



Teacher's Guide for:
Gyro on a String

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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Gyro on a String
A Rock-it Science Lesson
Filmed June, 2010

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Intro Quick Recap:



Intro:

- Instructor demonstrates bicycle wheel gyro: how it spins on the table, how it stays upright when suspended on a rope.
- Each child holds the wheel and turns to the right, then to the left, to feel the pull of the gyroscope.

Experiment Quick Recap: "Gyro on a String"



Experiment 1 -- Gyro on a String:

- Glue button onto CD.
- Put string through two button holes.
- Pass string through two plastic tubes.
- Tie the ends of the string together.
- Color CD with permanent markers to create illusion of color change when it spins.
- Holding gyro by tubes, students spin it to wind up the string, pull and release.
- Students move in various directions while spinning the gyro to see what happens.

Experiment 2 -- Spinning Top:

- Insert plastic Test Tube into hole in CD.
- Spin it on the table.
- Wrap curling ribbon around test tube.
- Insert pencil into test tube.
- Hold pencil lightly with one hand and pull the ribbon with the other.
- Pull pencil out of tube so the top spins freely.

Equipment List: "Gyro on a String"

Items needed for Instructor:

- Bicycle Wheel Gyroscope (special Rock-it Science item)
- Rope, about 2'
- Power Strips for Glue Guns
- Vinyl Table Cover

Items needed for Students:

Consumables (per student):

- Button, Wooden, about 1" with 4 holes
- String, Braided, about 2'
- Tubing, flexible plastic, 1/4" x 4", 2 per student
- CDs, 2 per student
- Test Tube, Plastic
- Ribbon, Curling, about 2'
- Pencil, unsharpened

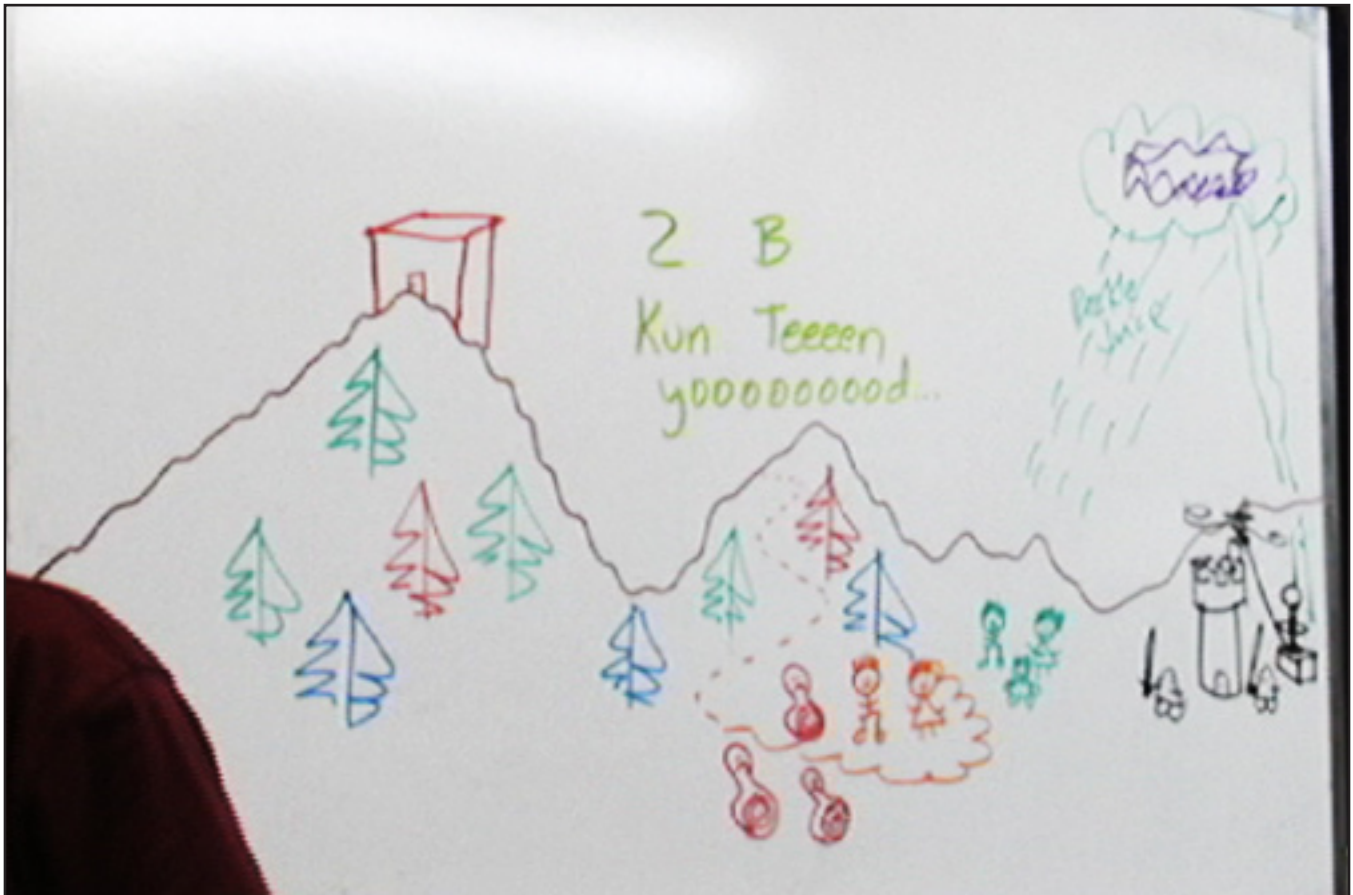
Other (per student):

- Glue Guns (1 per 2 students)
- Glue Sticks
- Permanent Markers

Prep Work:

- Cut Braided String to 2' lengths
- Cut Plastic Tubing to 4" lengths
- Cut Curling Ribbon to 2' lengths

Story Recap: "The Pickle Juice Rainstorm"



Part 1:

- Jack & Jill decide to move to the mountains.
- There are colored trees -- evergreen, redwood, blue spruce.
- Evil Mr. Fred is already there.
- Evil Mr. Fred builds a microwave device that he controls with a long stick.
- Microwave shoots energy into the sky and creates green and purple clouds.
- Clouds rain pickle juice on native people.
- People go to Cube City for help.
- Cube City calls Jack & Jill, who come with their Kick-Mes.
- J&J want to build houses to protect people from the rain.
- Native people have no saws or axes.
- How can Jack & Jill build houses?

Story Recap (cont.):



Ending:

- Jack & Jill put holes in a Kick-Me's stomach and run a rope through it to make a gyroscope.
- They spin the Kick-Me to twist the rope, then use the Kick-Me's sharp teeth like a chain saw to cut down trees and cut them into boards.
- They build big houses with lots of amenities.
- Evil Mr. Fred is jealous and decides to make a really big storm.
- He amps up the power on the microwave and it explodes when he shoots it.
- Evil Mr. Fred and minions are blown to dust.

Transcript: Intro



Bicycle Wheel with Handle

Have you guys ever ridden a bicycle before? Have you ever ridden a tricycle? Have you ever ridden a unicycle? Well, this is a regular bicycle wheel. It's like the front tire off of a bicycle, and it can spin, but it's got a nice handle on it. If I set it on the table, it tips over like you would expect it to. If I put it on a rope and then let go, it falls down like that. How can I make it so it doesn't tip over or fall down?

[Students make suggestions. One suggests putting the wheel on the table and spinning it.]

Oh, good idea, okay. Like a top. Let's try that. *[Starts wheel spinning and places it on the table, balancing on the short end of the shaft.]*



Bicycle Wheel Spinning on Table

Hmm. How come it doesn't fall over? *[Students make suggestions.]*

If you put your finger on it, will it still keep going? *[Students touch the edge of the spinning wheel, and it gradually slows down and starts to tip over.]*

What if we turn it over so that it's tall-ways? *[Balances spinning wheel on the longer end of the shaft.]* Don't touch it this time. Let's just see what it does.

[Spinning wheel gradually "walks" across the table.] It's walking somewhere. I wonder if it knows where it's going. Now it's walking away. See, it heard me. Oh, now it's coming back. Now it's going away. Our earth does something like this. Our earth spins and it stays the way it is. *[Student: "The earth spins way faster."]* That's true. The earth spins at a thousand miles an hour out near the edge, but the earth is so big it takes 24 hours for it to go around just one time. *[Wheel starts to teeter.]* Oop, now it's going to go.



Wheel Suspended on a Rope

Now we're going to try *[student's]* idea. We're going to spin it and put a rope on it. Will it now fall down? *[Student: "Put a rope on the other side."]*

[Wheel spins vertically with a rope supporting only one side of the shaft.] Invisible rope on the other side. How come it doesn't fall down now? *[Students offer suggestions.]*

Well, it's doing something that's hard to explain, but it's easier to figure out if you hold it yourself. So what I'm going to do is spin it and hand you the clear end. Grab it with both hands. When you get it, turn your entire body in a big circle this way, and then turn your entire body in a big circle that way, and see if you feel anything.



Student turns while holding wheel

[Each student takes a turn holding the spinning wheel while turning to the right and then to the left. The wheel pulls upward or downward, depending on the direction of the turn.]

Story: "The Pickle Juice Rainstorm"

Once upon a time, Jack and Jill decided to leave the big city and go live in the wilderness. They wanted to live amongst the big trees. So they got some binoculars and looked far, far away. They looked clear around the earth, and they found mountains. And they got onto the nearest butterfly train and headed for the mountains. It's a train made out of butterflies.

[Starts drawing trees in green.] Those are pine trees. *[Draws a red tree.]* These are . . . what kind of trees? *[Student: "Redwood trees."]* Yeah. *[Draws a blue tree.]* And what kind of trees are these? They call them blue spruce. There.

And somebody else had gotten there before them. *[Starts to draw a castle.]*

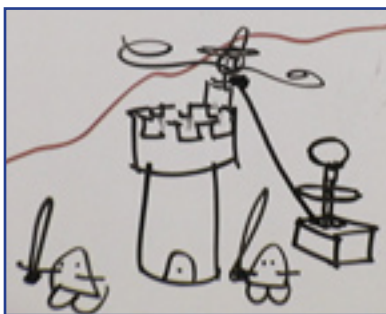
[Students: "Evil Mister Fred! How does he move his castle all the way around the world?"]



Mountains, colored trees, and a castle

He has his minions build new castles wherever he goes. Really fast.

[Student: "Why doesn't he call the Acme Store of Everything and transport his castle there?"]



Evil Mister Fred and his microwave

He could, but he doesn't. He builds new ones.

And Evil Mister Fred has invented something. Every once in awhile he invents things. He took a microwave oven and tilted it over on its back. And he ripped the door off of it, so now there's a big hole in it where the door used to be. And he stuck a baseball bat in the hole. And he put a garbage can lid on it. And then he stuck a basketball on top of that. And then he covered everything with aluminum foil. And then he took a big old stick and stuck that into the hole where he could reach it. Then he

could turn the microwave on full power, and he could wiggle the stick around in the hole this way and that, to see what would happen. That's how he invents things.

So he was up there, and he said, "Minion, turn on the microwave." And the minion said, "Do I gotta, boss? Every time I turn on something it explodes!" And Evil Mister Fred said, "Don't worry, it won't explode."

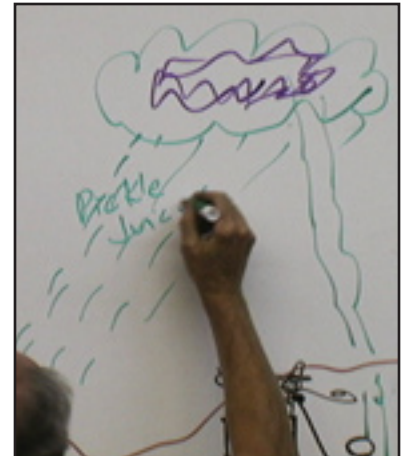
So the minion went over there, and he turned on the microwave and ran away as fast as he could. And it didn't explode. Then Evil Mister Fred said, "Well, let's see what happens." It went "mmmmmm," and he turned the stick and it went "MMMMMMM" [*higher pitch*], and it sounded like it was going to blow up. The all of a sudden, green light shot out of it. Green light shot way up into the sky. There were no clouds in the sky. But when the green light shot out, clouds started to form. Big green and purple clouds. And they started singing the Barney song. And then it started to rain pickle juice.

Well, there are people living there, and the people that live there didn't have houses because it didn't usually rain there. They would just sleep on the ground and do whatever they wanted to and never had to worry about rain. Well, now it's raining pickle juice on them, and the people are getting all wet. And sticky. And gooey. There's a whole bunch of people living there, and little kids, all getting covered with pickle juice. And the people didn't like being all wet and sticky, and they tried to wash off. They had to jump in a river to wash off. Plus it's really hard to sleep at night when the pickle juice is dripping in your face. And pretty soon they started to get sick because they just weren't used to this.

And they sent somebody off to the big city. It's a big cube city. And the big cube city has a door on it, and nobody can go in. They can go knock on the door, and they can ask questions, but they can't go in. And they sent somebody up there, and he knocked on the door and said, "Help! Something's falling from the sky on us. It's all wet and cold and sticky, and we don't like it. Can you make it go away?"

And the guy inside said, "Of course I can make it go away! Now, you go away." And he went back, not knowing if he was going to get any help or not. And the guy in the big city called Jack and Jill. He said, "Jack and Jill, we've got a problem over here. It's raining pickle juice." And Jack and Jill said, "What?" And he said, "Yeah, pickle juice. I don't know what's going on, but it's coming down like cats and dogs."

So Jack and Jill showed up to see for themselves a place where it rains pickle juice. And they met the people and saw all this happening and said, "Oh, I think I know who is doing this." Because they saw



Green and purple clouds raining pickle juice



People getting rained on.



The Big Cube City



Jack & Jill & their Kick-Mes

Evil Mister Fred's castle. "We've got to help you guys build some houses to protect yourselves from the pickle juice." And they said, "Do you have any saws?" And they said, "Sorry, we don't have any saws. We don't need a saw." "Do you have any axes?" "Sorry, we don't have any axes. We don't need axes."

And Jack and Jill said, "Well, we've got to help you build a house. If you've got no tools, how are we going to build a house?" And they thought for a little while, and they said, "Well, we've got lots of Jill hair, that's for sure." And then they looked around, and they had been followed the whole way there by their Kick-Mes. They said, "Hey, Kick-Mes! Can you guys chop down trees?" The Kick-Mes said, "We don't know how to chop down trees."

If you were Jack and Jill and wanted to help these guys build some houses, 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: "Gyro on a String"



Wooden button with 4 holes

Here we have some nylon kite string. What you going to do is, we're going to give you a piece of kite string, and you're going to put it through a button. Did you bring buttons today? No buttons. Well, maybe we have some buttons in the bag. We always have buttons in a bag.

In the old days, people made buttons out of wood. These are wooden buttons. It's real wood, too. They made buttons out of wood, they made buttons out of brass. There are four holes in the button. We want to choose two holes that are far apart. We'll put the string through a hole in



String threaded through a hole in the button

the button, and then we have a button on a string that we can go like this with if we want. *[Holds each end of string and spins it like a jumprope with the button in the middle.]*

But the string is really thin, and it might cut your fingers. So we're going to put an anti-finger-cutter on it. Here we go.



Thread string through tubing

We'll put an anti-finger-cutter on both ends, so we'll put this end in first. *[Slides one end of string through plastic tube.]* If you wiggle it enough, it'll eventually go through. There. There's an anti-finger-cutter on that end. And we'll put an anti-finger-cutter on the other end. There. We've got anti-finger-cutters on both ends. But I didn't do it right because I have to put it through the other hole first. *[Removes second tube and threads string through second hole in button, then replaces second tube.]*

[Student: What are we making?]

What are we making? Well, I'll show you what I'm doing. What could this possible be? Have you ever made one of these before? There. Now we've got some tubing and a button and a string. We're going to tie a knot in the end of the string. *[Students try to guess what it is.]* It looks like a number eight. It could be an hourglass. I can make the button stay there *[in the middle]*, or there *[near one end]*. Yeah, that looks like a kick-me.

If I wanted to, I could spin the button around *[turns the string like a jumprope with the button in the middle]*. And when you spin the button around, it wraps up the string and then the button spins. But it doesn't do anything. Well! That's not much of an experiment. If it doesn't do anything, we should always add something shiny to it, right?



The shape looks like an hourglass.



Glue button to CD

So [other instructor] has something shiny. He's got a whole bunch of shiny things. [Holds up a CD.] Doesn't matter which way you put it on. You stick it on the tube [threads one tube through hole in CD]. Now you've got a shiny thing. So you've got some strings and a button and a shiny thing. Will that do anything? [Spins string with CD on it.] Still doesn't do anything.

Now, we're going to glue the button onto the shiny thing. With hot glue. You could use cold glue, but hot glue works better. There's a hot glue gun. I don't think it makes a difference if they get glue on the string. [Glues button to CD.]



Completely assembled Gyro on a String

When we have a button glued onto a shiny thing with strings going through it, can you do anything with it? Can you saw lumber with it? No? Oh. I can make the glue get hard faster. [Puts CD under faucet.] Yeah, I can cool it off. There.

Now we can spin it around and pull on it. Now when I pull on this and let it go, pull on it and let it loose, pull and let it loose, pull and let it loose. And this is a gyroscope on a string. When you have it in your hands like this and you learn a rhythm -- pull, let loose -- pull, let loose -- pull, let loose -- try walking backwards while you do it. And then try walking frontwards while you do it. Try walking to the side while you do it, and try walking to the other side while you do it. Try moving upward while you do it, and try moving downward while you do it. And then, try moving in a circle, just to see what happens. Something does happen. And then, you can put colors on the disk. If you put all blues on half of it, and all red on the other half, what color should it make? Yeah, purple when it spins. So, this is the first part of the experiment. This is called Gyroscope on a String.

You know, it might be easier to glue the button on the disk first. Then we'll thread the strings through. So we're going to set up some glue guns. You only have to glue one thing, so we're going to give one glue gun for every two people. While you're waiting for it to warm up, you can draw on yours a little bit.

[Instructors set up glue guns, then pass out experiment supplies and permanent markers. Students assemble their Gyros and experiment with them.]

Experiment #2: Build a Top

Now, we have the world's simplest top for you to build. This is so hard, you won't believe how difficult this is. Are you ready for the hardest experiment in your life? Okay, here it is. Watch quickly, because I'm going to do this so fast you won't believe it. Here goes! *[Inserts a plastic test tube into the hole in a CD.]* Ta-da! There, I did it!



Insert test tube into hole in CD

And then you go -- *[spins test tube between palms and drops it onto the table, where the top continues to spin].* And you've got a top. So you're going to try to do that.

[Instructors pass out test tubes and CDs, and students put them together.]

[Student: Mr. Mac, you should glue the CD.]

Well, you can if you like. You don't really need to, but if it's fun, you can glue it.

Here's some Jill hair. *[Instructor passes out lengths of curling ribbon.]* Now of course, if you're going to have Jill hair, you need a pencil. Why? I'll show you.

Here I have a top, here I have Jill hair, and here I have a pencil. Can I do anything with that? No? Well, what if I wrap the Jill hair around the test tube? Have you ever wrapped Jill hair around a test tube



Wind ribbon around test tube

before? Does it do any good if I wrap Jill hair around a test tube? Of course, it couldn't do any good at all, could it? Now, I could put the pencil in the test tube. Will that do any good? Yes? What good could it do?

[Student: You could pull it really hard and then the top will spin really fast and the pencil will always come out.]

Wow, you're a genius! Let's try that. We could hold it like this so it's loose *[holds pencil in one hand and end of ribbon in the other]*, we could pull the Jill hair *[pulls ribbon, which makes the top spin]*, and -- ooooohhh *[top spins across table and onto the floor]*, and it's still spinning on the ground. Look at it, there it goes.



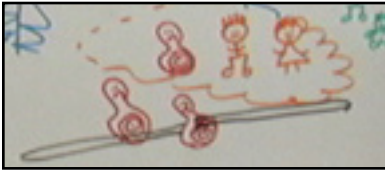
Insert pencil into test tube and pull on the ribbon

So, you've got the Jill hair. Now you need a pencil. *[Instructor passes out pencils and students experiment with their tops.]* It's easier to spin on the floor.

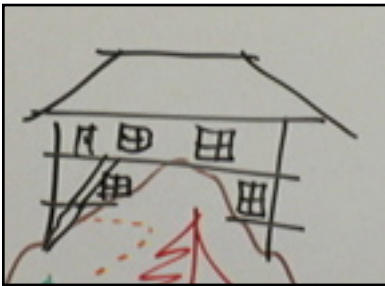
End of Story

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

So it's raining pickle juice on all the poor people, and Jack and Jill were called to help them build houses. And so they got some of their Kick-Mes, and they said, "Kick-Mes, we need saw blades. Are you guys saw blades?" The Kick-Mes said, "Yeah, we're anything you want us to be. We can be saw blades." So they poked a couple of holes in the Kick-Mes and they put some rope through them, like that, just



Kick-Me on a rope



Jack and Jill built a house



Evil Mister Fred blew up.

like the spinner thing you made. And then they would start the Kick-Mes spinning, and they'd start going bzz, bzz, bzz, like this, with the Kick-Mes spinning around. And the Kick-Mes have sharp teeth. And they took the Kick-Mes over to a tree and said, "Okay, Kick-Me, go through the tree." And they'd spin the kick-me and cut the trees down. And once the tree fell on the ground, they'd use the Kick-Mes to cut the trees into boards -- brmmm, brmmm, brmmm -- just like a Kick-Me chain saw. And they built houses for the native people. And the houses were kind of nice houses, like that, with several floors, and staircases, doorways, windows, swimming pools, tennis courts. They had a lot -- billiards room, games room, big screen TVs.

And Evil Mister Fred saw all this, and he said, "Boy, they can't have that! Their house is better than my castle. Look at those guys! And the pickle juice doesn't even get on them. I'll show them. I'm going to create a huge storm. " So Evil Mister Fred boosted the voltage to his microwave oven. Instead of a hundred and twenty volts, he put in one thousand two hundred volts. He said, "Just wait. When I turn the crank on now, hurricanes, tornadoes, ice storms are going to blow their house away. Ready, get set, go!" And he pushed the knob, turned it on, and the microwave oven exploded. Huge explosion. And Evil Mister Fred and his poor minions were turned into dust. And a little bit of mustache here, a little piece of hat there. 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.