



Teacher's Guide for:  
**Hand Crank Electricity**

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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Hand Crank Electricity  
A Rock-it Science Lesson  
Filmed June, 2009

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## Intro Quick Recap: *Hand Crank Electricity*

- A long time ago, a guy ran some electricity through a wire.
- He had a compass nearby, and the needle moved. When he turned the electricity off, the needle moved back.
- Electricity makes its own magnetism. If there's a magnet nearby, the magnet moves.

## Experiment Quick Recap: *Hand Crank Electricity*

- The hand-crank motor is a gear motor. There are permanent magnets and a heavy coil of wire inside.
- When the coil of wire turns next to the magnets, it makes electricity.
- Or, if you put in electricity, it makes the shaft turn.
- There's a gear box on top, so when you turn the handle, whatever's in there spins about four times faster than the handle does.
- Each pair of students gets a hand-crank generator and a cable with alligator clips on each end.

**Part 1:** Students connect the alligator clips to the wires on the generator and take turns turning the crank. While one student turns, the other touches the alligator clips together, then separates them. The crank becomes harder to turn when the alligator clips are touching. If they turn quickly, they can also make sparks when the alligator clips touch (turn off lights to see the sparks better).

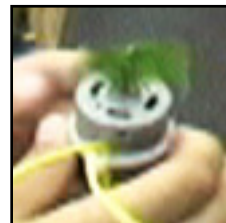
**Part 2:** Two groups (four students) connect their generators to each other. When one is cranked, the other one turns by itself. They can also try cranking both at the same time.

**Part 3:** Disconnect the alligator clips and resume working in single pairs again. Connect a small motor with a tape flag on the spinning shaft and take turns cranking in different directions.

**Part 4:** Hook up a small fan to the generator and take turns cranking. The fan should stop working when you crank backwards.



Hand Crank Generator



Small motor



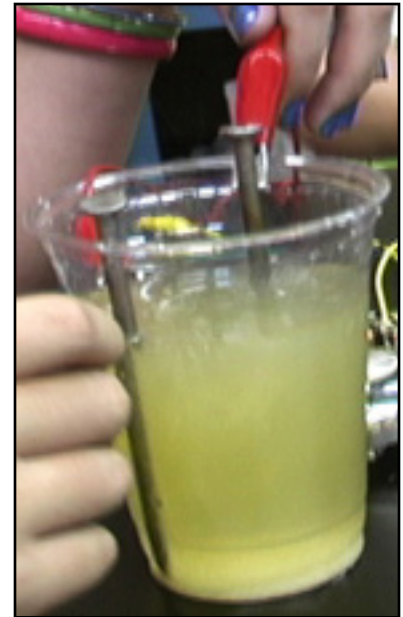
Small fan



Doorbell

**Part 5:** Hand out a doorbell to each pair of students, but don't tell them where to connect the second wire -- let them experiment. When they get it working, they should see sparks (turn off the lights to see them better). Once they get the bell working, pass out some more cables so students can connect multiple items if they wish.

**Part 6:** Disconnect all the devices from the generator, but keep two cables connected to it and connect a large nail to each cable with the alligator clips. Pass out a cup of water to each pair of students. Students put the nails in the cup of water, making sure they don't touch each other. Start cranking. Bubbles should appear. Then the Instructor adds salt to the water and more bubbles appear. One nail makes hydrogen gas; the other, oxygen gas. The color of the water will change and may even create slime on the surface.



Two Nails in Salt Water

## Equipment List: "Hand Crank Electricity"

### Items needed for Instructor:

- None

### Items needed for Students:

#### Consumables:

- Water, about 12 oz. per two students
- Table Salt (couple of teaspoons per two students)

#### Other:

- Hand Crank Generator (1 per 2 students)
- Insulated cable with alligator clips at each end (2 per generator)
- Motor, small, with piece of tape on shaft (1 per generator)
- Fan, 4" with housing (1 per generator)
- Doorbell (1 per generator)
- Nails, 4" (2 per generator)
- Cups, Clear Plastic, 16-oz (1 per generator)

### Prep Work:

- Inspect Hand Crank Generators and repair if needed

## Story Recap: "Jack & Jill's Electric Carnival"



### Part 1:

- On a stormy night, a traveling salesman in the shape of an octopus was struck by lightning. It didn't kill him, but now he's electrified, like an electric eel.
- Jack and Jill have a traveling amusement park with ferris wheels, roller coasters, merry-go-rounds, and rooms with mirrors in them.
- Evil Mister Fred is on vacation in his mountaintop castle with vultures flying around. He's not planning to do much evil while he's vacationing.
- But Jack and Jill set up their amusement park right below his mountain, and Evil Mister Fred can't stand hearing all the happy squealing and laughing.
- He sends his minions down to break through the fence and hit people on the head with baseball bats and raise big bumps on their heads.
- Jack and Jill give the people army hats so the minions can't hurt their heads. The minions are too stupid to hit them anywhere else, so the people are safe for now, but Jack and Jill know Evil Mister Fred won't give up.
- Sure enough, Evil Mister Fred cuts the power lines. People are trapped on the rides and in the mirror rooms.

## Story Recap (cont.):



### Ending:

- Evil Mister Fred had cut the power lines, so everything in the carnival is dark.
- Jack and Jill discover that if you turn the ferris wheel backwards it creates electricity.
- Jill gives Jack a bunch of caffeine and sugar so he can turn the ferris wheel really fast.
- He cranks so fast, all the rides start going really, really fast.
- The electrified octopus was riding on the merry-go-round, and as it turned faster and faster, he was swinging out and hanging on for dear life. His arms got longer and longer, and then he flew off.
- He bounced off the ferris wheel and landed on Evil Mister Fred's head, stuck his tentacles into his ears, and delivered twelve thousand volts of electricity that he'd stored up from the lightning.
- Evil Mister Fred's hair exploded off his head, and he was so embarrassed he didn't come back for a month.

## Transcript: Intro

There was a guy, a long time ago, like maybe four hundred years ago, who was running electricity through a wire. And he had a compass nearby, and the compass needle moved. Then he turned the electricity off, and the compass needle went back. And then he turned it on and it moved again. And he turned it off, and it went back. And he says, "Ah, I've made a great discovery." And everybody else didn't know that. Luckily, it actually was a great discovery, because when electricity moves, it makes its own magnetism. And if there happens to be a magnet nearby, the magnet moves, which is pretty cool. We can use this to do stuff. Today we're going to be doing some stuff with electricity, just to see what happens. But first we need a crazy story.

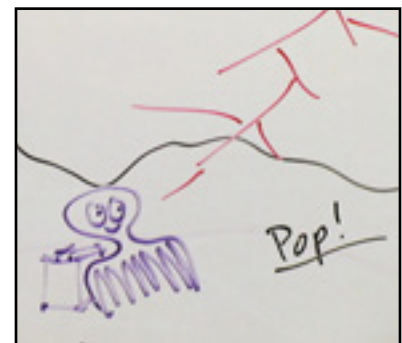
## Story: "Jack & Jill's Electric Carnival"

It was a dark and stormy night, and suddenly a shot rang out. And there was a flash of lightning -- ka-boom! And the lightning happened to hit a traveling salesman in the shape of an octopus. And the guy was selling vacuum cleaners, so he had a suitcase full of vacuum cleaners. But now he's an electrified octopus, kind of like an electric eel, except he's got eight legs. By the way, it didn't kill the octopus -- he's just electrified.

While this was going on, Jack and Jill were going along on a traveling amusement park. They had ferris wheels, they had roller coasters, they had merry-go-rounds, they had a room with mirrors in it. And they would set these up at various cities, and everybody would come and have fun. A ferris wheel has a bunch of cars on a circle that goes around, like that. And then a merry-go-round has a bunch of animals that go up and down while you go in circles, like that. And roller coasters -- we want a roller coaster going through everything -- there. There's a roller coaster. [Student: That doesn't look like one.] Oh, does it need two tracks? [Student: Yes.] Okay. There -- roller coaster. And let's put Jack and Jill in there.

And Evil Mister Fred is on vacation. He's decided he's going to relax a little bit and not do as many evil deeds as his usual amount. So he's up in his mountaintop castle enjoying the scenery. He likes it up there because there are vultures there. There he is. And up in the sky, there are vultures. They have really long necks, and they have ugly red faces. There -- that's a vulture.

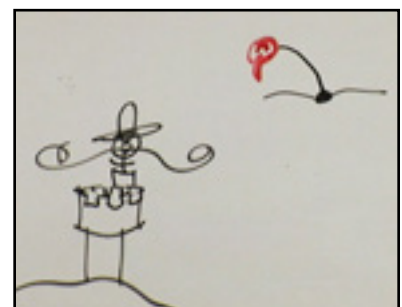
And Jack and Jill have all these people coming to their amusement park. They ride all the rides, they get sick and throw up, and they call that fun. And there must be thousands of people there. Evil Mister Fred is looking down, and he hears all the laughter and the screams and everybody having a good time, and he says, "How am I supposed to have a vacation with all those people having fun? They need to be miserable. Arrrggghh!" So he decides he's going to mess up their whole program. Evil Mister Fred first sends his



Electrified octopus.



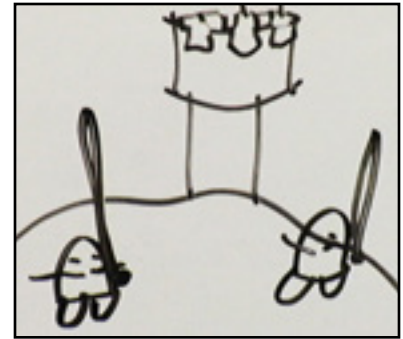
Carnival



Evil Mister Fred and vulture.

minions down with their baseball bats to help at the amusement park. He says, "Minions, go down there. If you see anybody, hit them on the head with your baseball bat. And the bump has to be at least a foot tall." The minions said, "All right, boss! I like this game."

So they went running down to the amusement park and beat holes in the fence, climbed on in, and whenever they saw somebody they'd say, "Boo!" and hit them on the head, and they'd have a big bump on their head, and they'd run away and cry. And Evil Mister Fred would hear them crying and he would say, "Ahhh, music to my ears."



Minions with baseball bats.

Then Jack and Jill handed out army helmets. And the minions weren't smart enough to hit them anywhere other than on their head, and now they didn't get any bumps and they weren't crying. They just thought it was fun to make fun of the minions. And Evil Mister Fred didn't like that. So Jack and Jill said, "You know, he's going to keep doing this. He's going to attack until he ruins our whole party. We've got to have some sort of a plan in mind." And Jack said, "I don't know. What kind of plan did you want?" And Jill says, "Well, we've got to try and figure out what he's going to do first. Is he going to just try to blow the whole place up, or is he going to let loose a bunch of itching powder? What's he going to do?" And by the time they were thinking about all the rotten things Evil Mister Fred could do, the next thing, it happened. It was nighttime, and all the electricity went out -- bzhewwww. Everything stopped. There were people trapped on the roller coaster in the cars upside down. There were people in the ferris wheel up in the chairs, and they couldn't get out. And there were people locked in the room of mirrors, and it was pitch black and all the doors were locked. They couldn't get out of there either. And Jack and Jill said, "Uh, oh, this is bad." And Evil Mister Fred said, "Ahhh, this is perfect. No more happiness down there." 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: "Hand Crank Electricity"

What we have is motors. These are motors, they're called gear motors. The part where the wires stick out is the motor part. There are permanent magnets in there. And there's a heavy coil of wire. And the coil of wire, when it turns next to the magnets, makes electricity. Or, if you stuff in electricity, it makes the shaft turn. On top of it there's a gear box, so when you turn this handle, whatever's in there spins about four times faster than this handle does. Well, it's kind of a handy thing. We're going to connect it -- you can connect anything you want to to this motor.

*[These are]* alligators. We call them alligator clips because if you squeeze their head, their mouth opens and closes. And you can put one on each wire. *[Student: Are we going to make those, Mister Mac?]* No, but you can use them. And we can turn the crank and make it do something. I'm going to just put this right on there.



Hand Crank Generator



Student tries to turn the crank while Instructor touches alligators.

I need a volunteer from the audience. *[Student]* is going to turn the crank. He's turning the crank. He says, "Aw, this is easy. Anybody could turn this crank." And I'm sitting here with these two alligators, and I'm going to touch them together -- thunk! *[Student starts to struggle to turn the crank.]* Uh, oh, now it's hard to turn. Now I take them apart. Fast. Thunk. Fast. Thunk. *[Instructor alternates touching and separating the alligator clips while student continues to try to turn the crank.]* Wait a minute *[turns off the lights]*. Now start. Okay, turn fast. *[Instructor again touches and separates the alligator clips rapidly.]* Can you see what happens when I click these? You should be able to see some sparks there.

So, the first part of the experiment is, you're going to find a partner to go cranky-cranky. You're going to play with this to make some sparks and see what happens. And after that, we're going to keep adding other stuff, and just see what you find out.



*[Instructor passes out a handcrank generator and one cable with alligator clips on each end to each pair of students.]* You put one alligator on each wire. You hook the wires on and then have one guy turn it and the other guy goof around with it. And then you take turns, you switch and let the other person do the handcranky thing. *[Student do this for a few minutes.]* When you get the hang of it, I'm going to turn off the lights, and then you're going to see if you can make some sparks.

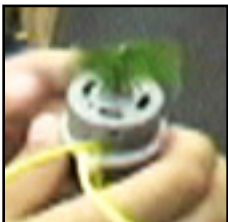


That requires that the handcranking person crank really fast. Are you ready for lights off? Okay, go ahead and make some sparks. You have to crank hard and crank fast. And then you switch. You let the other person do the cranky-cranky and you do the clicky-clicky. Don't crank so hard that smoke comes out of the motor.

You guys hook your handcranker wires up to their handcranker wires and see what happens. *[Students are grouped so that two pairs now work together.]* Connect theirs to your alligators. *[When students have two generators connected with alligator clips, one student turns the crank while the other generator turns by itself. Then they take turns. Then they try cranking at the same time.]*



Two teams of students hook up their generators to each other.



Small motor.

Okay, disconnect them. And connect yours to this now. *[Hands out a small motor with a tape flag on the spinning shaft to each pair of students.]* Connect your hand crank to one of these. *[Students connect the motor and turn the crank to see what happens.]*

Know how they make potato chips? They turn on a fan and throw a potato through the fan. This is for your fingers. *[Holds up a small fan.]* You're going to make finger potato chips. *[Passes out a fan to each pair.]* Hook the items up to the motor and see if you can make it spin. *[Students do this for a few minutes.]* Can you make it go in reverse? With any luck, your fan will not work backwards.



small fan.

*[Holds up a doorbell.]* On these things, you've got to figure out how to make it go. Don't bend stuff. You can hook one wire on the wire, but the other wire you have to figure out where it goes. *[Passes out a doorbell to each pair.]* Hook as many *[items]* together as you like. Do you want some more wires? *[Passes out an additional cable with alligator clips to each pair of students.]* Try the bell by itself first and make sure it works. Can you see the spark when you do it?



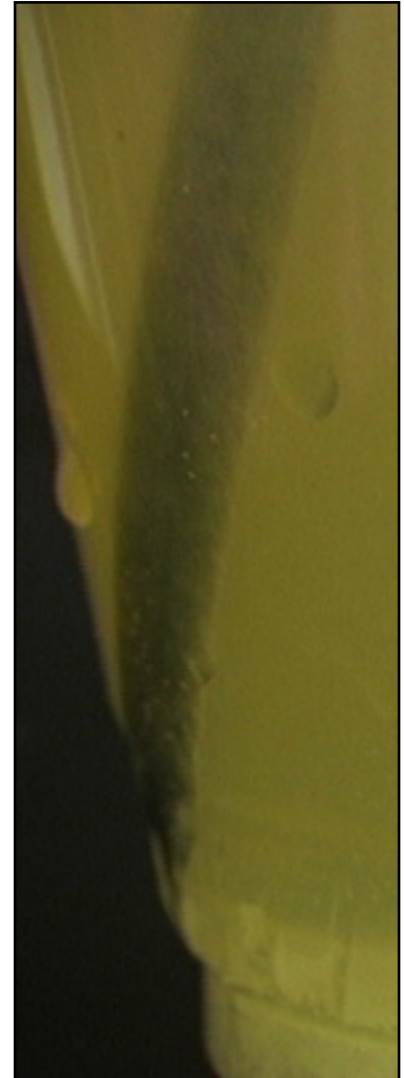
Doorbell

Okay, everybody stop. *[Instructor passes out two large nails to each group.]* Does everybody have two nails? Hook your wires to the two nails. Then dip your nails in the water and electrocute them. *[Instructor passes out cups of water.]* Put the nails in the water. *[Students put nails in water and start cranking.]* Does it do anything? *[Assistant: Don't let the nails touch each other.]* If you look very carefully, you might see some bubbles on your nails.



Two nail in salt water.

*[Instructor adds some salt to the first student's cup and the student starts cranking.]* Watch his hand. Keep cranking. *[Student: It's hard!]* Is it getting hard? *[Adds salt to the other cups, and students continue cranking.]* There should be some bubbles coming out at some point. One nail makes hydrogen gas. The other nail makes oxygen gas. Oh, this is great -- you've got slime on the top and everything.



Bubbles

## End of Story

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

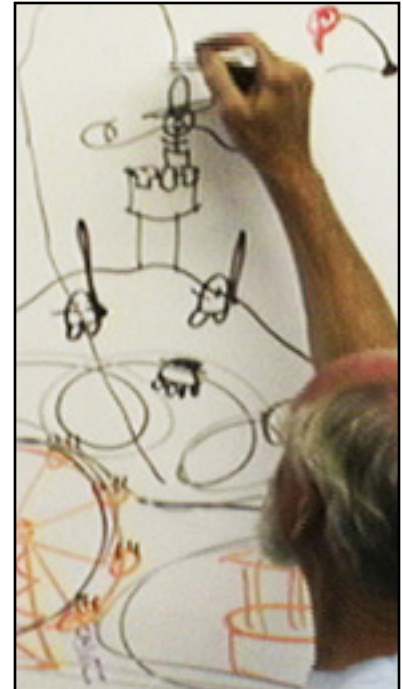
Evil Mister Fred was trying to ruin their amusement park. He cut all the power lines to the amusement park, and that's what made everything so dark. And Jack and Jill were trying to figure out how to light it up again. Now, the octopus just happened to be there, the electrified octopus, and he was riding on the merry-go-round, up and down on the horses. And Jack and Jill had discovered that if you turn the ferris wheel backwards, instead of using electricity it makes electricity.

So they were standing at the bottom pushing the cars with hands as fast as they could. And Jack wasn't pushing fast enough to satisfy Jill. So Jill gave Jack five bowls of sugar bomb cereal, three cups of coffee, and a whole bucket of sugar just to drink. And Jack said, "Yah!" And he started going foom, foom, foom, foom, like this on the cars. And the ferris wheel was going around so fast that people had to hang on for dear life. Instead of their cars sitting dangling from it, their cars were swung out like this, and the people were pressed inside on the floor. And they were screaming. And it was producing so much electricity that the merry-go-round started to spin faster than ever before. Instead of 120 volts going into it, it was getting, oh, about a thousand volts.

So the roller coaster went whup, whup, whup, whup, whup, whup, whup. And the merry-go-round would go whir, whir, whir, whir, whir, whir, whir, like this. And everybody's going, "Yeah!!!!" And our octopus guy was on the merry-go-round. He was hanging on with all eight tentacles. He was swinging out, and as he was swinging, his legs got longer, and longer, and longer. And then, he couldn't hang on anymore. He flew off -- sheeewwww -- and bounced off one of the ferris wheel cars -- ka-ching!! -- flew up into the air, and landed right on Evil Mister Fred's head. And his tentacles went into Evil Mister Fred's ears -- thoonk! Twelve thousand volts that he'd stored up from the lightning went right between Evil Mister Fred's eyes. And all of his hair exploded off his head. And he was so embarrassed, he didn't come back for a month. And everybody lived happily ever after except Evil Mister Fred.

## End of Lesson

***If you have questions about this lesson, please ask them through the [online Teacher Support Forum](#) on our web site.***



The electrified octopus lands on Evil Mister Fred's head.