



## Teacher's Guide for: **Liquid Density**

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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Liquid Density  
A Rock-it Science Lesson  
Filmed December, 2009

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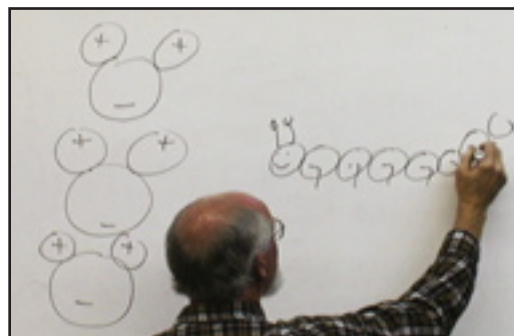
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## Intro Quick Recap:

- Chemists and physicists use the word density differently than most people.
- If you have two rocks the same size, the one that's heavier should be more dense.
- Teacher has two "rocks," but only one is real. The other is made of foam. Throw the foam rock to a student to catch. Then have the student crush it in his or her hand to show that it's not a real rock.
- The real rock is more dense than the foam because it weights a lot more for the same size.
- Gases can have different densities, too. If you put helium in the air, it goes which way? Up or down? Helium's a lot less dense than the air around us.
- You can also do it with liquids.
- Show students a clear plastic bottle with two different colors of liquids inside, blue and yellowish. Flip it over to show how the contents remain separate and the lighter one stays on top.
- Then show students a second bottle with two liquids of the same colors as the first bottle, but in reverse position. Tilt it to show how the contents move.
- In the first bottle, the blue liquid is water and the yellowish liquid is soy-bean oil.
- In the second bottle, the blue liquid is alcohol, and the yellowish liquid is soybean oil.
- Alcohol is less dense than water, and if you put a little bit of water in the alcohol, you can make it the same density as the oil. So it behaves like a lava lamp. The third bottle contains clear oil, and the blue liquid is alcohol mixed with a little bit of water.
- It's not the weight or density of the liquids that makes them behave this way.
- Draw diagram of "Mickey" water molecules showing static electricity as plus signs on their ears and minus signs on their chins. The molecules line up ears-to-chin because the negative guys like positive guys.
- So water molecules like to line up like magnets and stay tight together.
- Oil molecules don't have positive and negative on them. They look like caterpillars. And they get pushed around by the water guys. The water guys hang tight together and keep the oil away. That's why the liquids settle down fairly quickly when you mix them.
- Show students a three-layered bottle (red, white & blue): water, cooking oil, and brake fluid. Ask students to guess which one is the brake fluid.
- Red is the water (bottom), blue is cooking oil (top), and brake fluid is white (middle).



Water and oil.



Molecules of water and oil.

## Experiment Quick Recap: "Liquid Density"

### Part 1 -- Three-layered cups.

- Students work in groups of two. Each group gets an aluminum roasting pan and a clear plastic cup with a CD glued to the bottom, for stability.
- Teacher pours some water into each cup, then goes around again and pours in brake fluid, then adds cooking oil.
- Then the Teacher puts five drops of food coloring in each cup. The droplets don't dissolve right away. They sink slowly through the layers of oil and brake fluid and only disperse when they hit the water at the bottom.
- Teacher sets out several clear plastic cups containing various small lightweight objects such as Legos, corks, rubber bands, etc. These will be placed in the cups to see where they end up (what level).
- One of the items we used was a plastic "minion," a manufacturing castoff that just happens to be shaped like a minion. Students each get one and draw a face on it with permanent markers.
- Ask the students to vote on which item they think will sink to the bottom. Then ask them to vote on which one will stay at the top.
- Teacher selects one type of item at a time and lets students drop one into their cup. If the item holds any air bubbles, students will need to push it down to the bottom with a wooden skewer, then see how high it rises.
- Teacher repeats the process for each of the different items, giving students time to push each one to the bottom before dropping in the next one.
- Ask students where the various items ended up in their cups, compared to what they predicted.



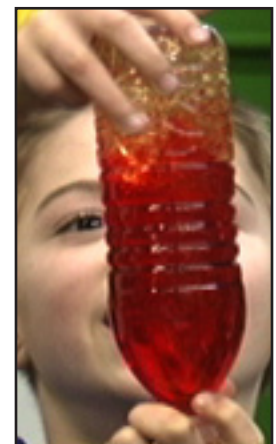
Three layers of liquids.



Objects to drop into the cup.

### Part 2 -- Two-layered bottle

- Each student gets a 1/2-liter bottle of water. They need to either drink or dump out about half of it.
- The teacher fills the remaining space in the bottle with soybean oil.
- Each student gets to choose what color food coloring they want in their water, and the Teacher puts it in.
- Students can also put their minion in the bottle.
- After putting the lids on tight, students can turn the bottles this way and that to see what happens to the liquids.



## Equipment List: "Liquid Density"

### Items needed for Instructor:

- Rock, about fist-sized
- Fake foam rock, same size as real one
- Plastic bottles, clear, about 1-qt. size (4 ea.)
- Food coloring, preferably at least 2 colors
- Soybean oil, about 2 quarts for demonstration bottles.
- Clear oil (about 1/2 quart for demo bottle)
- Dot 5 Silicone Brake Fluid (must be high-quality silicone, not regular brake fluid). About 1/2 quart for demo bottle.
- Water, about 2 quarts for demo bottles.
- Rubbing alcohol, about 1 quart for demo bottle.
- Pitcher for pouring oil.
- Bucket, 5-gal
- Cups, clear plastic, 16-oz. (about 8-10 for small items)

### Items needed for Students:

#### Consumables (per student):

- Water for cups, about 8 oz. per student
- Soybean oil, about 1/4 liter per student
- Dot 5 Silicone Brake Fluid (about 1 oz. per student)
- Bottled water, 1/2-liter size (1 per student)
- Wooden skewer (1 per student)

#### Other (per group of 2 students):

- Aluminum roasting pan
- Cup, clear plastic, 16-oz.
- CD
- Lightweight objects to place into the cups. We used corks, rubber bands, Legos, army men, plastic "minions" (manufacturing castoffs), wooden wheels, and bouncy balls. (One of each per group.)
- Scissors
- Markers, permanent, colored

### Prep Work:

- Glue CDs to the bottom of plastic cups, for stability.
- Place lightweight items in clear plastic cups.

### Prepare demo bottles:

1. Soybean oil, and water colored blue (can be any color).
2. Soybean oil, and rubbing alcohol. Alcohol should be the same color as the water in the first bottle.
3. Clear oil, and rubbing alcohol with a little bit of water added to the alcohol. Alcohol should be the same color as the water in the first bottle.
4. Water (red), soybean oil (blue), and brake fluid (cloudy white).



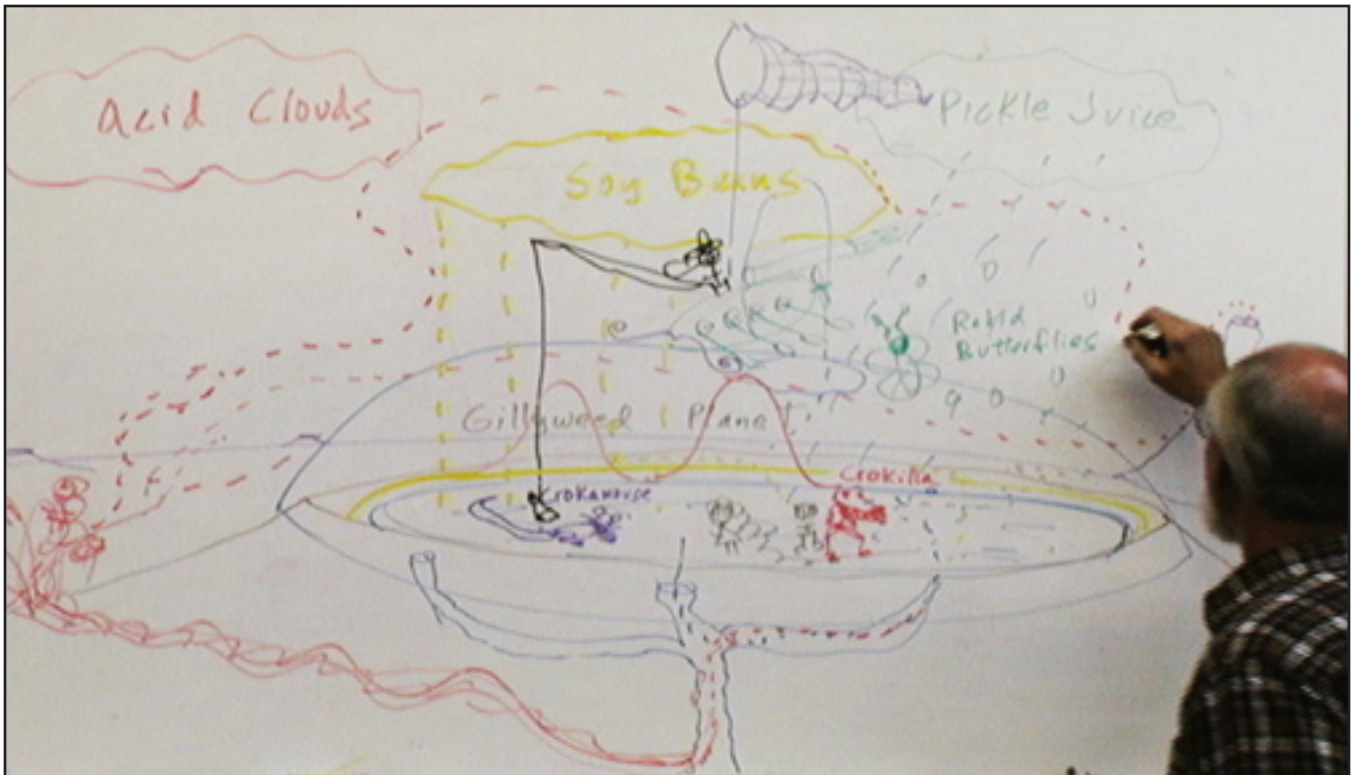
## Story Recap: "Jack & Jill and the Volcano Lake"



### Part 1:

- Jack and Jill went to a planet where there were a lot of volcanos. One of them had a lot of tunnels underneath and a lake on top.
- This was the Gillyweed Planet, so Jack and Jill ate the gillyweed, which gave them gills so they could breathe underwater.
- There were odd creatures, including a crokamouse (crocodile-mouse), a crokilla (crocodile-gorilla), and rabid butterflies.
- Jack and Jill were swimming in the lake with the crokamouse and the crokilla.
- Evil Mister Fred flew by on his vacuum cleaner and wanted to capture the creatures.
- He called the Acme Store of Everything and ordered a fishing pole. He put cheese on the hook, and the crokamouse bit it. But his teeth were so sharp he bit right through the hook, so Evil Mister Fred didn't catch him.
- Then Evil Mister Fred ordered a big net on a pole and snatched up the crokamouse in it. But the crokamouse chewed through the net and part of the pole and nearly ate Evil Mister Fred, so he had to drop the net and let him go.
- Then he transformed his vacuum cleaner into a submarine, with the minions rowing it from the inside. There's a rocket engine on top, and he can go in the air and under water.





### Ending:

- Jack and Jill ordered a big net to put over the lake to protect the creatures, but Evil Mister Fred turned his rocket engine vertically so the flames burned right through the net.
- He took his submarine into the lake and was chasing after the creatures, who tried to hide in the caves.
- Jack and Jill made the soybean oil cloud start raining, making a layer of oil on top of the lake.
- The crokilla could swim in the oil and go back down to the water when he needed to breathe.
- Evil Mister Fred took his submarine up into the oil layer, and it was hard to move around because it was thicker than the water. They got stuck between the layers and couldn't break through.
- Evil Mister Fred fed his minions super energy juice to make them row faster. The submarine popped up into the air and started chasing creatures again.
- Jack and Jill made the other cloud rain pickle juice, which is silicone oil. It settled between the water and the soybean oil. But it wasn't enough to stop Evil Mister Fred.
- Jack and Jill and the creatures went down into the tunnels and found a deep one that had a branch that went sideways. It opened up in a fountain on the side of the volcano. They were all thrown up into the air and then went running across the plain to get away from Evil Mister Fred.
- Evil Mister Fred followed them into the tunnel, and his submarine was also squirted high into the air. The rabid butterflies saw him and started chasing him.
- Evil Mister Fred flew his submarine into another volcano to hide, thinking it was another lake, but it was actually hot lava.

## Transcript: Intro

Have you ever heard the word “density” before? *[Students: Yes.]* My brother used to say I was dense. Chemists and physicists use the word density a little bit differently than most people. So we’re going to talk about density today and about something else.

If you’ve got rocks and you want to find out which one is more dense than the other one *[picks up two rocks and knocks one against the table a couple of times so it makes a noise]*, you can kind of feel them. The one that’s heavier should be more dense if they’re about the same size. One’s harder than the other. Do you guys like rocks? *[Students: Yes.]* Anybody here play baseball? *[Students: Yes.]* Who plays baseball? *[A student raises his hand.]* Okay, can you catch? *[Student: Yes.]* Okay, here, catch! *[Teacher throws one of the rocks toward the student, who tries to catch it.]* Now, just by receiving that rock, he’s turned into Superman. He’s so strong he can hold that in his hand and crush it with his bare fingers. *[To student]* Hold it up and crush it. *[Student does so.]* He’s Superman and he crushes it. *[Students realize the “rock” is made of foam.]* Ohhh, it’s foam! *[Holds up other rock.]* Is this one foam? *[Students: No!]* Yes. This one is a lot more dense because it weighs a lot more than the foam does for about the same size.



Two rocks (one is foam)

And you can have different density of gases, too. The air around us has about the same density of nitrogen and oxygen, but if you put helium in there, helium goes what? Up or down? *[Students: Up.]* Up. Helium’s a lot less dense than the air around us.

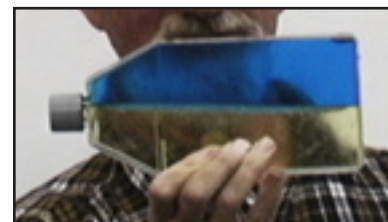
You can also do it with liquids. If you have something like, oh . . . *[Holds up a bottle with two colored liquids in it, blue on the bottom and yellow on top.]* Here, we have two liquids in this bottle. *[Student: Corn syrup and not corn syrup.]* One of them isn’t corn syrup, and the other one isn’t corn syrup. Oh, no. If I turn the bottle over, will the liquids stay where they are? Will the blue go to the top and the yellowy stuff go to the bottom? *[Students: Yes.]* Yes? Okay, here we go. *[Flips bottle over, and liquids reverse position.]* *[Student: It’s like a lava lamp!]* It’s like a lava lamp.



First bottle: Water & soybean oil

So which one is more dense? The yellowy stuff or the bluey stuff? *[Students: Blue.]* Yes, the bluey stuff is more dense. If we turn it this way . . . *[rotates bottle repeatedly so contents get interspersed a bit]*. One of them is water and one of them is not. Which one do you think is the water? *[Students: Blue. Top one.]* We have some votes for blue. We have some votes for yellow.

Well, how about this one? *[Brings out another bottle. This one has blue and yellow liquids in the opposite positions, blue on top and yellow on the bottom.]* If I turn this one on its side . . . *[Rotates bottle halfway, and liquid reorients itself so blue is still on top., then tilts it back and forth.]*



Second bottle: Alcohol & soy oil

They can make waves inside. Pinocchio's dad was on a boat out on the ocean, and he was swallowed by a whale, right? Gepetto. His name was Gepetto.

Well, there's no water in this container. *[Student: It's oil.]* One of them's oil. On of them's not. The yellow stuff is oil, that's soybean oil. You know how they make soybean oil? *[Student: Squeeze soybeans.]* Yep, you squeeze soybeans. So obviously, if you have baby oil, you . . .? Squeeze babies. *[Students laugh.: No!]* No? This is wrong? *[Students: Yes!]*

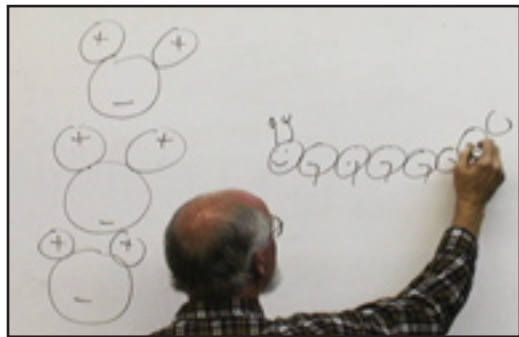
Well, the blue stuff in this one isn't water. The blue stuff happens to be rubbing alcohol, and soy oil. In this one *[first bottle]* the blue stuff is water and this stuff is soy oil. When you mix soy oil with water and leave it for a long time, it turns all cloudy like that. So you have those two.

What if you mixed some of the alcohol with the water? *[Brings out another bottle, with blue on top and a clear liquid on the bottom.]* We've got some clear oil in this one because it looks better. Now *[rotates the bottle, but the liquids do NOT immediately change positions]*. Alcohol is less dense than water, and if you put just a little bit of water in alcohol, you can make it the same density as the oil. Which is pretty cool. And this can be a lava lamp. If you put it under a hot light bulb, just before the plastic bottle melts, it starts acting like a lava lamp. And then it leaks and drools all over the lightbulb. *[Rotates bottle so that the blue liquid starts to float upward in clumps like a lava lamp.]* It's kind of neat the way that gushes around. You don't really need a lightbulb to make it work. It's more fun to do it in your hands. There, now we have some planets floating around.



Third bottle: Clear oil and alcohol with water.

I looked this up online to see what it was all about, and they say it's not the weight or the density of the liquids that makes them act like they do. There's something else that makes them act like they do. That something else is the fact that water acts like a bunch of magnets. Water guys like each other. Remember, I showed you once what a water molecule looks like? *[Student: Mickey.]* Yeah, it looks like Mickey Mouse. They have



Water and oil molecules

static electricity on their ears that's positive, and static on their chins that's negative. So if another Mickey shows up, he'll want to sit like this with his ears as far as possible from the other guy's ears, and his chin resting by the other guy's ears, because the negative guys like positive guys. And so a whole bunch of Mickeys in water will tend to stick tight together like a bunch of magnets. Oil molecules looks like caterpillars. And they don't have positive and negatives on them. And they get pushed around by the water guys. The water guys all want to hang tight together, and they shove away the oil guys. That's why the water stays separate from the oil.

*[Holds up the first bottle and tilts it.]* Like that. So the water guys here stick to each other. The alcohol guys *[holds up second bottle]* also have charge on them, and they stick together and keep the oil away. So these kinds of things will settle down fairly quickly when you mix them.





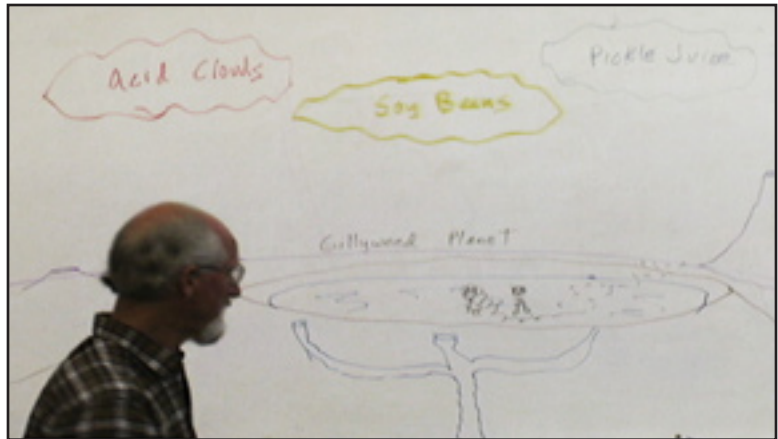
Fourth bottle: Oil, water, brake fluid.

Now, I wanted something else, something patriotic. I wanted three layers [*holds up a bottle with red on the bottom, cloudy white in the middle, and blue on top*]. It took four hours of Googling to find what we could use for our third layer, because it's not something that most people care about. [*Tilts bottle back and forth to show how the liquids tend to stay separate.*] One of these is water, one of them is cooking oil. The other one is brake fluid. What do you think -- brake fluid red? Well, we've got a nice mixture. [*Student: What is brake fluid?*] Brake fluid in your car, when you push on the brake pedal, there's a pump in there, and it pumps some brake fluid

into pistons that shove pads against the brakes on your wheels and makes your car stop. In this case, red happens to be water, this is cooking oil [*indicates top blue layer*], and that's brake fluid [*indicates clear middle layer*]. But some thing bizarre happens that you'll find out later in the experiment. But first, we need a crazy story.

## Story: "Jack & Jill and the Volcano Lake"

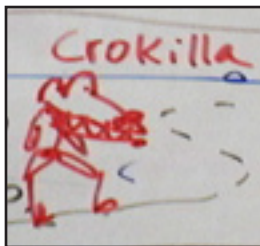
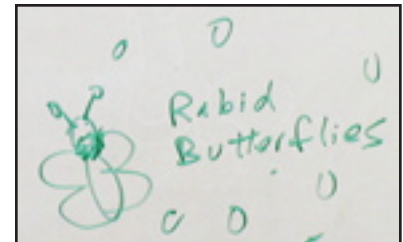
Once upon a time, there was a volcano on this planet. And there were other volcanos on this planet, way off in the distance. Volcanos all over the place. And there were clouds up in the sky, of sulphuric acid. And there were clouds in the sky made out of pickle juice. And we need some other kind of clouds. We've got clouds made out of soybeans, like that. And in this particular volcano, it had a lake in it, like that. And the volcano -- if you've ever seen volcanos, there are tunnels inside of volcanos. When the lava goes up through a volcano, it creates a chamber inside that spews out. And then when the lava goes back down, it leaves tunnels all over the place. There are tunnels in this thing that go various places. This one has just got three arms on it. And this one's all full of lava, because there's water on the lake.



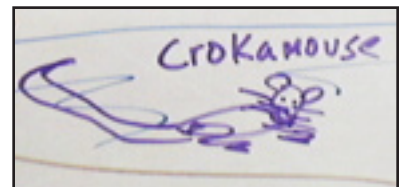
Volcano lake with clouds of acid, soy beans, and pickle juice.

And Jack and Jill are going to go visit the volcano for a holiday. *[Student: What's this planet called?]* This is called Gillyweed Planet. Whoever goes there, they have to eat gillyweed. You know what happens when you eat gillyweed? *[Student: You get gills.]* Yeah, you get gills, like fish have. So now Jack and Jill can swim underwater, and they can breathe whatever's in the water, because they've got gills, like a fish does. Instead of the gill on their neck, let's put the gills on their heads. So it looks like he's got hair, like that there.

And Jack and Jill are there to go swimming and play with the creatures that live there. What kind of odd creatures should live at this place? *[Students: Mouse. Whatever flies, with rabies.]* Whatever flies, with rabies. Okay. There's butterflies. They have rabies. They have foam coming out of their mouth. So there's rabid butterflies.

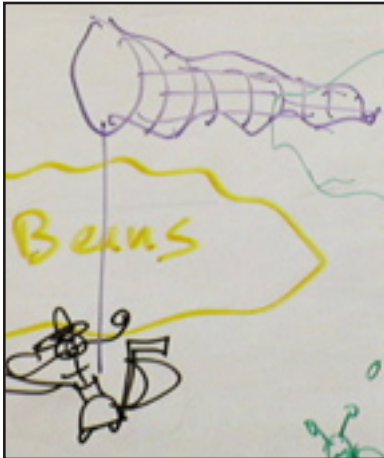


We need some creatures in the water. *[Students: A crocodile with a mouse head. A crokmouse. We need one more. [Student: A crocodile gorilla.]* A crocodile gorilla. There's a crocodile head on a gorilla body. There. So that's a crokilla.



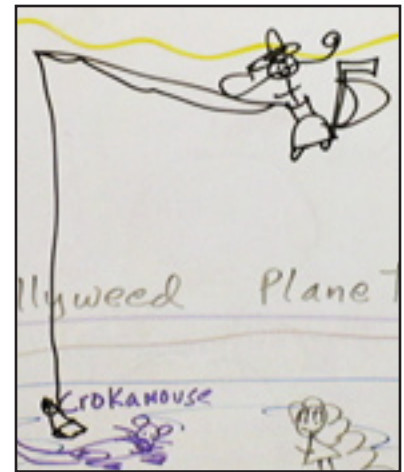
So Jack and Jill are there with all these crazy creatures, having a great time. And Evil Mister Fred happened to fly by on his vacuum cleaner and saw Jack and Jill playing with these weird creatures. And he said, "Wow, I've got to catch some of those." So Evil Mister Fred called the Acme Store of Everything and got a fishing pole. There, like that. Now he's got a fishing pole. And he didn't know what they ate. So he put some cheese on the end of it. And the crokmouse saw the cheese floating down there in the water and swam over and ate it. Well, the mouse, even though he has kind of a mouse head, he has very

sharp teeth. And he chomped right through the hook and cut the hook in half. So Evil Mister Fred rolled it back up and lo and behold, no hook on it. He says, "Darn! Took my hook. Need a better way to catch those things."

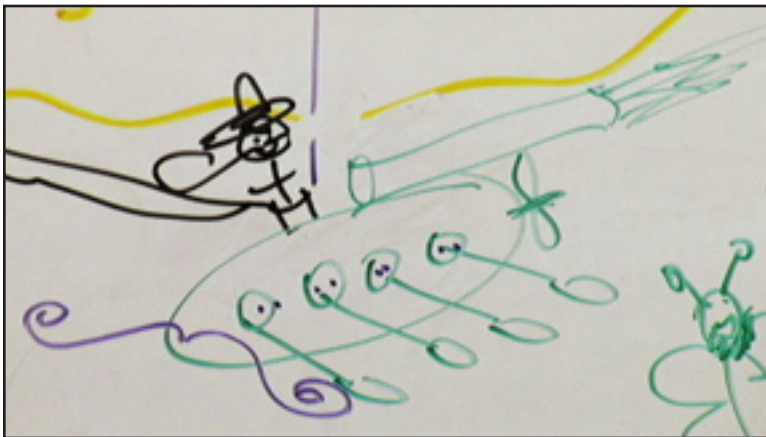


Evil Mister Fred's net.

He called the Acme Store of Everything and he ordered a big fish net. So he swooped down and he caught the crokamouse in a big fishnet. And he gave the vacuum cleaner full power -- vroom -- zoomed up in the air, and the crokamouse is in there busy eating the fishnet -- chomp, chomp, chomp, chomp, chomp. He's got strong arms and legs. He started climbing up the handle towards Evil Mister Fred. And he had just chomped off one of Evil Mister Fred's mustaches, and Evil Mister Fred decided he'd better let him go -- whoosh, back into the water.



Evil Mister Fred's fishing pole.



Evil Mister Fred's rocket-powered submarine.

And the crokamouse and the crokilla said, "Hey, you know, that guy's not going away. He's going to try and catch us." And Jack and Jill said, "We need some protection from him."

Well, they didn't know what he was going to do next. Next thing they saw, Evil Mister Fred had transmogrified his vacuum cleaner into a submarine. And it's got oars sticking out, and minions inside. There are portholes there. And he's got a rocket engine on top. And now he can go in the air,

and he can go underwater, and he's going to catch these guys. Jack and Jill said, "We've got to stop that Evil Mister Fred from catching us with that machine he's got, whatever thing that is." We'll put some minion eyeballs in there.

Now, if you were Jack and Jill and you've got to protect all the creatures on this planet from Evil Mister Fred, what would you do?

### Imagination and Brainstorming Time

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

We'll leave this To Be Continued . . .

## Experiment: "Liquid Density"

### Experiment, Part 1 -- Floating Objects in Liquids

We have two experiments to do. For the first experiment, we're going to put three different liquids into a cup, and then we're going to put stuff in the liquids to see what they do. The liquids are all gushy, so we're going to put the cup in a tub. *[sets the cup in an aluminum roasting pan.]* And we're going to pour in some water first from these water bottles *[pours water into the cup]*. You want it about a quarter full with water, maybe three fingers, three of your fingers worth of water in there. You can use any fingers you like.



Clear plastic cup with water three fingers high. Cup has a CD glued to the bottom for stability.



Top: soybean oil; Middle: brake fluid; Bottom: water

Then we'll put in some brake fluid *[pours it in.]* That's brake fluid. It has to be about one finger, or maybe a finger and a half of brake fluid. *[Student: Where do you get it?]* Where do you get brake fluid? This is called DOT-5 Silicone Oil Brake Fluid. You can get it at Kragen's or PepBoys. Ordinary brake fluid won't work. You say you need the most expensive brake fluid they've got in the store. That's what that stuff is. It has to be silicone oil.

And then on top of that, we'll put in some soybean oil. Imagine how many beans sacrificed their lives so that we could play with the soybean oil. *[Pours oil into cup.]* And you want about a finger or two of soybean oil. Now we've got three layers.

But the water layer isn't as colorful as we'd like. *[Student: Food coloring.]* Let's add to it a bit of food coloring. So we'll just put in five drops -- one, two, three, four, five. *[Drops of food coloring sink slowly through the two top layers without dissolving, then dissolve suddenly as soon as they reach the water.]*

You need to pick a partner to work with. Send somebody from your group to get one of these cups. Now, we need to add some water to those things. *[Teacher pours water into each group's cup.]* Let's put them in in the wrong order. Let's put in the cooking oil next. *[Student: Put in the food coloring.]* Oh, no, we need to put in the food coloring last, to mess it up. *[Teacher pours oil into each cup, then adds the brake fluid. The oil floats to the top.]*

Now that you've got this stuff, we're going to add food coloring. *[Teacher adds five drops of food coloring to each cup, with the drops spaced out. Students watch the color blobs slowly drop and finally burst*



Food color drops don't spread out until they reach the water.



through to the water level.] *[Student: It's like an upside-down volcano.]* Yeah, if you don't disturb it, it makes like an upside-down volcano.

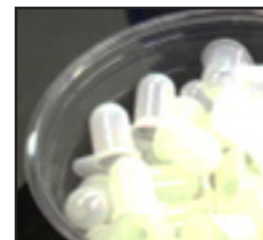
Over here we have some ordinary boring nylon cubes in a cup. We have some ordinary boring corks in a cup. Some ordinary boring rubber bands in a cup. Some ordinary boring Legos in a cup. Some ordinary boring pink army men. It's got to be embarrassing if you're an army man and you have to wear a pink suit. Some ordinary boring minions with no faces. You've got to have a face on your minion *[draws eyes and a mustache on the "minion" with a permanent marker]*, and some mustache. There. So now you have minions with a face. And some ordinary boring wooden wheels. And some ordinary boring bouncy balls.



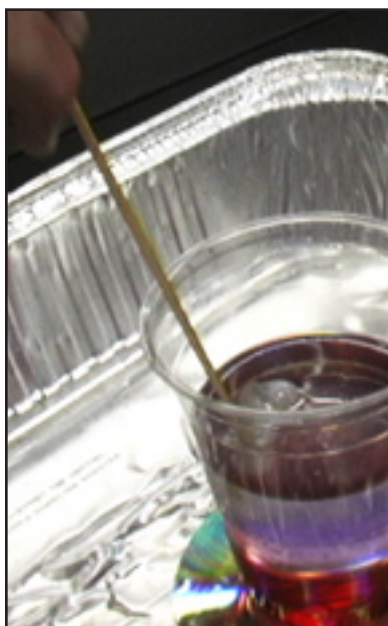
Small lightweight items.

Now, what we want to do is put them in one at a time and see where they sit. Will they all go to the bottom? Will they all go to the top? Now, before we put them in, we want to vote. Of course, we determine the laws of nature by voting. Let's just pick the one that you think will go to the bottom. You're going to vote by showing your hands. How many people think this one will go to the bottom? *[Holds up each cup of objects in turn for students to vote on.]* Now we're going to vote for the one you think will stay on the top. *[Repeats same process.]* Okay, so we'll just randomly do it, then you'll find out what's going to go in there first. You'll put them in yourselves.

Let's give you minions first. When you get a minion, *[draw a face on it]*. After you've colored your minion, drown your minion. *[Each student gets their own minion, even though two people share a cup.]* Do not put the marker pens in the liquid. If the oil gets on the marker pens, they cease to become marker pens.



Our "minions" are just manufacturing castoffs.



Use skewer to push items down.

*[Students color their minions, then drop them in their cups.]* You're going to need a poker. Sometimes stuff gets caught in a minion, like air bubbles. *[Gives each student a small wooden skewer.]* So if this is your minion helper, you're just going to poke him and shove him down and try to poke him around until he goes all the way to the bottom or wherever he's going to go. Once you have your minion down, take your sticks out. Once he's dead, just let him go to where he's going to go.

Next is going to be rubber bands. Put your rubber band in. Same sort of thing. After you put it in, push it all the way to the bottom and see where it goes after that. *[Students push rubber band down.]* Nobody predicted that the rubber band would go to the bottom, but alas and alack, there it sits. If you poke it all the way down, it stays down. *[Teacher passes out each of the other items in turn, giving students time to push them down before handing out the next item. After each one, the Teacher reminds them of how they had voted regarding that item.]*

[After students have added all the items to their cups] Okay, put the sticks in the tub and push all the tubs to the center of the table. We're going to let those sit and see if they change while we do experiment number two.

### Experiment, Part 2 -- Two-Liquid Bottle

For experiment number two, you need to dump out some water [holds a 1/2-liter bottle of water]. It's better if the label isn't on there [cuts the label off]. We'll take the labels off. And count down from the top one groove, two grooves. You need to make the water disappear down to the second groove. You can drink it, or you can pour it into that white bucket over there. Everyone needs a bottle. This one you don't need a partner for, so come over here and get a bottle. There are scissors over there. Put the label in the garbage can. One per person. [Each student gets a bottle, cuts off the label, and either drinks or pours out the extra water.]



Items in cup float or sink at various levels.



Students line up to get food coloring.

Then you get to decide whether you want red food coloring in it or blue. Line up here and tell me what color you want. [Students line up to have the Teacher drip food coloring into their bottle.]

Okay, take the lid off [Teacher fills the bottles to the top with soybean oil.] Put the lids back on. Oh, wait a minute. Before you put the cap back on, put a minion inside. [Students fish the minions out of their cups and drop them into their bottles.] [Students put the caps back on their bottles and turn the bottles into different positions to see what happens.] Make sure your lids are on tight.

Now, if you look at your minion, is your minion more dense or less dense than water? [Students: More. Less.] Looks like he's a tiny bit more dense than the cooking oil, because most of the minions look like they're kind of sitting at the bottom of the cooking oil.

[Note: Our "minions" are just manufacturing castoffs that happen to be similar in shape to a minion. You can use one of the other small items from the lesson, preferably one whose density keeps it suspended between the oil and the water levels.]



## End of Story

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

Evil Mister Fred now has a rocket-powered submarine, and his plan is to go and steal some crocomice and some crokillas and some other creatures living down in the volcano lake. And Jack and Jill say, "We've got to protect the animals. It's our obligation to make sure that they don't become endangered species because of that Evil Mister Fred. So they said, "We'll call the Acme Store of Everything and put a net over the volcano." So they got a big net, and they put it over the volcano, like that.

And Evil Mister Fred said, "Huh! They think they can stop me with a net." He just took his rocketship down, turned it and pointed it straight up, and gave it the power button -- vooomm!! Flames shot out of the back and melted a hole in Jack and Jill's net. And Evil Mister Fred zoomed right through the hole and said, "Mwa-ha-ha!" And ker-splloosh! Down he went into the lake.



Soybean rain makes a layer of oil on the lake.

Now he can go really fast because he's got all these minions paddling, he's got propellers, and he's zooming around trying to catch crocomice and crokillas. And the crocomouse went down into the caves, and the crokilla went down into the caves. And Evil Mister Fred said, "They can't hide from me. There's no place that I can't go."

And Jack and Jill said, "We've got to do something fast!" So they called the Acme Store of Everything and they said, "Acme Store of Everything, we need it to rain soybean oil." So it started raining soybean oil. So now, it created a layer of soybean oil on top of the lake, like that. And they told the

crokilla, "Hey, crokilla, swim up into the soybean oil and see what happens."

So when Evil Mister Fred wasn't there, he swam up inside the oil and says, "Hey, I can swim around in here really cool. This is great. Except I have to go down to breathe under the water, because there's no oxygen in the oil." So he'd go up into the oil, swim around, and go, "You can't get me, Evil Mister Fred!" And then he'd zoom down in the water and get away from Evil Mister Fred.

And then Evil Mister Fred took his submarine up into the soybean oil. And now it's really thick, and his minions are trying to oar. "This is hard work, Evil Mister Fred! It's hard to get out of." And they got right between the layers, between two oils, and they couldn't break through. They couldn't go up any higher because there was air above them, and they couldn't go down because there was stuff between the layers of the water and the oil. And Jack and Jill said, "Boy, that's pretty good! Evil Mister Fred's stuck! I like that. I wonder what he's going to do now."

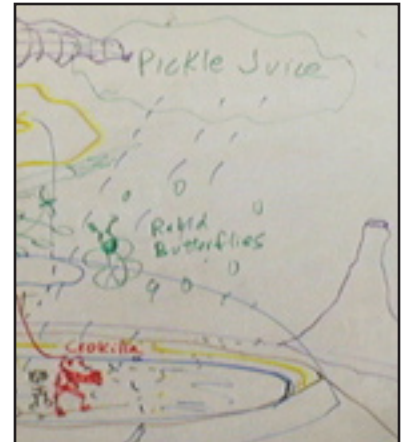
So Evil Mister Fred said, "Aw, we'll fix that." And he said, "Minions, drink this." And he gave them super energy juice. And now they started to paddle really fast. And the submarine shot out of the air like a porpoise jumping out of the water. And now he can chase them around again.

And Jack and Jill said, "Okay, let's try some thing else. Acme Store of Everything, we need a rain of pickle juice." Which happens to be silicone oil. And the pickle juice came down and settled between the



water and the soybean oil and created another layer. And Evil Mister Fred said, "Ha! That can't stop me. I've got plenty of energy juice. My minions can row through that perfectly." And then Jack and Jill said, "You know, he's right. He's going to be able to get us. He's sneaky. He's rotten. We're going to have to go down into the caves."

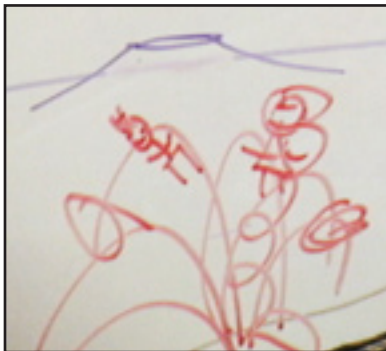
So Jack and Jill and the crokmouse and the crokillas, all the creatures went down in the cave deep under the ground. And they found a chamber underneath that led sideways, this way and that way. And they were going as fast as they could, swimming through the water sideways. And they said, "Whoa, we think we might be able to get out there." And there was a fountain out there, water squirting through the air. And Jack was thrown up into the air, Jill was thrown up into the air, and the crokilla and the crokmouse. Oh, we forgot to use the rabid butterflies.



Pickle juice rain adds a new layer.



Jack and Jill and the creatures went through the tunnels.



They squirted out the fountain.

So Jack and Jill came up -- crocodiles can live above the ground, and so can a crokilla. So Jack and Jill were running like crazy across the plain, trying to save their lives. And Evil Mister Fred went down the same tunnel with the submarine, shot through the air -- poof! And now he's flying through the air, and the rabid butterflies saw him. And they started flying, "Oh, boy, look at that! Evil Mister Fred!" And Evil Mister Fred and his submarine popped out, was flying through the air, and the rabid butterflies saw him and said, "Ooh-hoo, Evil Mister Fred! Let's go chew on his ears!" And the butterflies all flew over as fast as they could. And Evil Mister Fred said, "Nooooooo, not butterflies! Anything but that!" And he zoomed off as fast as he could, up over the soybean clouds, past the pickle juice, and he went to hide in this volcano, thinking it was a lake, too. But unfortunately, it was lava. And they all lived happily every 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.*