



Teacher's Guide for:
Corn Starch Monsters

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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Corn Starch Monsters
A Rock-it Science Lesson
Filmed July, 2009

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Intro Quick Recap:

Lesson Intro:

- Ask students if they are solid or liquid.
- Isaac Newton played around with stuff that sometimes acts like a solid and sometimes like a liquid -- “non-Newtonian fluids.”
- We're going to make a monster out of one of these fluids.

Experiment/Demo Quick Recap:

Experiment: Make a Liquid that's also a Solid

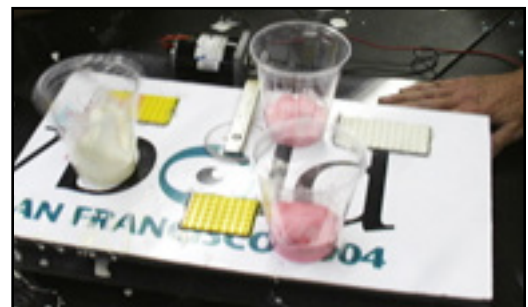
- Give each student a Plastic Cup. Add 2 tablespoons of Corn Starch and 1 tablespoon of Water.
- Students stir water and corn starch thoroughly.
- Students pour mixture out onto the table.
- Blow on the puddle to try to make waves, like a liquid.
- Make a fist and hit the puddle to see how it acts like a solid.
- Push a craft stick through the puddle to break off a piece.
- Push a finger slowly through the puddle.
- Move the craft stick in a figure eight to gather up the mixture, then let it drool off again.
- Use the craft stick to gather up the mixture and put it back in the cup.



Stirring the Corn Starch Mixture

Demo: Make Monsters with Vibrations

- In a large plastic container, combine 2 scoops of Corn Starch and 1 scoop of Water and mix thoroughly.
- Attach several clear plastic cups to a vibrating machine, put varying amounts of the mixture in each one, and color each one with different food colorings.
- Turn on the machine, which only has one speed, and let students touch it to feel the vibrations and see how the corn starch mixture moves around inside the cups.
- Attach some plastic cups to a shaking table, which has variable speed, and put varying amounts of the mixture into each cup.
- Turn on the table and increase the speed of vibration to see how it makes the corn starch move inside the cups.
- Add one or two marbles to each cup (optional) along with the mixture.



Shaking Table.

Equipment List: "Corn Starch Monsters"

Items needed for Instructor:

- Pipette
- 9 @ 12-oz clear Plastic Cups
- Large Plastic Container to mix cornstarch & water
- 2 cups Cornstarch
- 1 cup Water
- Large Metal Spoon for stirring
- Vibrating Metal Polishing Machine with 5 @ 12-oz clear plastic cups attached to the top.
- 2 Shaking Tables with 3 @ 12-oz clear plastic cups screwed onto each one with a screw & washer
- 2 DC Power Supplies
- 4 Insulated cables with Alligator Clips
- 2 Extension cords
- Marbles, Assorted sizes (about 10-20)
- Washup cloths
- Paper Towels for cleanup

Prep Work:

- Attach plastic cups to vibrating machine and shaking table.
- Make corn starch mixture in several colors and put it in the cups on the vibrating machine.

Items needed for Students:

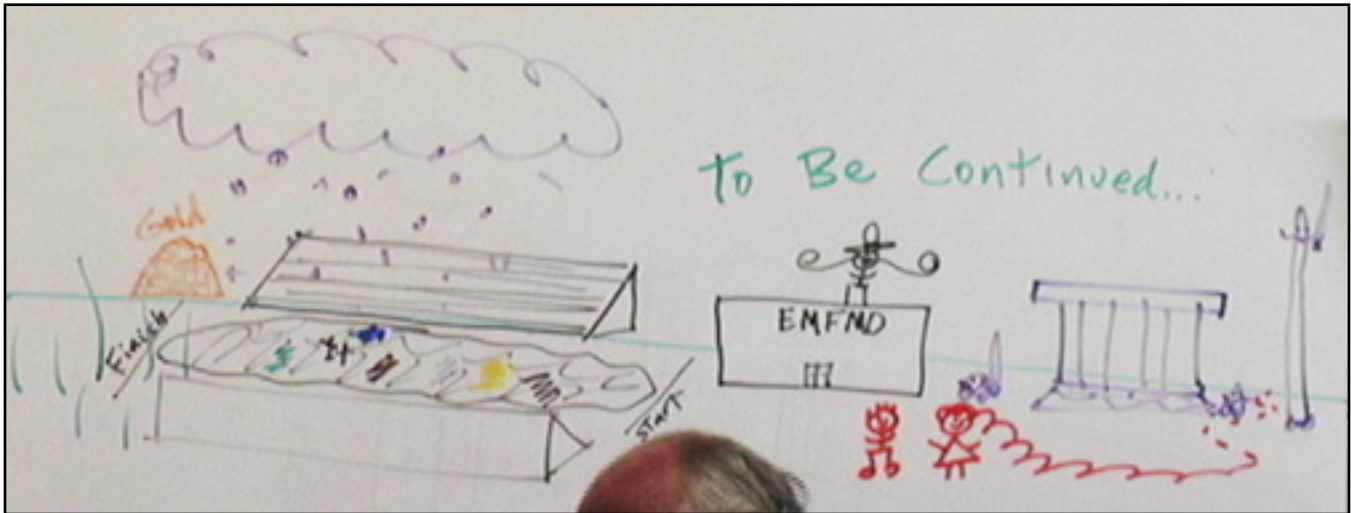
Consumables (per student):

- Corn Starch, 2 tbsp
- 6-oz plastic cup
- Water, 1 tbsp
- Food Coloring, a few drops (optional)
- Craft Stick

Other:

- None
-

Story Recap: "Jack & Jill and the Corn Starch Lake"



Part 1:

- Jack & Jill live in a place where everyone grows corn.
- A lot of the corn went to waste because it got ripe too fast or it wasn't ripe enough, so they just threw it away or fed it to the cows.
- Evil Mister called a meeting and told people he'd make them rich if they did what he said.
- He told them to grow their corn, but not sell it. Instead, they put it all in Evil Mister Fred's building.
- Evil Mister Fred told everyone to dance on the corn until a bunch of white stuff squished out.
- He took the white stuff, dried it, put it into a machine that turned it into powder, and sold it as corn starch.
- At first, he sold it at such a low price that all the other corn starch sellers went out of business.
- When he was the only seller left, he started raising his price over and over and made lots of money for everyone.
- After awhile, the corn starch in his bins got wormy, and the Health Department told him he couldn't sell it.
- He didn't know how to dispose of it, so he poured it into an empty lake bed and bulldozed it nice and flat. He thought it would be okay there because it hadn't rained in a long time.
- But then it started to rain, and the corn starch got moldy. It smelled so bad that birds flying over died from the smell.
- The mayor told Evil Mister Fred to get rid of it, but he refused. So he went to Jack and Jill.
- Jack & Jill said they had a plan to make money off the lake.

Part 2 of the story is told right after the Brainstorming, but before the experiment. See next page.)

Story Recap (cont.)

Part 2:

- Jack & Jill build bleachers all around the lake bed.
- They called in all the media and the GoodYear blimp.
- They put a Start line at one end of the lake and a Finish line at the other end.
- They put a pile of gold near the Finish line.



Ending:

- Jack and Jill organized a contest where people would race across the lake using anything they wanted -- canoes, motorboats, roller skates, pogo sticks, or just run or swim.
- Evil Mister Fred sent his minions out to hit the other contestants with their baseball bats so the minions would be the only ones left to win.
- Jack and Jill were doing okay on their pogo sticks, but the guys in canoes had a hard time paddling.
- Then the minions attacked, and it looked like they would win.
- Then an earthquake began, and the shaking made the corn starch crawl up out of the lake with big hands.
- The corn starch monsters started eating all the minions.
- Jack and Jill used their pogo sticks to bounce from one monster head to another, all the way to the Finish line.

Transcript: Introduction

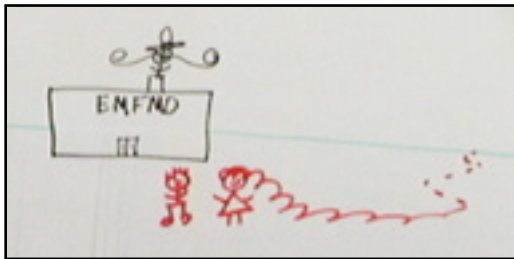
We're going to do some chemistry experiments first, and one of them is a kind of chemical that sometimes acts like a solid and sometimes acts like a liquid. Now, do you suppose you guys are solids or liquids? *[Students: Solid. Liquid. Solid, liquid, and gas.]* Ah, that's good -- you're solid, liquid, and gas. There's gas in your lungs. There's spit in your mouth, that's liquid. And you've got solid bones and solid flesh. Usually they say it's a liquid if you can pour it, or if you set it on something and it turns itself into a puddle. So you can take something like a glue stick, and a glue stick is a solid, but if it gets hot enough, it melts and becomes a liquid. And gases just kind of go wherever they want to go.

There are some kinds of things that sometimes act like solids and sometimes act like liquids. You can pour them, but if you hit them they act like a solid. And there was a guy named Isaac Newton who played around with this junk. So they call these liquids "non-Newtonian" fluids. Kind of weird stuff. We're going to see if we can do any kind of magic and stuff out of it. Ideally, we would like to make a monster out of it. A monster has to kind of have its own ideas of what it's going to do. It doesn't obey what we say. But first we need a crazy story.

Story: "Jack & Jill and the Corn Starch Lake"

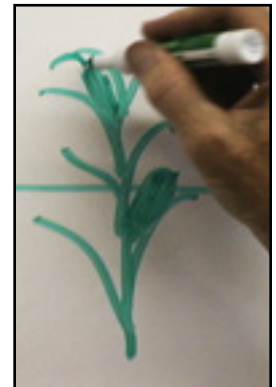
Once upon a time, Evil Mister Fred moved into a small town out in the middle of the place where they grow stuff. And the stuff that they're growing is corn. And corn grows nice and tall, and it has ears. Does corn have eyes? Does it have a nose? Does it have hair? Yeah, corn does have some kind of hairy looking stuff on the top. And it's got the ears. And it's got -- does it have teeth? Have you ever rubbed your hand on the edge of a corn leaf? Yeah, it hurts. It's got teeth.

So there's all kinds of corn growing out there, thousands and thousands of acres of corn. And Evil Mister Fred saw that the people were growing the corn, they'd pick the corn, and they'd sell it and people would eat it. But a lot of the corn went to waste because it got too ripe too fast, or it wasn't ripe early enough, and they just threw it away or gave it to the cows. And he said, "Ha! This is perfect." And Evil Mister Fred built



Evil Mister Fred's Money Opportunities

a huge building out there, and he called it Evil Mister Fred's Money Opportunities. It was a big empty building, and people came around and said, "Wow, you sure built a big building. What are you going to do with it?" And Evil Mister Fred said, "Well that's up to you. I think if you come here next Saturday night, we'll have a big meeting and I'll tell you what we're going to do." The people became and very curious and wondered, "What's he going to do?"

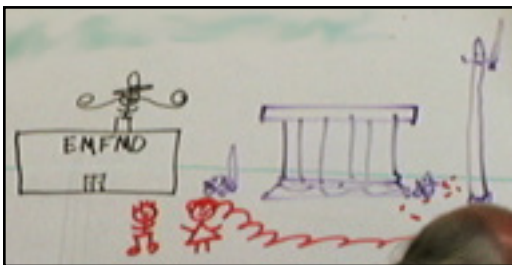


So a bunch of people all showed up, Jack and Jill amongst them, and Evil Mister Fred said, "What do you people make in a year?" One guy says, "Why, I'm practically rich -- I make ten dollars a year." And another guy said, "Oh, I make more than that. I make a hundred dollars a year." And Evil Mister Fred said, "Well, how would you like to make a hundred thousand dollars a year?" And they all said, "Yeah, that'd be great!" And Evil Mister Fred said, "And you don't have to change anything. Just grow your corn like usual and do what I tell you, and you'll make a hundred thousand dollars a year." Every-

body was cheering and saying, "Yeah, this is great -- we love this guy! We're going to be rich!" And Jack and Jill were standing back there saying, "What is he up to? You never know with that Evil Mister Fred." And Evil Mister Fred said, "Okay, first thing is, you have to promise to do everything I tell you to do." And they all said, "Yeah, we'll do whatever you say. That'll work, as long as you make us rich."

And he waited until everybody's corn was all ripe and ready to sell. And he says, "Okay, you're not going to sell your corn." And they said, "What? How are we going to get rich if we don't sell our corn?" He said, "Trust me. Just pick all your corn and put it in my big building." And they said, "Oh, boy, this sounds risky." But they did. They picked all the corn and put it in the building. And then one day he invited everybody over. The corn was sitting there, it was too ripe to sell anymore, and they thought, "Oh, no, this guy tricked us, now we're going to be poor." He says, "Okay, folks, take all the corn, take all the green stuff off the outside." You know it's got leaves, green kind of stuff on the outside. "Take all the green stuff off the outside." And they did that. He says, "Now, take off all the kernels." He had this machine to take all the kernels off. He said, "Put them in this great big tub. Now put on some nice clean shoes." They said, "What? Clean shoes? What are we going to do with clean shoes?" And he says, "It's obvious, isn't it? You're going to dance on the corn." And they said, "Oh, boy, this guy's nuttier than a fruitcake." But everybody said, "Well, as long as he's got music, we'll dance on the corn." So they all danced on the corn, squishy, squishy, squishy, squishy, squishy -- and this white stuff gooshed out of the corn. And he collected all the stuff that they danced on, squeezed out all the white stuff with a press, and said, "Now, you guys can go home and relax, and you're going to be rich." They said, "What?" And Evil Mister Fred took all the white stuff, dried it, put it into a machine that turned it into powder, and the powder they sell as corn starch. You can find it in stores.

And people said, "Hey! He's pretty smart. He actually used all of our corn, turned it into corn starch, now he can sell it all year long." And Evil Mister Fred said, "Yep, yep, yep." And he started selling corn starch at a cheaper price than anybody else. And people were buying his corn starch like crazy. The other corn starch companies all went out of business because they couldn't afford to sell theirs at such a cheap price. And after Evil Mister Fred had everybody buying just his Evil Mister Fred brand corn starch, then he started raising the price. First it was one penny a box. Then he raised it to two pennies a box, and people didn't complain. So then he made it four pennies a box. They thought, "Well, it's still a great deal." And then it was eight pennies, and then sixteen pennies, and then thirty-two pennies, and then it became sixty-four pennies, and then a hundred and twenty-eight pennies. Every few weeks he just doubled the price, until pretty soon the price of a box of corn starch was a hundred and twenty-eight dollars. And people said, "Wait a minute! It didn't used to cost a hundred and twenty-eight dollars for a box of corn starch." And Evil Mister Fred said, "Yeah, that's true. But it does now." And they couldn't get it anywhere else, because everybody else was out of business.



Evil Mister Fred's Mansion

And the people that provided the corn, Evil Mister Fred gave them a lot of money, and they felt rich. And Evil Mister Fred was the richest of all. He had a huge amount of money. He built himself a big mansion, put in tennis courts, swimming pools, got himself a limousine, servants, bodyguards, which of course were minions with baseball bats. Lots of minions. *[Student: Draw them skinny and tall.]* Oh, that would be funny,

wouldn't it -- a tall skinny minion, like that. And everybody was happy because Evil Mister Fred was making them rich. And Jack said, "I wonder where this is going to go?"

Well, not too long after that, Evil Mister Fred said, "I need some more corn starch in this place." And his minions said, "Boss, there's something wrong with our corn starch." He said, "Like what?" And one of the minions took a box and bit the lid off. And inside there was corn starch, but there was also a gazillion little white bugs crawling around, little wormy-looking things. And Evil Mister Fred said, "Oh, that's okay. Extra protein. Just go ahead and sell it."

And people stopped buying his corn starch because there were worms in it, and pretty soon the Health Department showed up. And they said, "You can't sell that. It's full of worms. Aw, that's gross!" And Evil Mister Fred had no choice. He took all the corn starch that was in his building and he said, "What am I going to do with this? If I throw it down the sewer, I'll get in trouble." And he found an old dry lake bed out there, used to be a lake years and years ago, and he filed it up with corn starch. And he says, "There. It hasn't rained there in a long time. It'll be fine." They bulldozed it all nice and flat.

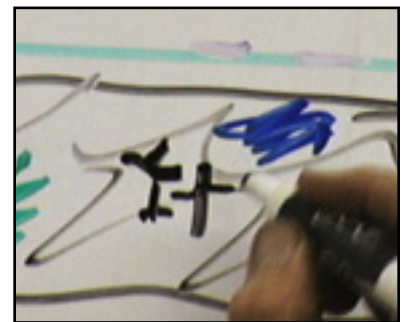


The Rain made the Corn Starch in the Lake Bed get Moldy.

Well, as luck would have it, next day it started to rain. A big purple cloud showed up, and it started to rain pickles and meatballs, [Student: And red and blue food coloring.] and red and blue food coloring, and water, and snow, and hail, and ice, [Student: And corn.] and corn. And pretty soon the dry lake bed wasn't dry anymore. The corn starch got all wet, and there was all this stuff in there, and it started to get moldy. After it got all moldy, there were spots of it that turned green. There were spots of it that turned yellow. There were spots of it that turned brown, purple, and it started to smell really bad. And it smelled so bad that some birds were flying overhead, and the smell came up on them and the birds went, "Acchh,

phew, acchh!" -- pshewwww, crash -- and died. So now there's dead birdy feet hanging out. And it made it even smell worse. And the smell was so bad, it ran across the town.

And everybody had good money there, but it stunk so bad they couldn't go outside. And the mayor of the town said, "Evil Mister Fred, you've got to clean that up. It's a big mess." And he said, "No." And the mayor says, "You have to." And he said, "No." And the mayor went to Jack and Jill and said, "Jack and Jill, Evil Mister Fred has created a huge disaster out there. It smells so bad, birds even die." Jack and Jill said, "Hmm. Maybe there's some way we can make money off of this." The mayor said, "Money off of a lake that stinks? How?" Jack and Jill said, "I've got a plan." Now if you were Jack and Jill, and you had a stinky, stinky lake, what would you do?



Dead Birdie Feet sticking up out of the Lake.

Imagination and Brainstorming Time

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

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

Part 2:



Bleachers around the Lake.

Well, Jack and Jill built seats -- they call them bleachers -- all around the corn starch. There were benches and benches and benches and benches, and there were seats there, and there were some out here. And they called the GoodYear blimp to come, they told all the tv stations and the radio stations and the internet stations they were going to have a special event there. And they put a line on this side that said "Start." And they put a line on this side that said "Finish." And they borrowed a huge pile of gold, and they put the pile of gold here. And that's

how we're going to leave our story before we do our experiment. We'll leave this To Be Continued . . .

Experiment: *Make a Liquid that's Also a Solid*

Now, we're going to experiment with corn starch. To do our experiment, you'll each get a cup and we'll put a scoop of corn starch in there, and a scoop of water. And you're going to stir it all up with a popsicle stick. And then we'll put in a drop of food coloring so you can make sure it's all mixed completely. And after it's all mixed up, we'll experiment with the stuff. So the first part is, we just need cups. You'll get a level scoop of corn starch in your cup. When you get your corn starch, you can stick your finger in there and see what it feels like. *[Instructors pass out plastic cups and craft sticks, then add corn starch and water. Students mix it up.]* Stir all the way down to the bottom, dig in a little bit. Dig down into the corners. *[Instructors examine each student's mixture and add a little bit more water if needed.]* It should feel kind of rubbery.



Stirring the Corn Starch Mixture



Making it Drool Out of the Cup.

Can you make your stick go slowly in circles in the stuff? After you get yours so your stick will slowly go in a circle, we'll do a test with it. After you think yours is mixed, hold your cup up in the air and turn it upside down and see if it will drool out. We want almost all of it to drool out. If you see stuff stuck in the bottom of your cup, raise your hand and we'll give you some more water. *[Students pour out their corn starch mixture onto the table.]*



Making Waves

If you have yours on the table, put your face close to it and blow really hard on it and see if you make waves. Okay, so it's acting like a liquid.

Now make a fist with your hand and go wham, wham, wham, and hit it hard. Now it's acting like a solid.



Push the Stick through.

Now take your stick and quickly run it right through the center and see if it breaks off a chunk.

Now take your finger and let it slowly go through the puddle. Slowly, slowly, slowly, slowly. And keep going.



Make a Figure 8

So it acts like a solid, it acts like a liquid. Now, there's a trick you can do with a popsicle stick -- oh, Sandy's already doing it. If you take your stick like *[student]* has, and you slowly push sideways and you kind of go wiggly-woggly, make like figure eights, you can pick up the stick and get all of it on the stick and then let it drool off. Here it comes -- ahh, splat! So see if you can pick yours up on the stick and let it drool off and see if any of it bounces on the table or does anything weird.

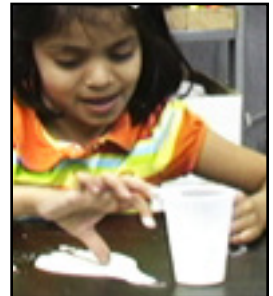


Put it back in the Cup.

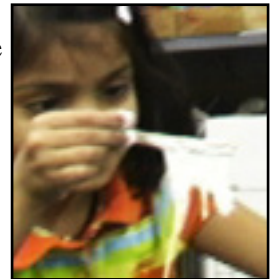
Now try to catch all of it on your stick and put it back in your cup.



Hit it with a Fist.



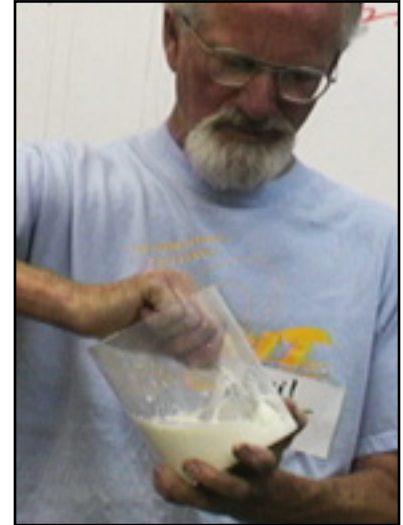
Push Finger Slowly.



Drool off Stick.

Demo: Corn Starch Monsters

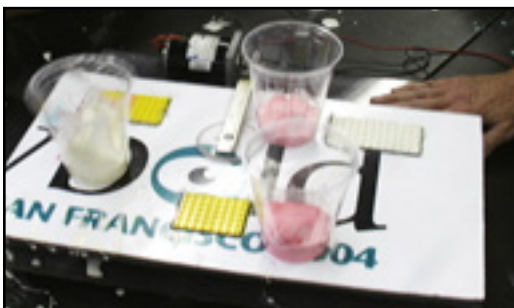
Here's two scoops of the same corn starch you guys were just using. Here's one scoop of water. And we'll stir it up. Now, if you go on the internet and you look up corn starch and vibrations, there are videos about it. And they took corn starch like this and they glued it to a speaker, you know, a speaker like a stereo speaker or a hi-fi speaker. And they turned on the sound, and they'd make it play a constant note, and you could see the vibrations in the corn starch. And they took a straw and they blew it right at the surface of the corn starch and make a hole in the corn starch. And the hole just sat there after they stopped blowing. The hole didn't go away. And then he blew another hole next to the first hole. And the two holes would go a little apart, and they'd come together, and they'd dance around each other. And I thought, "Okay, well that's cool." I tried it, and sure enough, that worked. But then I wondered what would happen if you used bigger vibrations. So I turned the stereo on higher and higher until it burned out the speaker. And it started to vibrate pretty good. It was just starting to act cool when the speaker burned out. So I thought, "Well, okay, how am I going to get big vibrations?" I could call the Beach Boys. But no.



Mix a Larger Batch.



Feeling the Vibrations.



Shaking Table.

My brother donated this thing, and it's just a machine that vibrates metal parts with a bunch of dirt kind of stuff in there, and it makes them kind of smooth on the corners. And if you turn it on -- it only has one speed, it's either on or it's off -- you turn it on and the corn starch starts moving around. There's different amounts in each cup. If I tap you on the shoulder, you walk by here and you put your hands on this and see what it feels like, then walk all the way around and go back to where you started. *[Students take turns placing their hands on the vibrating device to feel the vibrations.]*

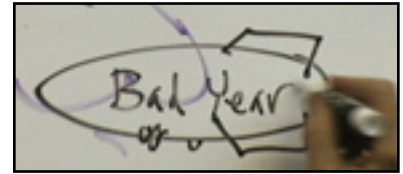
Now, we use a shaking table to create small earthquakes when we're testing little buildings and things. What we're going to do is be able to change the speed of the vibrations. This is like a battery pack, but you can use different amounts of batteries. And we can turn on the power, and we can make it go slow, or we can go faster. So now we can try all different speeds with this thing and see what happens. Now, I'm going to turn this

one on and drool some goo into the cups as it's vibrating. Let's pour some in these cups and see what it does. We'll put more in one cup than the others. Let's see what happens if we turn it on. *[Instructor pours mixture into plastic cups attached to shaking table and varies the speed of vibration. Corn starch mixture writhes around and as the speed increases, some of it is thrown out of the cup.]* I'm going to put a marble in here. *[Instructor puts one or two marbles of various sizes in each cup. The marbles get mixed around in the corn starch.]*

End of Story

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

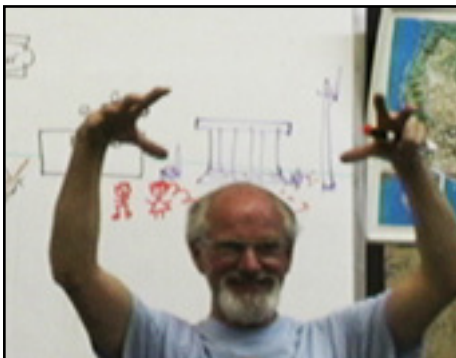
Evil Mister Fred created a disaster. And Jack and Jill built bleachers around it, and it smelled so bad that birds died. And they put a Start and a Finish and a pile of gold. And they said, "We're going to have a contest. We're going to see who can race across that the fastest. And maybe they'll take canoes, maybe they'll use motorboats, maybe they'll use rocket-powered roller skates. Maybe they'll use pogo sticks. Maybe they'll just run on tippy-toes to get across it. They could swim across it." And everybody was lined up here at the Starting line, and all the bleachers were filled with people, the GoodYear blimp was flying overhead -- this is the BadYear blimp -- all of the thing was being broadcast, people were paying thousands of dollars just to watch these guys jump into the stinkiest, smelliest, rottenest, horriblest stuff on the whole planet, and to see if they could make it all the way across. This was reality tv at its best. And they were willing to do it to see who was going to win the pile of gold.



The Bad Year Blimp

And Jack and Jill were out there, and they had pogo sticks. And Evil Mister Fred sent all his minions out there, and they had baseball bats. And what they were going to do was run out there and hit everybody with their baseball bats, and then they could win because there'd be nobody left but them, and Evil Mister Fred would get all the gold.

So the guys fired the starting gun - Bang! Everybody started going -- swimming, jumping, bouncing, any way they could. Jack and Jill were doing great on their pogo sticks, because every time they hit, the corn starch would harden up just like a solid. The guys in the canoes started to paddle, but they said, "Ohhh, man, it's really hard to paddle these canoes." And the minions were just going whack, whack, whack, whack, whack, like that, hitting all these people. And Jack and Jill said, "Oh, no, look what the minions are doing! They're just hitting people. That's not fair!" And Evil Mister Fred said, "Sure it is. They're winning, aren't they?" And the minions were getting ahead of Jack and Jill. And Jack and Jill said, "Oh, no, we're going to lose. Evil Mister Fred's going to get all the money, and we're going to be stuck." And



The Corn Starch grew huge Hands.

right at that point, there was a huge earthquake, and the ground was shaking, people in the stands were saying, "Cool, I like this!" And the corn starch started to crawl up out of the lake and form huge hands like this. It was moving all around. And the corn starch was going after the minions and eating one minion after the other. And Evil Mister Fred said, "Nooo!" And Jack and Jill were bouncing on top of the monsters going boing, boing, boing, from monster head to monster head. And Jack and Jill made it across the Finish line first, and the minions were eaten by the corn starch. And they all lived happily ever after except the minions and Evil Mister Fred.

End of Lesson

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