



Teacher's Guide for:  
**Wire with a Memory**

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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## Title Page of Video

Wire with a Memory  
A Rock-it Science Lesson  
Filmed July, 2009

**Rock-it Science**  
2110 Walsh Ave, Unit F  
Santa Clara, CA 95050  
[www.rockitscience.org](http://www.rockitscience.org)

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## Intro Quick Recap: "Spoon Bending"



Hold spoon between your thumb and forefinger.

- They used to make combination locks for bicycles.
- If the metal got really cold, you could hit it with a hammer and it would shatter. That kind of metal would get brittle in the cold, like glass. Nowadays, they make locks out of metals that don't break when they get cold.
- In our experiments, we're going to get some pieces of metal really cold and really hot. And you're going to stretch and bend them and see what happens.
- About twenty years ago, a guy named Uri Gellar claimed he could bend a spoon with the power of his mind. He'd hold it between his thumb and forefinger and rub his fingers gently back and forth. After awhile, the spoon would bend and then break in two.
- A magician offered to pay Uri Gellar one million dollars if he would let the magician hand him a spoon to bend. Uri never took him up on his offer. Was he really able to bend a spoon with his mind?
- Pass out spoons to students and ask them to hold it the way Uri Gellar did and see if they can bend it with their mind.
- Then let them forcibly bend the spoon a bit, then bend it back again, just to see how easy or hard it is to bend them.

## Demo #1 Quick Recap: "Springy Steel"

- There are different kinds of steel. Some kinds are springy, and some are bendy. This is springy steel, because it looks like a spring and is supposed to come back to its regular shape after you stretch it. But if you pull too hard, it doesn't work.
- Instructor holds a steel spring at each end with pliers and pulls back and forth to show how springy the spring is.
- Instructor holds one end of spring with pliers and has a student hold the other end with pliers, and they pull it so the spring stretches out and does not return to its original shape.
- Let's get it hot and see if it will come back. Instructor lights an alcohol burner and puts part of the spring in the flame. It gets red hot and starts to bend and get smaller.
- When Uri Gellar bent his spoon, it wasn't a stainless steel spoon. Part of it was, but the part he was holding was a type of metal that melts at body temperature. So his trick is a little different than the trick we're going to do.



Student and Instructor stretch spring with pliers.



End of wire in alcohol flame.



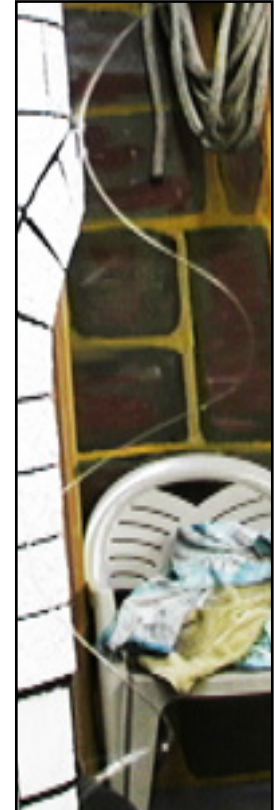
Wire bending in flame.

## Demo #2 Quick Recap: "Memory Wire"

- Instructor takes a 24" piece of nitinol wire and puts a piece of tape on each end to make it safer to handle.
- This wire is used for cell phone antennas and some glasses frames. It's more bendable than other wires, and it springs back after you bend it. But if you get it cold enough, it acts in an odd way.
- Instructor pushes the wire down into a thermos containing alcohol and dry ice, so that the wire is completely inside it. When he pulls it out, the wire is loosely coiled instead of straight.
- As the Instructor holds the wire by the top, it begins to warm up and slowly uncoils by itself and returns to its original shape.
- This is memory metal. It remembers its straight size and always tries to come back to it. But if you get it cold, it forgets what it was.



End of wire (with tape on it) is just visible; the rest is inside the cup.



Coiled wire gradually straightens.



Stretching out the small spring after removing it from the alcohol/dry ice.

- Instructor takes a small nitinol spring and dips it in the alcohol/dry ice mixture for a few seconds, then takes it out and stretches it out. The wire doesn't return to its original shape.
- Instructor holds one end of wire between his palms and rubs palms together, causing the wire to shrink up to its original size and shape of a spring.



Warming up wire between palms to make it shrink.



## Experiment #1 Quick Recap: "Cold Memory Wire"

- Each student receives a 24" piece of nitinol wire and two pieces of duct tape to put on the ends.
- Instructor sets out thermal jugs containing alcohol & dry ice, about one jug per 4 students.
- Instructor secures jugs to table with duct tape to keep them from tipping over.
- Students take turns pushing their wire into the jug to compress it, then pull it out and watch it straighten out again. Only one student at a time can put their wire in the jug. There should be time for each student to have at least two or three turns.



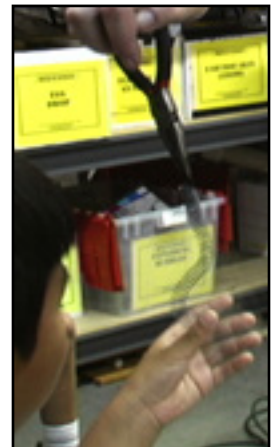
Pushing wire into thermal jug.



Pulling cold spring out of jug.

## Experiment #2 Quick Recap: "Cold Memory Spring"

- Instructor holds the end of a nitinol spring with pliers and dips it into the cold mixture for a few seconds, then takes it out.
- Student grabs the bottom of the spring and stretches it out.
- Students take the top end of the spring between their palms and rub their palms back and forth to warm the spring.
- The spring quickly shrinks up to its original size and shape.
- Instructor uses the same spring for each student in turn. Students do not get to keep the spring.



Upper right: Student is about to stretch the spring.  
Lower Right: Warming stretched spring between palms.

## Experiment #3 Quick Recap: "Hot Memory Wire"

- Instructor places alcohol lamps on tables, about 2 or 3 students per lamp, along with plastic cups of water (fire extinguishers).
- Instructor shows students how to bend their nitinol wire slightly and hold it in the flame.
- The hot spot in the wire turns purple, and it stays bent.
- Students use the same piece of wire they used in Experiment #1. They take turns using the lamps to make multiple bends in their wire.
- Then the Instructor helps each one in turn stuff their wire into a larger thermos jug of alcohol and dry ice.
- When they pull it out of the jug, Instructor helps them stretch it out straight.
- As the wire becomes warm again, it returns to its bent shape.



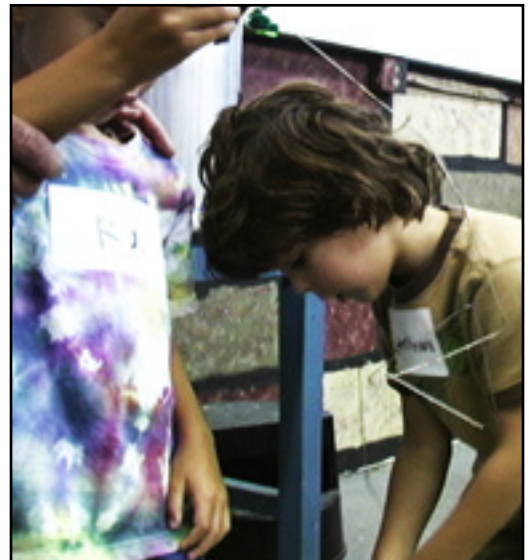
Heating bent wire with alcohol lamp.



Instructor prepares to dunk bent wire in thermos jug.



Instructor straightens wire, then hands it back to student.



Student holds top end of straightened wire, and it quickly becomes bent again.

## ***Equipment List: "Wire with a Memory"***

### **Items needed for Instructor:**

- Nitinol wire, 0.030" dia. (special Rock-it Science wire), about 24"
- Nitinol spring (specially made by Rock-it Science)
- Steel spring, .03" x .38" x 3"
- Thermos, wide-mouthed, approx. 1-gal size
- Pliers, any kind. At least 2 (more if there are assistants in the class).
- Dry ice, about 2 lbs for large thermos jug
- Alcohol, rubbing 91%, about 2 qts for large thermos jug
- Butane lighter

### **Prep Work:**

- Cut nitinol wire into 24" lengths, one for each student
- Prepare thermos jugs with mixture of alcohol and dry ice. At least 4 small jugs for students and 1 large one for Instructor.

### **Items needed for Students:**

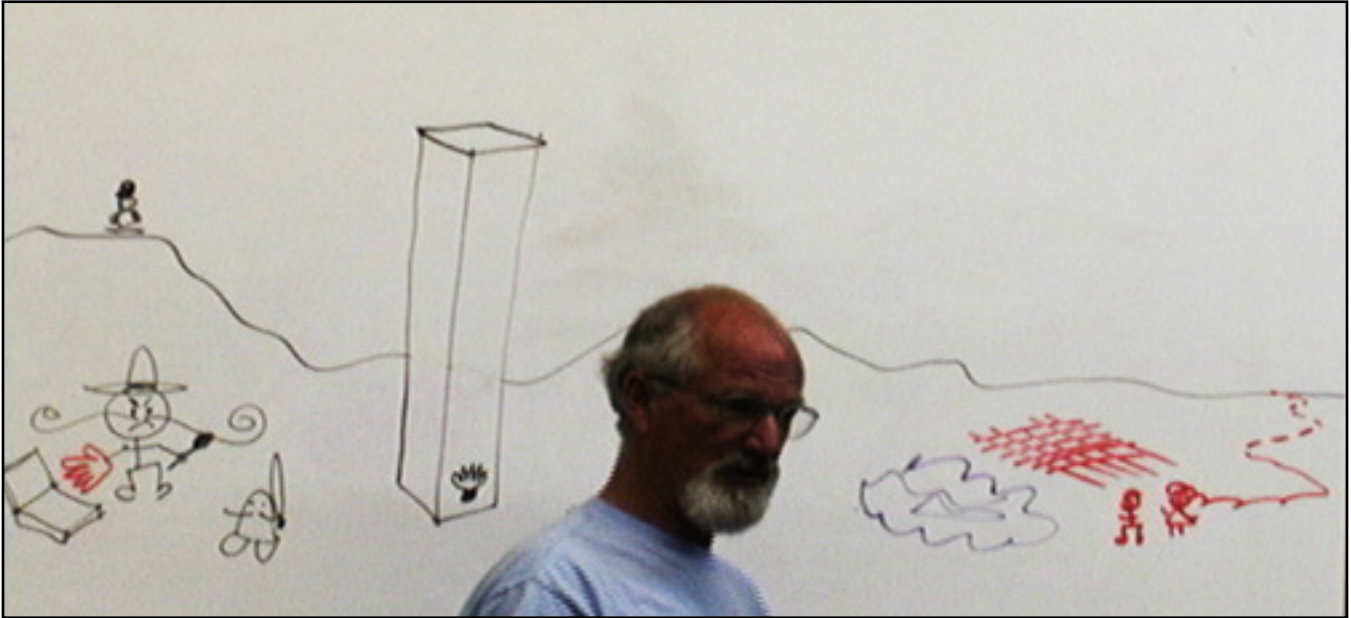
#### **Consumables (per student):**

- Nitinol Wire, about 24" per student
- Alcohol, rubbing 91%, about 8 oz. per 4 students
- Dry ice, about 1 lb per 4 students
- Duct tape, about 4" per student, plus about 3 ft per thermos

#### **Other:**

- Thermos, wide-mouthed, approx. 1-qt size (1 per 4 students)
  - Alcohol Lamps, about 1 per 2 students
  - Spoons, stainless steel, 1 per student
  - Cups, plastic, 16-oz, 1 per 3-4 students
  - Water, about 12 oz. per 3-4 students
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## Story Recap: "Evil Mister Fred's Burning Hand"

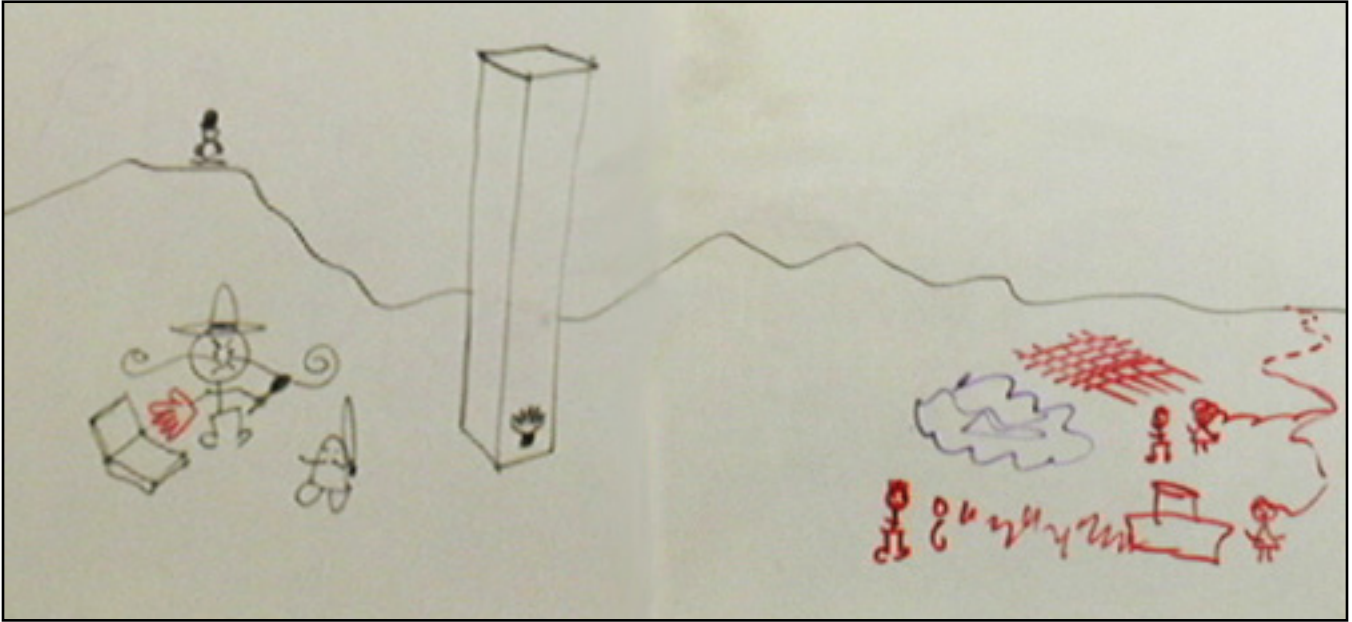


### Part 1:

- Evil Mister Fred wanted to take over the world, so he was practicing his look, frowning and making fists.
- Then he wanted to use his thought powers on people, like Darth Vader. He tried practicing on the minions, but they just thought it was funny.
- So he went to a guru on a mountaintop, who told him he needed to know himself. Evil Mister Fred thought this was worthless.
- He went online and found out about spoon-bending. But he didn't want to bend just spoons; he wanted to bend people, cars, buildings, everything.
- He started practicing with spoons, but they wouldn't bend.
- So he cut off his hand and put a fake one on. It had heaters in the fingers so he could bring his hand up to 2,000 degrees.
- Now he had real power. He could open a car door and melt the door handle. And if someone starts talking to him, he could hold his hand over their head and pretend to use his thoughts to make their head get hotter and hotter.
- He went to a nearby skyscraper, put his hand on the building, and melted a big hole in it.
- Then he had his minions throw pieces of paper all over Goodville, saying that Evil Mister Fred is now king. When he came to Goodville himself, they all threw rotten tomatoes at him.
- So he picked one person who didn't think he was king, and he put his hand on the guy's head, and cooked his hair. And the guy said, 'Yes, yes, yes, you're king!'
- So now Evil Mister Fred was going from town to town declaring himself king, and Jack and Jill didn't know what to do.



## Story Recap (cont.)



### Ending:

- The people all felt defeated and decided they might as well form an army and join Evil Mister Fred.
- So Jack and Jill and the army and some KickMes and a tank started marching toward Evil Mister Fred.
- Then they all saluted him. Do you know what happens when somebody salutes you? You have to salute him back.
- So Evil Mister Fred saluted them back and accidentally cut his own head right in half.

## Transcript: Introduction

Sometimes if you take a metal lock (they used to make combination locks for bicycles) and you'd put it on your bicycle and go away, watch a movie or something, come back to get your bicycle, and you'd find your bicycle gone. And the lock lying in pieces on the ground. And the metal that they used to make the lock, if you got it really cold and hit it with a hammer, it would just go biff! -- and break. And that was one kind of metal that when it gets really cold, it gets very brittle, like glass. Nowadays they make locks out of metals that don't break when they get really cold. Well, today in our experiments, we have some metal pieces, and you're going to get them really cold, and you're going to get them really hot. And then you're going to stretch them or bend them and see what happens to them.



Holding the spoon between thumb and forefinger.

Fifteen or twenty years ago, there was a guy from Israel called Uri Gellar. He would go on TV and say things like, "I can bend a spoon." And he would hold a spoon up to the camera. And all you'd see was his fingers moving like this. *[Instructor holds a spoon with his thumb and forefinger, at the place where the handle meets the bowl of the spoon, and rubs it gently.]* And the spoon would start to bend. Now he'd hand the spoon to somebody else. And they would look at it, and it would be solid again. And they couldn't bend it. It would be just like trying to bend one of these.

There was a magician who challenged Uri Gellar. He said, "Let me give you the spoon. And if you can bend it with your mind, I'll give you one million dollars." To this day, Uri Gellar has not taken him up on it. So was Uri Gellar really able to bend a spoon with his mind? *[Students: No.]*

I want to see if anybody here can bend a spoon with their mind. You only get to hold it like this *[between thumb and forefinger]* and see what you can do. You have to believe to make it happen. It's all in your mind. If you believe it enough, it will work. *[Instructor passes out spoons to students.]* Hold it with just one thumb and one forefinger and see if you can make the spoon bend. You have to think positive thoughts. You

have to channel all of your energy into your fingers, and the spoon will start to bend. Pretend like all the energy from the center of the earth is coming up through the legs of your chair, through your body, and into your fingers, and it's going to melt the metal in your very hands. *[Students hold spoons, but nothing happens.]*

Has anybody gotten the spoon to bend? *[Students: No.]*

We'll see if they're unwreckable after you bend them. *[Instructor forcibly bends a spoon, then bends it back to see if the metal will bend both ways without breaking. It doesn't break.]* Just take your spoon and bend it a little bit so you can bend it back again, just so you can see how strong it is. *[Students forcibly bend their spoons, then bend them back to their original shape.]* Now that you've seen how easy or hard it is to bend them, we're going to collect the spoons.

## Story: "Evil Mister Fred's Burning Hand"

Once upon a time, Evil Mister Fred was contemplating how he was going to take over the whole world. He wanted to be king of the entire earth. And he thought, "You know, if I'm going to be king, I have to be powerful. I have to look impressive. I have to have a big crown, I have to have a retinue of strong guys and tanks and stuff. And I have to furl my brow a lot, like that. And not smile too much. You don't smile if you're in charge and you're bad."



Evil Mister Fred looking mean.

So Evil Mister Fred was practicing his look. He was looking first at how he was going to do the unibrow thing, and then he decided it would be better if he had two eyebrows rather than one big one. And he liked making fists. He thought fists were good. Then he thought, "Now, the smile isn't that good." The smile was wrong. *[Instructor erases smile and replaces it with a frown.]* "Yeah, yeah, I like that look!"

And then he started saying, "Now I'm going to have to practice using my thought powers on people. When I meet somebody, I want to be able to look into their brain and see what they're thinking. And I want to be like Darth Vader and go, 'Ooooooh *[inhales raspily]*, ooooooh,' and scare everybody."

So he was practicing on the minions. And he had the minions come up and stand in front of him, and he'd stare at them. And the minions would go, "Hey, Boss, your face looks funny. You know you got a pimple on your nose?" And Evil Mister Fred would go, "Arrrghhh!" and he'd grab his baseball bat and go wham! wham! wham! -- and hit the minion with it. And he says, "This is not working."

So he went and talked to a guru. Up here on top of the mountain there was a guru who sat on a nice piece of carpet. He'd hover over the ground. There's the guru guy. And he'd say, "Hey, guru! What do I have to do to take over the whole world?" Let's give him a turban. There's a guru with a turban. And the guru says, "You must know yourself." Evil Mister Fred said, "I already know myself. I'm Fred." And the guru said, "That's it. You must know yourself. And that's all you need to know." And Fred went away saying, "Well, that was worthless."



Guru on mountaintop.

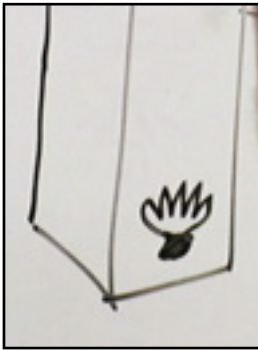
So he went online and he started studying cool things. And he saw the whole spoon-bending business. And he says, "Oh, yeah, that's great. I don't want to bend spoons, though. I want to bend people, I want to bend cars, I want to bend buildings, I want to bend everything." And he got some spoons, and he starting practicing with the spoons, and they wouldn't bend. He says, "Oh, man!"

So he cut off his hand, and he put on a fake hand. And he put heaters in his fingers so that now he could bring his hand up to 2000 degrees. He says, "This is going to be great! I go up to shake somebody's hand, and they don't like me. I'll just poof! -- boy, oh boy, and that'll be the end of their hand." Let's make his right had a red hand *[erases right hand and re-draws it in red]*. There, like that. Now he's got some real power. He can



Evil Mister Fred's new red hand.

go open a car door and melt the door handle, and just throw down molten lead or zinc or whatever it's made out of, go in and sit in the car, and if somebody starts talking to him, he can say, "Well, I think this thought." And start waving his hand over their head, and their whole head would get really, really hot. And if his minions would try and tell him lies, he could say, "Talk to the hand." And he'd get closer, and closer, and closer, and they'd go "Aaaaaaahhh!" and tell him the truth. So now he's got some real evil powers. And he says, "Oh, boy, I can take over the world."

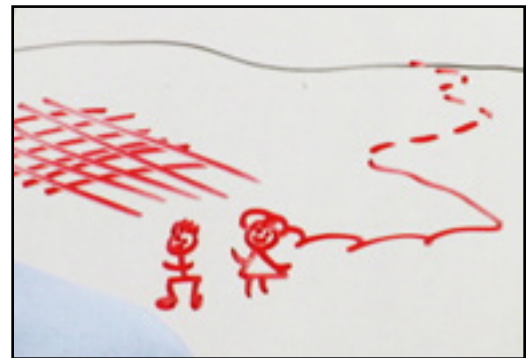


Hand-shaped hole  
in a building.

And there's a building nearby. Just a regular skyscraper. And Evil Mister Fred wanted to try his hand out on the building. There were people inside. And he walked over and he put his hand on the building, turned on the power -- foom! -- melted a big hole in the building. He says, "Yeah, I like this! This is great!" So he had his minions all run around and throw pieces of paper all over the place. And the pieces of paper said, "Evil Mister Fred is now king. You better do what he says or you're in trouble." And everybody said, "What? Evil Mister Fred king? I don't think so!"

And not too far away is Goodville. And Jack and Jill are there. And here came all these pieces of paper, declaring Evil Mister Fred the king. And Jack and Jill said, "Oh, boy, what is he up to now?" And Evil Mister Fred showed up at the town the next day. He says, "Everybody who doesn't think I'm king, come right here." And the whole town came up. And he said, "Now I'm going to convince you." And they all took out rotten tomatoes and threw them at him -- splat, splat, splat, splat, splat, splat, splat, splat, splat! And he said, "Arrrrgghh!" And he took a tomato and held it up in his hand and vaporized it -- foom! And everybody said, "Whoa! That was good." And they stopped throwing tomatoes at him.

And then he said, "Now I'm going to convince a few people here." And he picked one person, and he says, "Do you think I'm king or not?" And the guy says, "No!" And Evil Mister Fred put his hand on the guy's head, and foommm -- cooked his hair. And the guy says, "Yes, Yes, Yes, Yes, Yes, Yes, You're king, You're king, You're king! Just let go!" And Evil Mister Fred let go. And Jack and Jill said, "Wow, that was pretty good, actually! I don't know what we're going to do with that." So now they don't know he's got this fake hand. So now Evil Mister Fred has developed a following, and he created an army for himself, and he's going from town to town making himself king. Now, if you were Jack and Jill, what would you do?



Jack and Jill in Goodville.

## Imagination and Brainstorming Time

[Students make suggestions] (THERE ARE NO WRONG ANSWERS! Whatever they say, you should reply: "That's a good idea," "They might do that," etc. After brainstorming, proceed with the experiments, then finish the story.)

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



## Demo #1: "Springy Steel"



A steel spring is bouncy.

Okay, we're going to play tug-of-war with this spring. *[Instructor holds one end of spring with pliers and has a student hold the other end with pliers, and they pull.]* Okay, let's see, will it come back? Oh, it didn't come back. Darn.

Let's take this piece of metal and get it hot and see if it will come back when you get it hot. Let's see, how shall we get it hot?

I have an alcohol burner here *[lights alcohol burner with butane lighter]*. Now, we're going to heat up the wire and see if the wire will go back to being a spring by heating it up. *[Instructor holds wire in the flame, about two inches from end.]* Let's cook it for awhile and see what it does. *[Assistant turns off lights.]* Is it red? And is it now getting smaller? You know what happens to your fingers if you grab red wire? What's the wire doing now? *[Students: Bending.]* It's bending. We've reached the point where red wire isn't as strong as un-red wire. So we have this much wire out there, and that's how much it bent. Let's go a little further along, so there's more weight out there. We can just watch. So you can make wire sag if it gets hot enough, like that.



Holding the stretched-out spring in a flame.

Remember the guy that held a spoon in his fingers, and they played the spooky music, and he kind of rubbed his fingers? And he had to hold it for awhile, and then the spoon started to bend. *[Student: Why? Because his fingers were hot?]* His fingers were normal temperature, but the spoon wasn't a stainless steel spoon. It was part stainless steel, but the part that he was holding wasn't stainless steel. It was a type of metal that melts at room temperature. And he was using that in a certain mixture so that it would get really soft just by him holding it. And the spoon goes bendy, bendy, bendy, bendy, bendy, and then it's so soft when it's bendable that he can just let it fall into two pieces. So the trick he was using is a little bit different than the trick we're going to be doing today.

There's different kinds of steel. Some kinds of steel is springy and some of it is bendy. This is the springy steel because you can tell it looks like a spring. Springy steel is supposed to come back to its regular shape after you stretch it. Unspringy steel, if you stretch it a little bit, doesn't come back. And these guys have created this great stuff that *[stretches the spring]* boingy, boingy, boingy, boingy, boingy, boingy. It comes back. But if you pull it too hard, it doesn't work.



Playing tug-of-war with a steel spring.

## Demo #2: "Memory Wire"

Today we have some wires made out of nickel and titanium. When you get your piece of wire, you have to do something so that the end of it doesn't go through your eye, into your brain, and scramble your brain. So we're going to put on it a piece of tape. *[Instructor folds a piece of duct tape over each end of the wire.]* And now we can hold it and do stuff with it. This is the wire they use on cell phone antennas, it's used on some frames for glasses. It's more bendable than other wires, and it springs back after you bend it. And it's kind of neat that it's springy. If I get it cold enough, though, it acts in an odd sort of way.



Pushing wire into thermos.

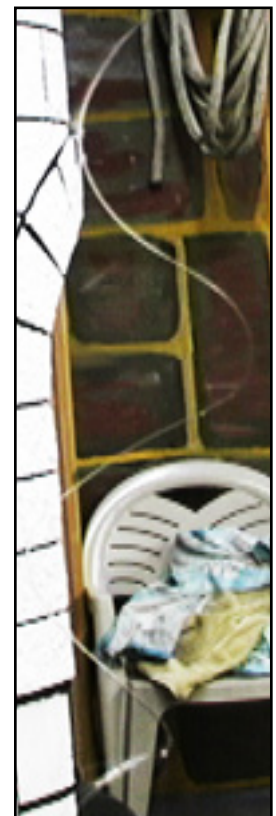
I've got a cup here. There's dry ice in there, sitting in alcohol. I'm going to put the wire in the cup *[pushes wire completely down into the cup, even though the cup is much shorter than the wire]*. How tall was that cup? Was it as tall as the wire? Where's the wire going? *[Students: You're squishing it.]* Oh, okay. *[Takes his hand away, then waves his hand over the top of the cup.]* Foam! Did it just spring out and I didn't see it? *[Students: No.]* *[Student: You put a hole in it.]* Oh, is there a hole in the bottom of the cup?

Well, I'm going to pull the wire out *[grabs top of wire and pulls it out]*. Let's just watch it and see what it does. *[Wire starts out loosely coiled from being forced into the cup, but as Instructor holds it by the top, it stretches out and becomes straight again.]* Now it's back to its original springy self. This kind of wire is called memory metal. It remembers its straight size and shape and tries to always come back to that. If you get it cold, it forgets what it was. It's dumb that way. So when I put it in the cup, it's cold, and it gets really soft when it's cold *[puts wire into cup again, then pulls it out]*. Then when I take it out, until it gets hard it's just like a piece of string *[wire is very pliable, then straightens again as it warms up]*.



Now, what if somebody made a spring out of this stuff? Let's find a spring made out of this stuff. Here's a beat up spring. I stretched this one too far, but that's all right. It's a little bit springy. Not as springy as the steel spring. I can stick it in here *[dips short spring into dry ice/alcohol mixture for a few seconds]*, and I take it out *[stretches spring out to a long length]*. It's broken. *[Instructor takes upper part of spring between his palms and rubs his palms together. As he does so, the spring gets shorter as it returns to its original tightly-wound shape.]*

Rubbing wire between palms.



Loosely coiled wire stretches out again.

## Experiment #1: "Cold Memory Wire"

For your experiment, you're going to be using a piece of wire. You're going to dip it into the mixture of alcohol and dry ice. If you fight over the container of alcohol and dry ice and it tips over on the table, nobody gets to use it after that. So you take turns. One person dips, you wait til they're done, they take theirs out, and then the next person can dip. Two people do not dip together. All right? And you can try the skinny wire, and you can try the coil-y wire. Maybe we'll even give you some real wire to stick in there. *[Student: Do we get to keep it?]* You'll get to keep the skinny wire. After that, you're going to do an experiment with the skinny wire. I'll probably show you that after you do the cold stuff. So let's put some of these out.

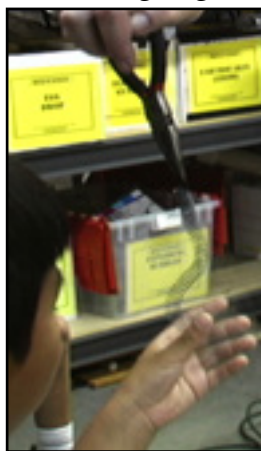
*[Instructor sets out thermal jugs containing alcohol and dry ice, four students per jug. Jugs are secured to the table with duct tape to keep them from tipping over.]* Don't touch it unless you're putting your wire in it. That's a good rule of thumb, isn't it? Now, when we give you your piece of wire, you need to put a piece of tape on the end. *[Each student receives a length of memory wire (about 2 ft.) and two pieces of duct tape to put on the ends. Then they take turns pushing their wire into the jug to compress it, then pull it out and watch it straighten out again. There should be time for each student to have at least two or three turns.]*



Pushing wire into thermos.

## Experiment #2: "Cold Memory Spring"

Okay, now we're going to take turns pulling on a spring. I'm going to dip it, and you're going to stretch it. You're going to be mean, you're going to be cruel, you're just going to stretch it until I say let go.



Instructor holds top of spring with pliers; student grabs bottom and pulls it straight.

*[Instructor holds one end of a small spring with pliers and dips it into alcohol/dry ice mixture for a few seconds, then lifts it out and holds it up in front of a student.]* Grab the bottom and pull. *[Student pulls bottom end and Instructor pulls top end, so the spring is stretched out almost straight.]*

Now take it in your hands and do this. *[Student rubs palms together with the stretched-out wire in between, so that it constricts back to its original coiled form again. Then Instructor repeats the experiment with the next student, using the same spring. Meanwhile, two assistants are doing the same thing with other students.]* *[Student: Do we get to keep the spring?]* No. These springs are really hard to get. *[After all students have had a turn, Instructor removes jugs from table.]*



Student rubs wire between hands to warm it up and make it coil up again.



## Experiment #3: "Hot Memory Wire"

*[Instructor places alcohol lamps on table, about two or three students per lamp.]* Now, whenever we're doing hot stuff, we need a fire extinguisher. *[Instructor sets out plastic cups of water on the tables, one for every two or three students.]*

This metal changes colors when you cook it. If you bend it a little and hold it in the flame and watch it, it'll start to get weak like the other one did. *[Instructor lights one of the lamps, bends a piece of the memory wire so it curves a bit, and places the curve in the flame for a few seconds, then holds it up so the students can see it.]* See how it turned purple? And it stays that shape. And you can change its shape, put it in a different spot, and maybe bend it in another direction. When it just starts to get weak, then you take it out. *[Instructor makes three or four bends in the wire by heating it in different places.]* You have to put a little stress on it. Keep bending it until it gets hot enough to bend on its own. And you can make as many bends as you like. There. It stays there now. Remember before when you bent it, it would come back again. After you heat it up until it turns purple, then it stays in that shape.

*[Student: Can you stretch it back out?]* Yeah, we can. We're going to put it in ordinary ice water. *[Instructor sets a larger thermos jug on the table containing ice water.]* I'm going to dip it in ice water *[dips wire in jug]*, and this wire, when you dip it in ice water, is supposed to be stretchable. Oh, and if you get it too hot, it won't work well, but we'll find out if I did it right. *[Instructor pulls wire out of ice water, but it doesn't straighten completely.]* Oh, it's almost doing it. I think I overheated it a little. Lets try it in the really cold one, see if that works better. *[Instructor dips wire into alcohol/dry ice mixture.]* I was hoping it would work in ice water. *[Pulls out wire, and it straightens almost completely.]* Yeah, it needs the alcohol mixture to work well. And now, I've straightened it out, and it's coming back to its original shape *[wire returns to its bent shape]*. So this piece of wire you get to keep, and you can shape it any way you want. And we'll see if we can make it work with ice water.



Heating bent wire with alcohol lamp.



Instructor prepares to dunk bent wire in thermos jug.

*[Instructor passes out alcohol lamps and lights them. Then students start heating and bending their wires. After they've all bent their wire, they bring it to the Instructor, who helps them dip it in the ice water. Then they pull it out, stretch it, and watch it return to its original bent shape.]*

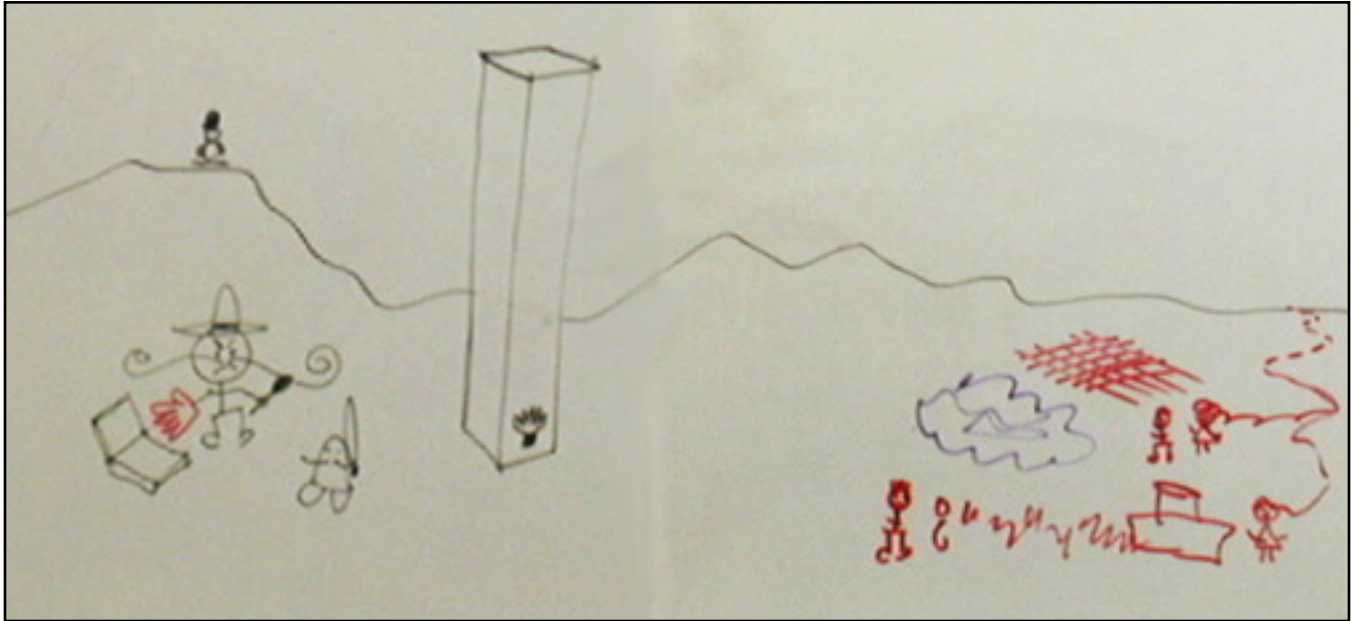


Student holds top end of straightened wire, and it quickly becomes bent again.



## End of Story

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



So Evil Mister Fred had a huge earthquake scheduled to come by at midnight. Jack and Jill found out. The people said, "Well, it looks like we're defeated. Evil Mister Fred's going to win. He's going to take over the world. Oh, no!" And Jack said, "Well, we'd better form an army group and join him." Jill said, "Yeah, let's do that." So Jack and Jill formed an army group and they started marching toward Evil Mister Fred. There's Jack, and there's a bunch of other guys, some Kick-Mes and a tank, and then Jill. And they went marching by Evil Mister Fred. They said, "Evil Mister Fred, we give up. You win." And they all saluted Evil Mister Fred. And you know what you have to do when somebody salutes you? *[Student: Salute him back.]* You've got to salute him back. So Evil Mister Fred saluted them back, and accidentally cut his own head right in half. 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.*