Miriam Class – Part 1

How many people here are kindergarten teachers?

Okay. How many people first grade?

How many are second grade?

How many are third grade?

Okay, combo teachers?

What grade?

T: First through fourth.

J: First through fourth – whew!

Well, we try to teach stuff that the kids will be excited about. We start off with activities that will get them thrilled. Any we go back and see if there's any science in it. If there is, then we'll eventually test it with home school kids, then we'll test it with Boys & Girls Club kids, and then we test it in the schools. And this last year, we've tested these lessons in Boys & Girls Clubs up in Redwood City, Menlo Park, and . . . up there somewhere. And at Bellhaven School and at Hoover School. And these are all primarily Hispanic areas, and most of their parents don't speak English. We figure if a lesson will work there, it should work anywhere. And it's been great fun. That is, the kids are so enthusiastic, they just love doing science.

And we also try and find lessons that teachers will do. And most of the teachers we've worked with don't like to do messy experiments in the classroom, especially with stuff they don't know about, because they're afraid something might happen, somebody might get hurt, or a kid might pour it down another kid's shirt, and often the kids don't behave exactly the way you want them to.

So today when we're doing the lessons, we're gonna start real simple, and we're gonna work our way up. And what I want to know is where your comfort level is. If I introduce something – a chemical, or a procedure – and you think to yourself, "No way!", raise your hand. Say, "No way – my kids would eat that stuff," or whatever you think they might do. Share that with us, so that we can either say,

“Okay, you’re right, don’t do that,” or “Here’s a way that you can get around that.”

Part of what we’ve learned is developing expectations. When the kids come in from the playground, they’re all hot and they’re sweaty. And they’re talking about the movies or the latest games that they’re playing on their computers. They’re not focused at all on what I want to do. And we have to do something to get them focused on what’s going on. And we’ve been doing it for eighteen years. We tell them a crazy story. And in the crazy story, their attention gets focused long enough for us to introduce the experiment and whatever else is going on.

And everything we do is based on, What does it take to make a child into a scientist? Well, luckily, you don’t have to do anything. Kids are already scientists. They’re better scientists that adults are by a long shot. They’re looking at everything, they’re trying everything — we just have to preserve that. And there’s two words that I’ve heard teachers use in all the classrooms -- a lot of them aren’t aware of it. The first word is “same” and the other is “different.” If you keep those words in your daily activities, you’re developing scientists.

Like, if you go into your classroom next fall, and the kids are all there, and they notice the classroom where all the kids are sitting, extremely observant. Each day, if you move one thing to another place and ask them, “Hey, I just moved something. Where’d it go? Which thing moved?” Kids’ll figure it out. By golly, you’ll find out there’s some kids there that’ll know. Adults have no clue.

For instance, I imagine you’ve all boiled water before. When you boil water, bubbles come up out of this water. Do the bubbles get bigger or smaller as they approach the surface? Let’s vote: How many people say the bubbles get bigger as they go to the surface? How many people say the bubbles get smaller as they go to the surface? Okay, make up a reason. If you’re in the “bigger” crowd, think up a reason. Why would the bubbles get bigger as they go up? Okay, raise your hand if you have an idea. You know, one word, two words — why do you think the bubbles might get bigger? (Pointing) Yeah, why would the bubbles get bigger?

T: I would say that the reason why, in the heat the electrons are moving quickly and making them rise to the

top, and as they force them into other ones, they accumulate and grow.

J: Okay, good! Yeah, why would they get bigger?

T: (indistinct answer, then all laugh)

J: Okay, from the “smaller” crowd, why would the bubbles get smaller when they go up?

T: They just do.

J: They just do! Well, that’s right — they just do! Well, you don’t’ really have to have a reason. Um, shall I tell you or make you go home and try it? (laughter) I’ll tell you, then you can still go home and try it. That’s the way a scientist does it.

The bubbles get smaller. One person out of the whole room. The bubbles get smaller.

Ts: Why?

J: Why. When you think about it, the water’s sitting there in the bottom of the pan thinking, “Oh, oh, I don’t like it here.” Some of the water starts to rise and you get convection currents. And pretty soon you get to the point where the water can’t rise fast enough, it gets overheated, and bam! You got a big old bubble. And it actually does make a pop sound and you can hear it. And then the bubble will disappear — bdoop! Completely. You say, “Wait a minute, I just saw a bubble and bam, it’s gone.” And then you watch longer, when it gets hotter the bubble will actually form and break free from the bottom. It’s a big bubble. But now as it’s going up it’s going up through cooler and cooler water. The hottest water’s at the bottom, and it’s getting cool enough for this steam which is in the bubble — it’s now steam — turns back into water and the bubble — fwooh! — will disappear halfway up. It’ll go up and boonk! — it’s gone, disappeared. And then, as time goes on, the bubbles will go further and further and further until they finally break the surface. And that’s where you’ll see the boiling.

Now, this is all about same and different. If a kid’s watching that and nothing’s happening, everything is the same, until you put in maybe some sparkles, and the sparkles start moving. And they say, “Wow! Before it looked

like nothing was going on and now the sparkles are all going around. Then when the bubbles appear there's noise, water is starting to steam on the surface, weird things are happening, and they can observe that there's something different taking place. And this is what science is all about: How are things same and how are they different? And anything you can do in all of your grade levels to incorporate that, you're making science.

Now, I'm going to start off with a crazy story. Today we're going to be doing chemistry. It will apply to all the standards for all of your grade levels. But I'm not gonna tell you how. At the end, we'll let you know how it applies to your standards. It's all done in a humorous, fun-loving spirit to develop their relaxation so they can make observations.

I used to work at NASA and we did the Jason program over there. The kids would come in and watch the whole thing on these three screens in front, and the teachers gave them sheets where they could check off things. They had to notice things. Well, there's three screens of different activities all taking place. And they're supposed to be looking for something on their list. Well, they're so focused at looking at what's on their list, they totally missed the point of the presentation. We don't do that. When we're doing experiments, we want them to make observations. We want to see how things are the same, we want to see how things are different. We want them to do it in a relaxed environment, and we want to play with their brains. We want to make them wonder, "What is this guy up to?" Because that way, you have their attention.

One of our teachers likes to wander around and make little noises because kids respond to noise. He moves a lot because kids respond to motion. And we use felt pens that are colored so that they're visual senses are affected.

So let's start off with something that looks like this. What would the kids in your class say?

TS: Mickey Mouse!

J: Mickey Mouse. Yep, this is Mickey Mouse.

And did you know that Mickey has two brothers. Most people didn't know Mickey has two brothers. One of his brothers used to work in the airport. These were the days when there

were propeller-driven airplanes. In order to start them, somebody had to stand on the ground outside the plane, grab onto the propeller, and give it a hard pull. Can you imagine what happened to his brother? One ear got chopped off. (laughter) It was horrible, poor guy lost his ear, and from then on he was known as Mangled Mickey. Poor little guy. But regular Mickey was able to play with him all the times, they still get along, cause they're fine.

Now Mickey's second brother was a little bit different. This brother lived upstairs in the building and he wasn't allowed to come down from upstairs because he had an ear growing out of his chin. And they called him Mutant Mickey. And regular Mickey was able to play games with Mutant Mickey, too. No problems there.

But Mickey had rules. He said, "Mutant Mickey, never, ever, ever go downstairs and go play with Mangled Mickey. It's just not allowed."

Well, one day regular Mickey had to leave. And Mutant Mickey was upstairs going, "Hm. I know there's somebody else downstairs. I wonder what he looks like. Does he look like me? Or does he look like regular Mickey?" So he opened the door and he snuck downstairs, and he heard some noise over in the corner, and he found Mangled Mickey. And he said, "Wow, he looks different, but he's still a mouse." He said, "Hey, my brother," and he ran over to him, and they hugged, and the next thing you know, bam, bam, bam, they started fighting. They were hitting each other with chairs, throwing things through windows, pulling down the curtains — it was a horrible disaster.

About that time, Mickey came home and saw this fight. And at the end of the fight, Mutant Mickey's chin ear had been torn off, and Mangled Mickey had duct taped it to his own head. (laughter) And regular Mickey said, "Aww, you guys have been bad, I told you not to do this. Now look at it, it's a huge mess.

Well, this is science. How could this possibly be science? We're gonna label these ears. And we're gonna label his head. Does that help at all? Who has an idea?

T: H2O.

J: Yeah, it's H2O. You'd be surprised, kindergarteners sometimes know this. It's H2O. What is H2O?

Ts: Water.

J: Water. Well, imagine this. That's what a water molecule looks like. Kinda bundled up more, but it looks like that.

Now, here we have Mangled Mickey, and we're gonna take his ear off because regular Mickey made him give it back. We're gonna put it back on Mutant Mickey. Does anyone know what this one is?

T: OH.

J: OH. Now why did you say OH instead of HO?

T: (indistinct) element.

J: Yeah. You know a bit of chemistry. Yeah, it's called OH. We're gonna put a minus by it — he's got one less ear. And it is called open. I'm not gonna be changing the name of it. What do you suppose you might call this?

T: (indistinct)

J: Yeah, H3O. We're gonna put a plus on that, because he's got an extra one. Now these OH's represent a whole class of things that taste really bad, and chemists call them a base. And they're things like soap, ammonia, lye, baking soda, stuff like that. Now, I always ask the kids, "Have you ever chewed on a bar of soap?" And most of them haven't. And I say, "Gee, have you ever licked a bar of soap?" And some of them have licked a bar of soap. My brother had to suck on a bar of soap once when he used bad words around the house. (laughter) And I tasted it, and boy, it tasted really bad. It's just not a good thing to have in your mouth. And all of these things here taste bad, but I don't recommend eating them. Are there any bases that you might eat? And kids don't think of anything they might eat, then they realize baking soda. That's in the kitchen. Mom uses that to cook with. And lye — luckily they don't know what lye is. Lye, you might, you'll find it in grocery stores in small plastic bottles — Red Devil Lye. It's a really, really nasty chemical. If you went swimming in a swimming pool full of liquid lye, you'd dive in. Immediately, your hair would all dissolve — wooss!—and fall off. And then your skin would all blister up and turn red and come off. And you'd see all the muscles as you're swimming around. Pretty soon, your muscles would all come

loose and fall, now you're a swimming skeleton. And your bones would eventually soften up and become real rubbery, and you'd be like Rubber Man swimming around in this (?). So real lye is very strong stuff, and it eats you up.

Now, on the other end, we've got this H3O stuff. Does anybody know what that might be?

T: Just a question about the lye. Is that the stuff — I can't remember — like back in the day when they used to fill in the dead people's, like in the pauper's thing, like in the pauper's burial, is that the stuff they'd sprinkle on top of them?

J: Yeah. It was usually lye or there's lime, which is calcium oxide. Both of those will do it really well. The lime is cheaper and works just as well. It's a white powder. You can put it on cows (indistinct). Yeah, good question.

Does anybody know what the H3O stuff might be?

T: (indistinct)

J: Yeah, acids. These guys are acids. Now, do you guys drink acid? How many people drink acid? Name one kind of acid you can drink.

T: (indistinct)

J: Citrus, yeah. Orange juice, you've got some down on the table. Lemon juice. Any other kind of acid that you might think?

T: (indistinct)

J: Yeah, there's some acids in wine. Yeah. There's acids in lots of things. Even milk has lactic acid. Uh, soda pop has lots of acids in it. There's carbonic acid and phosphoric acid in milk — I mean, in soda pop. Um, lots of foods have, like, tomatoes are acidic, you can can things that are acidic, they'll be preserved a lot longer. Some acids that the kids might be familiar with would be things like vinegar -- oh, I should have put bleach here — soda pop, in a car battery, there's sulfuric acid. And barf.

T: Nice. (laughter)

J: Barf is acidic. It’s got hydrochloric acid in it.

T: That’s not on the agenda, is it?

J: No, but if we have time, we’ll make some artificial barf. (laughter)

And these guys have that extra hydrogen. Now, whenever you mix an acid with a base, they both want what the other has. And there’s a reaction that takes place. Sometimes the reaction can be very, very dramatic. And other times, (indistinct) It depends on how strong they are. Water is right smack in the middle. It’s not acid or a base. We might say that it’s neutral. So Mickey could play with Mutant Mickey and with Mangled Mickey, and as long as you keep the two apart, then they’re okay.

So from a kid’s point of view -- and I’ve told this to thousands of kids — and I hear from their parents out in the parking lot: “My son or daughter came home and they’re eating dinner, and they start telling me about Mickey Mouse and his two brothers.” And it’s amazing how much they remember accurately just because we used a crazy story. And we do kindergarten through eighth grade, and it works for all of them. Which is very easy, you don’t have to remember. Now I tell them it’ll get them all the way to college. When they get to college, and the professor starts introducing acids and bases, they raise their hand and tell the Mickey Mouse story. And guys will come and wrap this funny shirt on them, with hands like this, and take them away to a room that’s really quiet and padded. They like that (indistinct).

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Now, we’re going to be experimenting today with acids and bases. But we want to do it in such a way that if stuff spills, it’s not a disaster, it won’t hurt their clothes, won’t hurt the floor, won’t hurt the carpet, easy to clean up. But we want cool things to happen. We don’t want them to just sit there and do nothing. Gotta do something.

We’ll put the Mickey Mouse story away, and the next one is “Octopuses.” Should we say octopuses or should we say octopi?

Ts: (murmur) Octopi.

J: How many vote for octopi?

How many vote for octopuses?

Well, I was in the octopi camp, and I called a lady over at the Monterey Bay Aquarium, her name was Barbara, and I asked her, “What’s right?” And she said, “Octopuses.” Heh, heh. I’ll go with that. It didn’t matter to me. And I started asking her, “Well, what are octopuses like?” She said, oh, they have a really nice one, just as you enter the aquarium, it’s a big octopus. And he’s usually kind of a tan color. But if he gets scared or angry he’ll turn red.

And the guy was the cleverest octopus around. On the top of the tank was hole no bigger than this. The octopus’ spread was over six feet. And they noticed, slowly, that the tank next to the octopus tank was — had fish disappearing. And they thought, “How could this be?”

And the octopus was sitting in the tank just tapping its tentacles on the wall, “Wasn’t me. I’m cool. I didn’t eat those fish.” So they put in a video camera and left it on all night. And what saw was coming out of this hole, a tentacle would come up and go splort! Then another one, and another, and then all eight of them were out. Then the octopus would pull on himself. It was like pulling a bag of water through a hole. It would just stretch, stretch, stretch, stretch, and his eyes would go boink, boink, pop through (indistinct) big eyes. Till his whole self was popped out. Then he’d go over to the edge, kind of hang on, and he kind of falls — splort, splort, splort — onto the floor, go across the floor, climb up the other tank, go in, and eat some of the fish. But, he didn’t eat too many, because he had to go back through the same hole. So he’d chew up some fish, come out of that one, and go back in and pretend like nothing happened.

T: That a real story?

J: That’s a real story.

T: It went across the floor and he went back to his own?

J: He went back to his own tank. They’re very intelligent. And without the video they couldn’t have proved this to anybody.

So the story’s going to be about octopuses, and they’re going to lead us to experiments about acids and bases.

Also, she said that octopuses have the ability to change their color rapidly. They put a board on the floor of the tank with, I think, with lights that turn on and off, red lights. And the octopus eventually settled down on it, and they were able to turn on the lights. And then the skin of the octopus developed red dots where the lights were. And they'd turn them on and off fast. And the octopus could change color four times a second with these lights. And they also noticed that the octopus could settle on a gravel floor and his skin became bumpy like the gravel to match the color. And the octopus obviously can squeeze through tiny holes, and they can squirt.

Now, we're going to use that as a way to introduce acids and bases. So we need an ocean. Kids don't seem to mind badly drawn pictures. And we need something that looks octopus-like. And this octopus has a crewcut. His name is Jack. And we have another octopus and she's got curly hair. But her hair is infinitely long — it never stops. And her name is Jill.

And Jack and Jill are hanging around down there in the ocean, with lots of other octopuses down there, and one of them is kind of a mess. This guy, he couldn't do things that other octopuses could do. He was all beat up. His name is Rudy.

The regular octopuses liked to (indistinct). They'd all form a line and they'd swim around and try to swim fast and swim slow. They'd go lay around with sunken ships and try to go through the portholes, and land on stuff and change colors and texture. But Rudy always messed up the game. He'd get tangled somewhere, and they'd have to spend an hour to untangle the poor guy. He could never change colors and textures. And he got shunned. The rest of the octopuses didn't want to play games with him. So Rudy went off and he would hide in a cave. That's him way in back of the cave.

One day, along came King Neptune, and he wanted to play a game with the octopuses and steal as much of their money as possible. So King Neptune brought a stack of cards along. He might have a beard, I suppose. And what else would a king have?

Ts: (murmur) Crown.

J: A crown, yeah that'd be good. Does he have flippers or feet? Flippers? We'll give him flippers. And let's give him

a stick with a ball on the end, like that. So he's King Neptune. And he's going to teach the octopuses how to play poker. And in poker, the idea is to keep a straight face. Don't let anybody know what you're thinking or what you have in your hand, whether it's good or bad.

And King Neptune said to the octopuses, go and bring all your gold in. We're going to play a game. And all the octopuses said, "Whoo-hoo! Poker! What is it?"

King Neptune said, "Ho, ho, ho. This is gonna be fun." And they all brought their treasures in. and they brought out a table, and the octopuses all sat around the table, and they started playing poker. And King Neptune said, "Oh, this easier than I ever thought. These octopuses change color. When they have a good hand, they turn green. When they have a bad hand, they turn red." He'd know when to bet. It didn't take him long before he'd won all their treasures. And he said, "Well, guys, nice day, thanks very much." And he had this whole entourage take the treasure and leave. As he was going he said, "By the way, I'll be back next month. Make sure you find new treasure."

And the octopuses went, "Oh, man!" Jack and Jill said, "We've gotta do something about this." Now, what do you suppose they did?

Ts: (murmuring)

J: What could they do with Rudy?

T: He doesn't change color.

J: He doesn't change color! Ho, ho, ho! Yeah, so Jack and Jill went and found Rudy and said, "Rudy, we're gonna teach you how to play poker." And Rudy said, "Nooo, I don't know this, I don't want to do this." Jack and Jill said, "Just calm down. We'll teach you how to play poker." So they spent a whole month training Rudy.

Well, at the end of the month he still wasn't good at it. So the rest of the octopuses all sat around the table. Rudy was at one end, King Neptune at the other end, and the other octopuses found ways to see King Neptune's cards. And they were only going to let Neptune play with Rudy and nobody else. And when King Neptune saw Rudy, he said, "Woah, this is great. All I've gotta do is play this guy? I'm gonna take all their gold in just a few hands."

Well, they started dealing the cards. The other octopuses just kind of floated by and noticed King Neptune's cards. If he had good cards they all turned green. If he had bad cards they turned red. All Rudy had to remember was the colors. And Rudy bet accordingly, and before long, he'd won back all of their treasure. He won King Neptune's royal orb, and he won King Neptune's crown, and King Neptune was not a happy camper. He went away angry. But Rudy said, "I did it! I can't believe it. I won back all the treasure."

And he was generous. He gave all the octopuses back what belonged to them. And they all cheered and said, "Okay, Rudy, you were great. What can we do for you?" And Rudy said, "Well, I'd really like to be able to change colors."

Now, if you were the other octopuses, is there anything you could do to help Rudy change his colors? Think of kids. What would they do?

T: (murmur)

J: What's that?

T: Paint him?

J: Paint him! That's what kids'd say — they'd paint him. What else would you do?

T: (murmur)

J: What's that?

T: Food color.

J: Food color! Yeah. Make him — they think you drink it. The kids will come up with great ideas. Paint him, food color, feed him weird foods, whatever. And you can take off on that any way you like.

Let's say the octopuses all go out and search for colored food to give to Rudy. And they try all these foods. And Rudy doesn't change color. And then the turtles go out on shore and they start patrolling around, and the turtles find some colored food. Some carrots, some apples, and some cabbages. And they'd bring them back. And Rudy tries these. And the only thing that works is red cabbage. Rudy eats the

red cabbage and changes color. By the way, what color is red cabbage?

T: Purple.

J: Ah, purple! It's the color of that shirt — purple. Why do they call it red cabbage? Whoever invented the name for it was colorblind or they were talking about something else. Because it is not red. Red cabbage. It's purple. And they gave it to Rudy. And Rudy changed purple. Jack and Jill said, "Wow, that's great! We changed your color." And Rudy said, "Yeah, I'm purple, all right, this is great. How do I change back?" And they said, "Uhhh, I don't know."

Would you just wait? Would you feed him other things? What could you do to Rudy to change him back?

T: Bleach him.

J: Bleach him! Ahh, you could bleach him. That'd work.

Well, we let the kids brainstorm for ideas. It's really important that they spend some time brainstorming and express their ideas so that you know where they're coming from. And we say, okay now we're going to do an experiment. We're going to use some red cabbage and find out what happens to it when we add other chemicals. From your point of view, there's chemicals in the red cabbage. And there's a lot of research going on about these chemicals. They're called flavenoids. And it's what makes carrots orange. Just about any of the leafy vegetables have flavenoids in them. This one is called, I think, it's one of the weird words that scientists make up. It's either cyanoanthins or anthocyanins. I think it's the anthocyanins that's in there that gives it this color. If you take the poor cabbage and throw him into a pot of boiling water, the water will change color, rip him all up, and you end up with a bunch of faded out cabbage leaves and blue water.

The blue water is good stuff. That's what we want. Here we have a container full of red cabbage juice, which is purple, that when you boil it, makes blue water. And it smells great. This is octopus perfume.

T: Eeoow.(laughter)

J: Kids don't know that. And we want them to see what's gonna happen when you put an acid in there and when you put

a base in there. And we want it to happen slowly so they can see what's going on. The easiest way I've found, which involves lots of little cups, you give each student five little cups. And they spread them out in a row right in front of themselves. They put five cups in a row, and the three middle ones get the blue juice. And one end one gets water, and the other end one gets vinegar. Doesn't matter which one, which way. And then we dump in some baking soda in that one.

And you got all these kids, got all these cups of liquid, what's gonna happen?

T: Knock them over.

J: They're gonna knock 'em over. And I've discovered that if you say, "Try not to knock them over," they knock 'em over! If you say, "It's okay if you knock 'em over. We'll just give you more." Or if the class is big and the kids are responsible, say, "When you knock yours over, come up here, get a tablespoon, refill it, and go back and sit down." They like that, having that responsibility. And surprisingly, fewer of them knock 'em over. Look, it's harmless stuff, so it doesn't matter if they knock them over.

So we usually pick some kids and go, "Here, give your friends five cups." There you go, five cups each. And you need a couple more people to help pass out cups. Everybody gets five cups — they're cheap. We get cups at Smart & Final or Costco.

(Teachers pass out cups)

Uh, you might put your papers away in case your neighbor spills.

Now we need three new people to help scoop out stuff. You put one scoop in each of the three middle containers. One scoop in each of the three middle containers.

While the kids are doing that, you get the baking soda. You get to decide which clear liquid to put the baking soda in. And you let the kids figure it out. Say, "Kids, smell the clear liquids. The one that has no smell, push it forward so I know that that's the water. Okay, the one that's clear that has no smell, push it forward in front of your line so

I know which one to dump in. And you'll know right away if it's the wrong one.

Yup, the one with no smell. And this is great, because if the student pushes the wrong one forward, when you dump in the baking soda, it fizzes. And they'll go, "Ohhh, it fizzed!"

Raise your hand if you like the smell of the cabbage juice. How many people don't like the smell of the cabbage juice? Yeah, that's uh, there's super tasters, there's regular folks, and there's people with, like, dead tongues. And the people that like the cabbage juice aren't the super tasters. The ones that have the really sensitive tongues don't like broccoli and brussels sprouts, and they don't like the smell of cabbage juice. And when you get around to doing some tongue tests in the classroom, this'll kind of give you an idea who's gonna have the real sensitive tongue. Most kids will kind of back off from cabbage juice, put their shirt over their face, push their chair away back, it's okay.

Now, how are we doing? Did we get everybody?

With kindergarteners, they'll kind of sit there and do what you say. The older they get, the less likely they are to do what you say. And here, I show them, I've drawn the cups up here. I tell them, "You're not gonna start now, and it's okay if some drips on the table, but we don't want you going so fast that you spill yours out. We want to create a mixing procedure like scientists do. We want just a little bit from each cup to be transferred to the next. And there's a very simple way to do it. You're going to use a scientific instrument know as your finger. And the finger is going to be doing some dipping. Whenever you dip your finger and you take it out, there's some liquid still stuck on it. Maybe a drop, maybe two, which is perfect. You'll dip your finger in one end. Doesn't matter which end you start with. Probably can't tell anyway. And then you'll dip it into the next one: dip, dip, dip, dip, until you get to the end of the row. Well, you don't go back to the beginning now — you go back the way you came. Dip, dip, dip, dip — dip, dip, dip, dip — dip, dip, dip, dip. You keep going back and forth: dip, dip, dip, dip — dip, dip, dip, dip. You're gonna all become dips."

And with kids, their fingers don't hold a lot of liquid. They're little fingers. Sometimes you have to tell them to

use two fingers instead of one finger. Your fingers are probably fine. And so, everybody start dipping. Start at one end and dip back and forth, and back and forth, and see what happens. And don't stop. Go all the way down the row, yeah, go all the way back. Don't stop until I tell you to stop.

T: Can we double dip?

J: Some people are already double dipping.

Girls, I think, have more manual dexterity at that age than boys.

Okay, everybody stop. (Many teachers keep going.) Look at your neighbors' cups. Do theirs look like yours?

T: (murmur) Yep.

J: Now, one of them had an acid in it. It was vinegar. One of them had a base in it. It was baking soda. Which one do you think had the acid in it, the pink one or the greenish one? How many people vote for the greenish one for the acid? How many vote for the pink one for acid? Ooh, the pinkies are right. The pink one has vinegar in it. Now I want everybody to pick up the pink one and hold it in their hands. And this is important with the students that they actually pick it up. Now, you're gonna pour all of your pink stuff into the closest cup. It may overflow, but that's okay.

Now, the anthocyanins that are in there take a little time to change. The vinegar added to the cabbage juice turns to a pretty good, what would that be, a magenta? Pretty nice color there. Now they're gonna pick up the one with the baking soda in it and pour it into its neighbor.

T: Should we stir it up first? The baking soda's really thick at the bottom.

J: That won't matter. It won't all dissolve.

Well, you've got kind of a teal color, I guess, a purple — turquoisey, and a magenta. You've just made an acid-base indicator. Cabbage juice is great stuff for indicating whether it's an acid or it's a base. Now you've got five cups. Three of them have liquid in them, two of them really full. You can mix them any way you want, but keep as much

as you can in the cups. Go. Mix them any way you want, but keep as much as you can in the cups. Mix them any way you want and see what happens. At this time I usually stand around and pass our paper towels. Wow, grape soda!

It's kinda neat to walk around the classroom while the kids are doing this, because some kids will mix a couple of them and they'll have reds and blues separate. Other kids will have it everywhere and have it all purple. At the end, if they're all kind of a bluish-purple, that's neutral. Now look at your neighbors' and see if they made theirs look like yours. If you can get ahold of a clear container of some kind, even a clear garbage bag will work, you might go around the classroom and have them throw their cups and the liquids into the container because they really want to see what happens when everybody mixes all of them together in one tub. So, you just bring this around and let them throw them in, and it's an easy way to clean up. And they get to see the fizz, and the smell kind of comes out of the container. Then you have them stack up their cups as you go by.

I want you to think about problems that you would encounter with the students you had last year doing this experiment. And we want a list of things that you think could happen with your kids. Think back to your kids. What would they do that you wouldn't want them to do during these experiments?

(John writes list on white board:

Kinders wouldn't do it.
One would drink it on a dare.
Mix wrong way.
Spill on white uniforms.
Pour on table.
Splash on face.
Share cups.
Go too fast.)

Okay, we have a list of things that can go wrong. And no experiment is complete without things that go wrong. We have a group of kinders that were so timid they wouldn't try different colors of apples, or sunflower seeds. They wouldn't try it because they might not want to stick their finger in the juice, or just be near it because their noses are very sensitive. Is there any way around it if they don't want to stick their fingers in it?

T: You could give them like a popsicle stick, or . . .

J: Yeah, a popsicle stick will work, a q-tip will work. Anything that's a little bit absorbent, if they don't want to put their finger in it, go for it. They can just put that in there instead.

Um, one would drink it on a dare.

T: We did.

J: Yeah. It's okay. When you make the stuff, you know, you boil it, it's sterile, the cups are new. It's not a problem.

Um, mix the wrong way. This happens just because kids are kids. You'll see one kid go boing, boing, boing, boing, and then they'll go back to the beginning, boing, boing, boing, boing, back to the beginning. And they're gonna get a different result than everybody else. That's why you say, "Look at your neighbors'. How is theirs different from yours?" Because it's all about how it's same and different. That's another experiment with something to learn.

Uh, spill on white uniforms. Luckily, they don't stain. But now kids are walking around the rest of the day with, you know, some color on their uniform. There's an experiment, if they don't mind. You can take a q-tip or a paper towel and dip it in vinegar and touch part of the stain. By golly, it'll change color. A little baking soda'll make it green, a little vinegar'll make it red. They've got something to show off at home when they get home.

Some kids will pour it on the table. Well, you know, it's gonna happen. There's not much you can do about it. I tried it outdoors, but I'll tell you, when I get groups that I have outdoors, it's like, "Whoa, look at the birds!" It's really hard to get them focused. I'd rather clean up the tables than have to deal with the distractions that are outdoors. It's not that hard to clean up.

Splash on their face. Yeah, some kids are gonna do it. Pour it on their head, you know. It happens. You got paper towels.

Sharing cups does happen quite a bit with this (?) groups. They're the most sharing people I've ever met. Oh, your cups empty, here, have one of mine. And you get a while

different experiment because now you've got two vinegars and no baking soda.

And going too fast, well, some of the guys just can't quite do it. They want to go fast. And they end up with stuff everywhere. But they usually end up at a table with the experiment going kind of the way you expect it, and a lot of other unexpected results. Either way, they're gonna learn about acids and bases and this cabbage juice that changes color, and that's what we want them to see.

When they go home, they're gonna be telling their parents about Mickey Mouse, they're gonna be telling them about these crazy octopuses, and this experiment that they did.

And we now have a problem that we haven't solved. Jack and Jill need to make Rudy change colors. Ho, ho, ho. The kids have just done an experiment. And you let them — they can form groups, or they can volunteer answers on their own. It's a great literature thing. At this point, kids really want to share some ending that they've cooked up. It's a perfect opportunity to have them go ahead and share it. And they like, often, totally ignore the experiment. You know, they're gonna give, you know, King Neptune a machine gun and something's gonna happen. But within any group of kids you'll have somebody say, "Oh, yeah, they're gonna feed Rudy some vinegar. And he'll turn red." Or they might feed him some baking soda. Make him eat some baking soda toothpaste, and he'll turn green. Or give him both, and he'll foam up and turn blue or purple. A jet-powered octopus.

So making up the end of the story gets their minds thinking, how do they transfer what they've done to a different situation really anchors the information in their mind. So you've got a fairly powerful tool in storytelling to use this way.

Now, in your classroom, I would be you use all sorts of stories. And is there any way any of your stories that involve color changes could relate to this experiment? So if you have this experiment in your curriculum at some time in the year, choose wherever you want to put it, if that story happens to be there with, you know, maybe it's raining pickles, you can incorporate that story instead of the Rudy story. And use any story you want. Any story that involves color changes works great for this. Does anybody have a story that involves color changing?

T: A classic one for kinders is Little Blue, Little Yellow.

J: Yeah, okay. If you're doing the story, there you go.

T: We were talking about (indistinct) or even at Easter, a lot of them color eggs.

J: Yeah, and they use vinegar and coloring to do their eggs. Great. Great connection.

Yeah, yeah, a chameleon book would be great, because they change color just like the octopus does. Yeah. If a kid asks how does the octopus change color, the lady at the Monterey Bay Aquarium said, "Imagine [end of tape]