



Teacher's Guide for:
Charcoal Heat Bags

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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Charcoal Heat Bags
A Rock-it Science Lesson
Filmed June, 2009

Rock-it Science
2110 Walsh Ave, Unit F
Santa Clara, CA 95050
www.rockitscience.org

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Intro Quick Recap:

- When steel rusts, it makes heat.
- We're going to make some rusty steel and see what happens.

Experiment Quick Recap:

Experiment Intro:

- Activated charcoal is different from regular charcoal because it has lots of little holes where poisonous things can get trapped.
- It's used in gas masks and water filters.
- We're going to use it as a catalyst. It creates a spot for a reaction to take place.
- The other part of the reaction is iron -- iron powder.
- Place a magnet inside a white cup, then bring the bottom of the cup close to the iron powder so the powder clings to the cup.
- Take the magnet out, and the powder falls off.

Experiment: Charcoal Heat Bags

- Students put on lab coats.
- Experiment will use iron powder, activated charcoal, and water with salt in it. If students get it exactly right, it should do something; if not, they get mud.
- Warn students not to blow on the powder.
- Students each get a 2-oz plastic souffle cup and a craft stick to stir.
- Instructor spoons iron powder and charcoal into students' cups, and students stir them.
- Set out a cup of salt water for each pair of students.
- Each student gets a plastic pipette and drips exactly 24 drops of salt water into their cup, then mixes it.
- Cups should get warm. Instructor uses infrared thermometer to take readings. If it doesn't work, Instructor may need to give some students more salt water or more powder.
- Put plastic lids on the souffle cups and see if they get cooler. Take temperature readings.
- Take lids off and stir again to see if the temperature increases again.
- Let students add more water to make "mud" and see if anything changes.



Activated Charcoal (at left) has tiny holes.



Iron Powder is attracted to the magnet inside the cup.



Stirring the powders in the cup.

Equipment List: "Charcoal Heat Bags"

Items needed for Instructor:

- 8-oz Styrofoam Cup
- Small Magnet
- Measuring Spoons, 1/4 tsp & 1/2 tsp
- Infrared Thermometer

Items needed for Students:

Consumables (per student):

- Powdered Activated Charcoal, 1/2 tsp each
- Iron Powder, 1/4 tsp each
- Salt Water, 24 drops
- 2-oz Plastic Souffle Cup, 3 per 2 students
- Lids for 2-oz Plastic Souffle Cups, 1 per student
- Craft Stick
- Eye Dropper, plastic

Other:

- Lab Coats

Prep Work:

- Mix salt water (1 part salt to 3 parts water)



Infrared thermometer.

Story Recap: "Jack & Jill and the Cave of Death"



Part 1:

- Jack and Jill are at Disneyland on the Pirates of the Caribbean ride, but the boat was modified by Evil Mister Fred.
- When the boat went down the waterfall, it went through a wormhole and ended up at an island in the Pacific Ocean.
- Island has palm trees, a volcano, and a "Death" cave that contains treasure. They don't notice that Evil Mister Fred's castle is also there.
- Jack and Jill enter the cave and notice little blinking eyes watching them as they go by in the dark. Then they find pictures of footprints on the ground and follow them to a chamber.
- On the table are two cookies and a key. One cookie makes Jack small, the other makes Jill large, and when they eat the crumbs they return to normal.
- The key opens the door to the treasure room where there's also a skeleton with a sword and some ashes from an old fire. Jack swung the sword around and it got stuck in the ceiling, making some white dust fall, then the sword came loose and fell.

Story Recap (cont.)

- The doors slams shut behind them and locks them in.
- They hear Evil Mister Fred laughing outside, saying that Jack and Jill will either starve to death or freeze to death because he put a cold ray in the cave. Then he walks away.



Ending:

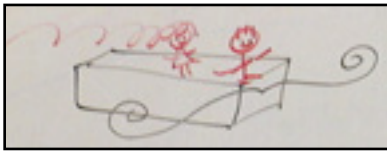
- Jack continues playing with sword, banging it rocks, and bits of iron are coming off the sword.
- Jill collects the iron bits, mixes them with ashes, uses salt from the ceiling (the white powder that fell), and some water. They stir them together so it will get hot and keep them from freezing.
- Jack keeps playing with sword, and strikes some sparks that catch Jill's hair on fire.
- Jill accidentally pushes her hair against the door and it catches fire.
- The door burns down and Jack and Jill run out, with Jill's flaming hair trailing behind.
- They run past Evil Mister Fred, who gets surrounded by Jill's burning hair, which grows infinitely fast, filling the chamber behind her.

Transcript: Introduction

[When steel rusts, it does something.] It makes heat. And somebody said, "Wow! I could make heat with rusting steel. I wonder if that's useful for anything." And they discovered that, yeah, it was useful for some things. Today we're going to make some rusty steel. We're going to see what happens when we do. But first we need a crazy story.

Story: "Jack & Jill and the Cave of Death"

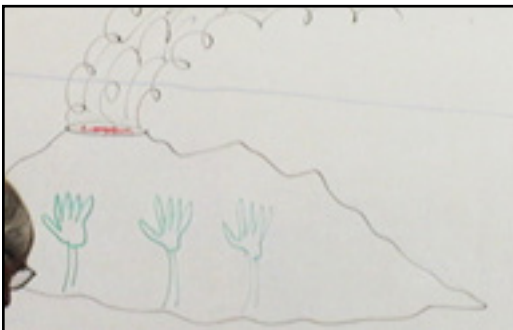
Let's see, once upon a time, Jack and Jill went to . . . did they go to Disneyland, did they go to the Death Valley, or . . . [Students: Disneyland. Disney World.] Okay, we'll send them to one of the Disney places.



The Boat at Disneyland.

Jack and Jill were riding on the Pirates of the Carribean ride. They were in a boat, like this. And when they got on, it was dark. They didn't know that this was not the same boat that everybody else was riding on. Let's see, Jack's sitting in there, riding on this boat, and Jill's down there on the boat. The boat goes down a waterfall and goes into the regular place

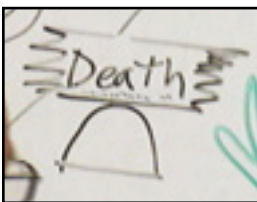
where boats usually go on this ride. They follow the water along and there's pirates and stuff. But Evil Mister Fred had modified this boat. If Jack and Jill had looked closely, they would have seen that it had a mustache on it. And when the boat went down the waterfall, instead of going to the rest of the ride, it went ka-boosh! -- right through the water, into a wormhole, and reappeared on an island out in the Pacific Ocean. Let's see, we need ocean out there. An ocean would have to be like this.



Island with Palm Trees and Volcano

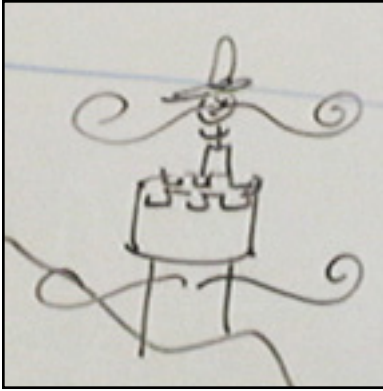
And there they were, floating in the middle of the ocean. And there was nothing there. And Jack and Jill said, "Whoa, what just happened? We were on a ride in Disneyland, now we're out in the middle of nowhere." And they turned around and they looked this way, and they looked that way. And while they looked that way they heard this ka-boosh! So they turned around to see what made the ka-boosh. And when they did, there was a big island right behind them. And the island had palm trees. You know what a palm tree looks like? It's got a thumb and some fingers, and there's the palm. And there

were lots of palm trees. And the island had lots of rocks, and it had a volcano. Islands out in the Pacific are supposed to have volcanos, so let's make this one a volcano, like that. And there was hot lava in the volcano. Do volcanos make smoke? Smoke and ash and stuff like that? Lots of smoke.



Cave of Death

And Jack and Jill paddled their boat over to the island. And they got out and they started searching around. And they found a cave there. And the cave had a sign on it. And all the sign said was "Death." And then when they looked closer, right at the very bottom, in little tiny letters, it said, "Death happens to anyone who enters here, but there's a great deal of treasure inside. And if you find the treasure and get out alive, you can keep everything you found." And Jack and Jill said, "Yeah, that's for us -- treasure. We like treasure."



Evil Mister Fred's Castle

So they ran right into the cave. It was dark in there. And Jack and Jill went all around, and had they taken the time to go explore the island first, they might have noticed that there was a castle on the island. Evil Mister Fred's castle. And Evil Mister Fred was standing on his castle with his binoculars, and he saw Jack and Jill come, and he saw them run right into the cave. And he said, "Mwha, ha, ha! Just as I thought. They've fallen into my trap, hook, line, and sinker. They'll never come out alive again."

And Jack and Jill wandered in the depths of the cave. It was dark, it was dank, it was dreary, it was drippy, it was dismal. And they said, "Oooh, this is a spooky, spooky place." And wherever they went, there were little eyes looking out of the darkness at them. When Jack and Jill turned to look at the eyes, the eyes would go blink, blink, like that. But they wouldn't do anything. And Jack and Jill said, "Come on out and fight like a man! Show us what you're made of!" And the eyes would just go blink, blink, and wouldn't come out. And Jack and Jill kept going and going, and then when their eyes got used to the dark, they saw on the ground pictures of footprints. They said, "Oh, cool! We'll just follow the footprints." And they're following these footprints along and said, "This is great! When we go to leave, we'll just follow the footprints back out again."

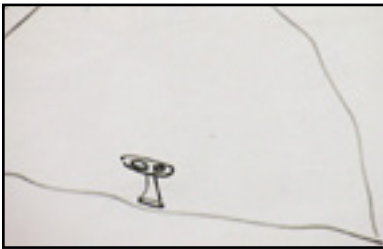
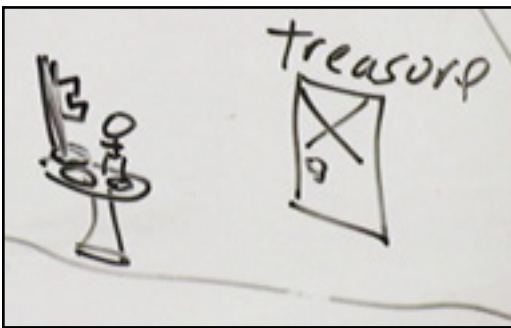


Table with Cookies

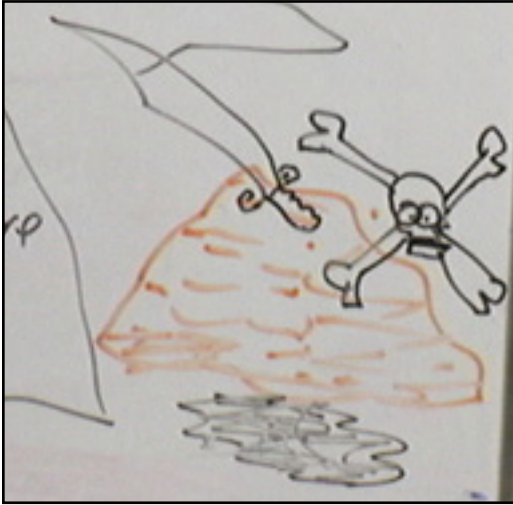
And they kept following the footprints deeper and deeper into this thing until they came to a big chamber. And in the chamber was nothing except a little table and a cookie -- two cookies. And Jack said, "Wow, that's nice. Somebody provided food for us." So Jack took the cookie and he ate it. And Jack all of a sudden went wshoomp! -- and became this tall. And Jill said, "Aw, Jack, you're messed up. You're really small." And she reached down and picked up Jack by his head and went wiggle, wiggle, wiggle. "You're a little tiny Jack." And she set Jack on the table, and Jill said, "I think I'll eat that, too." But Jill ate the other cookie. And all of a sudden, badoompf! -- Jill was huge. Giant huge. And Jill said, "Oops!" And Jack said, *[in a high pitch]* "Oops!" because his voice was really loud. Luckily, there were some cookie crumbs there, and Jill ate some more cookie crumbs and wshoomp! -- she shrunk down to regular size. Jack ate some cookie crumbs -- for Jack, the cookie crumb would be this big -- hahhh! And he returned back to normal size.



Key on Table and Door to Treasure

And they looked again on the table, and there was a key sitting there. And they said, "Oooh, a key, a skeleton key." And they saw a doorway, and above the doorway it said, "Treasure." And there was a big "X" on the door. "X" marks the spot. And there was a keyhole there. And Jack and Jill said, "Yeah, this is for us!" And they put the key in the keyhole, turned it, it went crrreeak -- and they pushed on the door and it went aaannnhhh -- pdoom! And there inside was more treasure than they ever dreamed of. There was a chamber in there with gold coins piled in huge piles all over the floor. There were dia-

monds, there were rubies, there were pearls, sapphires, emeralds, and there was even a milkshake sitting there. And Jack and Jill said, "Yeah, food! Riches! We're set!"



Treasure with Skeleton, Sword, and Ashes.

And as they were exploring, they also discovered something else sitting there -- a skeleton with bones crossed by it. And they said, "Uh, oh, this looks bad." And they also found a sword, a rusty old sword sitting there. A rusty old sword, and they saw that somebody had lit fires in there. There was a fire pit there, and it was filled with ashes. And Jack grabbed the sword. He said, "Yeah, I like swords." Whish, whish, whish. Jill said, "Be careful with that, Jack. It's a rusty old sword. It might break." And he went whish -- and sure enough, the sword broke. And the blade stuck in the ceiling. And Jill said, "Yeah, there you go, Jack. You'll walk right through that, and it'll fall down and hit you right in the middle of your head and you'll die." And Jack said, "Okay, I'll stay away from it." And the blade was going thwanggggggg in the ceiling. And as it was going thwangggggg, dust was falling down. It was white

dust that landed on the ground. And then the sword came loose and fell down. And then the door went ka-boom! -- and slammed closed. They heard something go crushhh! across it, and something else go kshhhhd! and something else go whssshhh!

And then there was a voice on the outside, and the voice said, "Mwa, ha, ha, ha, ha! You're doomed. You have your treasure, but now you're going to starve to death in that cave. And you're going to freeze to death because I put a cold ray in there. I don't know if you'll starve first, or freeze first, but either way, you're dead. And Evil Mister Fred walked away, singing a song to himself, "La, la, la, la, la, la, that's the end of Jack and Jill."

Now, if you were Jack and Jill, locked in a cave, and it's starting to get colder, and colder, and colder, and you don't see any food to eat, 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.)

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

Experiment:

Experiment Intro:

You're going to pick a lab coat, and see if you can put it on yourself. They're too big? No, they're not -- they fit just right.

This powdered charcoal. It's called activated charcoal. If you buy regular charcoal and look at it under a microscope, it looks like rocks, chunks, like that. That's regular charcoal. If you look at activated charcoal, it also looks like rocks. But it's got a gazillion little holes in it. There's so many holes in there that things like oxygen and chlorine and anything that's poisonous gets trapped in all those little holes. So they use it in gas masks for people who are going someplace where there's poison gas. Most poisons are absorbed by charcoal. And they use it to filter water in your house. When the water comes out of the pipes, sometimes it doesn't have a good smell or taste. It goes through charcoal, and then it's all perfectly clean.



Activated Charcoal (at left) has tiny holes.

We're going to use it as something we call a catalyst. It creates a spot for a chemical reaction to take place. And the other part of our reaction is iron. Iron comes in the form of a powder. Right here is some powder. The iron powder is very fine powder, just kind of looks like grey stuff. And does iron stick to magnets? Yes, no, maybe? *[Students: Yes!]* Okay, so I have a cup, white on the bottom, right? Here are some magnets. I'll put a magnet in the cup, and we'll put it near the iron powder, and it sticks. See? There's a magnet inside. *[Pulls magnet out of cup and allows powder to fall off.]* Ahh, boink.



Iron Powder is attracted to the magnet inside the cup.

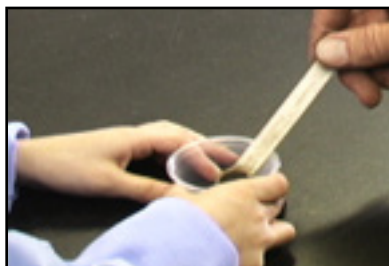
We're going to use the iron powder and the charcoal, and we're going to use some water with salt in it. And we're going to see what happens when we mix them together. If you get everything exactly right, it should do something. If you just don't do it exactly right, it makes black mud, which is kind of fun, too.

So you're going to need a small cup to do the experiment in, and we're going to put in stuff. *[Passes out a souffle cup to each student.]* We're going to put in a quarter of a teaspoon of iron powder in your cup. And then we're going to put in half a teaspoon of the black black powder.

Now, once when I was in high school, we were drawing things with pencils. And there were special pencils you could sharpen, and it would only sharpen the lead part of the pencil, which is black. And there was this cool little machine there, and you put the lead in there and go vwoo, vwoo, vwoo, vwoo, and you'd come out with a perfect point on it. Well, after about a hundred students did this, there's a whole pile of black stuff in the pencil sharpener. And one of the kids sitting behind me discovered you could take the lid off this pencil sharpener. And he looked inside, and there was a whole pile of black powder. He said, "Oooh!" The teacher was talking, and he was supposed to be listening. And then he went *[blows gently]* and the black powder moved. He said, "Oooh, all right!" *[Blows a strong puff of air.]* And the black powder blew out of the little bowl all over his face. And it made these little tiny black

dots. It didn't look bad at all, just a lot of little tiny black dots. And one of the other guys was sitting next to him, namely me, and said -- *[makes motion to wipe face with hand]*. And so he said, "Oh, okay." So he tried to rub it off. Well, as he rubbed, it got blacker and blacker and blacker, until he was a total black face with two white eyes. So when you get your black powder and it's in your cup, don't blow in the cup. You'll end up with iron in your eyes, powder in your eyes. If you want to blow in the cup, put on goggles and a hair net, and swimming goggles and an oxygen tank.

Experiment: Charcoal Heat Bags



Iron Powder



Charcoal Powder



Adding Salt Water



Checking the Temperature

So we're going to give you each a cup, and then you're going to get some of the iron and then some of the charcoal. *[Instructors spoon chemicals into students' souffle cups.]* When you've got some black stuff in there, you need a popsicle stick to stir with. We'll give you a popsicle stick, and you'll mix it all together.

We have some handy dandy drippers. We need to put twenty-four drops of salt water in there. You guys can count to twenty-four. We're going to try this with one -- can I borrow yours? *[Takes a student's cup and starts dripping salt water into it with a pipette.]* Okay, you're going to get a squirter, and you're going to drip into this thing twenty-four drops. And you really do need to count them and not lose track. If you do twenty-five drops, it won't work. If you do twenty-three drops, it won't work. We're going to count twenty-four drops. *[Counts out drops as he adds salt water to powder mixture.]*

Chemists do this kind of thing all the time. They have to measure stuff. *[Student: Do they always get it on their hands?]* Oh, boy, when I was a chemist, I had so many holes in my lab coat, and dirt and stains. And you're going to stir and stir and stir and stir and see if anything happens. What's going on in there is, the iron is trying to turn to rust. The salt water helps it turn into rust, and the charcoal is a place for it to turn itself into rust. *[Gives cup back to student.]* Stir yours.

And we'll give you another cup, one for everything two people, with salt water in it. And then we'll give you each these thingamajiggies *[pipettes]*. Each of you needs a squeezey thing. Pass the squeezey things around. And don't start putting in drops until everybody's ready. *[Instructor puts some salt water in larger cups, one per two students.]* You can practice dripping drops into your salt water container, not in your powder. In your salt water container. Try doing some drips in your salt water container. *[Several students had already started dripping salt water into their powder.]* Okay, well as long as half the class has already started, the rest of you can put twenty-four drops into yours and see what happens. Do it one drop at a time. *[Students add salt water, then start mixing the contents of their souffle cups. Most of the cups start to*

get hotter. Instructor measures the temperatures with an infra-red thermometer. Most temperatures were about 140-150 degrees F. If too much water was added to a cup, it turned to mud.]

Now we're going to rob it of oxygen. The poor little thing is trying to steal oxygen out of the air. We're going to put lids on so it won't get any oxygen. [Instructor passes out lids.] Now it's going to use up the oxygen in the container. It's going to starve to death. We're going to wait for it to cool a little bit. If you like, you can shake it. [Instructor checks temperatures again. Cups have cooled down considerably.]

Now they're cool. We're going to take the lids off and stir again and see if they get hot again. Take the lids off and stir and stir and stir. Okay, stir and see if they'll get hot again with the new oxygen that's getting stirred in. Now, if yours is getting hotter, keep stirring it for a little bit. If yours is not getting hotter, add five drops of water. Now if yours is hot and you've got a squirter there, you've got water there, add as much water as you want and see what happens. The idea is to make mud. You can make mud now, yes. Usually when it makes mud, it's cold. [Instructor takes more temperature readings. After all mixtures are converted to mud, souffle cups and popsicle sticks are collected in a trash bag.]

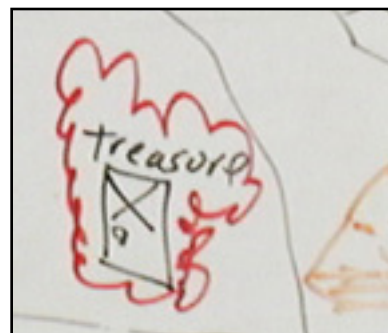
End of Story

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

Okay, so Jack and Jill were locked into a chamber with all this treasure by the Evil Mister Fred, and he wandered away singing happily. And Evil Mister Fred's happy, this is the best day of his life. Jack and Jill are locked inside of his chamber, and it's starting to get colder, and colder, and colder. And Jack's playing with the sword, banging it on the rocks and stuff, and all kinds of iron is coming off of his sword as he's rubbing it all around. And Jill says, "Oh, I've got an idea."

And she starts collecting all the iron from Jack's sword, it's powder everywhere. And she collects it all on top of a rock. And then she says, "Oh, let's add some of those ashes to it." So she takes some ashes and stirs it up. Then she says, "Now we need some salt water." And Jack says, "Well, you've got water, but we don't have salt water." And Jill looked up and she said, "Jack, the ceiling's white. I wonder what that is." [Student: Salt!] "Might be salt." So they threw the sword up on the ceiling -- kssshhhh! And salt started raining down. And they mixed the salt and the water and the ashes and the iron together -- sssshhhhhsss. And it started to get hot, just like yours did. It got hotter and hotter and hotter. Jack said, "Whoa, this is working great!"

He's so happy he takes the sword and wish, wish, wish, "I'm warm now. This is great." He's playing with the sword, and he makes some sparks with the sword -- bchinggg! And he accidentally caught Jill's hair on fire. Jill's hair is now going vwheoooo. And Jill says, "Oh, no! We're going to burn up in here. We're going to die instantly." And Jack said, "Oh, it's better than starving to death." And Jill's trying to get her hair out of the way, and she accidentally pushes her hair against the door. Now the door caught on fire. And the door burned completely down. And Jack and Jill were on the inside, and there were flames all around the edge of the door. They said, "Let's go for it!" And Jack jumped through and didn't catch on fire. And Jill jumped through, but her hair was still on fire.



The Door Caught Fire



Jill's Burning Hair left a
Trail of Fire behind Her

And Jack and Jill were running as fast as they could out of this cave, Jack in the front, Jill behind, and a trail of fire behind Jill. She looked like a comet going through the tunnels. And they ran right past Evil Mister Fred, Jack first. And Evil Mister Fred said, "Whoa, what was that?" Next thing, Jill goes by, and Jill's hair is growing really fast. Now Evil Mister Fred is surrounded by burning Jill hair, and he's going, "Aaaaaahh-hhh!" And Jill kept running, and her hair was growing infinitely fast, filling the chamber behind her, 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.