



Teacher's Guide for: **Hot, Cold & Fizzy**

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

[00:03] (These numbers are **time codes**, so you can refer back to the video.)

Hot, Cold & Fizzy
A Rock-it Science Lesson
Filmed June, 2009

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Quick Recap



Intro Demo:

- Teacher pours about 1 oz. of ammonia into a clear plastic cup and walks among the students, wafting the fumes toward them so they can each smell it.
- Add about 1 oz. of red cabbage juice to the ammonia. It changes color to green.
- Teacher pours about 1 oz. of red cabbage juice into a second cup.
- Add about 1 oz. of vinegar to the second cup. It turns purplish-red.
- Caution students about mixing ammonia and bleach, which creates poisonous fumes.

Intro Story:

- Draw three circular heads with circular ears: a normal one with two ears, a second one with only one ear ("Mangled Mickey"), and a third one with an extra ear on his chin ("Mutant Mickey"). Mangled Mickey lost his ear when he walked too close to an airplane propeller. Mutant Mickey grew his extra ear because he would sit for hours and think, with his chin resting on his hand.
- The three brothers live in a big house. Regular Mickey lives on the main floor, Mutant Mickey lives on the top floor, and Mangled Mickey lives in the basement.
- When Regular Mickey had to go out, he warned his two brothers to stay on their own floors and never, ever, go to the other one's floor.
- While Regular Mickey was gone, Mutant Mickey heard loud noises, gunshots, and screams from the basement. He ran down to help his brother, but when he opened the door he realized the sounds were coming from the television.

Intro Recap (Cont.)

- Both brothers ran to embrace each other, but just before they could hug, they started fighting furiously, throwing furniture, and wrecking the house.
 - When Regular Mickey came home, the house was a mess, Mutant Mickey's chin ear had been ripped off, and Mangled Mickey had taped the extra ear to his own head to replace his missing one.
 - Ask students what Mickey represents in chemistry. Write an "O" on his head and an "H" on each ear. Some students will usually know what two H's and an O represent (water).
 - So Regular Mickey represents water (H_2O). Mangled Mickey represents a base (OH^-) because he's got a missing ear. Mutant Mickey represents an acid (H_3O^+) because he's got an extra ear.
 - Bases taste bad. They include things like soap, lye (which is a really, really, really strong soap), alkaline batteries, poison.
 - Acids include vinegar, orange juice, lemon juice, tomato juice. Barf has hydrochloric acid in it.
 - In the experiment, we're going to use plain water (Regular Mickey) for the base of the experiment. We'll add a base to it (baking soda), and we'll add something that should be neutral (Dri-Z-Air, which is calcium chloride).
-

Quick Recap

Experiment -- Hot, Cold & Fizzy:

Part 1 -- Cabbage Juice and Calcium Chloride:

- Each student receives one ziplock bag. They can choose either a sturdy one that won't break or a thinner one that probably will break.
- Teacher puts 1 tablespoon of cabbage juice in each bag. Tell students to smell it but not drink it.
- Add 1 tablespoon of calcium chloride (Dri-Z-Air) to each bag.
- Students smoosh the contents together, feel it, and smell it. The contents will quickly start to warm up.
- Teacher uses an infra-red thermometer to check the temperature of each bag. Sometimes a bag will melt through.
- Add 1 tablespoon of baking soda to each bag.
- Have the students zip the bags shut immediately after the baking soda is added and shake them a bit to mix the contents.
- The bags will become inflated from the gas inside. If a bag pops, it can be zipped closed again.
- Ask students to notice whether it smells better or worse than before.
- Dispose of used bags in garbage can. Open the zipper a bit first so they don't take up a lot of space.

Part 2 (Reverse process):

- Give each student a new ziplock bag (the sturdy ones).
 - Add 1 tablespoon of cabbage juice to each bag.
 - Add 1 tablespoon of baking soda to each bag.
 - Teacher uses an infra-red thermometer to check the temperature of each bag. (The contents will get cold.)
 - Add 1 tablespoon of calcium chloride to each bag.
 - Have the students zip the bags shut immediately after the calcium chloride is added and shake them a bit to mix the contents.
 - The bags will get hot and become inflated from the gas inside. If a bag pops, it can be zipped closed again.
 - Ask students to notice the temperature change.
 - Dispose of used bags in garbage can.
-

Equipment List: "Hot, Cold & Fizzy"

Items needed for Teacher:

- Cups, clear plastic, 16 oz. (2 ea.)
- Ammonia, about 1 oz.
- Red cabbage juice, about 1 oz.
- Vinegar, about 1 oz.
- Thermometer, infra-red
- Measuring spoons, 1 tbsp. size (3 ea)
- Paper Towels

Items needed for Students:

Consumables (per student):

- Ziplock bags, 1-qt size, in two strengths (2 per student)
- Red cabbage juice, 2 tbsp.
- Dri-Z-Air (calcium chloride), 2 tbsp.
- Baking soda, 2 tbsp.

Prep Work:

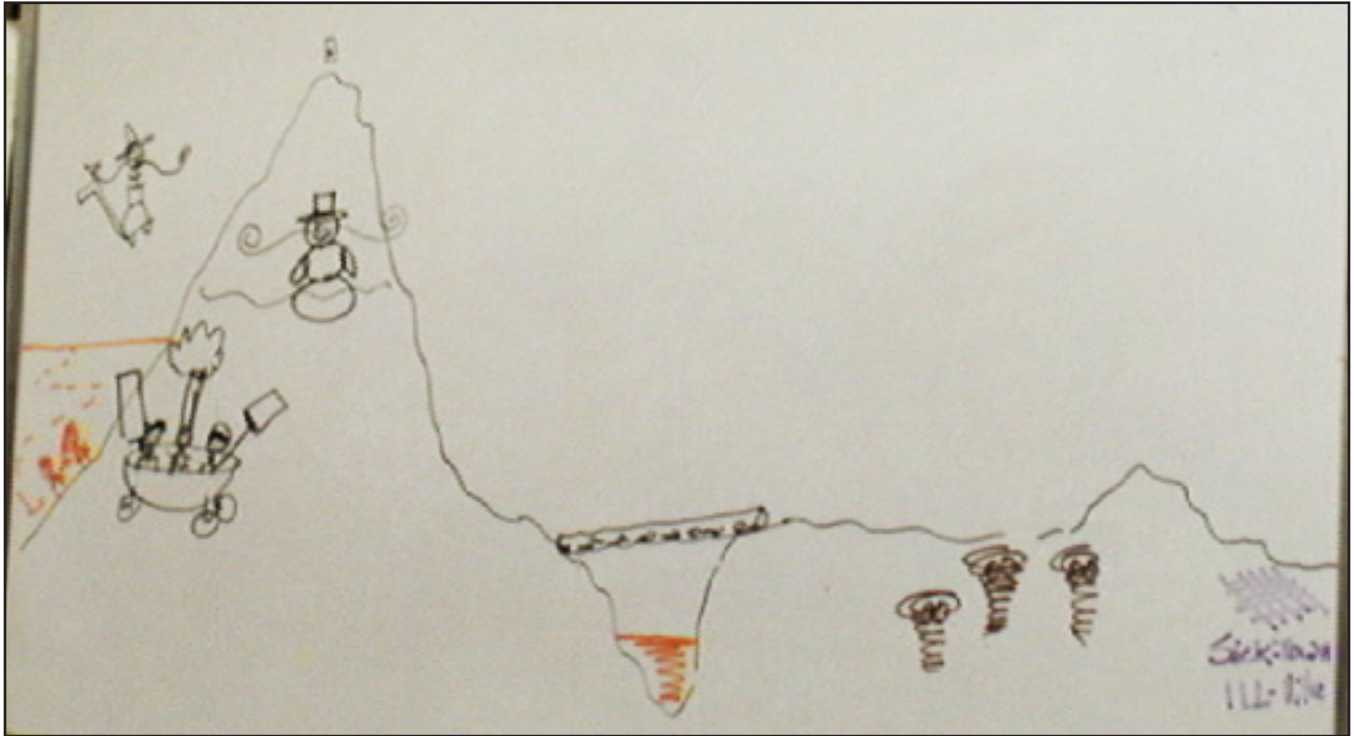
Make cabbage juice:

- Chop a red cabbage.
- Put in water to cover.
- Bring to a boil.
- Let sit for a couple of minutes.
- Strain to make juice.
- Keep refrigerated.
- One cabbage yields about one gallon of juice.



Infrared thermometer.

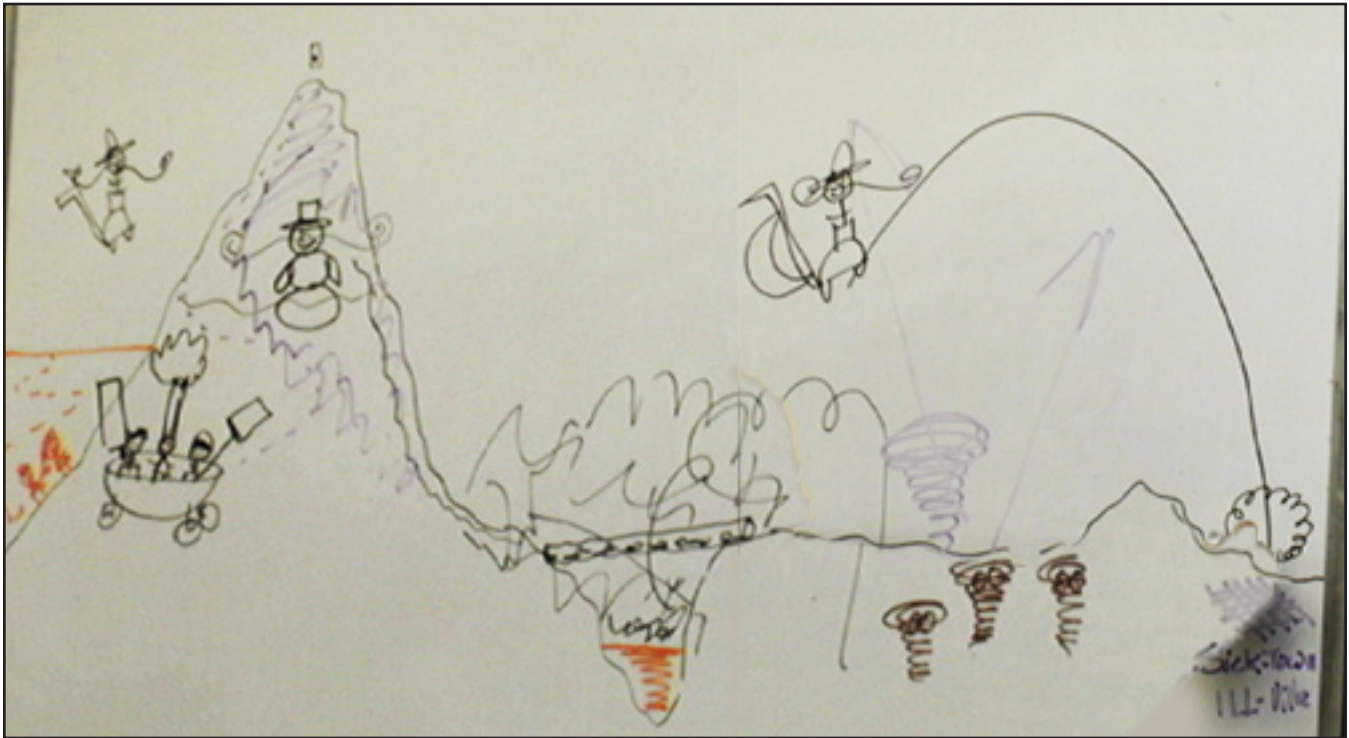
Story Quick Recap



Part 1:

- At the top of Mount Everest is the Acme Store of Everything.
- The Abominable Snowman lives up there. He's related to Evil Mister Fred, and he has a personality disorder. You can never tell whether he's going to be happy or sad unless you look at his eyebrows.
- In the valley, there's a river of hot lava with a partly-rotten log across it.
- On the other side, there are some little tornadoes (we call them tasmanian devils) dancing. If you get near them, you'll get hit with dirt and pebbles.
- Beyond that, there's the village called Sick-Town.
- Jack and Jill are coming with medicine to cure everyone in Sick-Town. It's in their backpack.
- On the side of the mountain, they see a butcher, a baker, and a candlestick maker in a bathtub. The butcher carries a knife, the baker wears a tall chef's hat, and the candlestick maker carries a shovel. He had lost his job because people don't use candles anymore, so now he works shoveling snow off roads.
- Jack and Jill invited these three to come along with them, so they made some wheels pop out of the bottom of their tub and followed.
- Evil Mister Fred has made the Abominable Snowman angry, drilled a bunch of holes in the log to weaken it, and told the tasmanian devils that the people who are coming hate tasmanian devils.
- Jack and Jill have to find a way to get past all of them to get to Sick Town.

Story Quick Recap



Ending:

- The butcher used his knife to cut the snowman in half, but the two halves went back together again, and the snowman threw the butcher back into the bathtub. The baker just hid in the tub.
- The candlestick maker had about eight hundred tons of road salt (calcium chloride), so he poured it onto the top of the mountain. It mixed with the snow and got really hot, and it melted the Abominable Snowman.
- It also created a huge avalanche of mud, snow, and rocks, which drove Jack, Jill, and the three people in the bathtub down the mountainside toward the rotten log.
- Just as they reached the bank, a bunch of water hit the hot lava, and a burst of steam came up and threw their bathtub beyond the log, landing near the tasmanian devils, who were about to attack.
- The baker and candlestick maker mixed some water with the leftover road salt in some bags and told the tasmanian devils it was their lunch. The devils devoured the bags.
- The bags got bigger and bigger in their stomachs, and the devils started to burp. This made them jet-powered, and one of them flew near Evil Mister Fred, who was flying over on his vacuum.
- Evil Mister Fred sucked up one of the devils in his vacuum cleaner bag, and this made the vacuum go bumping around in all different directions.
- Then the tasmanian devil exploded, creating a rocket-powered vacuum cleaner. Evil Mister Fred landed over the horizon in a mushroom-shaped cloud. Jack and Jill and the others delivered the medicine to Sick town.

Transcript: Introduction

[00:11] [We're going to do some chemistry.] There's ammonia. Oh, that's gross. Smell that. Is that ammonia? If you'd smelled it before, you'd know. Smelly, smelly, smelly. Okay, that's the way ammonia smells.

Let's put some red cabbage juice in it. Really dark blue. *[Pours cabbage juice into ammonia, sees it change color.]* Green.

[And here's vinegar -- acid. (Pours vinegar into a separate cup of cabbage juice, and it turns purplish-red.)] So, acid *[indicating cabbage juice and vinegar]*, base *[indicating cabbage juice and ammonia]*.

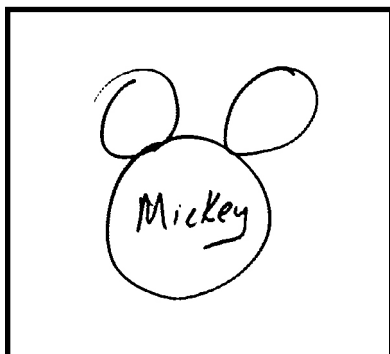
Be very careful mixing ammonia with things. You might get chloramine. In this case, you won't. If you're at home and you have some ammonia and some bleach, and you go, "I think I'll mix these together," you might create a poison gas. And if you happen to be in a small room like a bathroom and you just pour bleach into the toilet to clean it, then you pour ammonia into the toilet, it'll bubble and fizz and the chloramine gas will come out, and you'll die! And you'll die in a most embarrassing way. You'll faint and fall over, and your head will go into the toilet. And then, when you go to heaven, the guy in heaven that checks people in will say, "Yes, sir, how did you die today?" "Uhh, I drowned in the toilet." Oh, boy, guess where he's going to send you. Yeah, the other place.



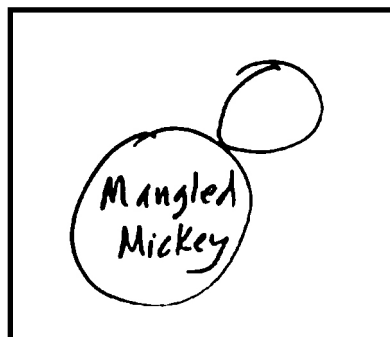
Pour cabbage juice into ammonia.



Acid and Base



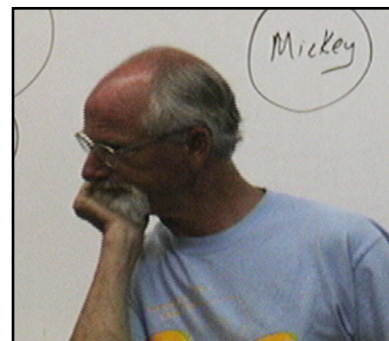
Mickey has two ears.



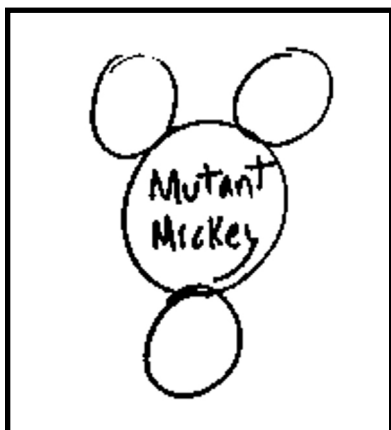
Mangled Mickey has only one ear.

There used to be a guy that looked like this *[draws a Mickey Mouse head]*. And there was another guy that looked like this *[draws a second mouse with only one ear]*. And there was another guy that looked like that *[draws a third mouse with two ears, plus a third ear on its chin]*. Of course, this one is Mickey. This one *[2nd mouse]* is Mickey's brother, and he worked at the airport in the old days. To start an airplane, you had to put your hands on the propeller and pull down really hard, and hopefully you don't hurt yourself. There's a guy inside that does all the controls and the plane starts up. If you're not careful, this is what happens *[points to missing ear]*. He got his head caught in a propeller and chopped off an ear. So they called him Mangled Mickey.

Now, if you're very thoughtful and spend all of your time considering, "Why are we here?" "Why is there air?" and "Why do toads have warts?", you start thinking, "Hmmm" *[rests chin on*



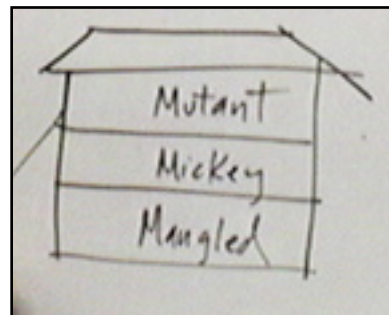
Mutant Mickey spent too much time leaning on his chin.



Mutant Mickey has three ears.

hand]. And if you think like this, “Hmmm” too long, you’ll irritate your chin and you can grow an ear right on your chin [indicates third mouse’s extra ear]. That’s what happened to this guy. They called him Mutant Mickey.

All three of them lived together in the same house. It was a big old mansion in Hollywood, on Hollywood Boulevard, and had three floors. The middle floor was the regular Mickey. On the top floor was Mutant Mickey. And on the bottom floor was Mangled Mickey. Occasionally the regular Mickey had to go make a

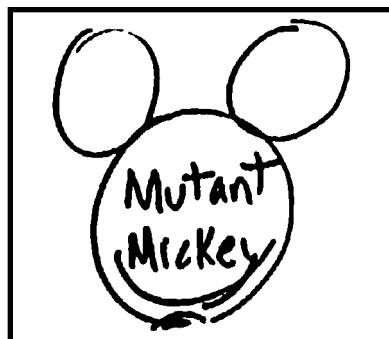


The three Mickeys' house.

movie. And he would run upstairs and tell Mutant Mickey, “Whatever you do when I’m gone, DO NOT visit your brother Mangled for any reason. No matter what. Stay where you are.” Then he’d run downstairs and say the same thing to Mangled Mickey. And then he’d go off to make his movie.

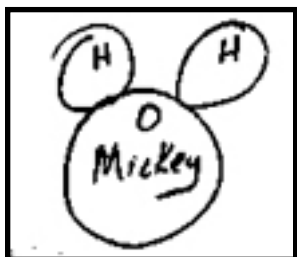
Well, one time he went off, and Mutant Mickey was upstairs reading a book, and he heard this terrible sound coming from downstairs. It sounded like a robbery was going on. Heard voices, heard gunshots. So he climbed down the stairs, ran around to the front door, broke open the front door with his foot -- crash! And there was Mangled Mickey watching tv on the big screen with the volume turned up full blast. And he looked at him and he said, “My brother!!!!”

And they ran towards each other and were just about to give each other a big hug, when they both turned around and boom! -- hit each other in the nose. And then he grabbed the sofa and crashed it over his brother’s head -- crash!! They pulled the curtains off the window, they ripped the carpet off the floor, they broke all the windows, they made holes in the walls, and they had a knock-down drag-out fight. At the end of the fight it was a terrible scene. And Mutant Mickey was standing there with a dumb look on his face, and his ear got ripped right off his chin. And Mangled Mickey had grabbed it and duct-taped it to his own head. There. That’s chemistry.



Mutant Mickey lost his third ear.

What does Mickey represent in chemistry? What do you think?



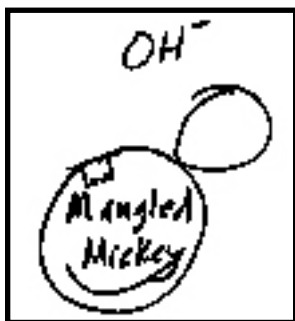
[Well, if regular] Mickey is neutral, we can give him an “H” on this ear, and an “H” on that ear, and an “O” on his head. Not because we shot a hole in his head. Does anybody know what two “H’s” and an “O” is?

[Student] Hydrogen. Water.

Yeah. “H₂O” = water. So regular Mickey represents water.



Mangled Mickey stole Mutant Mickey's extra ear.

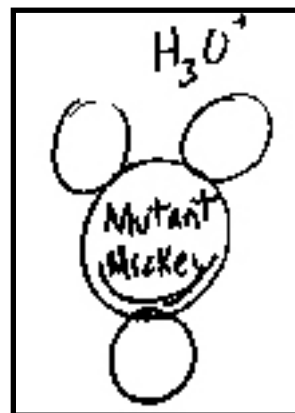


Mangled Mickey is a base.

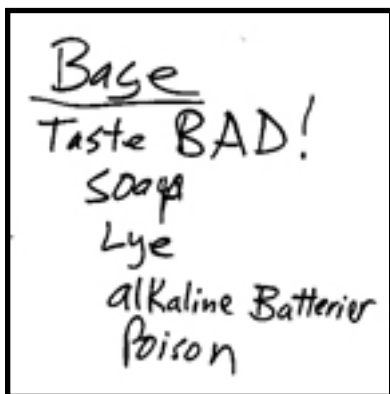
When you rip off one of his ears (let's take his ear back off), he represents "OH⁻", because he's got a missing ear. If he's got three ears, they call it "H₃O⁺", because he's got an extra ear.

This one represents a base [indicates Mangled Mickey]. That's the opposite of an acid.

And this one represents an acid [indicates Mutant Mickey]. It's the opposite of a base.



Mutant Mickey is an acid.

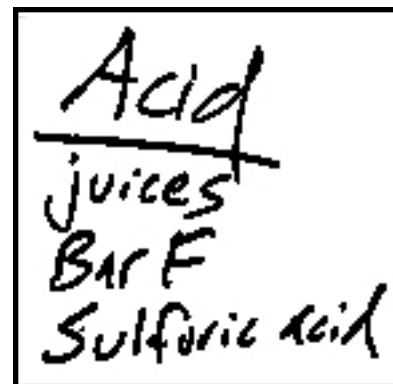


Bases taste bad!

Do you guys eat soap? No? My brother used to eat soap. Whenever he said a bad word, my mom would stick a bar of soap in his mouth. Yechhh! Bases taste bad. And they're things like soap, lye (which is a really, really, really strong soap), alkaline batteries, poison.

And acids, do you guys drink acids? Vinegar, orange juice, lemon juice, tomato juice. Do you ever barf? Barf has hydrochloric acid in it. [Writes on board: juices, barf, sulphuric acid.]

In today's experiment, we're going to use just plain water, the regular Mickey, for the base of our experiment. We're going to add to it a base, which is baking soda, and then we're going to add something which should be neutral, which is called Dry-Z-Air. It's kind of like table salt, but instead of sodium chloride, it's called calcium chloride. They use this in your houses sometimes. There's a machine with a fan inside that blows air through your house. And it sucks the air in past all these little white balls. And the little white balls see any moisture in the air. Remember when you blew on the dry ice and fog came up? That was the moisture in the air. This absorbs the moisture in the air, so it keeps people's houses drier than usual. But first we need a crazy story.

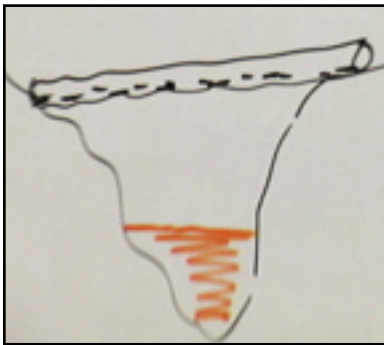


Some examples of acids.

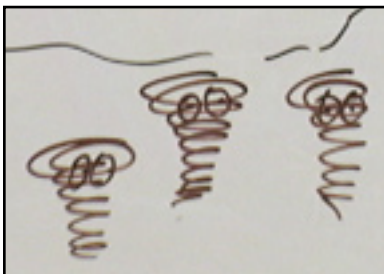
Story: "The Abominable Snowman"



Mt. Everest. The Acme Store of Everything is at the top.



Rotten log over river of hot lava.



Spinning tasmanian devils.



Jack & Jill on the mountain, and the Butcher, Baker, & Candlestick Maker in the tub.

[09:06] How about a story with an abominable snowman? Once upon a time, there was Mount Everest. This is the one that has the door above it for the Acme Store of Everything. And there's an abominable snowman up there. People in that area call him "yeti." There. There's the abominable snowman. And let's give him a hat. He's a happy snowman, unless he's not happy. When he's not happy, you don't want to be by this snowman. He can be a very sad snowman. He's related to The Evil Mister Fred, but he has a personality disorder. You can never tell whether he's going to be happy or sad unless you look very carefully at his eyebrows. You don't want to mess with the abominable snowman.

Down in the valley, there's a river of hot lava. And there's a log precariously perched over the river. It's been there for years and years, it's kind of rotten, but if you're very careful, you might be able to cross over the log and not fall into the hot lava.

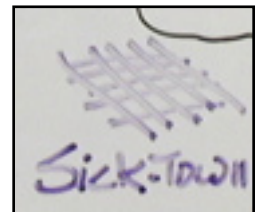
Beyond that there's some tasmanian devils dancing. These are little tornadoes -- I call them tasmanian devils. If you run into a tasmanian devil, all kinds of rocks and pebbles and sand and dirt will hit you in the eyes, and the nose, and the ears, and the mouth. And you'll come out just all packed with dirt. Got to watch out for tasmanian devils.

Beyond that there's a village with sick people. They call it Sick-Town. And Jack and Jill were on a journey. They have medicine to cure everyone in Sick-Town. They have it in a backpack on their back. And they have to get there over the top of Mount Everest. [Drawing] Here's Jack. Here's Jill. And on the way there, Jack and Jill found a bathtub. And sitting in the bathtub was a butcher, a baker, and a candlestick maker.

Here's the butcher. And a butcher usually carries a butcher knife, right? And here's the baker. Let's make the baker a girl. The baker's baking muffins, and a baker has a tall hat with a mushroom-looking thing on the top. And the candlestick maker, he lost his job. People don't use candles anymore, so he's working, shovelling snow off the roads. So he's got his shovel. He wears a hard hat.

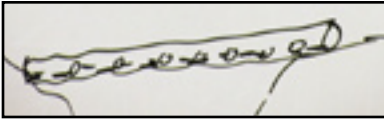


Abominable Snowman.





Evil Mister Fred on his flying vacuum cleaner.



Holes drilled in the log.

And Jack and Jill said, “Why are you guys sitting out here on Mount Everest in a bathtub?”

And they said, “I don’t know. We’re just on vacation.” And [Jack and Jill] said, “Well, not much of a vacation. You’re just sitting there in a bathtub.” They said, “Yeah, but we don’t have to do anything. This is great!” And Jack and Jill said, “Well, you want to come with us?” They said, “Sure!” So they pushed a button and wheels popped up on their bathtub, and they followed Jack and Jill.

Now, Jack and Jill had to get past the abominable snowman, they had to get past the hot lava on this crummy little log, they’ve got to get past the tasmanian devils, to Sick-Town. And Evil Mister Fred has been flying around on his vacuum cleaner, and he’s made the abominable snowman angry. And he’s gone and drilled a bunch of holes in the log so that it’ll break. And he told the tasmanian devils there’s some really mean people coming who hate tasmanian devils.

Now, if you were Jack and Jill, what would you do?

Imagination and Brainstorming Time

[14:20] *[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.)

Okay, we’ll leave this “To be Continued . . .”

Experiment: *Hot, Cold & Fizzy*

[16:24] Part 1:



Adding cabbage juice to a ziplock bag.

cabbage juice, you can smell it and look at it. Don't drink it because we need it for the experiment. Look how red our vinegar finally got. It took awhile.

Now, I'm going to add the calcium chloride to that. They call this road salt in some places. So have your bag open. After I pour the road salt in, you can smooch it around and feel it and smell it. *[Students feel mixture getting hot.]*



Checking the temperature of the mixture.

pellets inside mostly dissolved, or are there still a bunch of them in there? Well, they won't dissolve completely.

This time, when I put in the baking soda, zip it closed and then set it on the table, and run around and say, "Oh no, oh no, oh no!" It actually helps if you goosh them around a little bit. It kind of works better if you kind of do like this *[shakes sealed bag]*. *[The zip closures on the student's bags start to pop open.]* You can zip it back closed again after it pops. Test the temperature of the stuff. Then you can smell it while it's this way and see if it smells better or worse.

Now we need some ziplock bags. These are the el cheapo bags that are likely to explode. These are the more expensive bags that are not likely to explode. Jen will give an unexplodable bag to the unexplodable person, and I will carry around the explodable bags. If you want an explodable bag, raise your hand. If you don't want an explodable bag, your hand will be down and Jen will give you that kind of bag.

We're first going to put cabbage juice in your bag. When you get your



Adding calcium chloride to the cabbage juice in the ziplock bag.

Hold your bag up, and we'll measure the temperature.

[Student] Will the bag melt?

Sometimes the bag melts, yeah.

They should be cooling off now. Are the little



Adding baking soda to the bag.

We're going to throw these away and do the same reaction backwards. We'll use the same chemicals going backwards, so pop your bag open and throw your bags into the garbage can. Open them up so that they flatten out.

Part 2 -- Reverse Process:

Now we're going to reverse -- we're not going to completely reverse it, but we're going to reverse the order a little bit. *[Passes out new ziplock bags.]* This time, you're going to put in the cabbage juice, then we're going to put in the baking soda first and calcium chloride second -- the reverse order. So have your bag ready. *[Instructor adds baking soda to bags.]* Let's see how cold it is.

[Instructor adds calcium chloride to bags and students zip them shut. Bags get hot and start to pop.] Usually it gets so hot this time, it goes right through the bag.

Okay, put your bags in the garbage can. Now we need an ending for our story.



This bag's about to burst!

End of Story

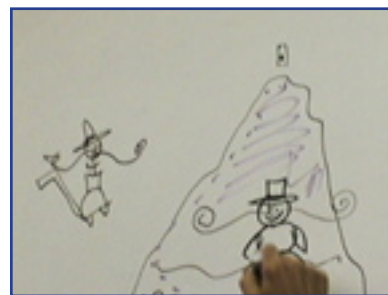
*** DO NOT * present this part of the lesson until after the experiments!**

[36:13] Jack and Jill have to make it past the abominable snowman, over the hot lava, past the tasmanian devils, to Sick-Town. And they looked at the abominable snowman, and they noticed his eyebrows were down. And they said, "Uh oh, he's in a bad mood. What are we going to do?"

And Jill said to the butcher, "Hey, butcher, you've got that big old knife. Go slice him up." The butcher says, "All right!" So the butcher jumped out, ran over to the abominable snowman, and went whoosh! -- just like that -- cut the abominable snowman right in half. But he's made out of snow. And the two halves just went back together, the abominable snowman grabbed him with his mustache, twirled him around, threw him up into the air, and he landed -- kerplunk! -- right back into the bathtub.

And then Jill said, "Hey, baker, what can you do for us?" And the baker said, "I can hide in the bathtub."

And then she said, "Oh, candlestick maker who now cleans roads, what can you do for us?" And the Candlestick Maker said, "Well, all I have is some road salt." And Jill said, "Well, how much?" He said, "Oh, about eight hundred tons." And Jill said, "All right! Go throw it on the abominable snowman." So the road guy grabbed his eight hundred tons of calcium chloride road salt, ran up to the top of the mountain, poured it all over the place, and it mixed with the snow and got really hot. Melted the snow. It got all over the abominable snowman and melted the abominable snowman.

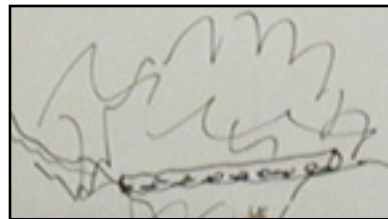


The road salt covered the mountain and melted the snow.



The avalanche begins.

Unfortunately, he put up so much stuff that it created a huge avalanche of mud, snow, and rocks. It went crashing down the side of Mount Everest from thirty thousand feet, and it took Jack and Jill, and the butcher and the baker and the candlestick maker in their bathtub to a trajectory of death. And they came down to the rotten log, and Jack and Jill said, "We'll never make it!" And there was a huge cloud of steam, dust, rocks, and broken log. And Jack and Jill's bathtub went down and hit this side of the bank, and it looked like it was going to teeter into the hot lava. But just at that point, there was a bunch of water that hit the hot lava, and a burst of steam went



Steam rises from the lava.

poof! -- and threw them out -- clunk! -- right by the tasmanian devils.

Jack and Jill looked at the tasmanian devils, and the tasmanian devils looked at them, and they said, "We're your worst enemies!" And Jack and Jill said, "Uh oh, this is bad! What are we going to do now?" And they said, "I've got an idea." They said, "Hey, baker, you got any baking soda?" And the baker said, "Yeah." They said, "Hey, road guy, got any road salt left?" And he said, "Yes." So they took some water, and they mixed them together in some bags, and they said, "Tasmanian devils, it's lunch time!" They mixed them both together and threw the bags at the tasmanian devils. And the tasmanian devils ate them



The tasmanian devils got bigger, and Evil Mister Fred sucked one up in his vacuum cleaner.



Evil Mister Fred disappeared over the horizon.

up. And the bags started to grow bigger and bigger and bigger inside the stomachs of the tasmanian devils. And the devils started to burp. As they were spinning and burping, they were like little jet-powered tasmanian devils. And they'd go pa-ching! -- one this way, and pa-ching! -- one that way.

And Evil Mister Fred, who happened to be nearby to watch the destruction of Jack and Jill, was flying overhead. And one of the tasmanian devils flew in his direction. Well, we thought he was going to hit him, but Evil Mister Fred said, "Oh man, that little dumb guy. I'll show him." And he flew down and sucked the tasmanian devil up with his vacuum cleaner. Now he's on the vacuum cleaner, and the bag is going bump, bump, bump, bump -- all different directions. And the Evil Mister Fred is now trying to hold on like a bucking bronco.

And then the tasmanian devil exploded, and Evil Mister is now on a rocket-powered vacuum cleaner. And he took off, and all Jack and Jill saw was over the horizon, a mushroom-shaped cloud. And they were able to get to Sick-Town and cure everybody of their terrible illnesses. And they all lived happily ever after, except Evil Mister Fred.

[41:00] **End of Lesson**

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