



Teacher's Guide for:
Melting Plastics

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.

Contents:

Quick Reference Sheets:

- Intro:page 2
- Experiment: *Melting Plastics*page 3
- Equipment List: *Melting Plastics*page 4
- Story, Part 1: *Jack & Jill in the Land of the Giants*page 5
- Story, Ending.page 7

Video Transcript:

- Intro:page 8
- Story, Part 1 : *Jack & Jill in the Land of the Giants*page 10
- Experiment: *Melting Plastics*page 13
- Story Endingpage 15

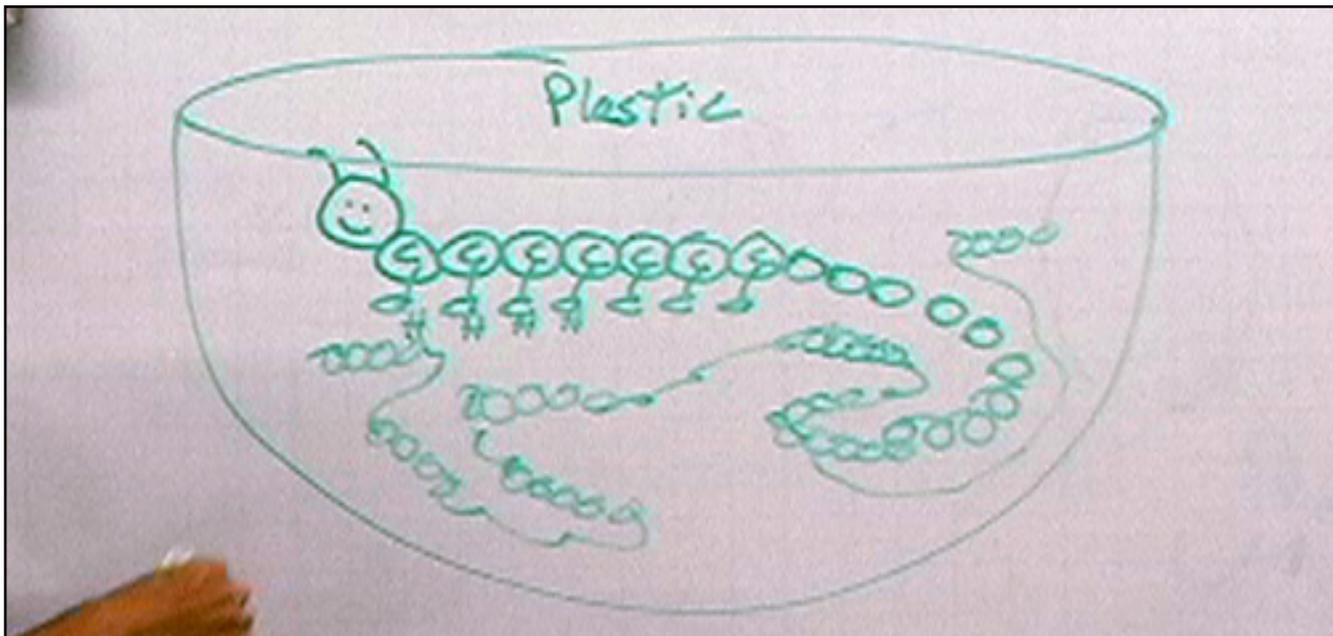
Title Page of Video

Melting Plastics
A Rock-it Science Lesson
Filmed June, 2013

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Intro Quick Recap:



- Suppose somebody put a bunch of caterpillars in a bowl, then put the bowl in the oven at a thousand degrees to cook them for dinner.
- To get to a thousand degrees, you have to seal the oven really tight, and the pressure gets higher and higher.
- This makes the caterpillars all come together into one long caterpillar.
- When the guy takes out the bowl and pulls on the caterpillars with his chopsticks, it comes out as one huge caterpillar.
- The caterpillar is angry at the guy who put the caterpillars in the oven so he could eat them.
- The caterpillar wraps himself around the guy, squeezes him like a python, and eats him.
- The caterpillars represent plastic. The body parts are carbon atoms (write "C" on each body part), and the tennis shoes are hydrogens (write "H" on each shoe).
- Before it became plastic, it could have been something like oil, or a gas like ethylene. You put them under pressure and temperature, and they squeeze together, and you end up with a long caterpillar-like thing.
- You could end up with a ziplock bag, which is polyethelene. "Poly" means "many" and ethylene is a kind of chemical. There are many ethylenes all stuck together.
- Other plastics are polystyrenes, which is styrenes stuck together.
- In the experiment, we're going to heat up different kinds of plastic to see what they do.
- Point out various objects in the classroom and ask students if they're plastic.
- Some clothes are plastic because some yarn is made from acrylic resin.

Experiment Quick Recap: "Melting Plastics"

- Lab stands are set up around the room, with hot air guns held in the lab stands, pointing down.
- Show students how to turn the air guns on and off, and tell them to keep the guns on level ONE so they don't get too hot. [At Rock-it Science, if the guns are turned up too high, it will trip the circuit-breaker and all the guns will stop.]
- Warn students that the silver tip gets very, very hot.
- When things start melting, keep them over the aluminum tray so they don't get on the table or on students' clothes or shoes.
- Sometimes objects will be hotter than they appear. If you touch it, you may not realize how hot it is right away because it takes time for the pain message to reach your brain.
- Before touching something, hold it with the pliers, wave it around, and blow on it to help it cool down. Then give it a quick touch to see if it's still hot before grabbing it.
- Have students work in groups of two or three and take turns using the hot air gun.
- Remind students not to pick up the hot air gun. Leave it in the lab stand and hold the plastic item under it.
- Have students try to turn on the gun to make sure it works and that they have it on the right setting.
- Instructor passes out a piece of acrylic yarn to each student and they take turns trying to melt it.
- Then the instructor passes out other kinds of plastic, one type at a time, and students try to melt them.
- After melting three or four kinds of plastic, the students are given a piece of wire to string plastic beads on. One end of the wire is bent so the beads don't slip off. After they string their beads, the students can ask the Instructor to bend the other end [optional].
- Students try to melt their strings of beads and see if they weld together.
- Then the Instructor gives each student a ziplock bag to melt, then a plastic cup.
- At the end of the experiment, students can take their melted pieces home in a ziplock bag if they want to keep them.



Equipment List: "Melting Plastics"

Items needed for Instructor:

- None

Items needed for Students:

Consumables:

- Wire, steel, 12-gauge, about 1 ft, 1 piece per student
- Yarn, acrylic, about 1 ft per student
- Ziplock bag, 1-qt size, 2 per student
- Cup, plastic, 16-oz
- Various types of plastic, such as styrofoam trays, plastic tubing, and clear plastic takeout containers.
- Assorted plastic beads, about 1 dozen per student.

Other (per student):

- Lab stands with ring to hold air gun, one stand per 2-3 students.
- Hot air guns, one per lab station.
- Aluminum roasting pans, one per station.
- Pliers, 1 per station.

Prep Work:

- Cut 12-gauge steel wire into 1-foot lengths. Bend up one end of the wire.
- Cut plastic trays, tubes, etc. into convenient sizes for melting.



Hot air gun, lab stand, aluminum pan.



Beads on wire, pliers..

Story Recap: "Jack & Jill in the Land of the Giants"



Part 1:

- A guy named Gulliver was in a shipwreck and was left floating on the ocean in a bathtub until he came to the land of the giants.
- He met a baby there and climbed onto its head. When the baby's parents came to pick it up, Gulliver was so tiny they didn't notice him clinging onto the baby's hair.
- They took him to their house in the giant city where they had a pet cog (combination cat and dog). Gulliver jumped off the baby onto the cog.
- Jack and Jill were already on the cog, but they didn't know how they got there. There were lots of giant fleas on the cog, so Jack, Jill, and Gulliver had to defend themselves against the fleas.
- They looked outside and saw a small black cloud with a mustache and with oars sticking out of it -- Evil Mister Fred's cloud. They could hear him laughing about how he had somehow sent Jack and Jill to this place.
- Jack and Jill needed to find a way to make themselves big so they wouldn't get eaten or squashed. They jumped off the cog and into a hole in the floor.
- They fell down a long way and landed on a carpet in a hallway. There was a tiny door just their size, next to a table with two cookies.
- Jill ate half of one of the cookies, and she grew bigger and bigger until she went up through the hole and came out huge, like the giants.

Story Recap (cont.): “*Jack & Jill in the Land of the Giants*”

- Jack ate half of his cookie, but he started shrinking. Then he had to climb up the table leg to get the other half of Jill's cookie. He ate it and became huge like Jill.
 - Now Evil Mister Fred was ordinary size, but Jack and Jill were giants. They could have easily reached out and crushed his cloud. Instead, they started blowing the cloud back and forth between them for fun.
 - Evil Mister Fred called the Acme Store of Everything and ordered a really, really hot sun.
 - The hot sun made Jack and Jill start to shrink. All the giant buildings were also shrinking.
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Story Recap (cont.): "Jack & Jill in the Land of the Giants"



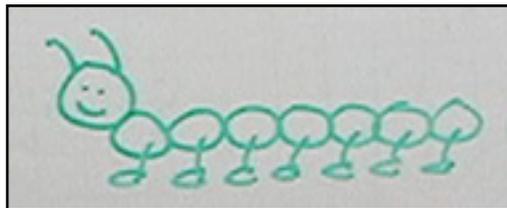
Ending:

- Jack and Jill were shrinking and getting soft (like the plastic beads), and they were afraid they'd get stuck together.
- They called the Acme Store of Everything and ordered rain clouds.
- In the giants' world, the rain clouds come down very low and rain upwards. So the rain was cooling off Jack and Jill and everything else in the giants' land, but it didn't reach high enough to cool off Evil Mister Fred.
- Evil Mister Fred started shrinking, and Jack and Jill decided to help him out.
- They got squirt guns and started squirting Evil Mister Fred to cool him off. But they squirted him a little too hard, and he fell off the cloud and landed on the cog.
- A giant flea saw him and sucked him up.
- Final instructions to students after the story: Don't try to melt plastic at home in the oven, because it will drip all over the elements in the oven and start a fire.

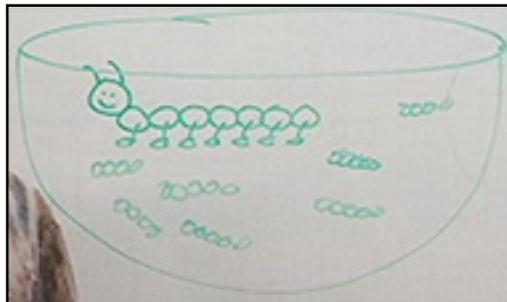
Transcript: Intro

There you go -- what's that? *[Students: A caterpillar.]* Yep! Caterpillar. And the caterpillar represents something that is used every day. If you take a whole bunch of caterpillars and put them in a great big bowl -- imagine a bunch of other caterpillars in there -- and the caterpillars are wiggling around in the bowl. And then somebody says, "Oh, look -- a bowl of caterpillars! Let's throw them in the oven and cook them up."

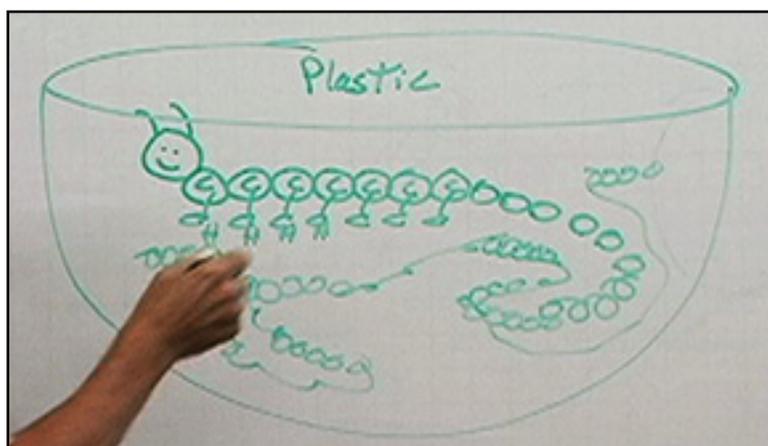
So they put the whole bowl in the oven, and they turned on the temperature. They turned it up to a thousand degrees. And in order to get a thousand degrees, you have to seal your oven really tight, and the pressure gets higher and higher and higher. And they think they're going to cook all those caterpillars and then eat them. But you know what the caterpillars do? They all combine together to create one huge long caterpillar. They're all attached.



Caterpillar



Caterpillars in bowl



Caterpillars joined together. C = Carbon, H = Hydrogen

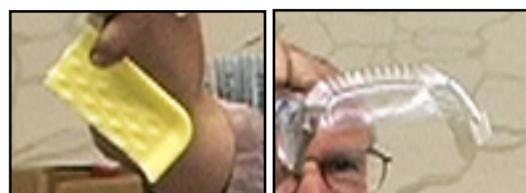
And then the guy takes out the bowl. And instead of having a whole bunch of caterpillars in there, he pulls on it with chopsticks and out comes this one huge caterpillar. And the caterpillar says, "Why did you put me in that oven?" And the guy says, "I was going to have you for lunch." And the caterpillar says, "I don't think so!" and wraps himself around the guy and squeezes him like a python, and the caterpillar eats the guy.

Well, these caterpillars represent plastic.

There are all kinds of things. The body parts are carbon atoms *[writes "C" on each body part]*. The tennis shoes are hydrogens *[writes "H" on each shoe]*. And before it's plastic, you could have something like oil, you could have a gas like ethylene. And you put it under pressure and temperature, and they squeeze together to become a real long caterpillar kind of thing. And you end up with stuff like plastic, oh, like a ziplock bag *[holds one up]*. They call this polyethylene. "Poly" means "many" and ethylene is a kind of chemical. There's many ethylenes all stuck together.

Well, these caterpillars represent plastic.

There are all kinds of things. The body



This one's polystyrene, which is styrenes stuck together. Believe it or not, that's also a polystyrene. Doesn't look like it. Then there's other kinds.

Polystyrenes

Have you ever seen these kinds of beads? They're kind of bouncy -- boing, boing, boing, boing, boing.

Well, today, we're going to be taking different kinds of plastics and we're going to heat them up and see if they do anything good. Is this plastic [*holds up a piece of wire*]? [*Students: No.*] No. Metal. Okay. The rest of this stuff looks like plastic. Is there anything at your table that's plastic? Yes, the tabletop is plastic. And that chair's plastic.

Some of your clothes are plastic, because -- There are some kinds of yarn that are made out of cotton, and cotton isn't plastic. But I think this yarn is made out of acrylic resin. If it's really plastic, when we heat it up it'll melt. If it's not plastic, it won't melt. We'll find out by testing it. But first, we need a crazy story.



Acrylic yarn.

Story: "Jack & Jill in the Land of the Giants"

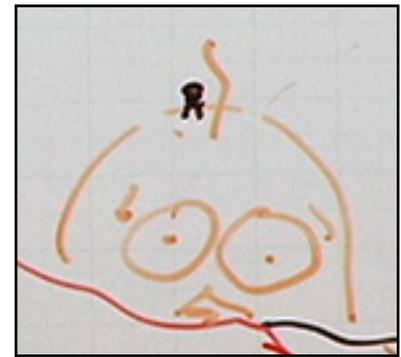
Let's see, once upon a time Evil Mister Fred had heard about a guy named Gulliver. Have you ever heard about a guy named Gulliver? Gulliver liked to travel from place to place. And he found fantastic things. Should we send Gulliver to the land of the giants or to the land of the midgets? *[Students: Giants!]* Giants, okay.



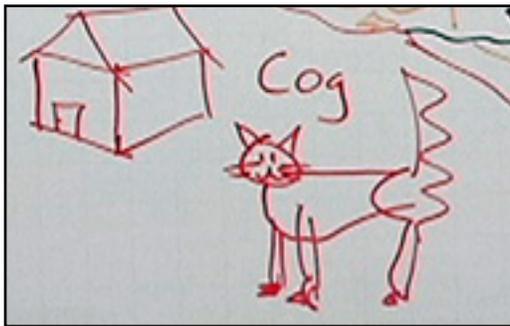
Gulliver in bathtub.

So Gulliver was in a shipwreck, and he was left floating across the ocean in a bathtub. There he is. He's lost at sea for months and months, and there's the sea. And he ended up coming to the land -- what should you call the land of giants? *[Student suggests "Artime."]*

So he ended up in the land of Artime. And when he got there, he met a baby, an orange baby. Let's make this the beach. And -- do babies have hair? *[Student: One hair.]* Oh, only one hair. There's a baby, like that. And he said, "Whoa, huge baby!" And he ran over to see what the baby was doing. He climbed on top of the baby's head, and he's about this tall on top of the baby. Well then, pretty soon the parents came to take the baby away. And they didn't even notice him. He was so small, he had to hang onto the one hair so he didn't fall off. He looked just like a little speck of sand on top of the baby.



Gulliver on baby's head..



And they took him over to their city. And their city had huge buildings in it -- sports coliseums, hotels, everything that we're used to seeing, but only a hundred times bigger. And the giants were all running around, and Gulliver had to watch out what he was doing. And let's say they took him to their house. Ordinary house, doors forty feet high. And he's just lost in the whole place. And they had a pet -- dog or a cat? *[Students: Cat! Dog!]* Okay, it's a pet cog. It had the head of a cat and the body of a dog. There. There's a cog.

And he thought, "Well, that'll be a safe place to stay." He'd jump onto the cog. And he jumped off the baby's head, landed on the cog, and what did he find? Jack and Jill were already there.

He said, "Whoa! More people! How'd you guys get here?" And Jack and Jill said, "I don't know. We just woke up one morning, and here we were." *[Draws Jill's hair.]* There's Jill hair, going on forever.

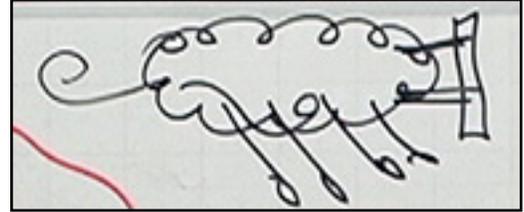
And they had to be very careful because on the cog, do you know what's on cogs? Fleas! There's giant fleas. And if a giant flea ate Jack or Jill, sucked the blood out of them, they'd die from loss of blood. And these fleas are hopping all over the place, and Jack and Jill have to defend themselves against the fleas. And they said, "Wow, this is just fantastic. A huge place of giants, all this stuff. How did you get here?" And he said,



Jack, Jill, and a giant flea on the cog.

“Well, I was in a shipwreck, and that’s how I ended up here.” And Jack and Jill said, “We don’t know how we got here. We were at our house, we woke up in the morning, walked outside, and poof! -- all of a sudden we’re here.”

And then they looked up in the sky, and what did they see? One little black cloud. And the cloud had a mustache, and it had oars coming out of it. It was Evil Mister Fred. And they heard some sounds coming out of the cloud. “Mwa-ha-ha! I’ve got ‘em now!” And Jack and Jill realized that somehow Evil Mister Fred had sent them to this giant land. And they thought, “Whoa, we’ve got to do something here. This place, we’re going to die. If we don’t get eaten by fleas, we’re going to get squished, stepped on, or put down the drain. Maybe the cog will eat us.” And Jill said, “Hunh! Look at these people. They live just like we do, but in a big, big, big, big world. Somehow we’ve got to make ourselves big.”



Evil Mister Fred's cloud.

So they jumped off the cog and they started running around the house. And they found a hole in the floor. And Jack and Jill said, “Well, can’t hurt. Let’s jump down the hole.” So they did. Down they fell, further and further and further down. And they landed on a piece of green carpet. And they came to a hallway. And at the end of the hallway was a little tiny door that was just perfect for their size. And next to the door there was a table, and on the table there were two cookies. And they said, “Huh! Cookies! Just for us, one for you, one for me.”



Hole and hallway.



Tall Jill.

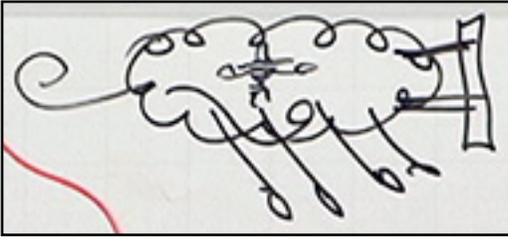
So Jill took one of the cookies and ate half of it. And Jill started to grow bigger and bigger and bigger, until she couldn’t fit in the hallway, and then up through the hole, until she became huge size, just like the giants.

And Jack said, “Yay! Cookies!” And he ate half of his cookie. You know what happened to Jack? Jack shrunk, and he got smaller and smaller and smaller and smaller until he was just a dot. And Jill said, “Jack! Where are you?”

Now, Jill is way up there, so her voice could be very deep. She’d say *[in a deep voice]*, “Jaaaack. Wheere aaare youuuu?” Well, Jack couldn’t even make it out. He says, “Oh, no! I’ve got to have that cookie.” So he had to climb up the side of the table and find Jill’s cookie. Well, now Jill’s cookie is the size of a swimming pool. And Jack has to eat it. So he took one bite and poof! -- he got bigger. Took another bite -- double size. Took another bite -- and then Jack became huge, too. So now Jack and Jill are just like the giants. And they said, “Oh, that poor guy. He doesn’t know about the cookies. Wonder what’s going to happen to him?”



Tall Jack and Jill.



Evil Mister Fred on his cloud.

Now, Evil Mister Fred, he's ordinary size. He looks down and he sees giant Jack and giant Jill. He says, "Uh-oh! This is not good. Jack and Jill could probably reach right up here, grab my cloud, and go scrunch! -- and squish it."

And about that time Jack and Jill looked up, and there was this little tiny cloud floating through the sky. And Jack walked up with his big eye and he looked in the cloud and he said, "Evil

Mister Fred, is that you in there?" And Evil Mister Fred said, "Get away, get away!" And Jack said, "Cool!" And he blew the cloud, and it went pheww! And Jill said, "Jack, what are you doing?" Jack says, "Evil Mister Fred's cloud. See?" And he blew it towards Jill. And Jill said, "Whoa, he's tiny, isn't he? What should we do with him?" And Evil Mister Fred said, "Uh-oh. I've got to do something fast!" So he called the Acme Store of Everything and he said, "Sun! I need a sun, a really big one, a hot one, super hot. Make it fast, please!"



Really hot sun.

And they delivered a really hot sun. And the hot sun came. And Jack and Jill were out in the sunlight, and they started to shrink. And Jack and Jill said, "Uh-oh. Sunlight makes things shrink." The coliseum was shrinking, the houses were shrinking, everything was shrinking smaller and smaller and smaller. If you were Jack and Jill, and you were being shrunk by a really hot sun, what would you do?

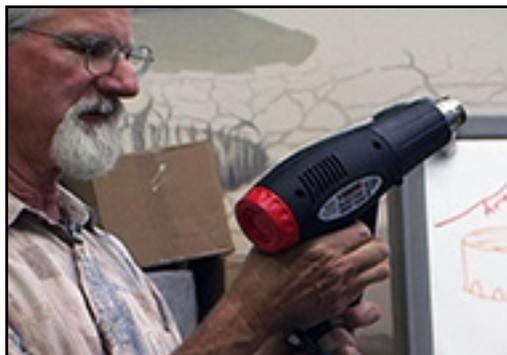
Imagination and Brainstorming Time

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

We'll leave this "To be Continued . . ."

Experiment: "Melting Plastic"

For our experiment, we're going to be using these hot air guns. The hot air gun has a switch on it. I'll bring it around so you can see. It has a switch on it that if you push the bottom, it'll click that way. If you push the top, it'll click to the middle. If you push again, it'll click to the top. Which is kind of neat. We could make it do lots of clicks. We want to use with the number ONE, the low power. You'll tell if you accidentally push number Two. It won't hurt anything, it'll just mean the circuit breaker will turn off and all the guns will stop. So let's leave them on number ONE so that they don't get too hot and break the circuit breaker.



Demonstrate heat settings on hot air gun.

The silver tip gets really, really hot. And everybody in the room will know if you touch it, because you'll scream and do the ooh-aah-ooh-aah dance. There's pliers at each station, and there's a tray. What you're going to be doing is, we'll give you samples of stuff, and you'll take turns holding it under the hot air and see if it changes due to the heat from the hot air gun. During the process, if you have something that's melted, keep it over the aluminum pan. Because we don't care if you get melted stuff in the aluminum pan. It's just hard to scrape off the table. And it's a good idea to keep it from dripping on your toes. Or your fingers.

And everything is going to eventually get hot. And you'll see something that looks really cool, and say, "It doesn't look hot. I wonder if it feels hot." And you'll pick it up. And you'll say, "Oh, it's not hot." That's because it takes awhile for the hotness to get through your skin, through the nerves up to your elbow, up to your shoulder, into your brain. And your brain says, "Aaaaaaahhhh!" But your mouth doesn't yet. Your brain sends the signal down to your mouth, and your mouth says, "Aaaaaaahhhh!" And then your fingers let go, and by then you've burned yourself. Delay between picking up hot stuff and burning yourself. So use the pliers, wave it around, blow on it, give it a quick touch like this to see if it's hot before you really pick it up and hang onto it. Okay?

So you're going to need partners, and there are six stations. There's thirteen people so there'll be one group of three. So go stand by a station, but don't turn on the gun yet. *[Students go to stations.]*

Okay, now try to turn on the gun. See if it'll go on. Leave it on the stand. Don't put it on high, just leave it on low. Okay, if you've already burned yourself, you get extra points.

First thing you're going to try to burn is a piece of what looks like yarn. You take turns. You each get one, and you try to melt it with the heat. Leave the gun in the stand. *[Instructor gives a piece of yarn to each student.]* We want to see what the yarn does. One at a time, you try to melt it or burn it. *[Students hold the yarn under the heat to see what happens.]*



Melting a clump of acrylic yarn.



Melting a piece of polystyrene.

[Instructor repeats this process several times, giving the students other plastic items, one at a time, to melt. Items include pieces of styrofoam trays, plastic tubing, and clear plastic food containers.]

Okay, everybody go over to the table. Leave your guns on. You'll each get one of these *[hands out pieces of wire with one end bent up]*. If you're not at the table, you won't get the thing you need to do the experiment. *[Brings out several containers of plastic beads.]* There's some people here who tend to be too grabby and create a big mess. Only take one or two at a time. Don't grab a whole handful. You're going to thread some beads onto the wire in any pattern that you'd like. And then you'll take it over to your hot air gun and cook them and see if they do anything.



[Students start stringing beads on their wire.] After you've put on all the beads that you want to put on, we'll bend the other end with pliers so they don't fall off. After you get the number of beads that you want on there, go cook it and see if they do

(Left) Stringing beads. (Below) Melting them.



anything. *[Students go to their stations whenever they're ready and start heating the beads.]* With any luck they should all weld together.

If you're done with that, we have a bag for you to melt *[hands out ziplock bags]*.

When you're done with the bags, we have a cup *[hands out plastic cups]*.

[When time is up, Instructor tells students to turn off the guns and gives them each a ziplock bag to put their melted pieces in so they can take them home.] Everybody go and sit where you were before. If you need bags to put your samples in, there are bags here.



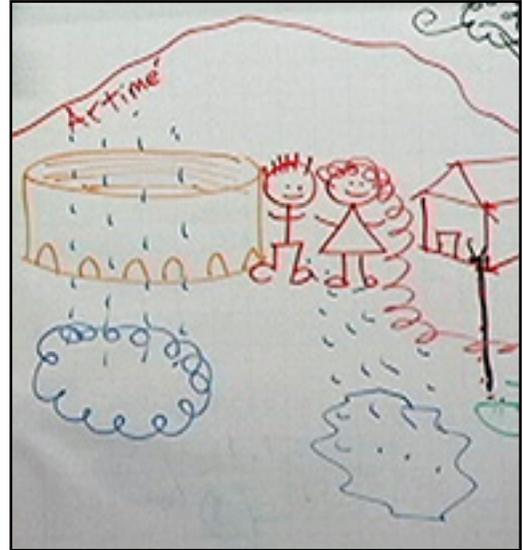
Melting a plastic cup.

End of Story

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

So Jack and Jill are now huge. And Evil Mister Fred is small. But then he ordered a really hot sun. And just like your plastics, Jack and Jill started to shrink, and shrink, and shrink. And they said, "Uh-oh. This can't be good. If we shrink really small, and we're getting soft, we could get stuck together" (like the beads on your wires). And they thought, "What are we going to do?"

And so they called the Acme Store of Everything, and they ordered rain clouds. Well, in this world, rain clouds come down at this level and they rain upwards. So the rain started falling upwards. More rain clouds. And it was cooling off Jack and Jill, and they stopped shrinking. But Evil Mister Fred is way up high in the air, and he's close to the sun that he ordered. Now Evil Mister Fred starts shrinking smaller, and smaller, and smaller. And Jack and Jill looked up and they said, "Aw, look at Evil Mister Fred! He's getting tiny. Should we help him out? He's going to die if we don't do something." So they got squirt guns. They said, "Don't worry, Evil Mister Fred. We'll help you."



Clouds raining upward.



Jack and Jill with squirtguns.

And they squirted water at Evil Mister Fred to cool him off. And Evil Mister Fred said, "Oh, thanks, water -- ptooo, right in the face! Just what I always wanted." And they accidentally hit Evil Mister Fred with a little too much water, he got really shrunk, and he fell through the sky -- "Aaaaaaahhhh!" -- right off his cloud, and landed on the back of the cog. And a flea saw him. And the flea said, "Huh! Wonder what that is," and hopped over and sucked him up. And they all lived happily every after, except Evil Mister Fred.

If you want to melt plastics at home, you'd better do it with a lot of care, because if you put something like this in your oven, it will melt and drip onto the elements in your oven, catch on fire, and the fire department will come and say, "Did you do that?" And you'll say, "Oops! Sorrrrry!" So don't put it in your oven. If you have a hot air gun, that's the way to go.

End of Lesson

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