

STAFF ONLY



Teacher's Guide for: **Flash Paper Ping Pong**

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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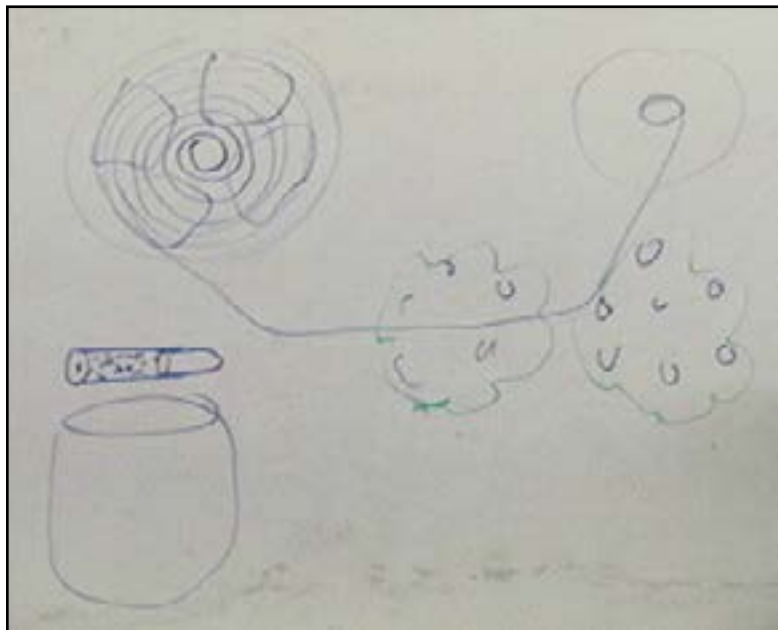
Flash Paper Ping Pong
A Rock-it Science Lesson
Filmed October 2010

Rock-it Science

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Intro Quick Recap:



- Magicians use nitrocellulose to make flash paper.
- To make it, pick a bunch of cotton, stuff it in a jar, pour nitric acid on it, and leave it there for a long time.
- Cotton is mostly cellulose, like sawdust, grass, bushes.
- Adding nitric acid changes the cotton to nitrocellulose.
- If you put it in a round thing with a piece of lead in front of it and put a flame at the other end, it goes boom. That's a bullet.
- You can also put it in a big silk bag, stuff it down a barrel, and put a bullet the size of a Volkswagen on top of it, and fire it.
- It's called smokeless gunpowder.
- Movie film used to be made of nitrocellulose because it made a nice plastic. They'd put silver on it and develop it and make film.
- But there's a 5K watt lightbulb shining through the film projector. And that would make it explode.
- To prevent that, they got oil from camphor trees and added it to the cotton while it was soaking in nitric acid.
- At the movie theatre, if the film got stuck in the projector with 5K watts shining on one frame, the film would start to melt. The projectionist has to get a fire extinguisher and put it out. If he doesn't notice in time, and the fire reaches the movie reel, then you can't put it out, and it burns down the theatre.

Experiment Quick Recap: "Flash Paper Ping Pong"

****Requires a well-ventilated space!****

Part One: Blend Ping Pong Balls

- Students work in pairs. Each team gets a blender and two ping pong balls to blend into small pieces. If the ball just bounces around and doesn't break up, take it out and stomp on it, then put it back in the blender.
- Give each team a clear glass mason jar and a large craft stick. Students pour the pieces from their blender into the jar.
- Instructor explains the danger of acetone exploding. If students spill acetone, the doors will have to be opened. In order to avoid explosion, part of the experiment will be done indoors and part of it outdoors.
- Instructor uses a turkey baster to put some acetone into each jar. Students mix it using the craft stick for a few minutes.
- It would take about eighteen hours to completely dissolve, so the Instructor collects the students' jars and brings out a jar of ping pong balls that have been completely dissolved in acetone.



Two balls per blender.

Part Two: Mirror Film

- This is done outdoors. Instructor pours the dissolved acetone solution onto a mirror and tilts it to make a very thin coating.
- Ask students to smell it. It should smell like camphor as well as acetone.
- Instructor uses a hair dryer to speed up the evaporation.
- Allow students to gently touch the coating. If it's cool, it's not ready. When it's completely evaporated, it will feel warm.
- Instructor uses a razor blade to scrape off the dried coating and uses the mirror to carry the pieces back inside. He also brings the jar of dissolved solution inside.



Solution on mirror.

Part Three: Burn Film

- Each student gets a small pair of tongs. Instructor gives each student a piece of the film from the mirror, and the student holds it with the tongs, gripping it at the top.
- The film should be spread out as much as possible, and only grip it at the tip.



Burning the film.

Experiment Quick Recap (cont.): “Flash Paper Ping Pong”

- Have students hold their tongs out over the table when they burn their film, and keep their hair out of the way.
- Give each team a barbecue lighter, but don't have them light it yet.
- Instructor removes the mirror and puts the remaining flash paper in a ziplock bag.
- Instructor turns off lights and goes around the table and lights each piece of flash paper while the student holds it. Students have the option of lighting their own. There should be nothing left afterwards. Turn lights back on.

Part Four: Real Flash Paper

- When magicians use real flash paper, they hide it in their hand, use a hidden igniter, and drop it just as they ignite it. Then the igniter disappears down their sleeve.
- This paper has been soaked for a long time in nitric acid, no camphor oil.
- Instructor holds a small piece of the flash paper between his fingers above the table, ignites it, and lets it drop.
- Lights out. Students have the option of trying this themselves, using either their fingers or the tongs. They do it one at a time, either lighting it themselves or having the Instructor light it while the student holds it in the tongs.
- This paper burns so fast it doesn't burn the table. Magicians sometimes burn it in the palms of their hands, but they have tough hands and also use protective gel.



Dropping flash paper.

Part Five: Fast Cotton

- Fast cotton has been soaked in nitric acid. It's called nitrocellulose. It's shipped wet so it doesn't explode during shipping.
- Instructor shows how to pull the cotton apart to make it puff up, which makes it burn faster.
- Instructor lights a piece in his open palm and it burns up completely.
- Lights out. Students have the option of trying this.
- The cotton needs to be puffed up, because if it's wadded up and you ignite it in your hand, it will burn your hand because the flame is concentrated in a small area.
- Instructor wads up a piece of cotton tightly and burns it on the table to demonstrate.



Puffing out fast cotton.

Equipment List: "Flash Paper Ping Pong"

Items needed for Instructor:

- Barbeque lighter
- Prepared solution of ping pong balls dissolved in acetone
- Turkey baster
- Mirror, approx. 18" x 24"
- Hair dryer
- Ziplock bag
- Razor blade

Items needed for Students:

Consumables (per 2 students):

- Ping pong balls, 2 per team
- Craft stick, large
- Real flash paper (1' x 4" piece per student)
- Fast cotton (1 small clump per student)

Other:

- Blender (per 2 students)
- Glass jar, approx. 12 oz. (per 2 students)
- Small tongs (per student)
- Ear protection (optional)

Prep Work:

- Put 3 ping pong balls in a blender and chop into small pieces. Add to 1/2 cup of acetone in a glass jar. Let sit for 3 days before class.
- Have an outdoor area available for the mirror segment.



Two balls per blender, two students share.

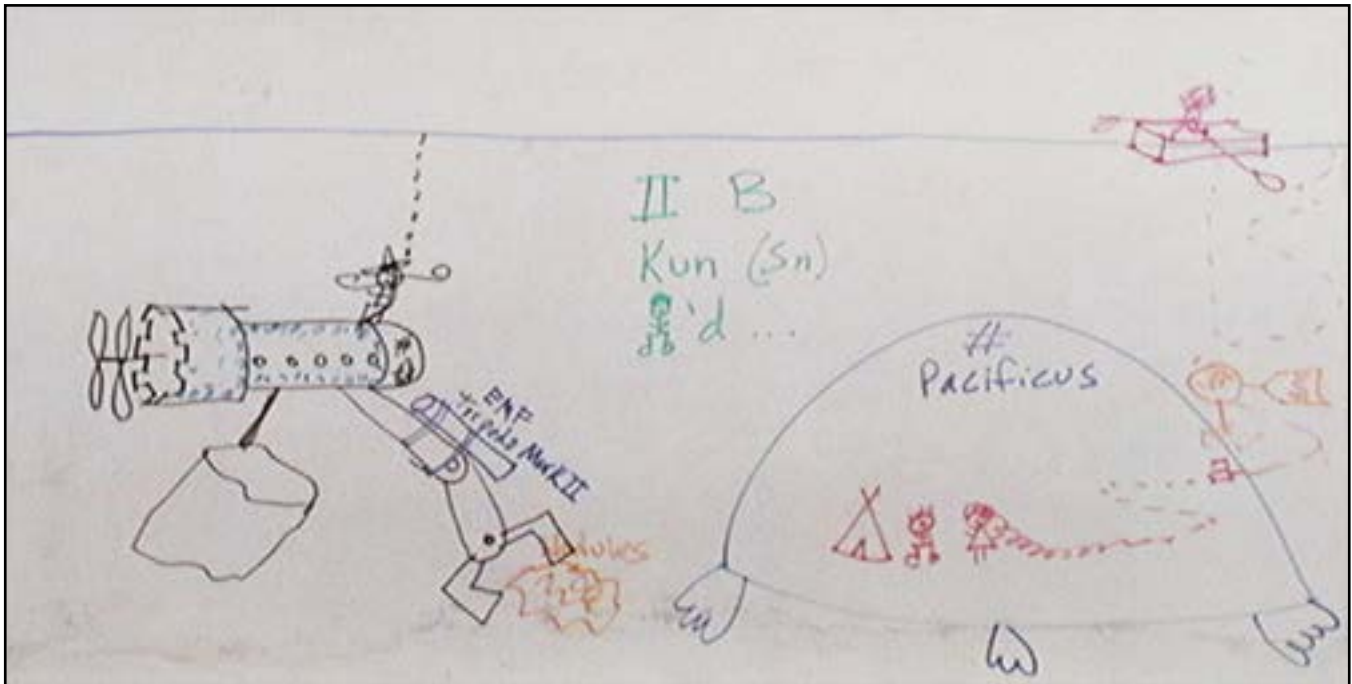


Mirror



Glass jar

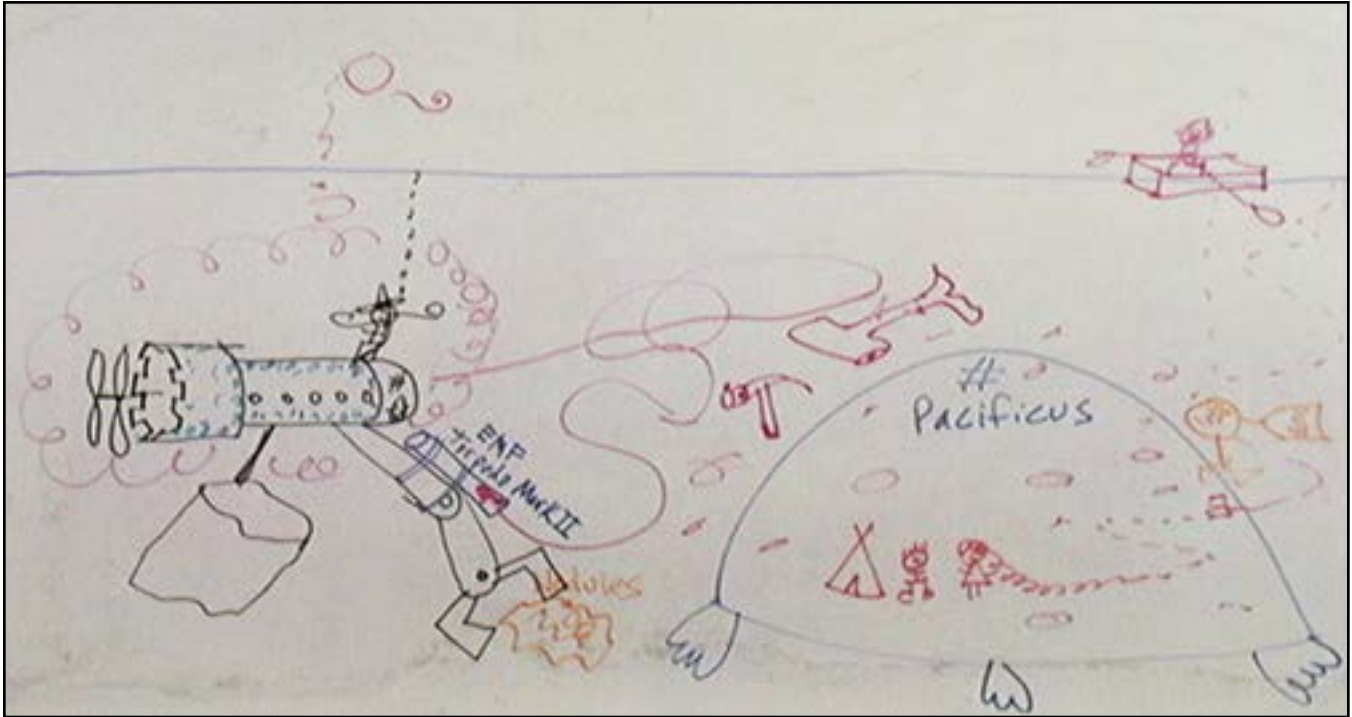
Story Recap: "Attack on the Underwater City"



Part 1:

- Jack and Jill lived in a tepee inside a pressurized domed city under the ocean called Pacificus. The dome has feet so it can walk around.
- They were collecting nodules from the ocean floor. Gold, manganese, platinum.
- When they get enough nodules, they put them out through a door, attach a balloon and a price tag, and let them float to the surface. They're collected by people in rowboats. Those people sell the nodules and give the money to the poor.
- Evil Mister Fred wants to steal the nodules, so he makes a submarine. He stands on top and breathes through a garden hose.
- The submarine has a robot arm that can pick up nodules and put them in a cargo bay that's hanging from a rope.
- Evil Mister Fred had made several submarines, but the minions kept wrecking them. They'd run into rocks, or open the door to see what was outside, etc., and they'd all sink.
- He ordered a bunch of ping pong balls and filled every empty space in the sub with them. So if he cut the rope on the cargo bay, the sub would float to the surface no matter what the minions did.
- He started stealing nodules and laughing at Jack and Jill. But they just wandered off somewhere else to collect theirs. And Evil Mister Fred wasn't happy because they were also getting nodules.
- He ordered a torpedo and attached it to the robotic arm. He planned to blow up the entire dome, kill Jack and Jill, and have all the nodules to himself.

Story Recap (cont.): "Attack on the Underwater City"



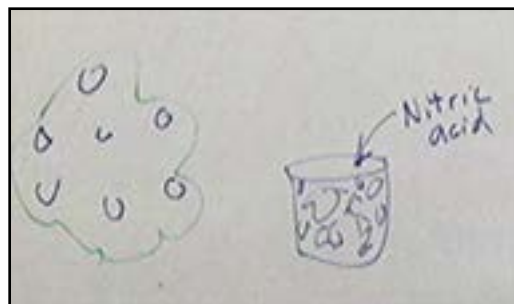
Ending:

- Jack and Jill realized that Evil Mister Fred was going to blow them up. Jill stuck her head out the little door and called some hammerhead sharks to guard the dome.
- Evil Mister Fred knew that wouldn't help, because it was a homing torpedo. It had a homing pigeon on it that would go wherever he told it. So he told the minions to tell the pigeon where to go.
- Evil Mister Fred launched the torpedo. It bounced off a hammerhead shark and started wandering around.
- The minions had told the pigeon to head "home," so the torpedo turned toward the sub, which was filled with ping pong balls.
- The sub exploded in a huge ball of fire.
- Bubbles of smoke rose to the surface. One popped, and a little piece of mustache fell out.

Transcript: Intro

Magicians like to produce fire out of nowhere. Makes them feel important. They open up their hand and flames shoot out. Or they have rings of fire. And they do it more or less safely, so they don't get burned too badly. They use a chemical called nitrocellulose.

And if you want to make nitrocellulose, you go out into a field where there's white puffballs growing on bushes. Cotton. And there's puffballs growing out there. And you collect a bunch of cotton, and you stuff it into a jar, and you pour nitric acid on it. And you leave it there for a long time. And cotton is mostly cellulose. Cellulose is mostly like sawdust, grass, bushes, stuff like that. And you can put the nitric acid on there. It changes cotton. It becomes nitrocellulose.



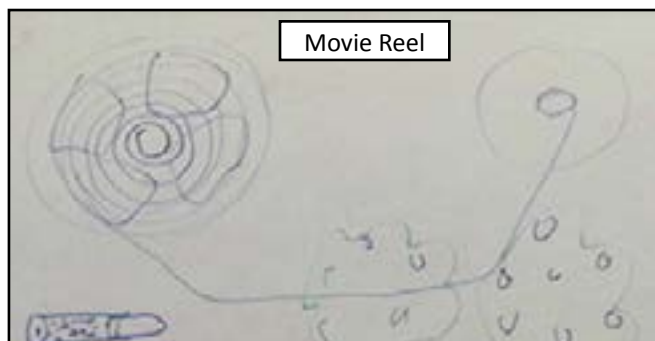
Cotton bush and nitric acid.

And this was kind of a neat invention. The guy who first discovered it probably hurt himself, because it kind of goes foomph! -- fast. But if you put it in a round thing and you put a chunk of lead in front of it, and it's all sitting in here, and then you give it a bit of a little flame start, it goes boom! It's a bullet. And you can use it in bullets like this, or you can put it in silk bags. Some of the silk bags are really big. And stuff it down a barrel, and put a bullet that has about the same weight as a volkswagen on top of it, and fire it. And it'll work just fine for that, too. It's called smokeless gunpowder.



Bullet and silk bag.

In the old days they used to have movie film that was made out of nitrocellulose. And it would go through the movie camera on a reel. So there's one reel over here. And it makes a really nice plastic. And you can put the silver halide stuff on there and develop it and make film. But there's about a five thousand watt lightbulb shining through it. And you know, the first trials ended in disaster, because foomph! -- there goes your camera.



Movie Reel

And they discovered that if you put some stuff in here while it's still liquid, stir it all around, it doesn't explode anymore. And the stuff comes from trees. You go find a tree that when you break the leaves, they smell. It's a camphor tree. And they get oil out of the camphor leaves. You put the oil in there, and now the movie film doesn't explode.

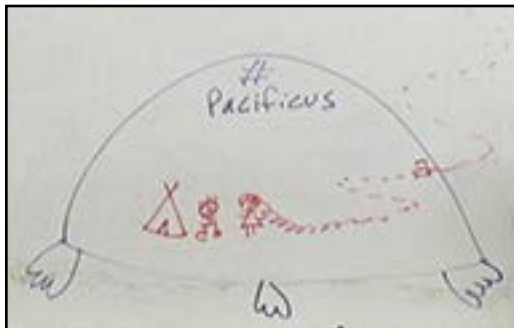
So when I was little, we'd go to the movie theater, and they'd be showing a show. And we'd be all screwing around, throwing popcorn at each other and stuff. And the guy that's in the projector room in back, he's reading a book. He's stuck in this room, and it's hot, and there's a bunch of scream-



ing kids outside, so he's reading his book. Well, when the film gets stuck in the projector, five thousand watts gets focused on one frame. And the frame, you know, on this giant screen -- you see the picture of Oliver and Hardy or whatever, and it starts to melt. And everybody goes, "Yayyyyy!" because this is really cool. And then you see flames across it.

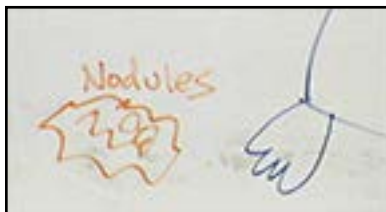
Well, if the guy in the back is still reading his book, then disaster ensues. If it starts to flame, he has to immediately grab a fire extinguisher and put it out. Because if the flame reaches the movie reel, it won't go out. And they burn down theaters that way. So today we're going to be using some of that stuff and see how it acts.

Story: "Attack on the Underwater City"



Underwater dome.

Once upon a time there was an ocean. And there was a city under the ocean, covered with a big dome. It was Pacificus. And living down there in their tepee were Jack and Jill. And they're collecting valuable stuff from the bottom of the ocean. There's a little door here that lets Jill's hair go out, like that. And their dome has feet so it can walk around. They have to keep enough pressure in it so the water doesn't come in. So it's a pressurized dome, and Jack and Jill can live in there.

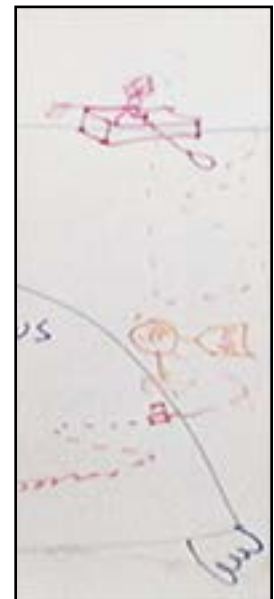


Nodules on ocean floor.

It can walk around, and they can pick up nodules from the ocean floor. They could be nodules of gold, of manganese, and platinum. And whenever they collect enough nodules, they put them through the same door that the hair goes out. They attach a balloon onto it with a price tag, and it floats to the surface where it's collected by people that are rowing around in rowboats. And then these guys collect money from the nodules

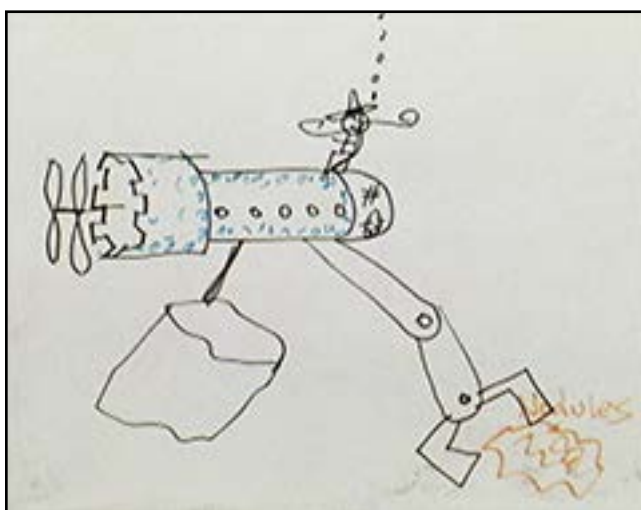
and they give the money to the poor. Really good. What's a nodule? It's a lump.

Well, of course Evil Mister Fred heard that Jack and Jill were down there wandering around with this thing, and he decides he wants to go steal those nodules himself. So he makes his own submarine. There should be a propeller. Maybe we should do two propellers, so it doesn't spin. We'll put two propellers, big ones like that, we'll put a nose cone on it, and some portholes like that, and there's minions inside.



Balloon and rowboat.

And Evil Mister Fred doesn't trust the minions, so he stands on the front. And he breathes through a piece of garden hose. And then they put a robot arm on it. It should have a cargo bay, too. So they've got



Submarine filled with ping pong balls.

a robot arm on there so they can pick up the nodules and put them into a bag that's hanging from a rope. That's their cargo bay. And Evil Mister Fred had made several of these submarines. And every time he made one, the minions managed to sink it, and he couldn't come back up again. He got really angry at the minions because they'd run into rocks, they'd open the outside door to see what was out there, just dumb stuff.

And so he called The Acme Store of Everything and he ordered a whole bunch of ping pong balls. And he filled every little space with ping pong balls. And now it was the unsinkable submarine. If you cut the rope to the bag of nodules, it would be light enough



Torpedo on robotic arm.

so it could float to the surface no matter what the minions did. And Evil Mister Fred thought he had the invincible submarine. So he's out there collecting nodules, and Jack and Jill saw him out there laughing at them, going "Nyah, nyah, stealing your nodules."

And Jack and Jill would just wander off to collect what they could. And Evil Mister Fred wasn't happy with that, because Jack and Jill were also taking some nodules. So he called The Acme Store of Everything and he ordered a torpedo. He could put it on the robotic arm and then he could aim it. So he's got a torpedo. His plan is to shoot the torpedo at Jack and Jill's Pacificus dome there, they'll die, and then he has the entire nodule business to himself.

Now, Jack and Jill, they're no dummies. They look out the window and they see "EMF Torpedo Mark II." That's just the name of it. And they say, "Uh, oh. Evil Mister Fred has a torpedo. Now, I'm sure he's not going to just use that for nothing. And we're in deep trouble." So if you were Jack and Jill and you're under the ocean collecting stuff and you notice this, 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: "Flash Paper Ping Pong"

Part One: Blend Ping Pong Balls

It's an easy experiment. First part, we need some old ping pong balls, and we need some blenders. So what we're going to do is put ping pong balls in the blender and blenderize them to make them small. *[Instructor passes out blenders, one per two students.]* Try out the buttons, see if it works. *[Instructor passes out two ping pong balls to each team.]* Put them in the blender and blend those guys. *[Sometimes, a ball will just bounce around inside the blender but won't break apart. If this happens, have student turn off the blender, take out the ball, put it on the floor and stomp on it, then put it back in. Blend into small pieces.]*



Two ping pong balls per blender.

[Pass out a clear glass jar and a large craft stick to each team. Students pour their pieces from the blender into the jar.] Acetone is the ingredient, I think it's just about the only ingredient, in fingernail polish remover. If you go to a business where they use acetone, you can't even open the can unless you are wearing an anti-static outfit and an anti-static strap, in an anti-static room with super ventilation, with explosion-proof motors.

Now, suppose you've put on some new fingernail polish and you don't like the looks of it. So you want to take it off. So you open a can of fingernail polish remover, and you start cleaning it off, and you're smoking a cigar while you're doing this. And you accidentally spill the fingernail polish remover on the carpet. And then the dog runs by and splashes it all over. Now you've got fumes all over in the house. And if you light up your cigar, you could blow the roof right off the house. So we're going to open up the back door. We're going to do just part of this indoors. The rest we're going to do outdoors.



Adding acetone

I'm going to add some acetone to your pieces. If you spill it, then we have to open up all the doors and make the room very cold. *[Instructor uses a turkey baster to squeeze some acetone into each jar.]* Then you try to stir it. *[Students stir the mixture of acetone and ping pong ball pieces for a couple of minutes.]* Is it getting sticky and gooey yet? All you need to do is dissolve it so it's a nice even paint. It only takes eighteen hours, so stir fast. There's a type of disease, I think it's a form of diabetes, where your body starts creating acetone, that stuff. And it goes into your lungs, and if you get near a flame, your entire chest cavity could explode.



Stir pieces and acetone.

We're going to make this like a cooking show. We're going to make eighteen hours pass instantly. Ta-daa! Eighteen hours just went by. *[Instructor brings out a jar containing ping pong ball pieces that have been completely dissolved in acetone.]* Here's some dissolved stuff. So we're going to take this *[collects jars from students]*.

Part Two: Mirror Film

For the next part we need to go outside. Let's go out to the back porch. We want to make a ping pong ball into a very thin layer. So here's the dissolved ping pong. We pour some on a mirror. And then we tilt it and let it run down. Now most of it is at the feet end, the tentacle end. Does it stink? It should smell like camphor as well as acetone.



Use hair dryer to dry the film completely.

[Instructor uses a hair dryer to dry the liquid on the mirror.] Acetone evaporates really fast. You can see it's already dry here. Now there are some thin spots right here, and it gets thicker as we go this way. The thickest spots are down here where the drops are. *[Student: Will it explode?]* No, in order for it to explode, there has to be a certain percentage of it, and there isn't that much. *[Instructor runs his hand gently over the surface to see if it's dry.]* It's not warm yet. It has to be warm. When it's warm, that means it's all evaporated. Feel the mirror. *[Students gently touch it.]* When it feels warm, we're done. There, that's good enough.



Tilt mirror to make a thin film.

Now, when your parents ask, "What did you do today in class?" you say, "Well, we used mirrors and razor blades, and we scooped stuff into rows." They'll be reassured with that. *[Instructor uses a razor blade to begin to scrape off the dried coating from the mirror. Once it gets started, it may be possible to peel it off in large strips.]* Okay, now we're going to take this back inside, and I'm going to give you pieces of it, and you're going to burn it. *[Instructor picks up the mirror with the peeled paper on top of it, and takes it and the jar of liquid back inside.]*

Part Three: Burn Film

[Each student gets a small pair of tongs. Instructor passes out a small piece of the flash paper to each student, and they attach it to the tongs.] Hang



it from the top. This is nitrocellulose, modified with camphor, because ping pong balls are made out of nitrocellulose, if they're the good ones. When we burn it, you're going to hold it over the table, not over your hair, not over the floor, not over your lap. If you have long hair, and you hold it close to your long hair, your hair might do the foof! thing. So hold it out over the table when we burn it.



Use razor blade to scrape and peel off film.

[Instructor passes out barbecue lighters, one per team.] Don't light them yet. [Instructor removes the mirror from the table and puts the remaining flash paper in a ziplock bag.] We're going to go fairly quickly around the table. You want it to be spread out as much as possible. If yours is being held mostly by the tongs, just grip it by the tip. Hold it like that. You want to hold as small a part of it as you can. [Lights out. Instructor goes around the table and lights the pieces of flash paper one at a time. Students have the option of lighting their own.] There should be nothing left. [When finished, lights on.]

Part Four: Real Flash Paper

Okay, this stuff is like flash paper. And to show you the difference, we have some real flash paper. Magicians usually have this hidden in their hand, and they'll wave their hand in the air and let it loose just after they ignite it. They have a special igniter that fits in the palm of their hand that you can't see. After they ignite it, the ignition device slides by a wire down into their sleeve.

So with this stuff, you hold it over the table. You can hold it with the tongs if you like. *[Instructor holds the corner of a small piece of flash paper with his fingers, lights it, and lets it drop onto the table.]* And the magician lights it and lets it go, like that. So you want it to be out here somewhere on the table. You don't have to do it if you don't want to. *[Instructor passes out a small piece of real flash paper to students who want to try it.]* This paper is soaked in nitric acid, no camphor oil. It's tissue paper that's been soaked for a long time in nitric acid.

Okay, we're going to do one at a time. *[Lights out. Students take turns burning their paper. They can either hold it in their fingers or use the tongs.]* Okay, hold it out over the middle of the table. If you let it go, it does a poof thing. After I light it, you squeeze the tongs and let it fly. It's easier if you hold it and then just let it go. *[When finished, lights on.]* Now, this stuff burns so fast that it doesn't burn the table. Magicians can actually burn it in the palm of their hand. But they have fairly tough hands, and they put some gel-like stuff on there just to make sure.

Part Five: Fast Cotton

Now, the next sample is called "fast cotton." I call it flash cotton. This is cotton that's been soaked in nitric acid. You take a little bit of it and you puff it up, because when they ship it, it's all wet when they ship it, because the post office doesn't like things blowing up in your mailbox. The more puffed up it is the better it works. And they have a sparker again that makes this stuff go. *[Instructor holds some of the cotton in his open palm and lights it.]* If you *[lights it]*, and it's gone! And it's just weird stuff.



Lighting real flash paper.



Dropping the real flash paper.

Now, you can do it on the table, you can hold it with your tongs. *[Student: What does it feel like?]* It feels warm. So if you want to do this, hold your hand out. I'll give you a piece, and you spend some time and puff it. *[Passes out cotton to students.]* If you feel your hands aren't tough, just hold it on the table or with the tongs. *[Student: Can I put it on my tongue?]* No, don't put it on your tongue. Your tongue's too wet, it'll put it out.

In the old days, ladies used to wrap their hair, they'd puff their hair into this big beehive shape. And then they'd spray flammable hair stuff all over it. Then they'd go to a wedding where they had candles. That was interesting. We'll go around here, you hold it the way you want. *[Lights off, students take turns lighting their cotton. When finished, lights on.]* So that stuff is nitrocellulose. If you have a party in college, and somebody brings out a bunch of flash cotton, you know what it is. And you know that it needs to be puffy. If they give you a piece that's all wadded up tight and say, "Here, hold that," you know enough to not hold that. Because it burns slowly if you wad it all up. We should wad one up so you can see the difference.

Strangely enough, the fast burning is what protects you. If it burns slowly, then it can burn your skin. *[Instructor wads up a piece of the cotton tightly, places it on the table, and lets one of the students light it without turning off the lights.]* We'll just do one in the light so you can see it. *[Student lights it.]* That would have burned your hand, because all the flame is concentrated in a small area.



Fast cotton needs to be puffed out.

End of Story

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

So Jack and Jill saw the torpedo and they thought, "Uh-oh. That Evil Mister Fred is going to blow up our place. So Jill stuck her head out the window, and she can talk to fish. And she called hammerhead sharks. And a bunch of hammerhead sharks showed up. There's a hammerhead shark. And I guess they don't really look like that. They look more like this. There's an eye out there, and there's one on the other side. They've got fins. So she called all those hammerhead sharks. And the sharks were all over the place, guarding their dome.



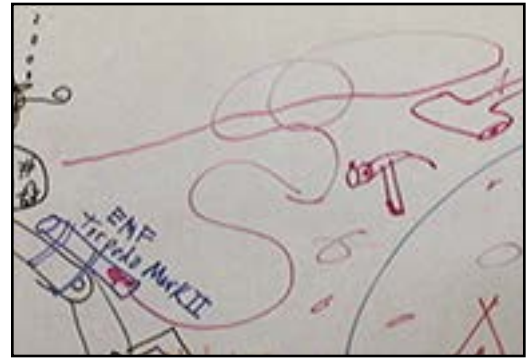
Hammerhead sharks.



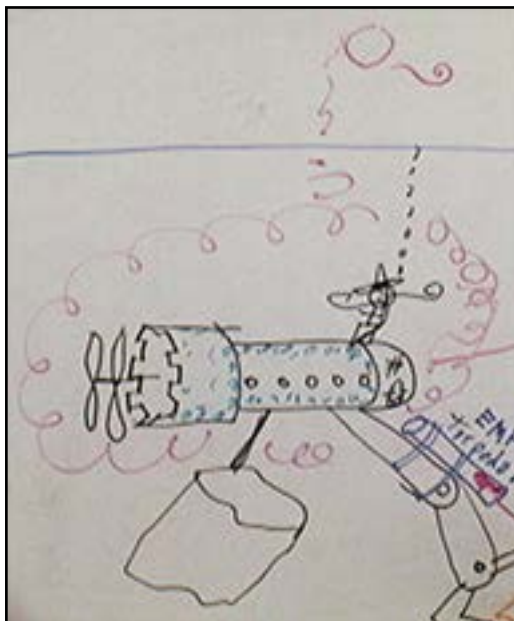
Pigeon in torpedo.

And Evil Mister Fred said, "Well, a fat lot of good that's going to do. This is a special torpedo. This isn't the Mark I, this is the Mark II. This is a homing torpedo. It's got a pigeon in it. And the pigeon is trained to go where I tell it to go." And he told the minions to tell the pigeon where to go.

So Evil Mister Fred launched the torpedo. It shot out of here, came to one of the hammerhead sharks, the hammerhead shark hit it -- boing! -- and it went around in circles a little bit. Jack and Jill were just plugging their ears and closing their eyes. And it started to home -- on home.



Torpedo's homing path.



Now Evil Mister Fred had protected himself by filling his entire submarine with ping pong balls. When ping pong balls ignite, what happens? [Student: They explode.] And if they develop pressure they explode faster. If you double the pressure, they go four times faster. So Evil Mister Fred's submarine exploded in a huge ball of fire under the ocean. And bubbles of smoke rose to the surface. And one of the bubbles popped, and a little bit of mustache fell out. 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.