Teacher's Guide for:

Blowing Glass

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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Blowing Glass
A Rock-it Science Lesson
Filmed October, 2009

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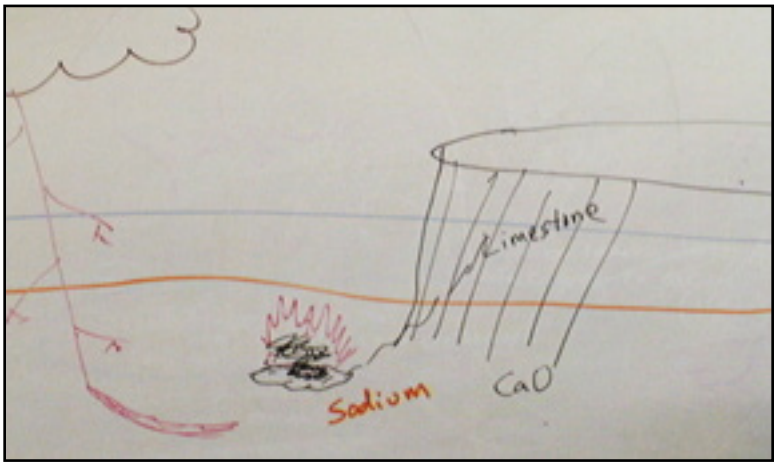
Intro Quick Recap:

- In olden days, a castle could have openings in the walls for windows, but they had no glass.
- They could take lambskin and scrape it until it was very thin, then put oil on it and place it over the window holes. It kept the cold out and let some light in, but you couldn't see through it.
- If you were on the beach and made a wood fire, when the fire burned out, sometimes the sand underneath would clump together in a blob. The fire was almost hot enough to melt the sand.
- If lightning hit the sand, it would melt part of the sand together in a shape like an elephant's tusk.
- If you broke it, the inside might be crystal clear.
- If you built a fire near a limestone cliff, where the dust from the limestone mixed with the sand, and if the fire was really hot, you'd get a larger glob of melted sand. If you broke it and scraped it, you'd find that it was glass.



Lightning melting sand, a fire on the beach, and a limestone cliff.

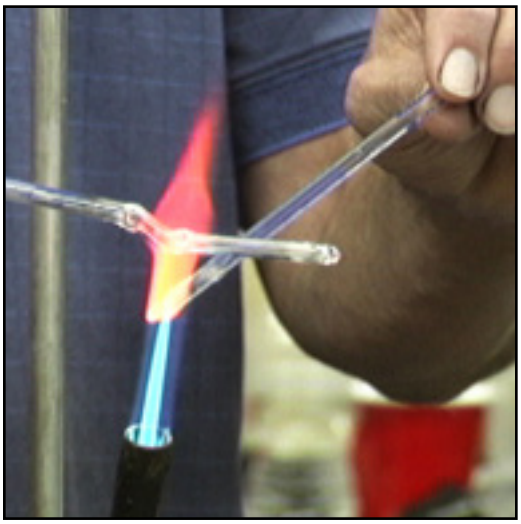
- Glass requires sand and limestone, which has calcium in it (usually calcium oxide). Limestone can make the sand melt at a lower temperature.
- But it's not real glass until you have sodium in it.
- If there's salt from the salt water in the beach sand, plus limestone, and a really hot fire, you could make glass. But it's not very good glass.
- Good glass requires perfectly white sand, good quality limestone, and good quality sodium (like Arm & Hammer Baking Soda).
- When they made glass from good ingredients, they could melt it and pour it onto flat steel sheets, but it would often break as it cooled.
- To keep it from breaking, you have to keep it hot and cool it very, very slowly. That's called annealing.
- If you add boron to glass (like Pyrex), it doesn't crack as easily as regular glass.
- Show students glass tubes that have boron in it. These tubes can be used to suck chemicals into it, but there's a copper blob on one end so you don't suck it into your mouth. These will be used in the experiment.


Pyrex glass tube.

Experiment Quick Recap: *"Blowing Glass"*

Propane torch duct-taped to lab stand, with sand and water in aluminum pan.

- Students roll up baggy sleeves and tie back long hair. They also wear goggles at all times during the experiment, no exceptions.
- Students work in groups of two. Each group gets an aluminum roasting pan with about a half-inch of sand in the bottom, a propane torch, and a lab stand base and metal rod, and a plastic cup. Students assemble the lab stand, place it in the pan, and duct-tape the torch to it. They fill the cup with water and place it in the pan. After the Instructor demonstrates the techniques, students will each receive 2 glass tubes (Pyrex pipettes).
- If a previous class has used the equipment, there may be sharp pieces of glass in the pan. Students can ignore them or use them if they wish.
- In the experiment, students will heat glass until it's red-hot. But when the red color goes away, the glass can still be very hot. To avoid being burned, students should always hold the glass tube by the end that has a bit of white fluff in it. If the fluff turns black, that means it's been heated and shouldn't be picked up.
- Instructor demonstrates the process:
  - Light the torch with a barbeque lighter and point the flame away from your face.
  - *Part 1:* Place the end of the glass tube in the flame and heat it slowly. The sodium in the glass gives it an orange glow.
  - Glass has high surface tension, so when it melts, it wants to form a sphere. So when the end of the tube is melted, it forms a ball and seals off the end.
  - If you heat glass, it doesn't usually crack unless you heat it really fast. It cools on the outside first, then the inside shrinks. Get it hot and dip it in water, and it breaks off.
  - Glass transmits heat very, very slowly, so the end of the tube that you're holding won't be hot.
  - *Part 2:* Heat another part of the tube until it softens and bends under its own weight. You can do this in more than one place to make a shape, such as an animal.
  - To add "ears" to the animal, heat a part of the first tube and the tip of a second tube. Then touch the end of the second tube to the hot spot on the first one and pull it away slowly. The second tube stretches into a thin length, then breaks off when it



Heating two tubes, getting ready to combine them.

Experiment Quick Recap (cont.):

becomes too thin. You can put the end of the "ear" into the flame to create a kind of little ball at the end.

- Each student gets two minutes to work with two tubes, then their partner takes a turn. It's better to use the torch one person at a time so they don't mess up each other's work.
- When finished, put the hot end of the glass down in the sand so nobody picks it up. Do not put hot glass on the tabletop because it will melt the tabletop.
- *Part 3 (optional, for those who want to try it):* The glass in these tubes is thick, so it's difficult to blow a bubble in it. To blow a bubble, make sure one end of the tube is sealed off. Then heat up a section of the tube and blow hard into the open end. The bubble will usually pop.

- Each student receives two glass tubes, and they start by just working with one to get used to heating it. Then they use both tubes to practice making "animals" or other shapes by bending and combining two pieces of glass.
- After students work with the glass for awhile, Instructor passes out pliers so students can see what happens if they squish part of the softened glass.
- Students can take home their bent glass if they like.

Blowing a bubble in the glass tube.

Equipment List: "Blowing Glass"

Items needed for Instructor:

- (same as students)

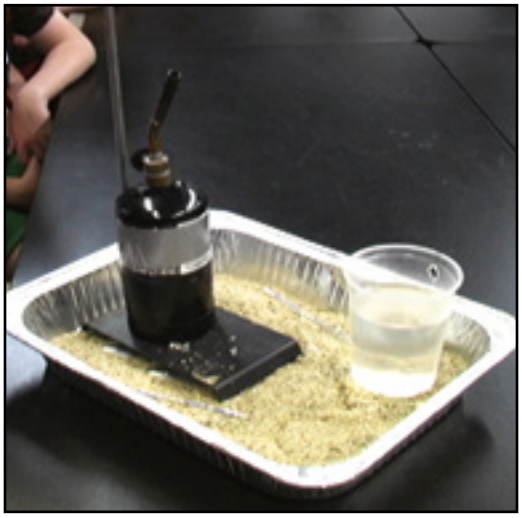
Items needed for Students:

Consumables (per student):

- Pipettes, Pyrex, disposable, 10 ml, 2 each
- Duct tape, about 2 ft.
- Water, about 8 oz.

Other (per group of 2 or 3 students):

- Roasting pan, aluminum, large
- Lab stand (metal base and vertical metal rod)
- Propane torch
- Sand, about 1/2 inch deep in pan
- Lighter, barbeque
- Pliers
- Cup, plastic, clear, 16 oz.
- Goggles



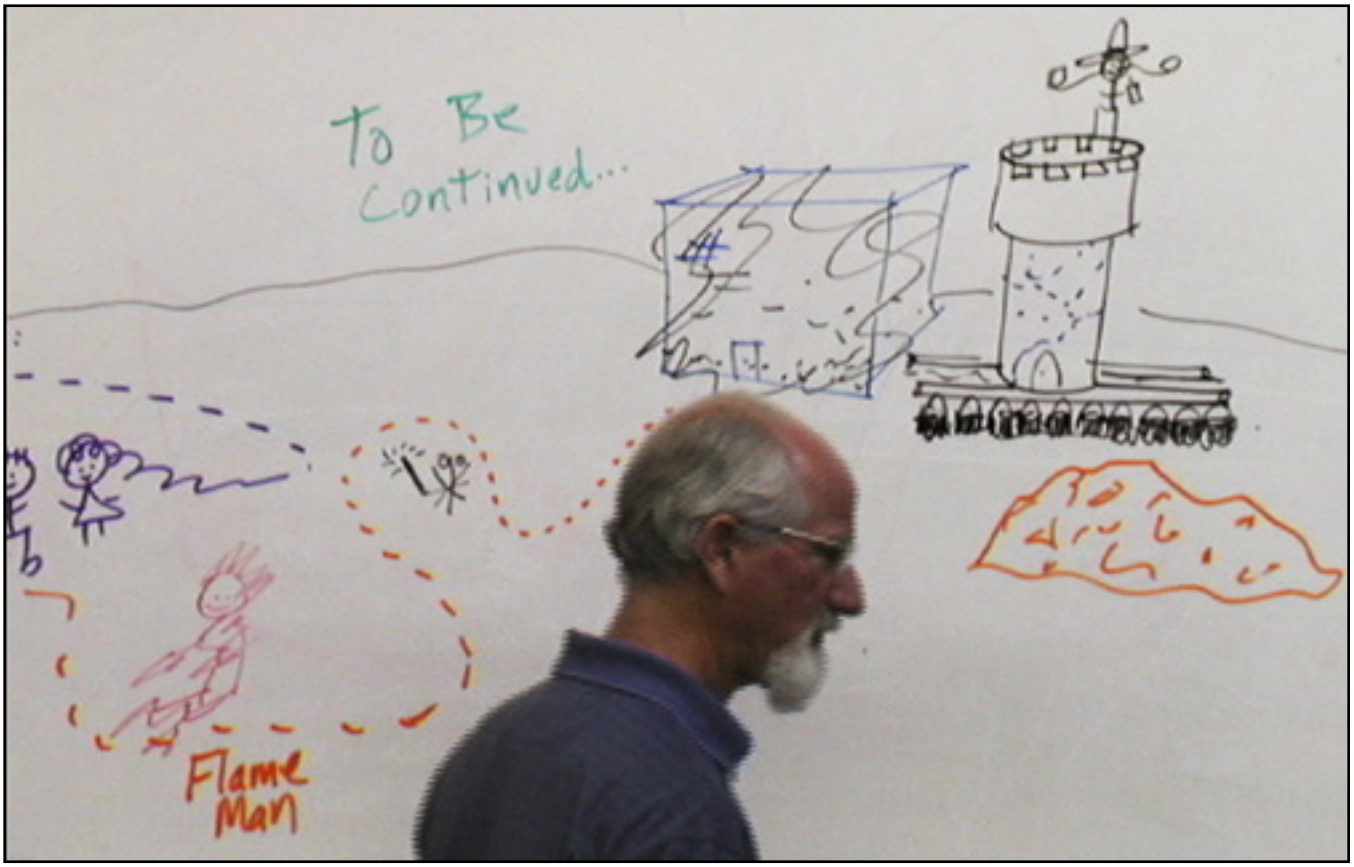
Propane torch duct-taped to lab stand, with sand and water in aluminum pan.

Prep Work:

- Check the propane torches to make sure the nozzles work and there's enough fuel.
- Put sand in aluminum pans.

Pyrex glass tube.

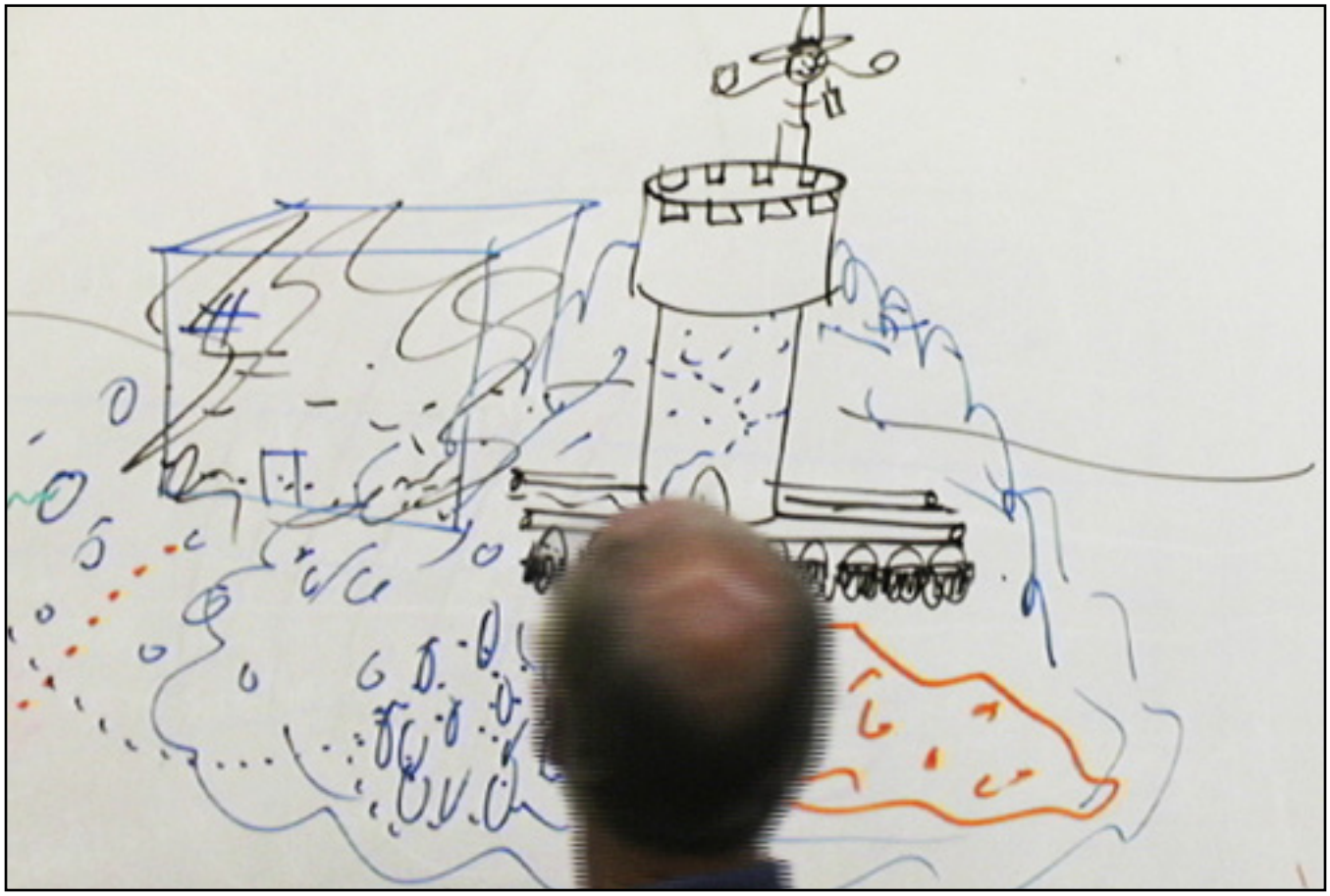
Story Recap: "*Jack and Jill and the Crystal Palace*"



Part 1:

- Evil Mister Fred has put his castle on two logs and made his minions carry the logs across the countryside while he looks for something bad to do.
- To make the minions go faster, he put dog collars on them that would deliver electric shocks.
- They saw a huge castle made out of glass, and the people living there had lots of gold objects.
- He had the minions hit the castle with their baseball and destroy it completely. The people ran away, and the minions brought back the gold.
- The people called Jack and Jill for help.
- On their way there, Jack and Jill met a Flame Man. He was lonely because no one would touch him, so he had no friends. Jack and Jill invited him to come along with them.
- Then they met an asterisk with eyes, floating in midair. It was an old fairy that didn't have a lot of magic power, but could do a few things. Jack and Jill invited the fairy to join them, and they went to the crystal palace and saw that it was destroyed.
- Meanwhile, Evil Mister Fred called the Acme Store of Everything and ordered steel armor for his minions. This also allowed them to use real weapons, so now they had swords instead of just baseball bats.

Story Recap (cont.): "*Jack and Jill and the Crystal Palace*"



Ending:

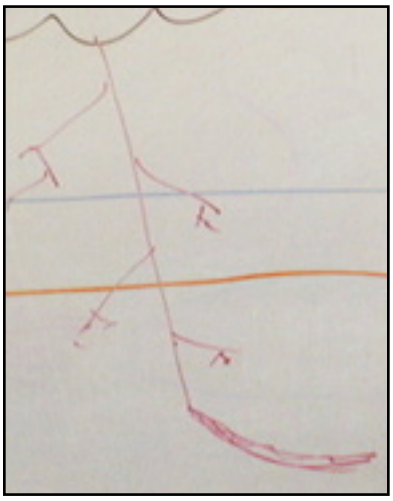
- Jack and Jill asked Flame Man to burn up Evil Mister Fred, but he said that was too easy. Instead, he asked the asterisk fairy to make the pieces of glass come alive.
- The fairy was able to make one piece of glass come alive, and it grew arms and legs and became a glass person. Then the minions broke it into a million pieces.
- Then all the pieces came alive, and each one became a glass person, thousands of them. And the minions smashed them all again.
- And all the pieces of glass came alive again, and now there were a million glass people.
- They wanted to be friends with the minions, so they swarmed over them and Evil Mister Fred and smothered them in a huge pile of glass.
- Then the Flame Man melted the outside of the glass so it became solid. *[This line is missing from the video.]*

Transcript: Intro

In the old days, if you built a big castle somewhere, and you wanted windows in it, you could have a hole. But they had no glass. So they would take something like lambskin, and they'd scrape the lambskin and it would get really thin, put oil on it, and they'd put the lambskin over the opening to keep all the cold out. And you could get some light through it, but you couldn't ever see through it.

Blob of sand under fire.

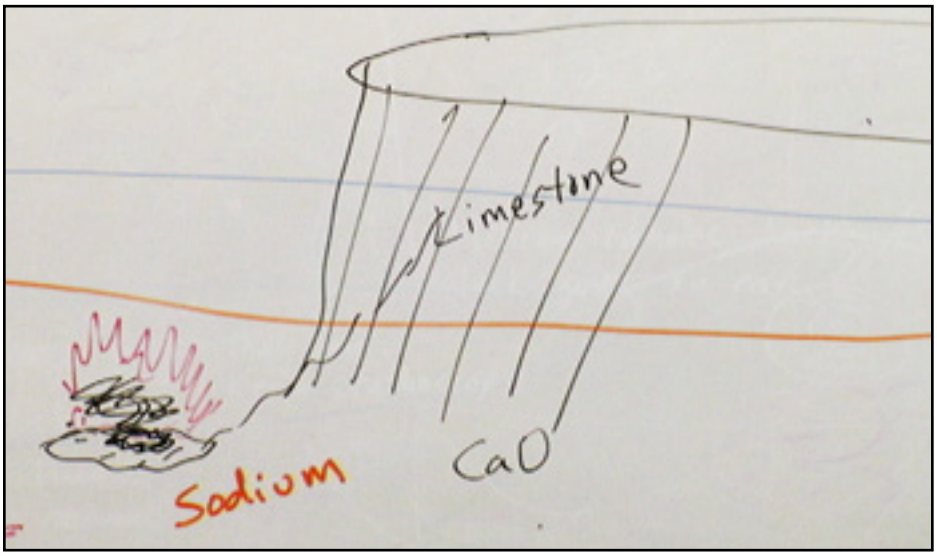
They noticed, however, that if you were out on the beach . . . suppose this is some beach back here, and there's some ocean out there . . . and you'd stacked up some wood and made a fire out there, that sometimes, after the fire was all out, they'd look under the fire and discover that some of the sand had clumped together in a blob. And the fire was almost hot enough to melt the sand.



Lightning melts sand.

And they also noticed that if a storm came by and lightning hit the sand, that the lightning would create long things that looked kind of like the tusk of an elephant and melt the sand all together. And you'd actually pick these up and throw them around. And if they were melted strong enough, if you broke it, you might find that on the inside it was crystal clear.

And if you happened to build your fire by a cliff, and the cliff happened to be made out of limestone, and the dust from the limestone mixed with the sand, and you built your fire there, if you made your fire really, really hot -- instead of getting just a little glob of melted sand underneath, you could get a big glob of melted sand. And if you break that and scrape it, you'd find that you had created glass.



Limestone cliff provides calcium and salt water provides sodium.

So glass requires sand and limestone. Limestone has calcium in it, calcium oxide typically *[CaO]*. And the limestone can make the sand melt at a lower temperature. But it's not real glass yet. It needs one more thing. It needs to have sodium in it.

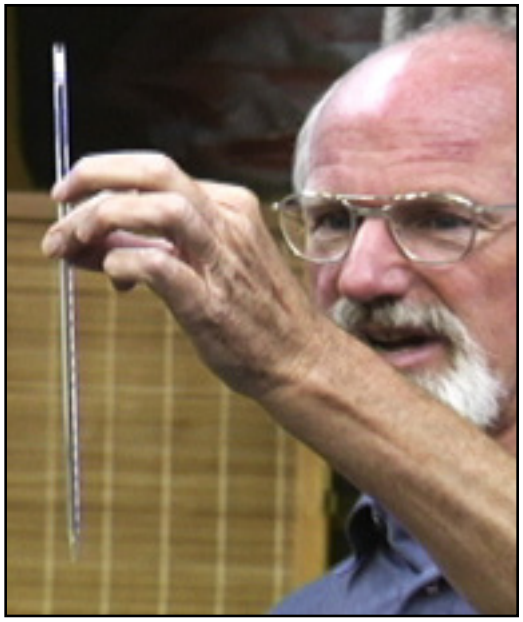
Now, if you're out at the beach, where are you going to find some sodium? *[Student: The water.]* All right! How did you know that? *[Student: Because it's all salt water.]* Salt water. And what's salt made out of? *[Student: Sodium and chloride.]*

You're right! There's sodium chloride in the water. So if there's salt there and there's limestone there, and you have a fire that's hot enough, you could make glass. It's kind of crummy glass.

To make really good glass, you need perfectly white sand, and you need good quality limestone, and a source of good quality sodium. Sodium chloride doesn't work that great. But if you took like Arm & Hammer Baking Soda, baking soda is good. Mix that with the sand and you can make good quality glass.

The glass that they make from that, they could melt it and pour it onto flat steel sheets. And it would cool off, and then as it cooled, something bad happened. *[Student: It would break.]* Yep. It would just break. Because as the glass cools, stresses build up in it, and pretty soon -- chingggg! -- it breaks itself. *[Student: How do you make it not break?]* Well, you have to cool it really slowly. So if you pour it out and then keep it hot, and just very, very slowly cool it down, then it won't break. They call that annealing.

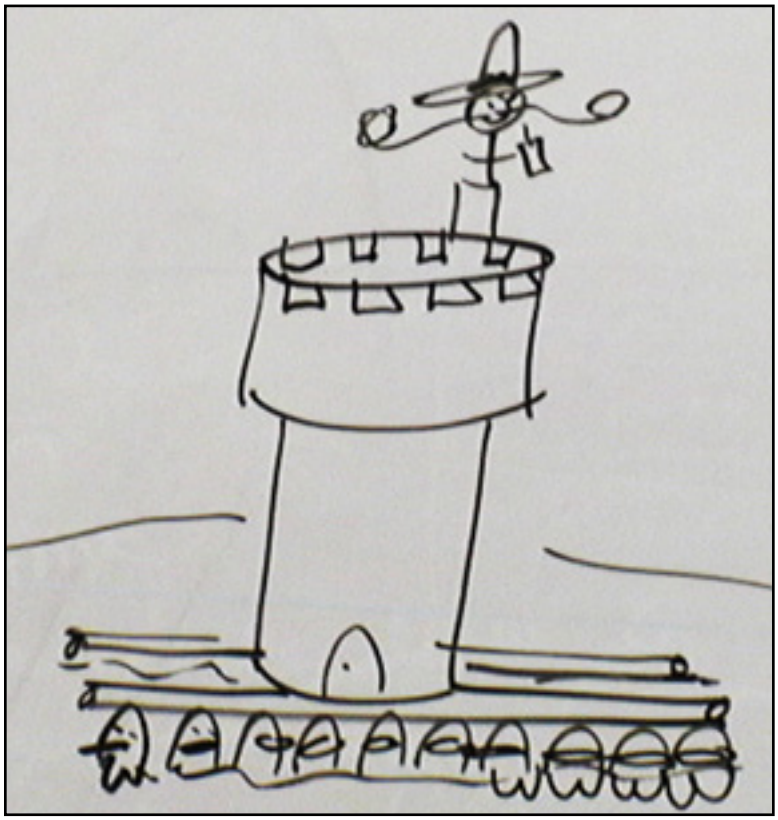
Or you can add something else to your glass. You can add boron to it. Good old boron. That's Pyrex glass. Today we're going to be using glass that has boron in it. The chemists put it in these tubes. There are numbers on the tubes. You can actually suck on this end and suck toxic chemicals up inside. They put this copper blob in there so you don't suck them into your mouth and die. It's got numbers on it so you can measure how much junk you're sucking up. This is called Pyrex glass because it's got boron in it. It doesn't crack as easily as regular sodium glass does. The windows in your house are made out of regular old sodium glass. Well, today we're going to do some experiments with glass. But first, we need a crazy story.



Glass tube (disposable Pyrex pipette).

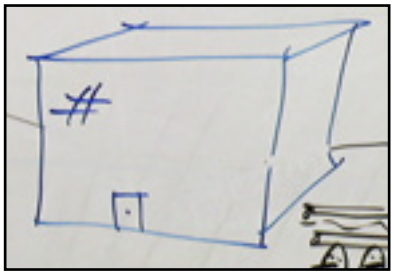
Story: *"Jack and Jill and the Crystal Palace"*

Once upon a time, Evil Mister Fred was out marching across the countryside with his minions, looking for something to do that's bad. And he'd put his castle on two logs, like that. And he put the logs on top of the minions' heads. There's all these minions there, carrying his castle. And Evil Mister Fred of course was on top, directing everything. And he had a . . . What would be a good thing to make the minions go faster? He put dog collars on them that, when he pokes his remote control, it shocks the minions. He'd say, "Okay, minions, faster!" And the minions would say, "Boss! This thing's heavy!" And he'd say, "Faster, faster, faster!" -- bzzzttt! And the minions would go "Owwwww!!" And then they'd go faster.



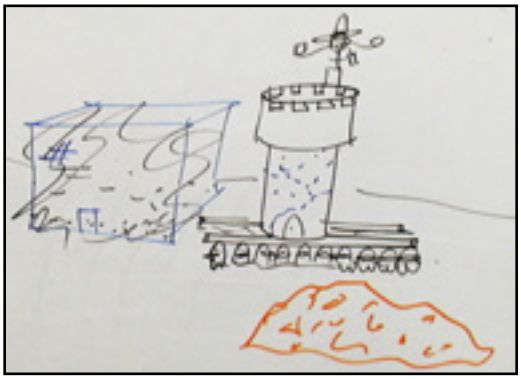
Evil Mister Fred's minions wearing dog collars.

And as he was going across the countryside, lo and behold, he saw a crystal palace. A huge castle-like structure all made out of glass, like that.



Crystal palace.

And he said, "Whoa, check that out!" And there were people in there living the good life. Everything was made out of gold. Their cups and their spoons and their saucers and their shoes -- everything was made out of gold. He says, "Whoa! I like that place, made out of gold, filled with gold. Okay, minions, put the castle down." And they went ka-thump! And they threw the castle down, and it broke, which made him really mad. But he said, "We have more important things to do. Grab your baseball bats, run over there, hit the crystal palace with your baseball bats, steal all their gold, and bring it back."



Destroyed palace and pile of gold.

So the minions said, "Yeahhhh!" And they grabbed their baseball bats and ran over there and banged on the crystal palace. And they broke it. They broke it all to pieces. Big pile of rubble. The people that were inside ran away screaming. The minions grabbed all the gold and brought it back. Now they have a pile of gold.

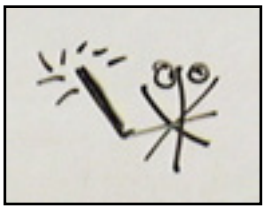
Well, pretty soon, news went across the entire country. "There's an evil guy around here who'll stop at nothing. He's broken our crystal palace and stolen our gold. We've got to stop him." So they called Jack and Jill and said, "Help us out! We've got to stop that Evil Mister Fred."

And Jack and Jill said, "Okay, we'll head over to your country and see what we can do."

So Jack and Jill were on their way over, and during their walk over there, they found a guy sitting by a tree. And the guy was all made out of flames. What should they call him? *[Student: Flame Man.]* Flame Man. Okay. They said, "Why so sad?" And he said, "Well, nobody wants me for a friend." Jack and Jill said, "Well, I think I can understand why." And Flame Man said, "Well, yeah, I just go to shake their hand. Next thing you know, they're running away screaming. I just don't understand it." And he leaned back on the tree that he was sitting next to and boom! -- the tree caught on fire. He said, "Life just isn't good for a Flame Man." And Jack and Jill said, "Well, you can come along with us, and maybe we'll find some way to help you out." So the Flame Man went with Jack and Jill off to try and stop Evil Mister Fred.

Jack & Jill with Flame Man.

A little while later, they came to an asterisk. And the asterisk was just floating in midair. And the asterisk had a magic wand, like that. And it had some eyes. And they said, "Whoa, what are you?" And the asterisk said, "Well, I'm a really old fairy. I used to have all kinds of great powers, but now I've got my magic wand, and I float around, and I can do a few things, but not too much." And Jack and Jill said, "Well, why don't you come along with us, and we'll go fight Evil Mister Fred?" The fairy said, "Oh boy, oh boy, oh boy, I like this! I'll go fight that Evil Mister Fred!"


Asterisk fairy.

So then they saw the crystal palace, all broken to pieces. And they said, "What a tragedy. What a beautiful place it was. And Evil Mister Fred has destroyed it." And off in the distance they heard Evil Mister Fred laughing, "Mwah-ha-ha!" With all his gold, Evil Mister Fred called the Acme Store of Everything, and he ordered steel armor for his minions. He didn't need to put helmets on their heads because they're already really hard. And with armor on, now they could use real weapons. Before, if you gave a minion a sword, he'd just go stick the other minion, and Evil Mister Fred would have to glue him back together again. Now they've got armor, so they can use swords, and they can go fweew! fweew! -- they can hack at each other, and it's okay if they cut a few pieces off them. He can always glue those back on again.


Minions with armor.

Now he has an invincible army. And Jack and Jill came along, saw Evil Mister Fred and his army, and said, "Uh-oh. This is bad. How are we ever going to stop him?"

If you were Jack and Jill, what would you do to stop the Evil Mister Fred?

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: "*Blowing Glass*"

Well, for our experiment we're going to be using fire. If you have long baggy sleeves, you might want to roll them up. If you have long hair that tends to fall in front of your face, you might want to tie it back.

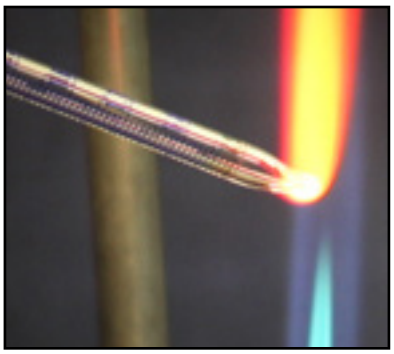
Propane torch duct-taped to lab stand, with sand and water in aluminum pan.

[Each group gets an aluminum roasting pan with about a half-inch of sand in the bottom, a propane torch, a lab stand base and metal rod, and a plastic cup. Students assemble the lab stand, place it in the pan, and duct-tape the torch to it. They fill the cup with water and place it in the pan. When this video was shot, a previous class had already assembled the equipment.]

We're going to be using these setups. Lucky for you guys, the last class set them all up, so you don't have to do it. See, we have here your container of water to use as your fire extinguisher; propane torch. You'll find there are pieces of glass in there that are already sitting in there. You can ignore them or use them, whatever you like. There are little tiny pieces of glass in there probably as well. You can pick them up, squeeze them in your fingers. If you start to bleed, you can do the ooh-aah-ooh-aah dance. There are bandaids over there.

Every time I do this experiment, somebody screams really loud, jumps up and down, does the ooh-aah-ooh-aah dance, and runs off to the bathroom, and then you hear water running. And you say to yourself, "Uh-oh. I wonder what they did." Well, you're going to be heating up glass to the point where it's red-hot. Now, glass, when it's red-hot, is red -- which is cool. So after you do whatever you're going to do with it, you might set it down. And then later you might pick it back up. Glass, after the red goes away, is perfectly clear. And if you pick up the end that you heated, then you do the ooh-aah-ooh-aah dance. Because you can't tell which was the hot end and which was the cool end. So I recommend that you only pick it up by the end that has the little white fluff in there. If you accidentally heat that end, or heat it for whatever reason, the white fluff turns black. Don't pick up black fluff. You'll find out, one way or another.

So I'll show you a couple of things that we can do. You have choices about how you want to do your flame. You could point it at your face. Or you could point it away from you. I recommend pointing it


Ball forms at end of tube.

away from you. *[Lights torch and places end of glass tube in the flame.]* The glass likes to be heated kind of slowly. If you put it in the flame, the glass has this nice orange glow. Even though this is Pyrex, it still does have sodium in it, and the sodium gives it that orange glow.

Now, glass has very high surface tension. What that means is, when it melts, it wants to form a sphere. So now we have Rudolph's nose, right there. It makes a ball, and it seals off the end.


Hot tip shatters in water.

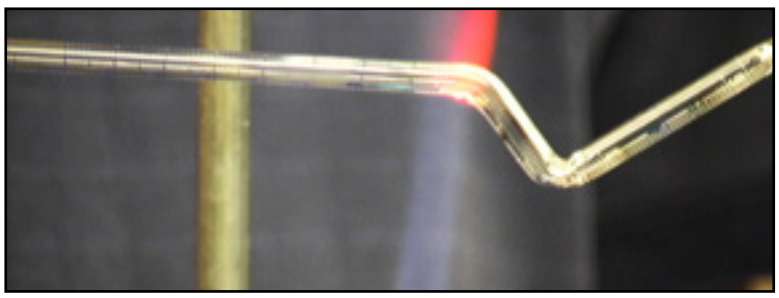
Now, glass, if you heat it up, doesn't usually crack, unless you heat it really fast. But when you cool it, it shrinks. And it cools on the outside first, then the inside shrinks. So if I get it hot and then dip it in the water *[dips end of heated glass rod in glass of water]* -- doink! -- it breaks off.

Now, up until the last class, nobody had ever really scattered hot broken pieces of glass across the entire classroom. And somebody in the last class discovered a way to do that. *[Student: How?]* If you heat it up and get it melted and happen to have some water in there, and then dip it in the water, and then quickly take it out to look at it, then hot shards of glass shatter across the room. Luckily, everybody was wearing their goggles so they didn't get any glass in their eyes.

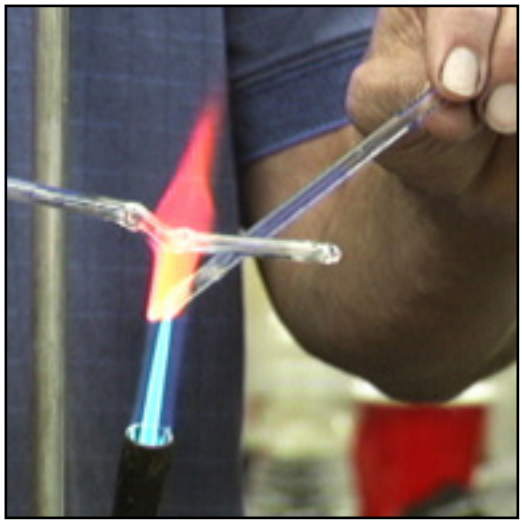
So the first part of the experiment is just to heat the tip, make a ball, and then stick it in the water and see if it breaks off or not. *[Student: What happens if it doesn't?]* That means you waited too long before you stuck it in the water. Then you can make another ball, kind of seal off the end a bit. *[Instructor holds broken end of rod in the flame.]* In the flame, the paint turns white, and it makes kind of a green flame.

Then take some spot on it, and heat any old place you feel like. *[Instructor holds the rod in the flame, a couple of inches from the end.]* It helps if you turn it while you heat. And just let it sag. *[Tube sags, forming a right-angle bend.]* Now you've made a bend. And if you want to have something to take home, don't dip it in the water after each thing you do, because every time you dip it in the water, it breaks off and you end up with a bunch of little pieces in the water. If you want to have something to take home, then you can dip it in the water after each bend.

Now, that part's going to stay hot for a long time. One of the nice things about glass is, it transmits heat very, very slowly. So where my hand is, isn't going to be hot. If I heat another place . . . *[Student: Can you bend it back?]* You can try. It's harder to bend it back. *[Instructor continues heating a second spot on the glass, making another right-angle bend.]*


Making second bend in the tube.

Ever seen them make little creatures out of glass? They take glass like this, and then they shape it into something. This is starting to be an anteater. Now suppose my anteater needs legs. You'll each get two



Heating two tubes.

"Ear" with a ball at the end.

Stretching the second tube to make an "ear."

pieces of glass to work with. Suppose I want this anteater to have, oh, maybe ears, or antennas, or something like that. I'll heat the top of his head and then stick the two together, and then pull slowly. *[Instructor holds a part of the bent tube, and the end of the second tube, in the flame at the same time. Then he touches the end of the second tube to the heated spot on the first one, and slowly pulls the second tube away. The glass stretches into a thin length, then breaks off when it gets really thin.]* Now he's got an ear. And then you can melt it to create a kind of a ball at the end *[holds end of thin "ear" in the flame]*. Now he's got an ear with a goofy end on it. And then you can heat up both of these again. *[Student: Is it important that you pull slowly when you do that?]* Oh, you can pull fast, and you get a little ear like that. I pulled really fast, and now he's got a short ear. You can give him eyes and ears and legs and whatever you feel like.

You're each going to get about two minutes of time, and then you have to let the flame be used by your neighbor. When you're done with your glass, put the hot end down in the sand so nobody picks it up. Don't put any glass on the table; it'll melt the tabletop.

Now some people want to try to blow a bubble. If you want to try to blow a bubble in it, you heat up a section of it. *[Instructor heats up another section of the first tube.]* This glass is really thick, so it's really hard to blow a bubble. If the end is sealed off, you can just . . . This is where, if you have long hair, you don't want to lean into the flame. *[Instructor blows hard into cool end of tube.]* It bubbled out and then it popped. So you can create warts on your creature by blowing bubbles on him. And it actually does burst the bubble, and now he's got a hole in him. The creature can use it to store stuff.

So you're going to be working with a partner. You'll each have two rods of glass. It's better if you work one at a time, so you'll have about two minutes, and then you'll switch places. If you want to, you can work both together in the same flame. I usually hear comments like, "No! Awww, look what you did!" when people work together. If you like to do things like that, you can do that.

You need to wear goggles, and you need to be standing the whole time. If somebody burns their hand and drops their glass, you don't want to be sitting. *[Students push chairs back and stand at table.]*

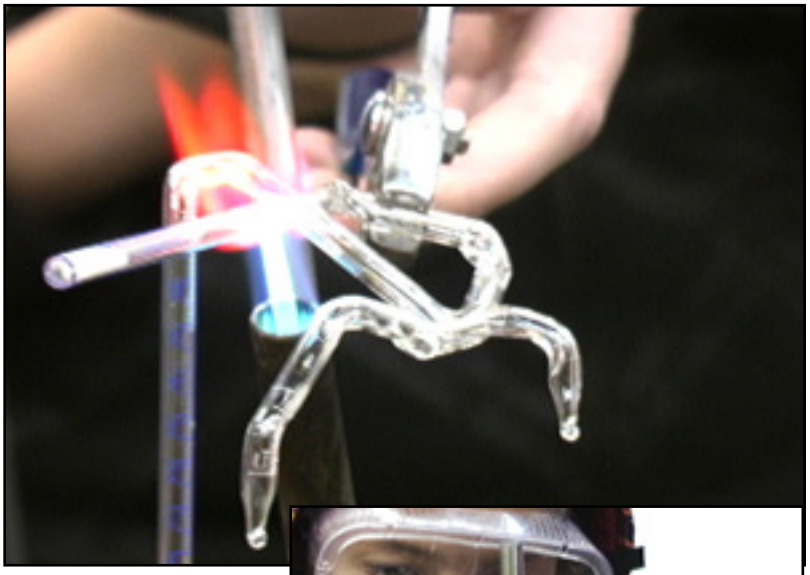
Choose someone to work with, and then come and get one of these tubs, and try to get it to your table without dropping it on the floor. The aluminum foil pans are weak.

[Students get into groups of two or three and get their tubs containing sand, a propane torch, and a glass of water. They also put on goggles. Instructor passes out two Pyrex pipettes to each student.]

At some point, I'm going to give you pliers. Get your glass red-hot and squish a part of it and see what happens. *[Instructor passes out pliers, one to each group.]*

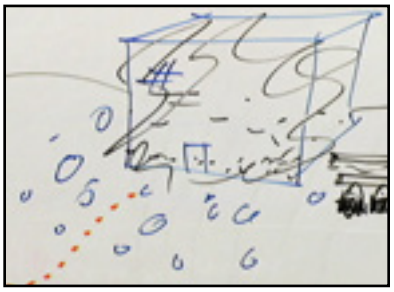
During the time of the experiment, if I see you without your goggles on your eyes, you'll have to sit in the back. Because you never know, if somebody accidentally lets one fly, you don't want glass in your eye. *[Instructor passes out a few barbeque lighters.]* Here's a lighter. Once you get yours lit, you can share the lighter with your neighbors. So you can light your torches.

First, melt the tip and try to make a ball. *[Students practicing heating the glass, then try the various techniques demonstrated by the Instructor. Some use pliers to hold the rod when making bends in it. At the end of the experiment, students put their trays back on the cart. They can take home their pieces of glass if they want. Instructor collects lighters and pliers.]*



End of Story

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

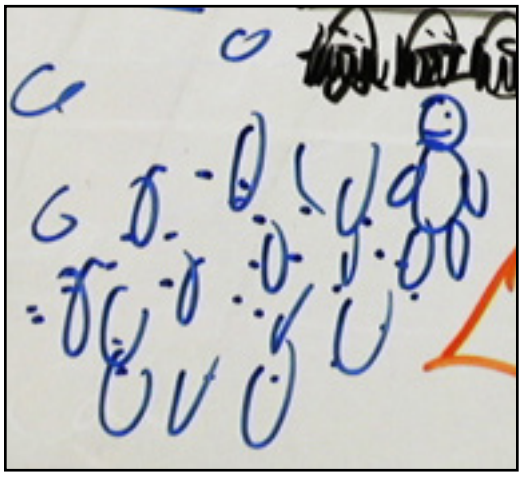


Broken glass around palace.

Where were Jack and Jill when we left them? *[Student: They were traveling with Flame Man and the fairy, and they saw the crystal palace that was destroyed.]* And they said, "Oh, no, look at this place. It's a mess." Then they turned and they saw Evil Mister Fred, who had put armor on all his minions. And he gave them steel-plated baseball bats. An invincible army. And swords. And anything else they wanted. And Evil Mister Fred was on top of his castle saying, "Mwah-ha-ha!"

And Jack and Jill said, "All right, Flame Man. You want to just go burn Evil Mister Fred up?" And Flame Man said, "Well, I could, but that would be too easy. Let's try something different." He said, "Hey, fairy lady! See that broken castle with all the glass on the ground? Can you make the glass become alive?" And the fairy lady said, "Well, I don't know. My powers aren't as great as they used to be, but I'll give it a try."

Green sparks from fairy's wand hit a glass fragment, and it turns into a glass person.



Fragments from the broken glass person turned into a million glass people.

So she cast a spell: "Eeny-meeny-chili-beany-turn-alive!" Bwooossshhh! And all these lime green sparks shot out and hit one piece of glass. And the piece of glass started to wiggle and shake. And then it stood up and it grew arms and legs and became a glass person. And she said, "Whoa, I did it! Yay!" So now there's a glass person. And Jack and Jill said, "Well, that doesn't look like a very good army person. One hit, and he's going to break into a million pieces." The fairy said, "Oh, give it a chance." So they said, "Okay, glass person, go fight against the minions."

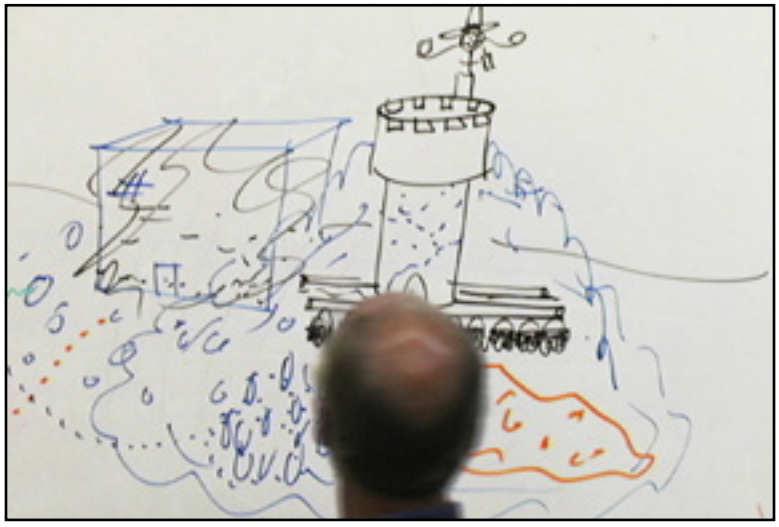
So he wandered over there. The minions looked at him and said, "Whoa, you can see through this guy. Cool!" And one minion went whack! -- and his arm broke and fell off. Another minion said, "Neat!" And went whoosh! -- both legs broke into pieces. And then the rest of them attacked him like sharks in a feeding frenzy. And they beat him all into dust.

Well, the minions ran away cheering, but all of the pieces of the glass man started to grow and wiggle. And each of them turned into their own glass man. So now there's thousands and thousands of glass men forming right before their very eyes.

And the minions, they're not being discouraged. They said, "All right, more fun!" So they ran over there and started banging on those guys. And each one of those guys turned into a thousand new guys. So now you've got a million glass men. And the minions are way outnumbered. And the glass men say,

"Friend! Friend!" as they're chasing the minions around. And all of the glass men wanted to hug the minions. And before long, all these minions are with this huge pile of glass men all around them. And the minions are saying, "No! Let me go! Leave me alone! Stop it! Don't do that!"

And Evil Mister Fred is now surrounded by an army of overly-friendly glass men. And Evil Mister Fred said, "Noooooooo!" *[Then the Flame Man melted the outside of the glass so it became solid.]* And all they saw was a huge pile of glass with screams inside. And they all lived happily ever after, except Evil Mister Fred.



Evil Mister Fred and minions ovewhelmed by glass people.

End of Lesson

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