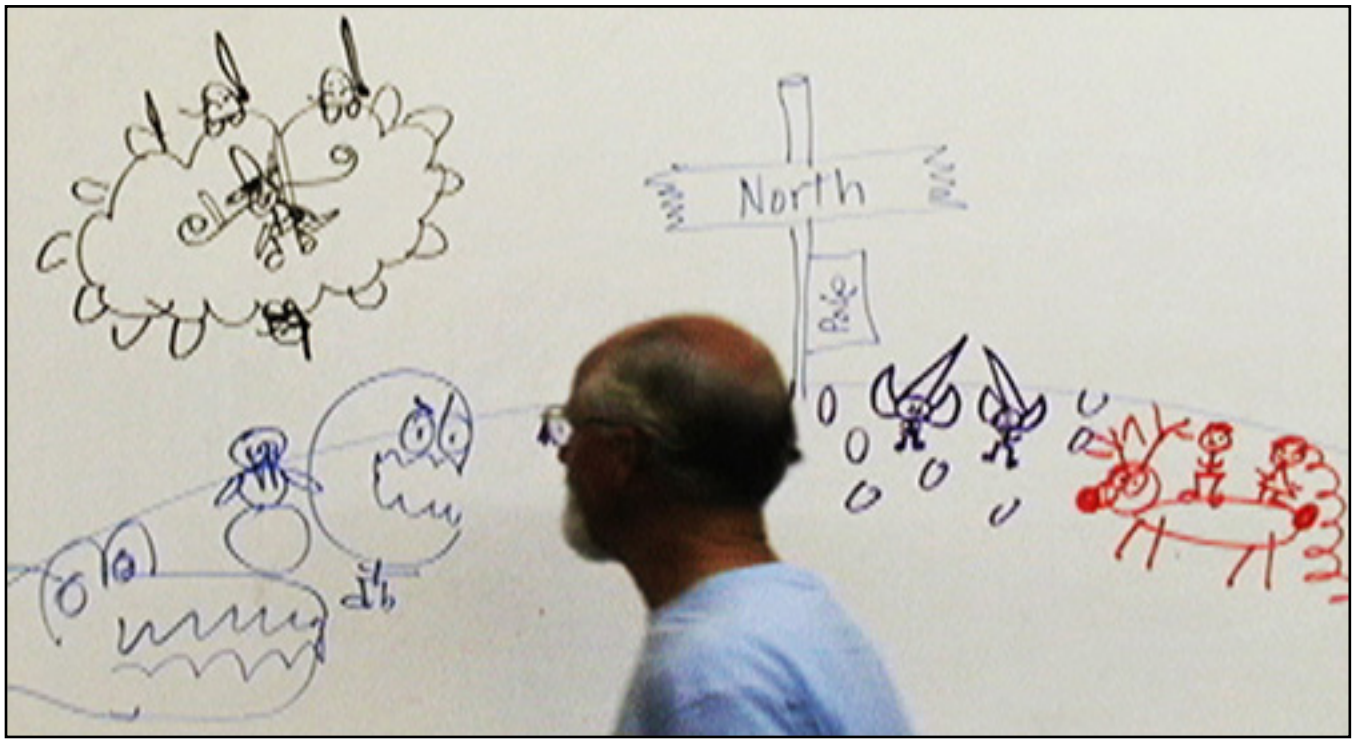
Prep Work:

- Cut aluminum tape to same length as chopsticks.
- Cut steel rope to size.
- Attach crimp-on studs to ends of wire.
- Cut foam to size, about 1/4" longer than battery.

For alternate (preferred) Foam Cutter design:

- Cut aluminum tape to same length as chopsticks.
- Cut steel rope to about 6". Separate into individual strands, or have students do this during the lesson.
- Cut foam noodle into slices on a band saw. (See video)

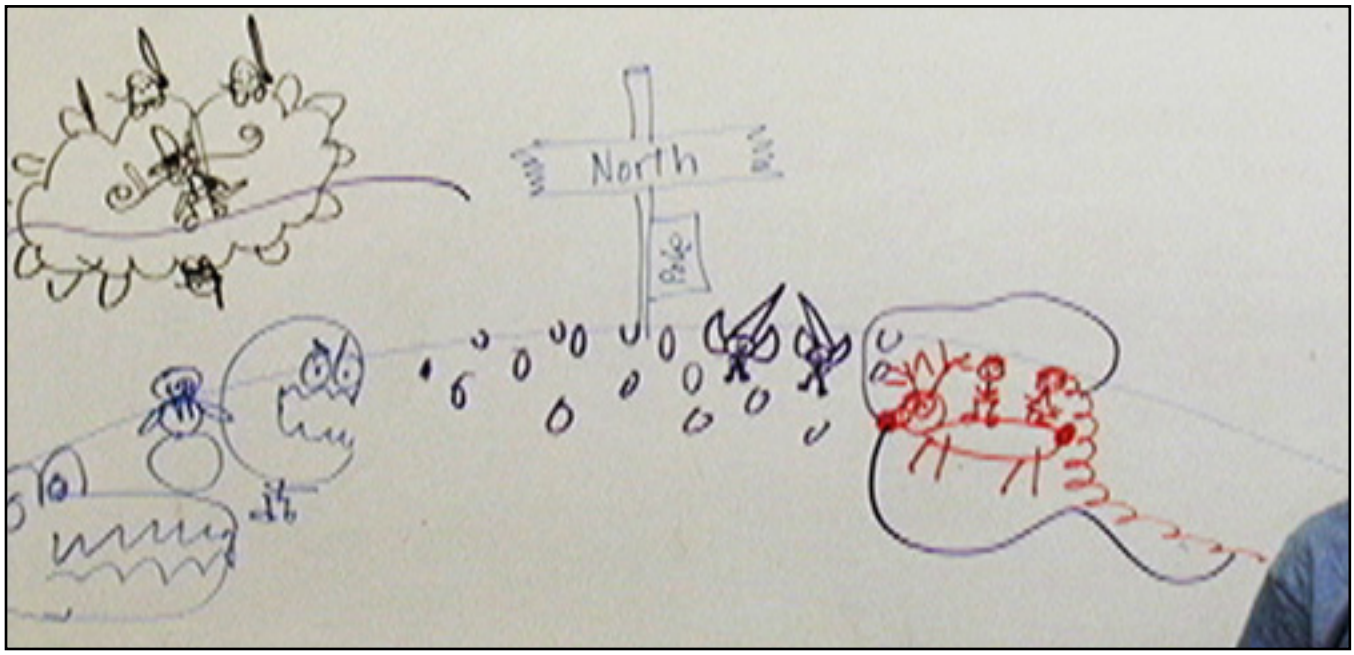
Story Recap: "*Jack and Jill and the Snow Creatures*"



Part 1:

- Evil Mister Fred decided to wreck Christmas by stealing all the presents at the North Pole. He flew there on a cloud with his minions.
- The elves can make all the presents because they move incredibly fast.
- Evil Mister Fred told his minions to hit the elves with their baseball bats, but the elves were too fast for them. They just moved out of the way.
- The next day, Evil Mister Fred tried to show the minions how to hit the elves, but he couldn't do it either, and he ended up getting hit by the minion's baseball bats himself.
- Santa called Jack and Jill to come and help. They climbed onto Rudolph and started riding around to see what was happening.
- Evil Mister Fred had his minions build a bunch of evil-looking snowmen. Then he ordered a bottle of Aliveness Powder from the Acme Store of Everything and brought them to life.
- But the snow monsters weren't mean. They started singing and dancing. So Evil Mister Fred spread pepper all over the monsters, making then sneeze. Then they became nasty and angry.
- Evil Mister Fred sent the monsters to start eating the elves.

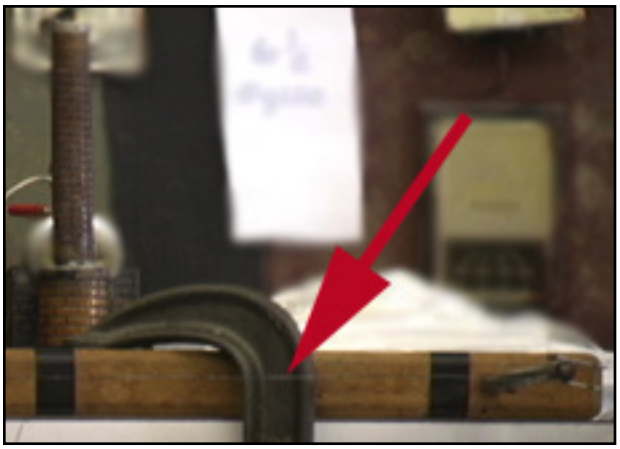
Story Recap (cont.): "*Jack and Jill and the Snow Creatures*"



Ending:

- Jack and Jill hooked up some wires to Rudolph's nose. Then they stuck the wires on Jill's hair.
- Then they told Rudolph to start flying around. As he flew, he generated energy with his nose.
- The energy went through Jill's hair and made it glow red hot.
- They flew over the snow people and cut them to shreds. The elves that had been swallowed jumped out.
- Rudolph flew up to Evil Mister Fred's cloud and cut it in half. Evil Mister Fred fell on the snow monsters, and the ones that were still alive ate him up.

Transcript: Intro



A thin wire is stretched between electrical connectors

For the sciencey part, if you stick your finger in the electrical outlet, what happens? *[Students: You get shocked.]* You get shocked. Do you get hotter or colder? *[Students: Hotter.]* Hotter. Yeah, whenever you put electricity through stuff, it gets hotter. It almost never gets colder, but there are some times when it may get colder, too.

If you put electricity through a thin wire, you can make it as hot as you like, depending on how much electricity you put through. And electricity is measured with things called volts and things called amps. So volts is like how far the electricity can jump. So lightning has lots and lots of volts. Amps is how much of it is flowing, like how much water flows down a river. *[Points to large foam cutter wire]* This wire, we're only going to put six volts on it, and it's got two amps going through it.

The hot wire melts through the styrofoam tray. . .

[Holds up a styrofoam tray] Now, you've probably all played with styrofoam before. You can kinda squish it, it's kinda soft. This kind of styrofoam, if you touch it to a wire *[holds styrofoam tray against wire, which slowly cuts through it],* you can melt through it. That's with six volts. *[Student: But where's the liquid that you just melted?]* Well, it solidifies as soon as it gets away from the wire.

Now that's twelve volts. When you put twelve volts through the wire, instead of two amps, now it's got four amps going through it. Now we can take it *[cuts through foam again, more quickly this time].*

[Holds up a block of foam] This stuff is made out of polyethylene -- like milk jugs, water bottles sometimes -- and lots of air bubbles. So let's see what happens when we put polyethylene on it. *[Holds foam against wire, slides it back and forth to cut through].* And you can cut through it. The liquid just solidifies, you know, like your hot melt glue guns. You melt it, and then when it cools, it gets hard again. That's the same thing with this.

. . . and a polystyrene cup

[Holds up a 16-oz plastic cup] This is a cup -- it's made out of polystyrene. *[Holds cup against wire, moving it back and forth until it cuts through]* We'll take a cup and let it melt through there. And you melt the cup out.

[Holds up a glue stick] This is a glue stick. These are the same ones you guys use. *[Runs glue stick back and forth along wire]* It's melting. *[Wire cuts through glue stick]* Watch the smoke. *[Runs glue stick back and*

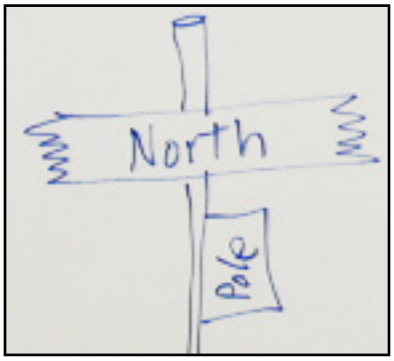
forth again] If you ever need some nice, reasonably safe smoke, this is polyethylene smoke.

[Holds up foam block and glue stick] This stuff and this stuff are the same stuff. You can glue things together with it. Today we're going to be putting electricity through wires and experimenting with it.

. . . and a smoking glue stick.

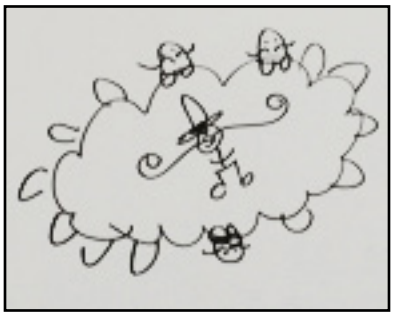
Story: *"Jack and Jill and the Snow Creatures"*

Okay, now we can do a crazy story. Let's see. Once upon a time, Evil Mister Fred was sitting around in his castle, just thinking about what kind of evil things he could do. And he thought, "What's the evilest thing I could possible do? Should I wreck Thanksgiving? Maybe make all the turkeys fly away. Should I wreck Fourth of July and steal everybody's firecrackers? Should I wreck New Year's Day and not let anybody have any fun? Or should I wreck Christmas, and not let anybody have any gifts?" So he decided to wreck Christmas. He's not going to let anybody have any gifts.



Evil Mister Fred goes to the North Pole.

There. The North Pole. And Evil Mister Fred thought, "Boy, I'm gonna go to the North Pole and steal all their presents." So he got on his minions and -- Let's have him fly on a big cloud. Evil Mister Fred is flying along on his cloud, clear to the North Pole (it's warmer in the cloud). And he's got some minions riding along. He makes them ride outside. Minions, minions, minions, minions. There -- minions all over it.



He flies on a cloud with his minions.

And there's a guy named Santa Claus at the North Pole, and he gets all the credit for being the Santa and giving away all the gifts, but you know who makes all the gifts? *[Students: The elves!]*

The elves make all the gifts. They do all the hard work, Santa gets all the glory. And the elves are little purple guys. They wear pointy hats and they've got little bodies, and they have big ears. Like that, there's an elf. So there's elves all over the place. And the elves have to make -- oh, about six billion gifts a year. That's kind of a lot of gifts, you know, six billion a year. And they could work really fast. And elves also talk really fast. And their hands work so fast you can hardly see their fingers move. And when they walk from place to place, all you see is a flash of light -- bshew, bshew, bshew, bshew -- elves running everywhere.

There are elves all over the place.

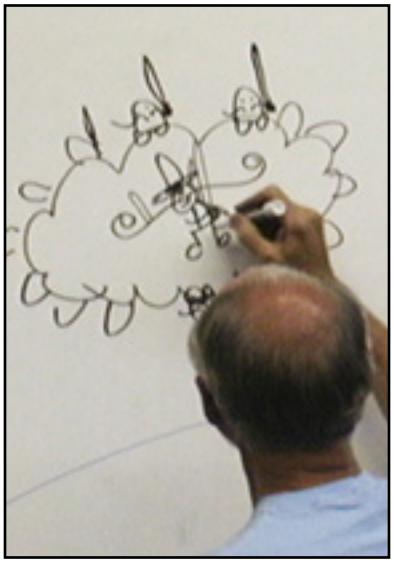
So Evil Mister Fred landed his cloud close to the North Pole. He said, "Minions, grab your baseball bats." So the minions all grabbed their baseball bats. And he said, "Go find those elves and hit them on the head." And all the minions said, "All right!" They jumped off the cloud and ran toward Santa's place, and they were ready to hit the elves.

They go fwhew! *[swings bat downward],* and the elves just go boop! *[steps aside]* because the elves are so quick, they would miss. And then the minions would try to hit somewhere else, and the elves would just dodge. And then the minions said, "Okay, I'll show you guys!" And went whoosh! like this *[swings bat horizontally],* and the elves would just jump up in the air. And the minions couldn't hit them. And the minions were trying so hard to hit them that they were hitting each other. And after about an hour, the minions were so tired out, they couldn't even wiggle their arms, and they went back to Evil Mister Fred with bumps on their heads.

The minions went after the elves with their baseball bats.

[Student: They don't have arms, I thought.] Or their mustaches, because they swing them with their mustaches. And they went back to Evil Mister Fred, and Evil Mister Fred said, "All right, did you hit them all on the head?" And the minions said, "No, boss. They were too fast. We couldn't stop 'em. We didn't know what to do." And Evil Mister Fred said, "Can't you guys do anything right? Arrgh, I'll show you."

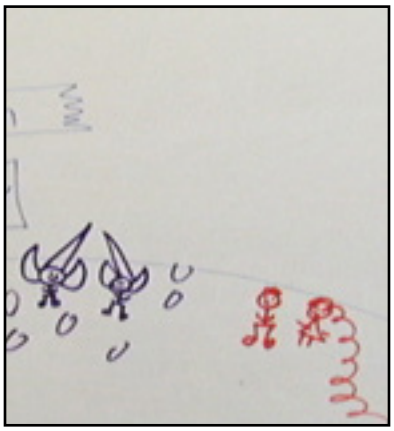
So the next day, Evil Mister Fred jumped off the cloud, got his own baseball bat, and took the minions out to show them how to hit little elves on the head. And of course, Evil Mister Fred had no more success than anyone else. Plus, Evil Mister Fred got hit by the minions. So he had bumps on his head, and bumps on his arms and bumps on his knees. Let's put some bumps on Evil Mister Fred. He got bumps on his mustache. Because he got hit by the minions. He said, "Aw, we need a better plan for this." So he went back to his cloud to think of a neat plan to do.



Evil Mister Fred ended up with bumps all over.

Now, pretty soon word got out that the North Pole was under attack. Santa was in a war, and he needed reinforcements. The rest of the people in the world sent Jack and Jill up there to stop whatever it was that was going on.

So Jack and Jill went up there, and Santa said, "Hey, good to see you again. What's up?" And Jack and Jill said, "I thought there was war going on." Santa said, "Oh, no, it's okay. You know, they can't hit my elves. They're too quick." And Jack and Jill said, "Oh, well, so maybe we can just hang around, take some rides on the reindeer, and have some fun." And Santa said, "Yeah, go for it!"



Jack and Jill came to help Santa and the elves.

So Jack and Jill got on Rudolph. There's Rudolph. Do reindeer have a tail? *[Student: Yeah. It's a ball.]* Oh, a ball? There. So they rode around on Rudolph for awhile. And Evil Mister Fred was busy while they were playing around. Evil Mister Fred said, "Minions, start making snowmen." And the minions said, "Snowmen? What for?" And Evil Mister Fred said, "Because we need them. And make them look evil."

So the minions started making snowmen. They had snowmen with fangs, snowmen with giant mouths, snowmen that looked like monsters, like alligators. And Evil Mister Fred created an entire army of snowmen. And he said, "Ah, now all we have to do is make our snowmen alive." So he called the Acme Store of Everything and he ordered a whole bottle of Aliveness Powder. All you have to do is shake it on something and it'll become alive. And Evil Mister Fred went out there and shook the powder on all the monsters. And the monsters came alive, and the monsters started dancing around, singing Merry Had a Little Lamb. And Evil Mister Fred said, "You're supposed to be evil. Nobody's going to be afraid of you if you're singing Mary Had a Little Lamb. The monsters said, "Sorry, that's just the way we are." And Evil Mister Fred said, "Arrgh!"

Jack & Jill rode around on Rudolph.

So he called the Acme Store of Everything and he ordered some pepper. And he spread pepper all over the monsters. And they sneezed, and then they became ornery and nasty and angry. Yahhhh! And Evil Mister Fred said, "Okay, monsters, go eat the elves!"

And the monsters went out, and there were so many of them, they crowded the elves all together and went, "Arrumph!" And they started eating elves. And the word got to Jack and Jill. And Jack and Jill said, "Noooo! We've go to stop 'em!" If you were Jack and Jill, what would you do to stop these monsters?

Evil Mister Fred created an army of snow monsters to eat the elves.

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: "*Foam Cutters*"


A piece of wire with "hands."

And we're going to make something. The something we're going to make needs a battery *[holds up "C" battery]*. And we want the batteries to heat up a little piece of wire. And you remember yesterday, Jen was sitting back there going tap, tap, tap? She was tapping on the end pieces of these wires so that they have hands. *[holds up small piece of wire with a #8 crimp-on stud for 18 guage wire on each end]* See that? They've got hands. We want the electricity to go from one hand to the other hand.

Now, to get the electricity to go through the wire, the electricity comes out the top of the battery and goes back in the bottom. And the wire is not long enough to reach from top to bottom. So we're going to connect them. We're going to use -- let's see, whats the most ridiculous thing we could think of to make electricity go through? How about chopsticks? Yeah, we need chopsticks. *[holds up a pair of chopsticks]* There, chopsticks!

These are not swords, these are not daggers, they're not to be used to take boogers out of your nose. They're kind of sharp in some cases. But does electricity go through chopsticks? *[Students: No.]*

You're right. They're made of wood. They don't sell metal chopsticks at the store. So what we're going to do is we're going to turn them into metal chopsticks. You take some metal tape and you peel off the covering. This is aluminum tape. And we'll take a chopstick and set it on the tape like that. It's pretty sticky tape, so if we just roll it up *[rolls chopstick in tape]*. And we want to squish it around the pointy end, because the hands on the wire are pretty small, so it needs to have the pointy end tapered. Then we'll do the other one.


Place the chopstick on the aluminum tape and roll it up.

So when you put the stick on the tape, just put it on the very edge of the tape like that, set it on the table, and roll. There, now you have some metal chopsticks. There -- who's got the food?

Now, we can put our wire on the chopstick, kind of let its hands grip onto it. *[slides connectors over pointed ends of chopsticks]* There, now he's holding onto the top of the chopsticks.


Slip the wire "hands" over the pointy ends.

Now, if we take our battery, we can just put the battery between the ends of the chopsticks and electricity will go through the wire.

[Student: How do we keep them on?] Yeah, that's a good question. How do we keep them on? Well, Jen figured this all out. Jen is a physics major. That means she has a really big brain inside of her head. We had some foam sitting there, so we can use some tape. We can kind of tape things together so that they don't fall apart.

So if you put a little bit of tape on your battery, that kind of holds the battery on to one end *[tapes battery to one chopstick]*. There, now you have at least half of a battery stuck to a stick. Then you can take your

piece of foam, and tape it onto the battery. *[Places foam block above battery, between chopsticks, and tapes foam to battery]* Now you've got it taped onto the battery. But you've got this other stick dangling out there. We can tape it onto the foam *[tapes other chopstick to foam block]*.

Now you've got two sticks, a battery, a piece of foam, so that this stick isn't touching the battery. So sad. What should we do? We could tape it down. How about if we just squeeze it. *[squeezes bottom ends of chopsticks so both ends contact the battery]*. So when you let go, you're not wasting electricity. You just go squeezy, squeezy, squeezy. And when you do squeezy, it gets hot. When you un-squeezy, it gets cold. Let's try it on a piece of foam and see if it does anything. So we'll squeezy it and now *[wire cuts through foam tray]*.

If you want to make a mouth with lots of teeth, you just go wiggle, wiggle, wiggle. Now. there's a mouth with a whole bunch of teeth. If you want to make an eye, you can go in and make an eye *[cuts shapes out of foam]*. There's an eye now -- you've got a half of a monster face. So you can make anything you want to out of that.

[Student: Are we gonna make those?] Yeah, you're gonna make these, okay?

[Assistant, passing out chopsticks] Be very careful of these, chopsticks are very, very sharp.

[Students build foam cutters and cut shapes out of a foam tray. They can also color the pieces if they wish. At the end of the experiment, give each student a ziplock bag for their foam pieces.]

NOTE: See the lesson video on our web site for instructions on building an alternate version of the foam cutter. The alternate version allows the students to experiment with different lengths of wire to see which length cuts best.

Tape one end of the battery to one chopstick, then tape the foam block to the battery.

Tape on other chopstick and squeeze.

You can cut a foam tray into a monster face.

End of Story

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

Evil Mister Fred just made an army of snowmen, and he sprinkled pepper on them to make them angry, nasty snowmen. And they were going to charge into Santa Clause's territory and eat up the elves. And some of them had already eaten up some elves. Jack and Jill said, "We've got to do something to stop them." And Jack said, "We need power, more power." So they hooked up some wires to Rudolph's nose. And they stuck the wires on Jill's hair. And they said, "Rudolph, start flying around."

Jack & Jill hooked up wires to Rudolph's nose and stuck them on Jill's hair to make it hot.

And Rudolph took off into the air, and he's flying around. And when he generated enough energy with his nose, it went through Jill's hair and made her hair glow red hot. And they went down and flew over the snow people and they cut them all to shreds. And the ones that had swallowed elves, the elves jumped out really fast. And Evil Mister Fred said, "You can't do that! You leave my army alone!" And Rudolph said, "Cool! Let's go visit the guy up in the cloud." And Jack and Jill said, "Okay."

So they zoomed up to visit Evil Mister Fred and accidentally cut his cloud right in half. And Evil Mister Fred fell out -- "Ahhhhhh!" -- and landed on some of his snowmen. And the ones that were still alive ate him up. And they all lived happily ever after, except Evil Mister Fred.

Rudolph cuts up the monsters, then cuts Evil Mister Fred's cloud in half. The monsters eat him up.

End of Lesson

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