



Teacher's Guide for: **Tornadoes**

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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Tornadoes
A Rock-it Science Lesson
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Intro Quick Recap:



- The Sun shoots charged particles at the Earth, and the particles are deflected by the Earth's north and south magnetic fields. Some come to the North Pole and some to the South Pole.
- Some of the particles are positive charge and some are negative charge. There's a little bit of charge separation, so there's a current that flows through the Earth, and that creates our magnetic fields.
- Our magnetic fields help protect us from the charged particles by pointing them at either the penguins or the polar bears, and the charged particles also create the magnetic field that deflects them. So it balances. It also creates the Northern and Southern Lights.
- As those charges build up, they help create thunderstorms. The charged particles in the clouds can interact with the fairly weak magnetic field.
- If a cloud meets some warm, wet air that's going in one direction and some cold, dry air that's going in another direction, they can create spinning air where they meet.
- At first, the air spins slowly sideways, but it can suddenly bend downwards and create a tornado.
- Some people think it's best to leave your windows open during a tornado, to keep your roof from being blown off. But MythBusters tested this and found out it doesn't make any difference. Roofs are blown off by large pieces of flying debris, not by the wind itself.
- Tornadoes don't drive pieces of straw through trees. What happens is the trees bend over in the strong wind, which causes cracks in the trunk. A piece of straw gets blown into the crack, and when the tree straightens up, the crack closes around the straw.

Demo #1 Quick Recap: "Shoot a Pencil through a Box"

- Put some oil into an air gun to lubricate the tube.
- Drop a sharpened pencil into the tube, point upward.
- Point the air gun at a cardboard box and shoot the pencil out at about 150 mph.
- Show that the pencil makes a hole in the box, but the lead doesn't break.
- Add a little more oil in the tube so the pencil is lubricated, and shoot again.
- This shows that a tornado doesn't have a lot of power with small items, even though it can do a lot of damage with large things, like a car.



Demo #2 Quick Recap: "Smoke Tornado"

- *[Note: This is an elaborate device built by Mr. Mac. It's not required for the lesson, so we don't include detailed info on it in this Guide.]*
- The Smoke Tornado device has clear plastic panels. Most of them are sealed with tape, but every other one has the bottom edges open.
- There's a leaf blower and flashlight on top.
- There's a stage fog machine on the bottom.
- Turn on the smoke, the flashlight, and the fan to show how the stage fog swirls like a tornado.
- Turn off the room lights so only the flashlight is illuminating the fog.
- Turn up the leaf blower to higher speeds to show how fast the tornado swirls.
- The one thing this device doesn't show is how a real tornado can wiggle and wobble (the snake dance).



Experiment Quick Recap: "Tornado in a Bottle"

- Each student receives a set of plastic bottles, one inverted on top of the other and sealed together. The Instructor shows students a set of plastic bottles, one inverted on top of the other and sealed together in the middle. The bottom bottle is about three-quarters full of water with some glitter in it to make the water's movements more visible.
- The Instructor inverts one bottle to show how the water will start to flow from the top bottle to the bottom one if you shake it a little. Students are cautioned that if they want to shake the bottle, don't hold it in the center, because this will make the top bottle fall over and break off. They need to hold the top of the upper bottle when they shake it. Also, they don't get to squeeze the bottles or unscrew them.
- There are four different kinds of bottles, but the students don't know what the differences are. It's up to them to observe the differences. Some bottles will be easy to use, and some will be harder.
- Tell students not to do anything with the bottles until everyone gets theirs. Then pass out the bottles, one set to each student. Since it's hard for students to reach the top of the bottles when they're on the table, we allow students to stand or sit on the table during this experiment.
- At the Instructor's signal, they invert their bottles and start shaking and swirling them to make a tornado.
- After a few minutes, tell students to switch bottles by passing them counter-clockwise to the next person. Then they try to make a tornado in their new bottle and see if it's any easier or harder than the first one.
- After a few minutes, pass the bottles counter-clockwise again. Repeat this five or six times, so each student is likely to get each of the four types of bottles.
- Have students invert their bottles, get a tornado started, and then let it go by itself to see which ones make the best tornadoes.
- Reveal to the students that each of the bottles has been marked on the bottom with one of four colors of ink. Have students invert their bottle, get a tornado started, then let it go by itself again. This time, see which colors drain the fastest. Have them put up their hand when their bottle is empty. The Instructor calls out the color of each one as they empty. (The black ones empty fastest, followed by blue, then red, with green being the slowest.)
- Call the students' attention to the size of the hole at the intersection of the two bottles. Have them note which colors have larger or smaller holes. (Black is the largest, green the smallest.)
- Have students invert their bottles again and see if they can make



Experiment Quick Recap, cont.: "Tornado in a Bottle"

their tornado do the snake dance. (They may notice that the larger the hole, the harder it is to make the tornado wiggle, because the water flows out too fast.)

- Tell student the story about how flushing a toilet in the Northern Hemisphere makes the water swirl counter-clockwise, while flushing it in the Southern Hemisphere makes it swirl clockwise. At the equator, it could go either way, or just go straight down with swirling at all.
 - Have students try to make a tornado that goes counter-clockwise. Then try to make one that goes clockwise.
 - Have them switch bottles and try it again with a different bottle.
 - Let them go into the bathroom and flush the toilet to see which direction the water swirls.
 - Have students turn over their bottles carefully to create as little movement in the water as possible, then watch to see if it will start spinning on its own. (None of them do.)
 - Reveal that MythBusters tested a bunch of water bowls in the Northern and Southern Hemispheres as well as at the equator, and they discovered that it doesn't make any difference. No matter where you are on earth, the water can swirl either clockwise or counter-clockwise or not at all.
-

Equipment List: "Tornadoes"

Items needed for Instructor:

- "Smoke Tornado" machine (optional, see next page)
- Air gun
- Sharpened pencil
- Cardboard box
- Machine oil (a few drops)

Items needed for Students:

Consumables:

- None

Other (per student):

- Bottles, clear plastic, 2-liter size, joined neck to neck with a bottle connector, with a washer between them. The washer has a hole through it, and there are four different sizes of holes used for the various sets of bottles.

Prep Work:

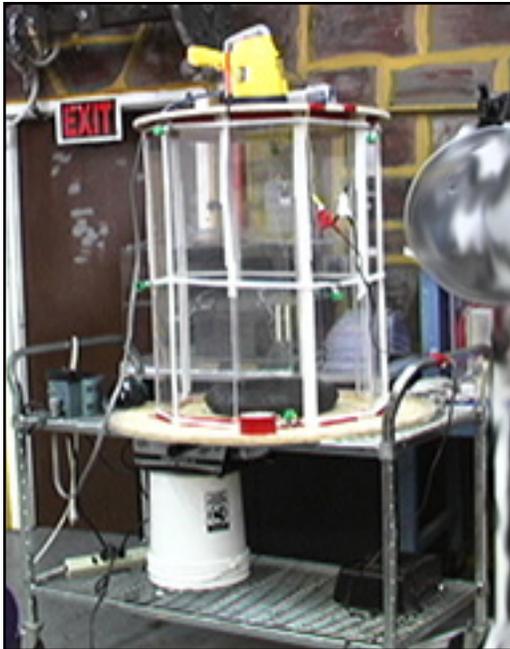
- Construct tornado bottles:
Go online and search for "vortex bottle connectors." The bottles screw into them. We add washers with openings in the following sizes: 1/4", 3/8", 7/16", and 1/2". To make the larger size holes, you may need to enlarge the hole in the plastic connector, using a drill or a hot metal rod. One bottle in each pair is filled about 3/4 full with water, with some glitter added to it.



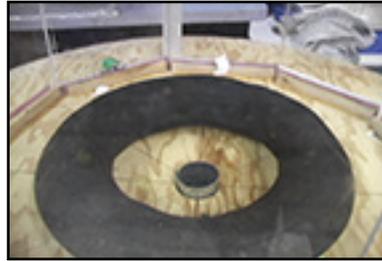
Equipment List, cont.: "Smoke Tornado Maker"

Optional Item, for the very adventurous:

- We realize very few teachers will actually build this device, so we'll just give you a few shots of it here, for those who are interested. There's also a short video clip (no audio) on the web page for this lesson. If you're handy with tools and would like more info so you can build it, please ask your questions in our Support Forum.



Tornado machine on rolling cart.



Rubber tire with hose from fog machine.



Left: Opening for leaf blower.
Right: Opening for flashlight.
(White tubes are just reflections.)



Flashlight and leaf blower.



Battery charger.



Tubing and connector.



Fog machine sitting on a bucket, with hose.

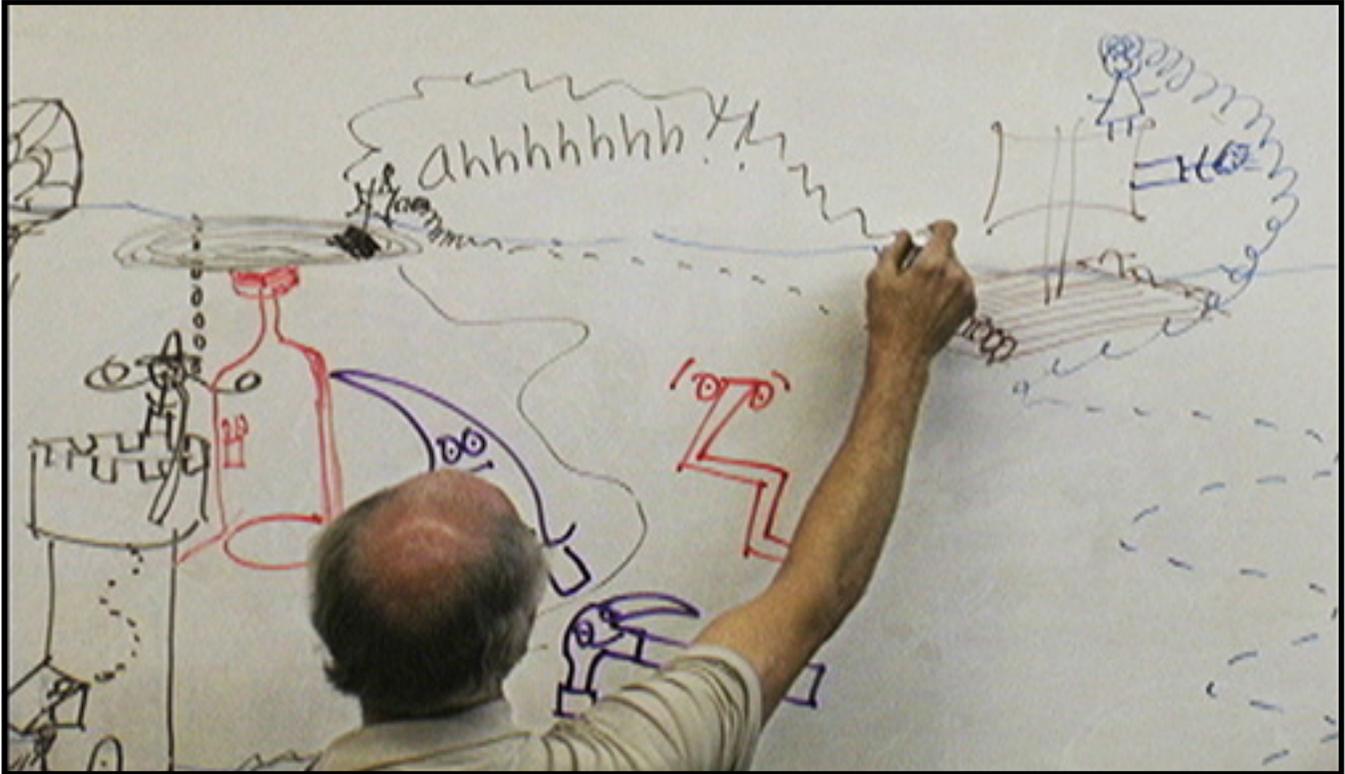


Controllers.

Story Recap (cont.): “*Evil Mister Fred's Whirlpool*”

- This got the attention of some ocean creatures, including a swordfish, an electric eel, a hammer-head shark, and a chain saw killer shark.
 - Up on the surface, Jack and Jill were passing by on a raft and saw the plastic bags appearing and disappearing. They got closer and asked the minions what they were doing, but the minions wouldn't tell them.
 - Jill looked under the water and saw the castle, Evil Mister Fred, and the fish hanging around.
 - Evil Mister Fred wanted to get rid of Jack and Jill, so he ordered a giant blender from the Acme Store of Everything and used it to make a whirlpool near their raft.
 - Jack and Jill's raft was being drawn into the whirlpool, and they started going around in circles.
-

Story Recap (cont.): "Evil Mister Fred's Whirlpool"



Ending:

- Jill can talk to animals, so she stuck her head under the water and yelled "Help" to the fish.
- The hammerhead shark swam up and smashed the raft so Jack and Jill were thrown clear of the whirlpool.
- Then Evil Mister Fred asked the swordfish to go and chop up Jack and Jill. In return, he would sharpen the swordfish's sword. The swordfish agreed and headed toward Jack and Jill.
- Jack yelled to the electric eel for help. The eel started swimming and also called to the chainsaw shark, so now three fish were swimming toward Jack and Jill.
- The electric eel got there first and zapped the swordfish, erasing his memory cells. His memory changed so that he now thinks he's supposed to kill Evil Mister Fred. He starts swimming toward the castle.
- Evil Mister Fred goes down through his trap door into the castle to hide. The eel follows him, but can't find him. The swordfish is hacking at the outside of the castle but can't break through. The the chainsaw fish starts chopping at the castle and cuts the top off.
- Evil Mister Fred floats out in a big bubble, and the hammerhead shark devours him.

Transcript: Intro

There's Sun. There's Earth. Earth has magnetic fields around it. North and South magnetic fields. And the Sun shoots stuff at us. The Sun is kind of a practical joker. It likes to shoot us with bullets that are really fast. They travel at about one-tenth the speed of light, and they hit us. They try to hit us anyway. And they come shooting in, and some of them get deflected by the magnetic field and come to the North Pole. And some of them get deflected and go to the South Pole. These are called charged particles, because some of them are either positive charge or negative charge.

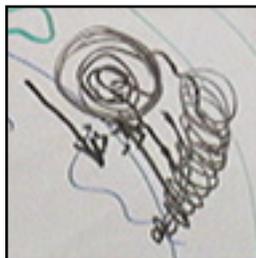
There's a little bit of charge separation, so that there's a current that flows through the Earth, and that creates our magnetic fields. So our magnetic fields help protect us from the charged particles by pointing them at penguins or polar bears. And the charged particles also create the magnetic field that deflects them, so everything balances out perfectly. It also created something called the aurora borealis, Northern Lights, or aurora australis, down at the bottom, those lights in the sky.



Thunderstorm.



Winds create Tornado.



As those charges build up on the earth, they help create thunderstorms, angry clouds, lightning bolts come down here and there, like that.

And the charged particles in the clouds can also interact with the fairly weak magnetic field. If you have a cloud and it happens to meet some wind going this way that's warm and wet, and if it happens to meet some going that way that's cold and dry, sometimes, right where they meet, they can create spinning air.

At first, the air spins sideways, like this, kind of a really slow sideways tornado. But under certain circumstances, the sideways spinning tornado can all of a sudden start bending downwards and create what we call a tornado. Tornadoes are always associated with big storms and lightning, and flying houses and cows and witches on bicycles.

Now, they had an episode on MythBusters where they wanted to find out: Is it better to leave your windows open in a tornado, or closed? And some people said, "Well, it's better to leave them open, because when the tornado comes over, it cre-



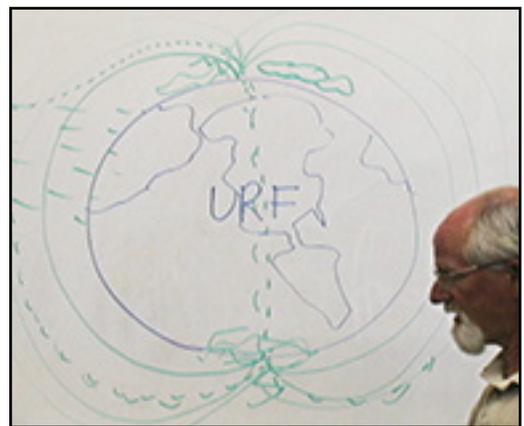
Sun and Earth with magnetic fields.



Sun shoots charged particles.



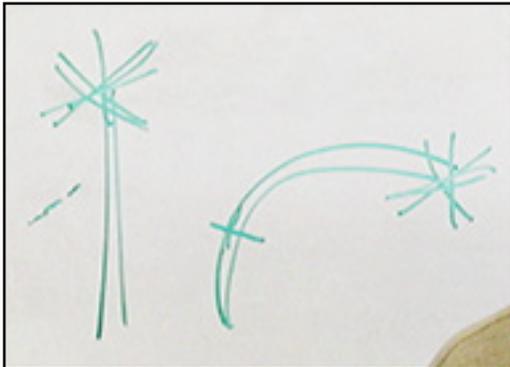
Particles deflected to N and S Poles.



Earth's magnetic current and auroras.

ates suction and can suck the roof right off your house.” So of course they did that. And it turns out that it didn't help to have your windows open. Same as being closed. A tornado didn't really suck the roofs off the houses. What it did was, the tornado contains all kinds of debris -- flying cars, cows, people, witches on bicycles, and the debris hits your house -- bam! -- breaks the windows, knocks down the walls, and blows your house away. So it's all the junk that's in there that messes everything up.

Of course, somebody said, “Hey, a tornado came by, picked up some straw, like, you know, a piece of wheat or grass, and drove it into a telephone pole or through a palm tree or something like that. And winds are three hundred miles an hour up in a tornado.



Palm tree bends in the wind and straw blows into the crack.

Well, what really happened is, if you have a tree in a tornado, would it look like that [*straight tree*] or would it look like that [*bent over tree*]? [*Students respond.*] And when the tree is bent, cracks form. And sometimes they go longways like in a palm tree, and sometimes they go sideways like other trees. So if you're a piece of straw and you're just blowing around in the wind, dum-de-dum-de-dum-de-dum, and you happen to land in the crack in a tree, and then the wind stops -- whew! -- tree goes back up, crack closes, there's the straw right through the middle of the tree. And people would say, “Whoa, that wind was so strong it drove the straw right through the tree!” No.

Demo #1: “Shoot a Pencil through Cardboard”

We can show you a simple example. I just put an air gun here, and I put some oil in it so it's slippery inside. We'll just put a pencil in there, and we're going to point it at this cardboard box. And we just point it right at the box, and it's going to come out there at about, oh, a hundred and fifty miles an hour. So let's see what it does. [*Shoots pencil at the box.*]



Put pencil into air gun.

It leaves a little bit of a hole. [*Shows pencil tip on other side.*] It didn't even break the lead at a hundred and fifty miles an hour. So the wind itself doesn't have that much power with little things, but if you get a



Shoot cardboard.



Other side.

whole car flying at the piece of cardboard, that'll hurt. If you lubricate it a little bit, just the tube [*squirts some lubricant into the airgun tube*], it lubricates the pencil, too. And it can come out a little bit slipperier. [*Shoots pencil at box again.*] It leaves an oil splotch. And still, it just barely flattened out the end of the lead.

Story: "Evil Mister Fred's Whirlpool"

Now, we need a crazy story. Once upon a time, Evil Mister Fred thought his minions needed some training. They needed to learn how to be Seals. Not the kind of seals that eat fish, but the kind of Seals that are Navy guys that go out and sneak up like commandos and put explosives underwater, and do stuff like that. They weld things underwater, and they have to be really tough. So Evil Mister Fred said, "Minions, got a job for you. We're going to go out into the North Sea, where it's really cold, and you're going to build a castle for me." The minions said, "Oh, boy, let's go build a castle!" And he said, "Under the water, on the ocean floor." And the minions said, "What??" And Evil Mister Fred said, "Yep, we're going to toughen you up."



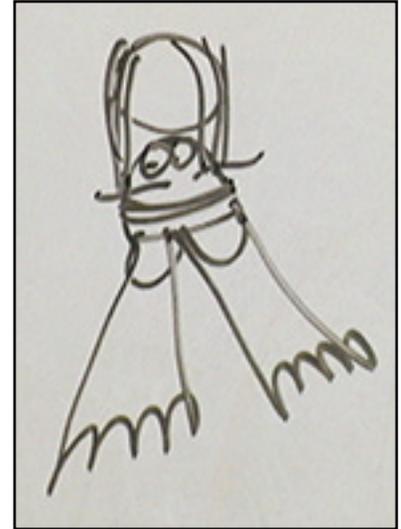
Breathing through a straw.

then burped under the water -- braaap! And all the air went into the castle. Well Evil Mister Fred didn't know that they were burping underwater. And then pretty soon he started breathing, and he said, "Ohhhh! Pizza breath! Aw, that's horrible! What are you guys doing?" And the minions said, "What? Not us. We're being good." And Evil Mister Fred said, "Okay. I got a better idea." And he told the minions to swim to the top, and he gave each of them a plastic bag. And they had

So they went to the North Sea. And here's the bottom of the ocean down here. First he put goggles on his minions so they could see underwater. And he put swim fins on them. And then he tied a big rock to their head with duct tape. Now, the minions could sink this way; otherwise they'd float. And they'd get a couple of rocks and they'd go down and they'd start building his castle. And pretty soon Evil Mister Fred had a full-fledged castle under water. His minions were learning how to hold their breath for forty-five minutes. And Evil Mister Fred, he gets to stand on his castle under the water. We'll give him a straw or something to suck air out of the castle, with bubbles, like that.

So he's underwater, they're building the whole thing, and Evil Mister Fred discovered that he's running out of air. He says, "Minions! Bring me some air." So the minions said, "Okay." Evil Mister Fred put kind of a shed on the side of his castle, like this, and the minions were supposed to swim under it and dump the air out so the bubbles would be caught by the shed, and there'd be a hole leading to the inside to fill his castle with air, and then he could breathe again when he's on the top.

The minions said, "All right!" They swam to the surface, took a big breath of air, went down, and



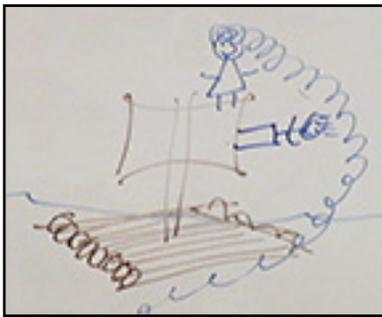
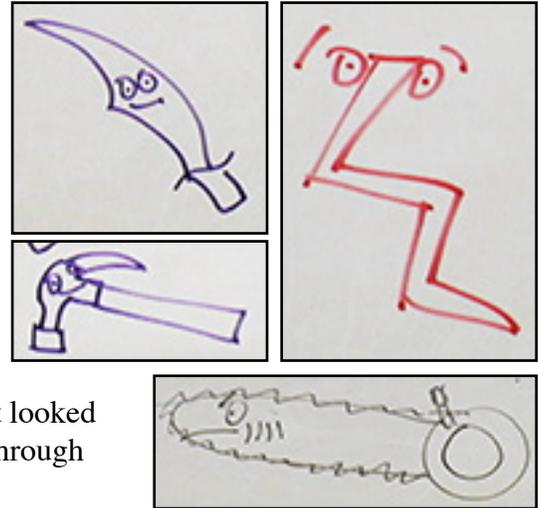
Minion with rock and fins.



Plastic bag.

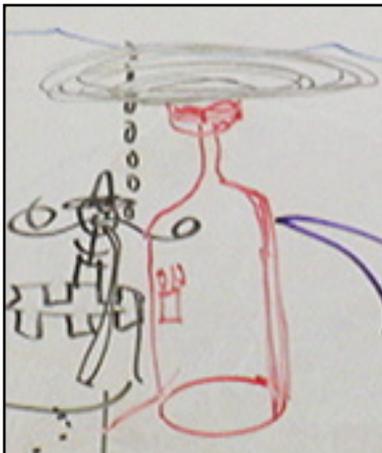
to wave the plastic bag in the air until it was full of air, and then they had to scrunch up the end, swim down, and release the air from the plastic bag. No more burping in the castle. And Evil Mister Fred now had fresh air.

So there were about fifty minions that would go up and down, and up and down with their bags, filling up the castle. Now, this got some attention. There was a swordfish that came by and saw this and wondered what was going on. There's the swordfish. He thought this was very strange behavior, but he didn't do anything. And then there was a hammerhead shark. And then there was an electric eel. And a killer shark. Could be a chain saw. There, killer shark chain saw. All these creatures were hanging around watching what was going on. They weren't the only ones. Up on the surface it looked kind of strange. Plastic bags would appear from nowhere, fly through the air, get them full of air, and disappear.



Well, Jack and Jill happened to be coming by on a raft, and they saw this. And they said, "We've got to go check that out." So they paddled over to where the plastic bags were going and said, "Hey, minions, what are you doing?" And the minions said, "Nothing! Busy! Go away, don't bother us!" And down they'd go.

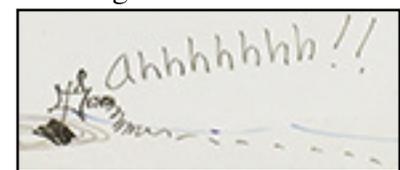
So Jill stuck her head under the water and looked, and she saw Evil Mister Fred's castle down there with Evi Mister Fred blowing bubbles, and all the fish hanging around, and the minions going up and down and up and down. And she said, "Evil Mister Fred, are you being good?" And he said, "Heavens, no!" And Jack and Jill said, "Huh!" And Evil Mister Fred said, "Oh, those busybodies. They're always trying to mess up my fun. I'll get rid of them."



Making a whirlpool with a blender.

So he called the Acme Store of Everything and he ordered a blender. This is the kind of blender that you can stick it in a glass of milkshake with ice cream and pickles and stuff. It's got an On and Off switch, and it's got a propeller on it. When you put it in the drink, you go "Rrrrrrrr," and it grinds it all up. So Evil Mister Fred hooks this up to his castle and he turns it on. And when he did, it created a whirlpool, like that. And at the bottom of the whirlpool, you'd look in there, and there's steel blades flashing around. Anything that gets caught in there gets all ground up.

Jack and Jill were on their raft, and they were being drawn into the whirlpool. And they were starting to go around in circles. If you were Jack and Jill, what would you do?



Raft caught in the whirlpool.

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 . . ."

Demo #2: "Smoke Tornado"

[Note: This is an elaborate device built by Mr. Mac. It's not required for the lesson, so we don't include detailed info on it in this Guide.]



This is a thing. It's got a rubber tire at the bottom, kind of a strange place for a rubber tire to be. It's got plastic panels. Most of them are sealed up with tape, but the bottom has edges that are open on every other one. It's got a leaf blower on the top. It's got smoke coming out of it. And it's got a flashlight up there. And we can turn on things, like *[turns on leaf blower]* we can make the fan go. We can make smoke *[turns on stage fog]*. And we can turn the light on and off. So we'll turn on the fan, and we'll give it some light, and we'll give it some fog. *[A smoke "tornado" forms in the chamber.]*

Would it be worse or better if I use higher speed? *[Increases speed of leaf blower gradually until it's very high, while the smoke spins faster and faster. Then Instructor turns off the room lights so only the flashlight is illuminating the tornado, and gradually slows down the leaf blower until it stops.]*

So now, that's doing some of the things that a tornado does, but it's not doing one thing that tornados do. It's not doing the snake dance. You know how tornadoes wiggle and wobble? So later I'm going to add some high voltage to it and see if we can -- not today, but later, like a month or two. Because it's going to take five or ten thousand volts to make it do the snake dance.



With room lights turned off.

Experiment: "Tornado in a Bottle"



[Indicates two bottles, one inverted on top of the other.] There's water there *[lower bottle]*, and there's no water there *[upper bottle]*. I want the water to go from there *[lower]* to there *[upper]*. *[Student: Flip it!]* Flip it, okay. *[Flips bottles over to reverse their positions.]* So I flip it over and it starts to snow *[referring to glitter in the water]*. Now, there's water there *[upper]* and there's no water there *[lower]*, and I want the water to go from there to there. But you don't get to squeeze the bottles.

And if you decide to swirl it or shake it, don't hold it from the middle, because when you do, this bottle *[upper]* goes *[indicates bottle falling over]* and breaks off. So if you want to swirl it or shake it, put your hand on the top and swirl it and shake it. *[Places hand firmly on top of bottle, and some bubbles rise from the lower to the upper bottle.]* What's it doing? Kind of slow. Now, there's four different kinds of bottles. Please do not unscrew them from themselves. You have to figure out which ones are different from the others. Each person is going to get one, and you don't get to swirl it, or shake it, or poke it, or squeeze it, until everybody has one. *[Passes out bottles.]*

Now, if you're less than twenty feet tall, you're probably better off standing on the table. *[Students climb onto the table.]* Okay, now make the water go from one to the other. Try to make a tornado inside, too. *[Students shake and swirl their bottles.]* Some of them should be easy. Some of them should be hard. *[After a few minutes]* Now, let's see you hand your tornado maker to the person clockwise from you. *[Students pass on their bottles.]* Everyone should have a new one now. And see if it works any different than the one you had.

[Students continue swirling and shaking their bottles. After a few minutes, the Instructor has them switch again, and repeats this until each student has used at least four bottles.] Try to make it so the tornado will start and go by itself without you always shaking it.

Have you noticed what makes some bottles lucky and some unlucky? *[Students offer suggestions.]* Have you noticed that some evil person put some ink on the bottles? Every bottle should have some ink on it somewhere.





Now, let those run all the way to the bottom if you can. Once they're empty, leave them empty at the top. *[Students let the bottles run down.]* Here's a green one that still has liquid in it. This one's a red one, still has liquid in it. Now, this time when I say go, you're going to turn them over, get them going, and once they start doing the whirlpool, don't shake it anymore. And we'll see which colors go fastest. Okay, ready, set, go. Get the whirlpool started, don't shake them anymore.

[Students invert their bottles, get the whirlpool started, and leave them alone.] And put your hand up when yours is finished, when the top is empty. There's a black one empty, another black one empty, another black one empty, a black one empty. What else is empty here? A blue one, a blue one empty, a red one empty, black one empty, red one empty *[continues to call out the colors as the bottles empty]*. Here's a green one that still has something in it, here's another green one that still

has something in it. Okay, so the greenies look like they're the slowest, the blackies look like they're the fastest, and the blues and the reddies are kind of divided between those.

Now, look carefully at the intersection between the two bottles. Stare inside. There should be a hole in there. Do the blackies have a big hole or a little hole? *[Students: Big.]* Do the blues have a medium hole or not a medium hole? *[Students: Medium.]* Do the reddies have hole that's big or small? *[Students: Small.]* What size hole do the greenies have? *[Student: Eeny-teeny.]* Teeny-weeny. So now you know the difference between all the bottles. Switch. *[Students switch bottles again.]* This time, try to make the whirlpool do a snake dance. Can you get a good snake dance with the blackies? *[Student: No.]* No, too fast.

Okay, everybody stop for a second. One of the guys in another class is a sailor. He used to sail the seven seas. He went up to the arctic, he went down to the antarctic, he went to the Indian Ocean, he went over to the Gulf of Mexico. When he was up in the northern hemisphere of the planet, the northern part where North America is, he flushed the toilet like everybody does, and watched the water. And it would swirl counter-clockwise. When he was in the southern hemisphere, by Australia, he flushed the toilet and the water would go clockwise. And when he was right over the equator, he couldn't tell which way it was going to go, or it would just go straight down without making a whirlpool at all.

Now, when you shake yours, try to make a whirlpool that goes counter-clockwise. If you look at a clock, the second hand is going clockwise that way. Try to make one that goes the opposite way of a clock. *[Students swirl their bottles.]* When you get tired of watching it go counter-clockwise, either turn it around or turn it over, and try to make it go clockwise. *[Students swirl the bottles again.]* Switch, and try the same thing with the next bottle you get. Did it work both ways? Try to make it go both directions with this bottle. Do one way, then stop and do it the other way. When you get bored with this, go in the bathroom and flush the toilet and see which way it spins.

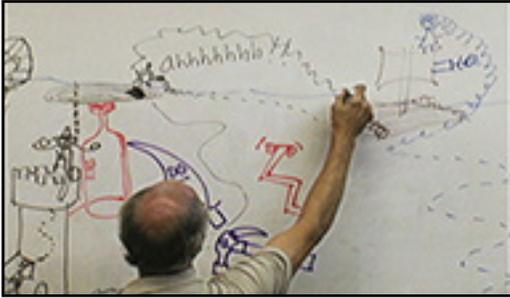
[Instructor lines up four sets of bottles, one of each color.] Okay, these are arranged according to the size of the hole. Green is the smallest, black is the biggest, red's medium, blue's a little bigger. Now we'll wait for our green guy to be done *[green bottle still has water in the upper section]*. And you'll see pretty much the same amount of water. Can you think of some way that we could tell, what kind of test could we do to see if these want to spin one way more than the other? *[Students offer suggestions.]*

Well, let's just turn them over and see if they start spinning on their own. So you'd have to turn it carefully so that you don't accidentally start it going. And see if it will spin without us doing anything to it. *[Instructor carefully inverts each of the bottles.]* So, the black one didn't spin on its own. The blue one is bubbling, the red and the green don't have enough oomph to make them go. There's turbulence in there, you can kind of see the glitter move around, but there's so much surface tension, it can't start. Now, MythBusters did this. They got a great big bowl, perfectly spherical bunch of bowls, and they went places and they let the water run out. And they discovered that it was purely random. Northern hemisphere, they could go clockwise, they could go counter-clockwise. Southern hemisphere, they could go clockwise, or they could go counterclockwise. On the equator itself, they could go either way. So there really wasn't any preference according to the earth's gravitational field, magnetic field, electrical field, or birds flying around in your heads.



End of Story

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



So Jack and Jill are on their raft. And their raft is trapped in the whirlpool. And they're screaming, "Ahhhhhhhh!" And Jill sticks her head under the water and screams, "Help!" She can talk to fish. Down there is a hammerhead shark, a swordfish, electric eel, and a killer shark, a chain saw shark. And the hammerhead shark came to the rescue. He swam as fast as he could, swam up there, saw Jack and Jill going round and round in circles, and he smashed their boat to bits. All the logs went flying everywhere, and Jack and Jill, who were on the sail,

floated up into the air and were carried away from the whirlpool.

And Evil Mister Fred said, "Aw, well that's not any good. I don't like that." And then the swordfish swam over to Evil Mister Fred and said, "What's up, Evil Mister Fred?" And Evil Mister Fred said, "I need some help. See those two people up there drowning in the ocean? Can you go chop them up for me?" The swordfish said, "Well, what's in it for me?" And Evil Mister Fred said, "Well, I'll sharpen your sword for you." And the swordfish said, "Cool!" So he's swimming over to chop up Jack and Jill.

And Jack and Jill saw the swordfish coming with a gleam in his eye. And they said, "Uh-oh. He looks likes he's in for trouble." And Jack yelled to the electric eel, "Electric eel, we need help right away!" And the electric eel started swimming after the swordfish. And the eel called to the chainsaw fish, "Chainsaw fish, we need help!" And the chainsaw fish is now following the electric eel. So there's a parade of fish going towards Jack and Jill, two to rescue them and one to chop them up.

Well, which one should get there first? *[Students: The eel.]* The electric eel gets there first and zaps the swordfish -- bzznnggg! -- which erases his memory cells and changes his memories completely. And now he thinks he's supposed to kill Evil Mister Fred. And so the swordfish turns around and is heading toward Evil Mister Fred. Evil Mister Fred says, "No, no!" and goes down the trap door into his castle. Who's following the electric eel? *[Students respond.]* The chainsaw fish, and I wonder if the hammer guy's anywhere near? First the electric eel goes in, and he can't find Evil Mister Fred. The swordfish is hacking at the castle but can't break through. Then the chainsaw fish comes along and starts chopping away at the castle -- bshhhhhhhh! -- and cuts the top off. And the top falls off, Evil Mister Fred floats out in a big bubble, and now one of them is going to devour Evil Mister Fred. *[Students shout their preference.]* The hammerhead is elected to devour Evil Mister Fred. And they all lived happily ever after, except 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.