Teacher's Guide for:

Launching Film Cans

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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Launching Film Cans
A Rock-it Science Lesson
Filmed June, 2013

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Intro Quick Recap:

- There are lots of ways to make carbon dioxide gas.
- We're going to try four different ways to make it, and see if we can blow the lid off something.

Experiment Quick Recap: *"Launching Film Cans"*

Part 1: Vinegar and Baking Soda


Small bottle goes into film can.

- Students wear eye protection.
- Explain to students that they're going to receive a small plastic cup (film can), a smaller plastic bottle, and a lid for the can.
- They will put a small amount of baking soda in one of their containers and a small amount of vinegar in the other (doesn't matter which one), then put the lid on and shake it to see if the lid pops off.
- Caution students to hold the container pointing upwards while they're shaking it so the lid doesn't hit anyone when it pops off.
- Instructors set out large clear cups of vinegar, cups of baking soda, and tubs of water on the tables. Each cup of baking soda has the handle of a cut-off plastic spoon to use for a scooper.
- Give each student a film can, a lid, a small plastic bottle, and a plastic syringe (for the vinegar).
- The lids fit very tightly, so if they don't pop off, it may be necessary to use pliers to pry them off in order to try again.
- If the lid does pop off, the student retrieves the lid, rinses it off in the water tub, and tries again.
- Students try various combinations of baking soda and vinegar in different containers and different amounts, to see which works the best.
- At the end of this segment, students rinse off their containers and lids so they're clean for the next segment.
- Instructors collect the cups of vinegar and baking soda.


Press the lid on tight.

Part 2: Alka-Seltzer and Water

- For this segment, students use the film cans and lids, but not the small bottle.
- Students fill their film cans about half-full with water, the Instructor gives them an Alka-Seltzer, they drop it in, and put the lid on. No need to shake it.

Part 3: Baking Powder and Water

- Students decide how they want to combine the chemicals. They can start with some water in their film can and the Instructor will add a blob of baking powder. Then they need to put the lid on quickly.
- Another way is for the Instructor to put some baking powder in the film can, and then the students puts water in the small bottle and places it in the film can before putting on the lid.
- After putting the lid, students shake the container to mix the chemicals.
- Students will discover that this combination of chemicals doesn't produce enough carbon dioxide gas to blow off the lid. It just fizzes.

Part 4: Dry Ice and Water

- Caution students about dry ice safety.
- Dry ice is one hundred degrees below zero. If you touch it for ten seconds, you'll get frostbite.
- It's okay to touch it quickly for a second or two.
- Students use the film can and lid, but not the small bottle.
- Students fill their film can about half-full with water.
- Instructor drops a small piece of dry ice into the container and the student puts the lid on. No need to shake; just set it on the table and wait.
- Students can use the same piece of dry ice multiple times, as long as they add more water.
- After popping the lids a few times, students can turn the container upside on the table and see if it will blow the can off.
- At the end of the experiment, have students put all plastic items and dry ice pieces into the water tubs, and the Instructor will collect them.
- Then give students towels and have them dry off the tables.

Equipment List: "Launching Film Cans"

Items needed for Instructor:

- Cups, clear plastic, 16-oz, for chemicals (2 cups per 2-3 students)
- Plastic spoons with the bowl cut off (1 per cup of baking soda)
- Plastic tubs, about 1-gal size (1 per 4-6 students)
- Plastic tub, 1-qt size, for dry ice pieces
- Pliers (1 per 4-6 students)
- Towels, terrycloth, large (2 per table)

Prep Work:

- Buy dry ice
- Break dry ice into small pieces
- Put baking soda, baking powder, and vinegar into cups
- Put water into plastic tubs

Items needed for Students:

Consumables:

- Baking soda (about 1 tablespoon per student)
- Baking Powder (about 1 tablespoon per student)
- Vinegar (about 1 tablespoon per student)
- Dry ice (about 1/2-inch cube per student)

Other (per 2 students):

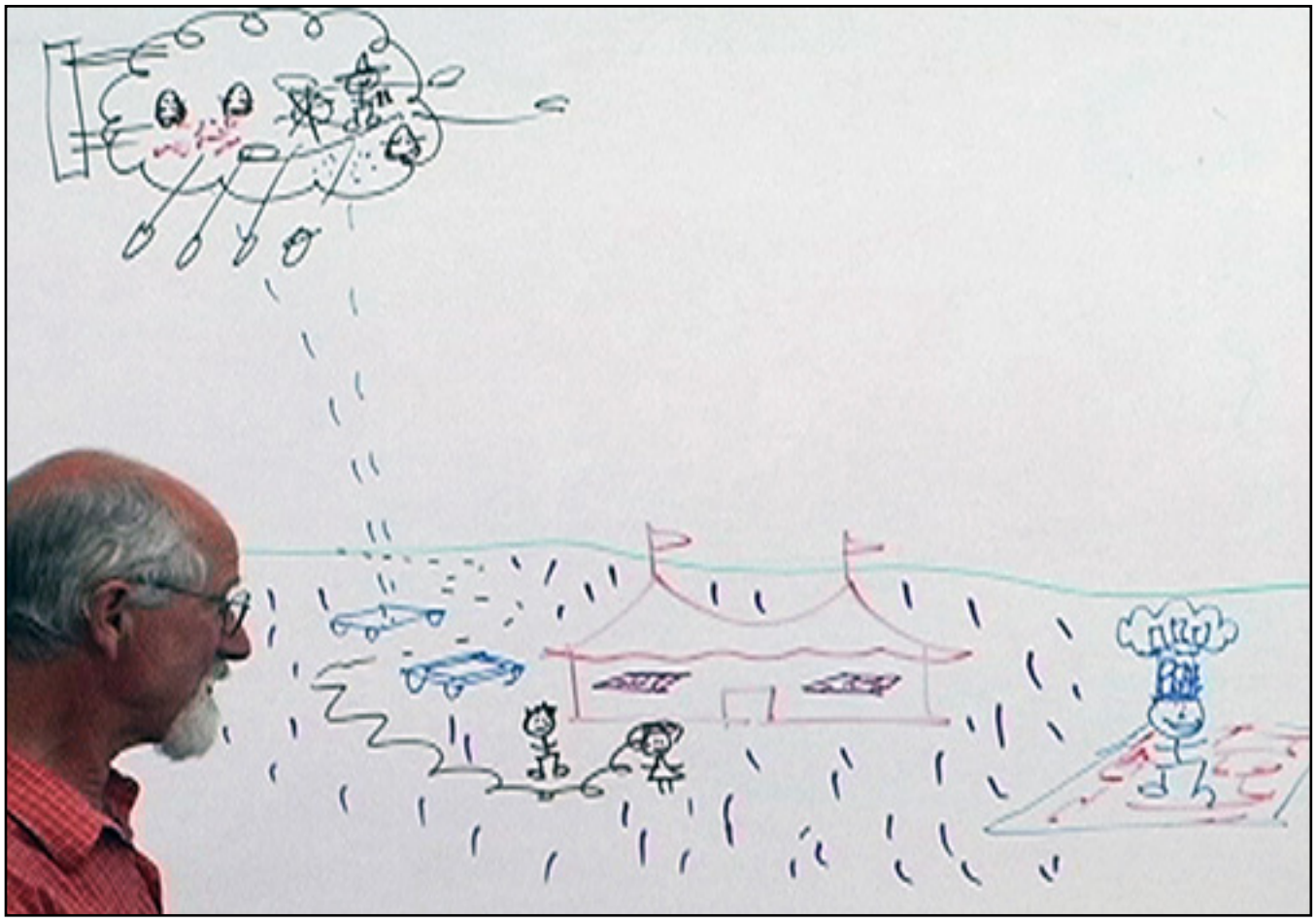
- Plastic film can
- Film can lid
- Small plastic bottle that will fit inside film can, with room to shake around.
- Plastic syringe
- Goggles

Plastic film can, lid, plastic syringe, clear cups for baking soda and vinegar, plastic tubs for water.

These tiny bottles were donated to us as manufacturing castoffs. You can use any kind of similar plastic container that fits inside the film can with enough clearance to let the contents mix when shaken.

Instructor's plastic tub containing small chunks of dry ice.

Story Recap: *"Evil Mister Fred Attacks the Food Festival"*



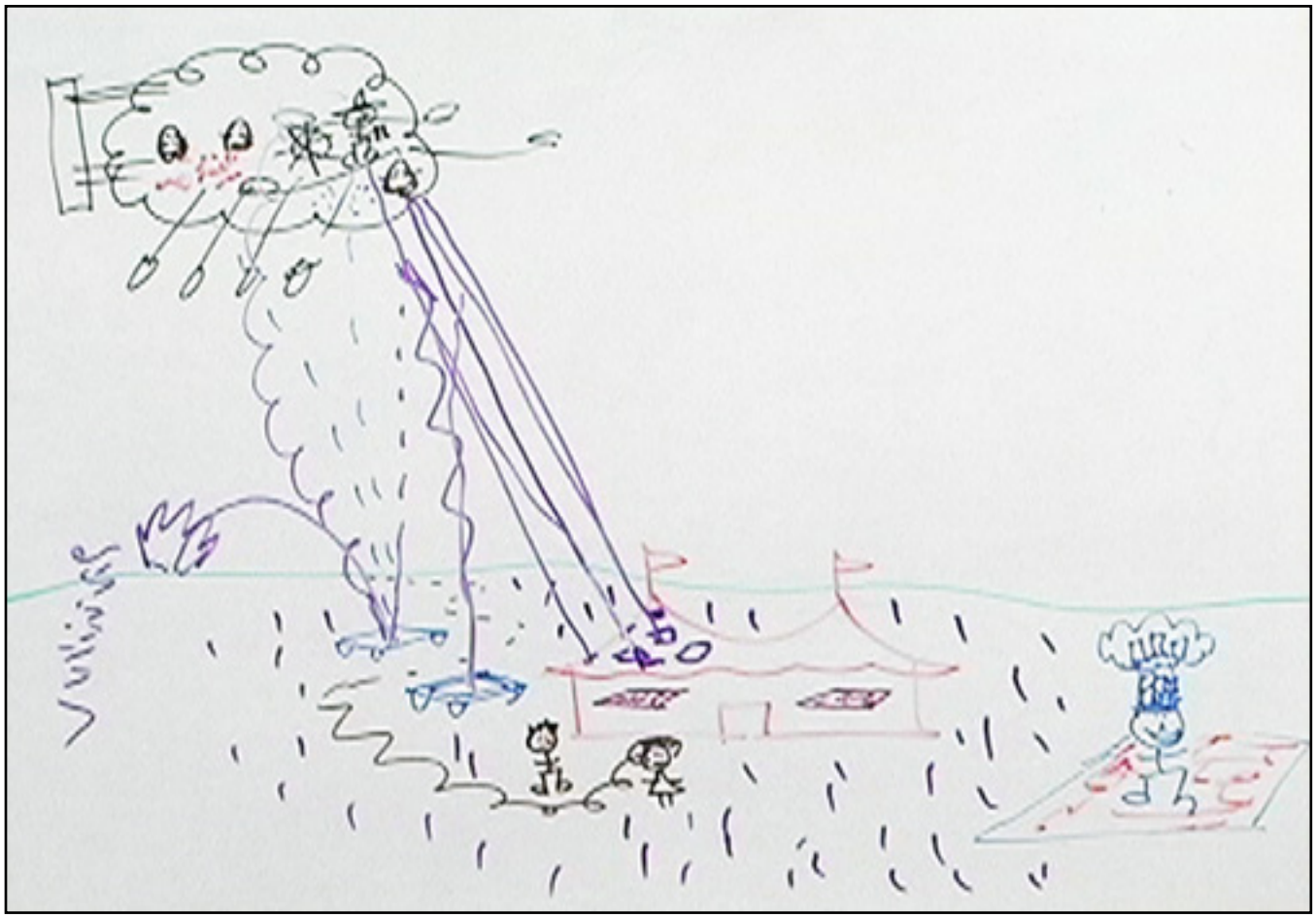
Part 1:

- There was a Great Food Festival where chefs would come from all over the world to a big field, set up circus tents, and cook food for people for free.
- You had to have an invitation to attend the Great Food Festival, and Evil Mister Fred wasn't invited.
- Evil Mister Fred was hovering overhead on his flying cloud. He brought some rotten tomatoes and eggs to throw down at the people.
- Jack and Jill knew Evil Mister Fred would try to spoil the festival. So they had ordered instant trampolines. When they turned the sprinklers on, the trampolines would spring up out of the ground in an instant.
- When Evil Mister Fred and his minons stated throwing things, they turned on the sprinklers, the trampolines appeared, and the tomatoes and eggs bounced back up and hit Evil Mister Fred.
- Evil Mister Fred took his cloud away and called the Acme Store of Everything. He ordered some ground heaters and had them secretly delivered to the ground underneath the tents where the chefs were cooking.

Story Recap (cont.): *"Evil Mister Fred Attacks the Food Festival"*

- He also ordered some bullet-proof chef's hats and gave them away to all the chefs, who thought this was great.
- Since the chefs were so busy cooking, they didn't have time to run back and forth to the cupboard to get ingredients, so they kept a lot of things inside their hats. They had things like ketchup, mustard, mayonnaise, baking soda, gravy, butter, etc.
- The chefs put their new hats on with their ingredients inside and started cooking and sweating.
- Evil Mister Fred had put a chemical on the hatbands that would turn into glue when it got wet from the sweat.
- When the chefs tried to reach inside their hats to get their ingredients, they couldn't get the hat off.
- After awhile, the food stopped coming because the chefs ran out of food and couldn't get into their hats.
- Then Evil Mister Fred turned on the ground heaters and the floor started to get hot. The chefs started jumping around because their feet were getting hot.

Story Recap (cont.): *"Evil Mister Fred Attacks the Food Festival"*



Ending:

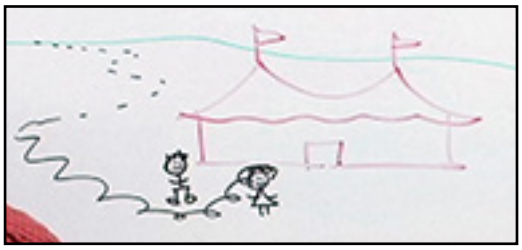
- The chefs are jumping up and down because the floor is getting hot.
- This is making the jars inside their hats bounce around so they break.
- Some of those foods in the jars contain vinegar, and now they're combining with the baking soda.
- The force of the gas made the heavy bullet-proof hats pop off the top of the chefs' heads.
- The hats shot up, breaking through the top of the tent, and hit Evil Mister Fred in the stomach.
- It knocked him off his cloud, and he hit a trampoline. This bounced him back up where he was hit by more hats.
- This continued until he finally bounced over the horizon and ended in an explosion.

Transcript: Intro

So there's lot's of ways to make carbon dioxide gas. And we want to trap it in something and blow the lid off, because it's fun to do. So in our experiment, we're going to try four different ways to make carbon dioxide gas and blow the lid off something. But first, we need a crazy story.

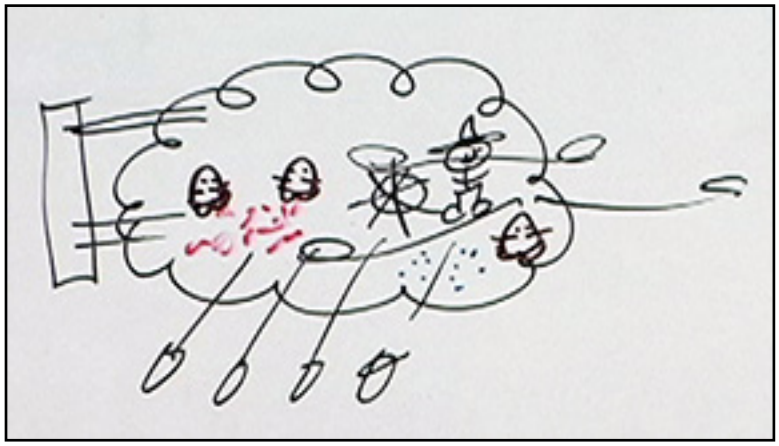
Story: *"Evil Mister Fred Attacks the Food Festival"*

Once upon a time, there was the Great Food Festival. Every year, people came from all over the world to this big open field. They put up giant circus tents, table, kitchens, they had cooks from everywhere come, so that people could taste food from all over the world. There's a nice tent. And it was free, which was the best part, because you could just go in there and eat and eat and eat all kinds of stuff.



Jack and Jill at the Food Festival tent.

Jack and Jill wanted to taste their food, so they were there. And the chefs were working day and night to make the best food that they could. And you kind of got an invitation. It wasn't free for everybody. You had to have an invitation. But nobody ever invited Evil Mister Fred. Can you imagine that? Not inviting Evil Mister Fred. And he doesn't like to not be invited, because he likes free food.

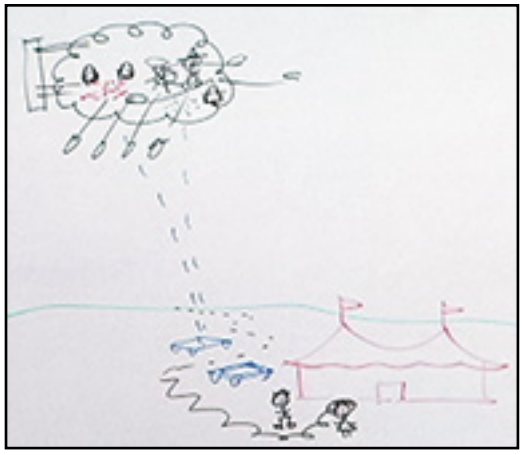


Evil Mister Fred and his minions on his flying cloud.

And Evil Mister Fred was hovering over the place where the festival was going to be in his flying cloud. Got a rudder on it, and it's got a steering wheel, and it's got oars to row it through the sky, and it's got a mustache. And Evil Mister Fred's inside. And his plan is to ruin the festival. So he brought some rotten tomatoes to throw at them, a bunch of eggs to throw at them. There's tomatoes, there. And he brought a bunch of eggs. And his minions would have the opportunity to throw all this stuff down on the people.

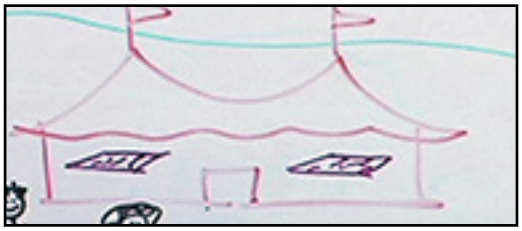
Trampoline

And Jack and Jill kind of had an idea that Evil Mister Fred might try something like this. They thought, "Well, you know, there's going to be all these people, and Evil Mister Fred is certainly going to come, and he's going to try to ruin it." And they had different kinds of plans all set up to take care of Evil Mister Fred. One of the things they had was, they had some instant trampolines. If you turn on the sprinklers around it, the trampolines grow up out of the ground in about one nanosecond. There's trampolines. And when they saw Evil Mister Fred up there, they said, "Yeah, I think he's going to do something bad. Everybody ready?" And they said, "Yup!"


Tomatoes bounced off the trampolines.

And Evil Mister Fred and his minions started throwing down tomatoes, they pushed the sprinkler button on, the sprinklers turned on, and boop, boop, boop, boop, boop, boop, boop -- the trampolines appeared all over the place. And when the tomatoes came down, they'd hit the trampoline and splat! -- they'd hit Evil Mister Fred with his own tomatoes. He got hit with his tomatoes and his eggs and everything that he had. And he said, "Arrrggghhh! Those guys. I'll show them. They can't do that to me. I'm the famous Evil Mister Fred. Arrrghhh!"

So he took his cloud away and he called the Acme Store of Everything. He says, "Acme Store of Everything, I need a ground heater." And they said, "Well, what temperature?" And he says, "Oh, I don't know -- red hot will do." And they said, "Okay, where do you want it delivered?" And he had ground heaters delivered under the ground secretly in the cooking areas wherever food was being prepared. And here's all these ground heaters there. And the cooks were walking back and forth right on top of them and didn't know it.


Ground heaters under the tent.


Chef's hat.

He said, "Now I need some new chef's hats." And they said, "Well, what kind do you want?" He says, "Oh, bullet-proof." And they said, "Okay, we've got lots of bullet-proof chef's hats."

Ever seen a chef hat? Looks weird. Looks like a mushroom. Like if you're a chef and you've got this hat, it's a tall hat. It's all poofy on the top, like that. That's a chef's hat. So Evil Mister Fred gave away free chef's hats to all the chefs. The chefs work in there. Well, the chefs were so busy cooking and everything, they can't leave what they're cooking to go over to the table or the cupboard and pick out the stuff that they need. So their hats hold the ingredients that they need. So they might have some ketchup in there, and some mustard in there, and some baking soda inside the hat. You could just lift up your hat, and in here would be the ketchup and the mustard and the mayonnaise, and gravy, and butter, whatever you need to cook with is right on top of your head.


Chef with food stored inside the hat.

Well, Evil Mister Fred gave them free chef's hats. And all the chefs said, "Wow, what a great hat. I love this hat. This is perfect." But Evil Mister Fred had put a hatband on it that when you started to sweat -- because you're working over a hot stove, and you're working fast to feed all these people -- when you start to sweat, the sweat would mix with the chemicals in the hat band, and it would glue the hat onto your head. So then the chefs would go reach up there and try and get something and err, err, err -- the hat would be stuck on their head. It didn't matter how hard they pulled, that hat was stuck.

Chef standing on ground heater.

Thousands of people at the Festival.

And Evil Mister Fred said, "Then I'll turn on the hot floor, and the chefs will be doing the ooh-aah-ooh-aah dance, because their feet are going to get burned up, because the floor's hot."

Now he'd never tested this before, so he didn't know if it was going to work or not. And now, it's the middle of the day, there's a hundred thousand people there, crowding all over the place, enjoying the good food, listening to music, talking to each other, having a great time. And then Evil Mister Fred noticed that the food stopped. His hats were working. The chefs had run out of stuff, and now the rest of the stuff was glued on top of their heads. And he said, "Yeah! This is great!"

And then he pushed the remote control button, and the floor started to get hot. And now he heard inside the tents, "Ooh-ahh! Ooh-ahh! Stop! Don't do that! Oh, that's terrible!"

Now, if you're Jack and Jill, and you saw what was going on, 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: *"Launching Film Cans"*

Part 1: Vinegar and Baking Soda

Okay, we're going to go over there, and we're going to stand around all the tables, and we're going to give you some small plastic cups with lids that fit on nice and tight. And then we're going to give you another little tiny bottle-looking thing that will fit inside. And then we'll give you some chemicals. And you're going to put some of the chemicals in the cup, some of them in the little tiny bottle thing, put the lid on, and then shake them. And see what happens. When you shake them, it's going to generate carbon dioxide gas.

So if you shake them and then stare at the lid, it might pop off and smack you in the nose. So it would probably be a good idea to take some eye protection. So if you happen to be out there and you really are curious about what happens if it hits you in the face, you've got your goggles on. So come get a pair of these. If you have eyeglasses, you're okay. But if you don't, wear some of those.

For the experiment, you'll be using a white cup that looks like this, and a kind of a yellowish creamy-colored little tiny bottle, and a lid. The lid fits on way too tight, which is good for our purposes. And it doesn't have an easy way to get it back off again. So we have some pliers that are over here. Maybe we'll put out more pliers so you guys can get the lids off. If your lid gets stuck on there, you grab the pliers and pop the lid off that way.

You're going to put stuff inside. You're not going to mix both things together inside for most of the time. You're going to put one thing in the little bottle and the other thing in this *[film can],* drop the little bottle inside, put the lid on, and go shakey, shakey, shakey. Now, while you're doing the shakey, shakey, shakey part, hold it straight up, because if you're going shakey, shakey, shakey, and the guy next to you is saying, "Eh, what are you doing?" -- Bam! -- right in the ear. And he gets it with the lid. So you want to hold it straight up so it goes up.

So first thing we're going to do is pass out the cups, the lids, and the little bottles. We're going to start out with ordinary baking soda and vinegar. And you'll choose how much baking soda you want to put in, and how much vinegar you want to put in, put on the lid, and shake it and see if anything happens.


Scooping baking soda with a cut-off spoon.

[Instructor puts baking soda in large clear cups] And we put in the baking soda a cut-off spoon. That's your scooper, because you don't need a lot.

[Instructors place cups containing baking soda and cups containing vinegar around the tables, one set of cups for every two or three students. Each baking soda cup has a cut-off spoon in it. They also set out a pair of pliers on each table and some plastic tubs of water for rinsing the containers. Then they pass out a film can, a lid, a small bottle, and a plastic syringe to each student.]


Using the syringe to get vinegar.


Filling the tiny bottle with baking soda.


Putting it into the film can, which contains vinegar.


Snap the lid on tight and shake, and see if the lid pops off.

So when you have all three things, and you've got vinegar and you've got baking soda, if you want, you can put vinegar in [the film can] and baking soda in [the small bottle], or you can put vinegar in [the small bottle] and baking soda in [the film can]. Whatever way you feel like. Put the lid on tight, go shake, shake, shake. So go ahead and mix stuff together. If you shake yours and the lid doesn't do anything, we'll put one of these pliers on each table. You can use it to pry off the lid.

[Students start assembling their containers with the chemicals inside, shake them, and see if the lids pop off.] Oh, that one worked! Then you go find the lid, rinse them off, and try it again.

[After a few minutes] Now, we have three more experiments to do with this, so I'm going to give you about one more minute to try this one.

Okay, time's up for baking soda and vinegar. You want to keep your squeezer and your little cup. We're going to pick up the vinegar. Don't reload with these. We need to start with a new batch of chemicals. Keep your squeezer, keep your bottles, keep the lids. Rinse out your bottles in the water so you start with a clean bottle.

Part 2: Alka-Seltzer and Water

Next, we're going to try Alka-Seltzer. In the last class, they seemed to have the best results by putting water in their cup already. We handed them the Alka-Seltzer piece, you throw it in the cup, put on the lid, and hope for the best. Everybody should have a clean empty cup with water in it, about half full. You don't need the little guy yet, you just need the big bottle and your lid. Make your cup about half full. When you're ready, put your hand out and say, "Alka-Seltzer for the poor!" When you're ready, drop it in your cup, put on the lid, smack it down hard, and see if it does anything. *[Instructors pass out Alka-Seltzer, students put it in their cups and put the lids on.]*

Part 3: Baking Powder and Water

Next, we're going to be using baking powder and water. Rinse out your cup and your lid, and rinse out the little funny-shaped cup, too. We're going to come by and throw a blob of baking powder in your cup. You can do it either way. If you have water there, we'll throw it in, and you're going to have to put on the lid really fast. If you want to, you can put water in the little bottle, put the lid on, and then shake it. *[Instructor scoops some baking powder into each student's cup, the student adds water, puts the lid on, and shakes it. This time, the lids don't blow off.]* Aww, they fizz, but they don't blow. So sad. That's why we do experiments like this. It makes a little fizz, but not enough to blow the lid off. So sad. Rinse those out, take the lids off with pliers and rinse them out.

Part 4: Dry Ice and Water

Next one is dry ice. Again, you need the cup about half full. Everybody stop -- shhh. When it's quiet, I'll tell you the warning. Dry ice is a hundred degrees below zero. You don't want to be picking it up in your fingers like this because you'll burn your fingers. I did some tests, and it takes ten seconds of holding to give you frostbite. Frostbite is bad. It makes your skin blister. If it's really severe, your skin will turn black, which is a lot of fun. So if I were you, if you want to pick it up, just a very quick touch, and then you go, "Ah! That hurt!" A hundred below zero is really cold.

We're going to drop it in your cup, put on the lid, and see if it blows the top off. Your cup needs to have a little bit of water in it. If your cup is ready for dry ice, raise your hand. *[Instructor places a small piece of dry ice in each cup, and the students put the lid on. No need to shake.]* If you don't lose your dry ice, you can do more than one pop.

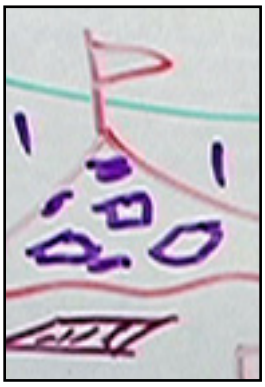
[After a few minutes] We've got a couple of more minutes. This time, put water in it, we'll add dry ice, and you can put it on the table upside-down. If you already have dry ice in yours, just add water, put the lid on, and turn it upside down. You're trying to blow your cup into the air this time. *[After a few minutes]* You've got one more minute.

[Teacher gives a ten-second countdown.] Time's up! If it's plastic, put it in the bucket -- plastic lid, plastic squeezer, plastic bottle. If it's not plastic, we'll pick it up. *[All plastic pieces and bits of dry ice go into the tubs of water and the Instructor picks them up.]* Then you grab a towel and rub it all over the table. *[Students grab towels and dry the tables.]*

Which one did you like best? I know, your favorite was baking powder! *[Students: No.]* No? Oh. Baking soda and vinegar? *[Students: No.]* Alka-Seltzer? *[Students: No.]* Dry ice? *[Students: Yes!!]*

End of Story

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



Holes in the tent.

So now you've got a bunch of cooks in here, and they have their hats stuck on their heads with stuff inside. Some of the stuff inside was baking soda. Some of the stuff inside had vinegar in it. And Evil Mister Fred was going to turn on the hot floor. Oh, this is going to be good, because now the cooks are going to go, "Aah-ooh-aah-ooh!" They're going to be shaking everything on top of their heads. And then the jars are going to break. And the vinegar's going to mix with the baking soda.

And then their hat, being bullet-proof, is going to launch right off the top of their head and leave big holes in the top of the tent. And the hats are kind of heavy. And the hats went boomity-boomity-boomity-boomity-boom!

Chef hats hitting Evil Mister Fred.

And they shot up there and hit Evil Mister Fred right in the stomach, like that. And it knocked Evil Mister Fred right out of his own cloud -- "Aaaaaaahhhhhhh!" And he hit one of the trampolines -- ka-boing! Back up into the air, and more hats hit him -- boom-boom-boom -- "Aaaaaahhhhhh!" Boing! Back up into the air. And everybody said, "Wow, that's really good, Evil Mister Fred! Do that again!"

And he's going, "Help meeeee!" And eventually, he bounced off the trampline, over the horizon, and left a big explosion. And a little piece of mustache drifted out of the explosion and slowly fell to the ground. And they all lived happily ever after, except Evil Mister Fred.

Explosion and piece of mustache drifting away.

End of Lesson

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