



Teacher's Guide for:

# Tops

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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Tops  
A Rock-it Science Lesson  
Filmed June, 2009

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## Intro Quick Recap:

- Instructor ties a loop in a rope and hooks it around the shaft of a modified bicycle wheel.
- Suspend the wheel by the rope and show how the wheel starts to fall if not supported.
- Ask students how to keep the wheel from falling.
- Spin the wheel and show how it now stays upright when only suspended by the rope.
- Ask students why it doesn't fall.
- Slow the rotation and show how the wheel begins to fall over.
- Have each student hold the spinning wheel by the handle and turn to the right and to the left to see how it feels. Tell them not to tell anyone what it feels like until everyone has had a turn. (When they turn one way, the wheel pulls downward; the other way, it pulls upward.)
- Put the spinning wheel on the table so it spins like a top. Then turn it upside-down so it spins on its handle.
- As the wheel slows down, students can see how it starts to wobble. Instructor stops it before it can stop completely, because it might skid across the table.



The spinning wheel, held only by a rope at one end of the handle, doesn't fall.

## Experiment Quick Recap:

- Give each student a plastic test tube and tell them to make it stand up on its round end.
- Give each student a CD. Students push the round end of the test tube through the hole in the CD and spin it, trying different techniques to make it spin faster longer.
- Give students permanent markers to identify their top.
- Unobserved, the Instructor wraps some curling ribbon around a test tube top and puts a pencil inside the test tube.
- Then the Instructor places the top on the table and quickly pulls the ribbon to make it spin. Don't let the students get a good look at how it's constructed.
- Give each student a pencil and some ribbon and let them figure it out.



Push the test tube through a CD and spin it!

## ***Equipment List: "Tops"***

### **Items needed for Instructor:**

- Modified bicycle wheel
- Rope (about 2 ft.)

### **Items needed for Students:**

#### **Consumables (per student):**

- Plastic Test Tube (should fit snugly in CD hole)
- CD
- Pencil (unsharpened)
- Curling Ribbon (about 2 ft per student)

#### **Other:**

- Permanent Markers

### **Prep Work:**

- Create modified bicycle wheel
- Cut curling ribbon to 2-ft lengths.

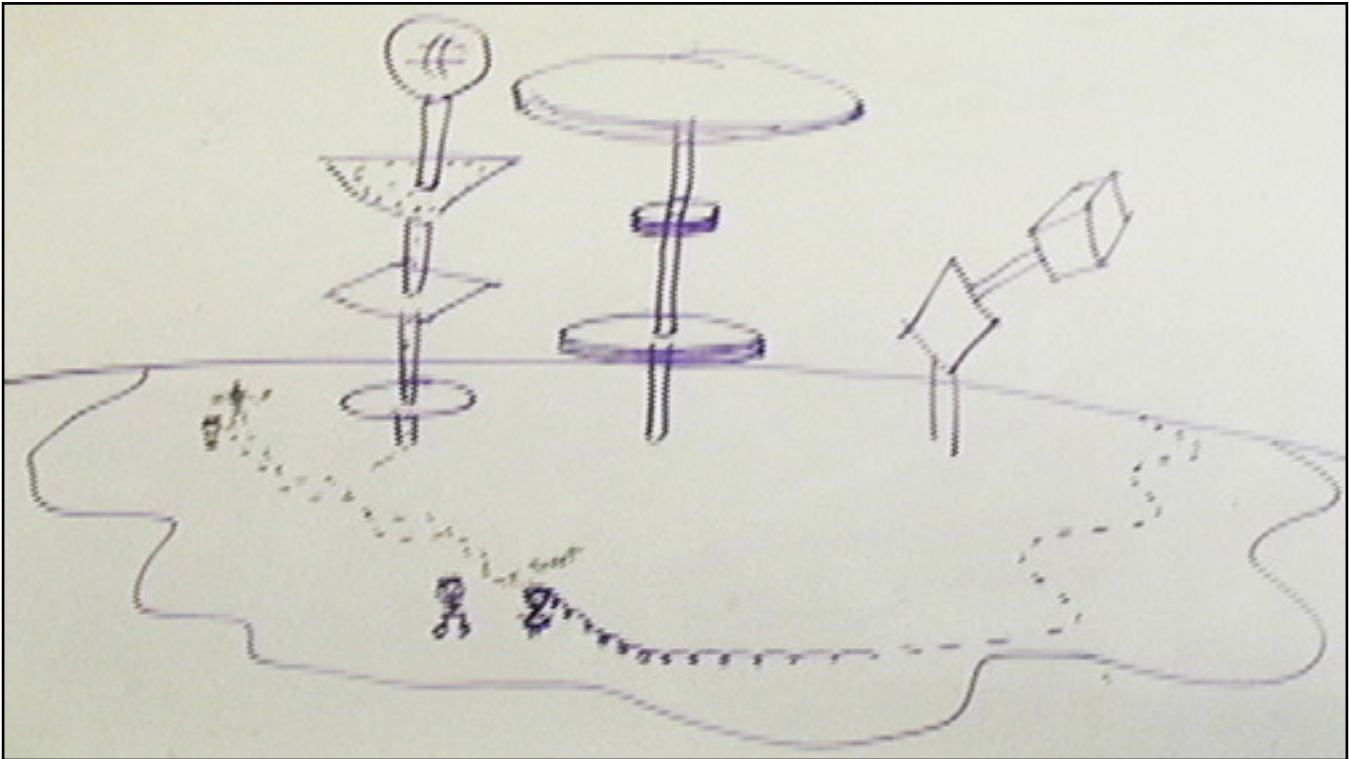


This bicycle wheel has a handle.



A pencil in the test tube and a ripcord made of curling ribbon.

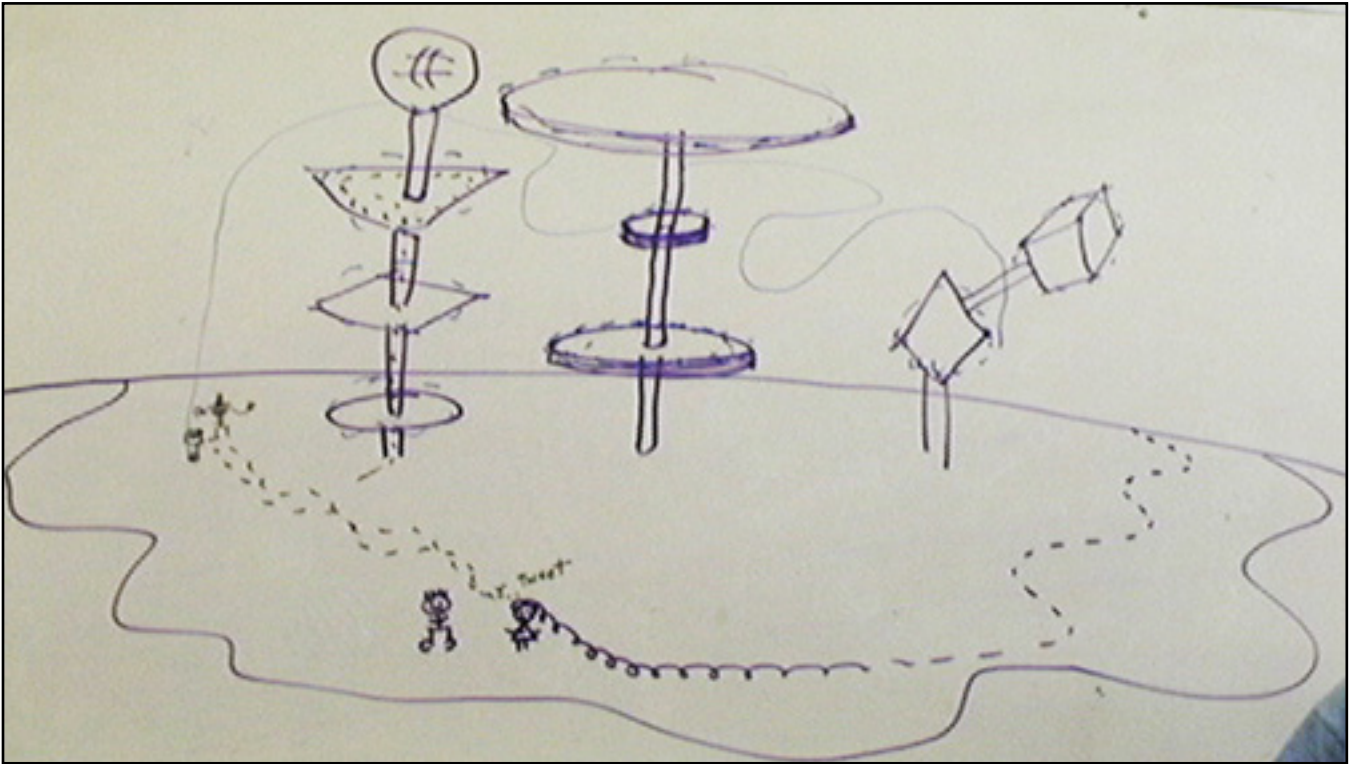
## Story Recap: "Jack & Jill's Spinning City"



### Part 1:

- Jack and Jill were building cities. They decided to build one on an island out in the ocean.
- They called the Acme Store of Everything and ordered a bunch of Big City Stuff.
- There were pages and pages of complicated assembly instructions, so Jack decided to burn them and just assemble the pieces his own way.
- He ended up with some buildings that were very skinny at the bottom, then spread out in a flat disc shape, then got skinny again, then fat again, then skinny again, then fat again.
- Jack and Jill were concerned that the buildings were so unstable that they might blow over in a strong wind.
- Evil Mister Fred had built his castle nearby, but it was really small compared to Jack and Jill's big buildings, and he was jealous.
- He sent his minions to sneak into the buildings and jump up and down in unison to make the buildings shake and fall apart. But the minions couldn't coordinate their jumping and ended up just arguing with each other and hitting people with their baseball bats.
- Jack and Jill realized Evil Mister Fred was going to try to knock down their buildings.
- Evil Mister Fred called the Acme Store of Everything and ordered a giant earthquake, set to happen at midnight. Then he and the minions started cheering his plan.
- Jill sent a little bird over to the castle to eavesdrop, and the bird told her what he was up to. So they knew there was an earthquake coming at midnight.

## Story Recap (cont.)



### Ending:

- Jack and Jill were trying to think of ways to save the city from Evil Mister Fred's earthquake. They thought about tying helium balloons to the buildings to hold them up, but it would take too many. They thought about lifting the buildings into the air with jet engines and then setting them gently down again, but they wouldn't have enough time to do it before midnight.
- Jill called all the birds on the whole planet and had them sit on the round edges of the disc-shaped buildings, facing the same way. Just before midnight, they all started flapping their wings.
- As the birds flapped, the buildings started to slowly spin in circles, the spun faster and faster.
- There was one building that was lopsided so it didn't spin right, and as the birds flapped their wings, the building started to rip itself off the ground.
- When the earthquake hit, the buildings bounced up in the air and spun, but didn't fall down.
- The lopsided building was wobbling dangerously, and the birds lifted it clear off the planet. It flew through the air and landed on Evil Mister Fred's castle.

## Transcript: Introduction

*[Instructor ties a loop in a rope.]* Anything that I tie to this rope will be able to defy gravity. It's an anti-gravity rope. It will make things that ordinarily fall down, not fall down. So if I tied this around your neck and tied the other end to the ceiling, you won't fall down.

*[Brings out a bicycle wheel fitted with a handle.]* This is a bicycle wheel, and it's got a handle on it. We're going to put this rope on it, and then we're going to let go. Will it fall down and clunk *[student]* on the head? It probably would fall down. How can I keep it from hitting him? *Student:* "Spin it." We'll see.

*[Starts the wheel spinning, attaches the rope to it, holds it by the rope just above a student's head.]* Here we go. *[Wheel remains upright.]* Aw, how come it doesn't fall down and hit him?

*Student:* "You're still holding it."

How come the wheel doesn't fall off the rope?

*Student:* "Because it's spinning."



Instructor ties a loop in a rope.



This bicycle wheel has a handle.



The spinning wheel, held only by a rope at one end of the handle, doesn't fall.

Because it's spinning. If we don't let it spin, it will fall off. In fact, can you see it doing a slow rotation around the rope? If I stop the slow rotation, see what happens. *[Stops the rotation, and the wheel begins to fall over.]* Oh, it tilts.

Now, I could try to tell you how that works, but it's more fun if I spin it up and let you hold it in your hand. And when you get it in your hand, you first go this way *[turns counterclockwise]* and then go that way *[turns clockwise]*. And see what you feel. After you feel it, don't tell anybody what you feel.



If you stop the rotation, the wheel starts to fall over.



A student tries to turn in a circle while holding the spinning wheel.



If you set the wheel on a table, it spins like a top.

Okay, everybody in line, step back five hundred and thirty-two paces. *[Students form a line, first student steps forward. Instructor spins up the wheel and hands it to the student to hold by the handle.]* Grab that and turn around in a circle. *[Student turns counterclockwise.]* Now go the other way. *[Student turns the other way, and the wheel pulls downward.]* Okay, now stop. Good. *[Each student repeats this experiment in turn.]*

So, you probably found out that one way you rotate, it wants to go down. And the other way you rotate, it wants to come up and brush your teeth for you. That's this force that allowed it to stay up when I had it on the rope.

What if I put it on the table? *[Spins up the wheel and puts it on the table, where it spins like a top.]* What if I turn it upside-down? *[Turns wheel over so that it spins on its handle.]* Pretty soon it's going to tip over and slide on the table and hit someone. Who's it going to hit, do you think? *[As wheel slows down, it starts to wobble. Instructor picks it up before it stops.]*

So, this is a top, or a gyroscope, and we're going to be doing experiments with those. But first we need a crazy story.

## Story: "Jack & Jill's Spinning City"

Once upon a time, Jack and Jill were given the job of building cities. There were no cities there. And they had a bunch of land, a big island out there in the ocean, and they thought, "Well, what kind of a city should we build? Should we make a city out of tepees? Should we make a city out of old shoes? Cardboard boxes?" And Jill said, "Naww, let's make big cities." Jack said, "All right. I like big cities."

So they called the Acme Store of Everything and they ordered Big City Stuff. And it all came in boxes, with instructions that said, "Insert piece A-1 into piece A-2." And there were all these instructions that went on and on and on for page after page after page after page. And Jack said, "Oh, we don't need those." He took the instructions, wadded them all up, and burned them.

And so they had all the pieces there, and Jack said, "I know how to put this stuff together. No problem."



Jack and Jill need to build a city.

Well, he started building a building, and it looked kind of strange. It came up kind of skinny-wise, and then it got kind of fat-wise, and then it went skinny again, and then there was a little fat thing on it, and then it got skinny again, and then there was a really big fat thing.

And Jill said, "Jack, that's never going to stand up." He says, "Well, okay, it might not. It might tip over. Just don't let the wind blow. We'll build another one next to it and maybe we'll put the two together."

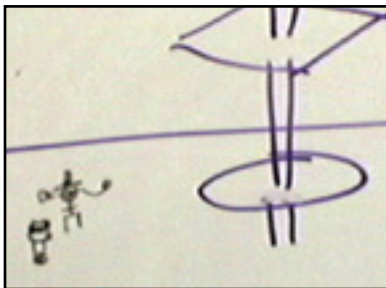
And he started building the next one, and hoping the wind didn't blow it down. He made some square ones. And he tried triangles. And he didn't plan it too well, because they didn't touch each other, and it looked like these were going to tip over, too. He put a big ball at the top.

And these were really big things. You could put five stories of apartments in here, stores, shopping malls, racecar tracks, all could fit inside one of these, like that.

And Evil Mister Fred saw what Jack and Jill were doing and he said, "Hey! They're making something good -- I don't like that, and it's really dramatic."

*Student: "What is dramatic?"*

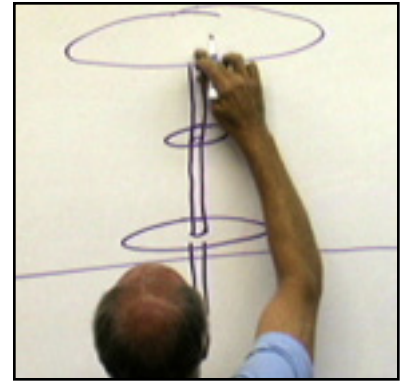
Dramatic means it's spectacular, fun, big. He made some weird ones, too.



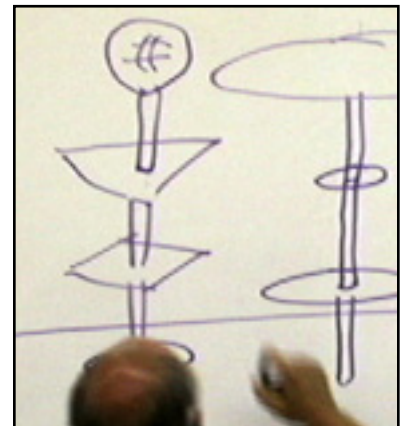
Evil Mister Fred's castle was tiny compared to Jack's buildings.

And Evil Mister Fred needs a castle nearby. And Evil Mister Fred just has this little castle, and he was jealous because Jack and Jill were making really big things. And he said, "Oh, I've got to stop them from doing that. This is really good -- they're going to become famous, and nobody's going to pay attention to me." So he said, "What should I do, what should I do?"

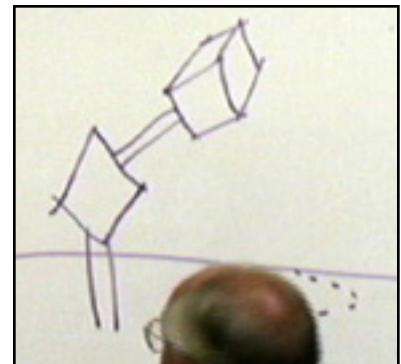
He said, "Minions, I want you to go out there. I read in a book -- I can read -- I read in a book that if you go up on a building like that, and all the minions go together and get on the same floor, and just do this [*jumps lightly up and down*], the building will start to shake. And as it shakes, the windows will break, and the furniture will tip over, and the whole building will come crashing to the ground." And the minions said, "Yay, boss! This is great! We wanna do it, we wanna do it!" It never occurred to them that if the building came crashing to the ground they would be inside of it, because they're minions.



Jack's first building was fat and skinny.



For the second one, he used a square and a triangle.



He also made a weird one.



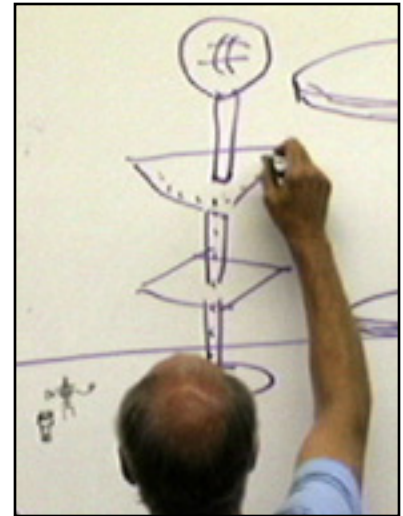
So the minions ran over to the first building, took the elevator up to the top triangle, and they all got in there, and they all started to shake up and down. But they're minions, and they couldn't get organized. One guy was jumping up while the other guy was going down, and other guys were arguing with each other, they were hitting people with their baseball bats, and they weren't making the shaking motion that Evil Mister Fred needed.

And Jack and Jill saw them doing that. And Jack and Jill said, "Uh, oh. This is bad. Evil Mister Fred tried to knock down our building. We've got to do something to stop him."

In the meantime, Evil Mister Fred called the Acme Store of Everything and said, "Acme Store of Everything, I need some serious energy here. What have you got?" And they said, "Well, we have five different kinds of earthquakes, hurricanes, tornadoes, and a few snowstorms." And Evil Mister Fred said, "Ooh, tornadoes? I like tornadoes. Hurricanes -- I like hurricanes, too. But -- earthquakes! Nobody knows they're coming, do they?" And the guy said, "Yep, they never can tell." And Evil Mister Fred said, "I want a big earthquake. A really big, nasty, rotten, shake-em-all-up earthquake." And the Acme Store of Everything said, "Okay, we'll deliver it at midnight tonight."

Well, Evil Mister Fred said, "Yeah!! At midnight, they're coming crashing down. This is great!" He started celebrating, and all the minions were cheering, and everybody heard them cheering.

And Jill, she can talk to animals. She sent a little tiny birdie over there. It flew over there to see why Evil Mister Fred and his minions were cheering. And the birdie heard everything they said. The birdie came back and said, "Oh, no! Evil Mister Fred's got an earthquake coming in at midnight. Everything's going to shake down." If you were Jack and Jill, what would you do?



The minions jumped up and down on one floor of the building.



A little bird told Jill what Evil Mister Fred was planning.

## 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.)

And we're going to leave this "To be continued . . ."

## Experiment: "Tops"



Try to make a test tube balance on its rounded end.

Okay, for our project you're going to try to make a test tube stand up. You're going to make it balance on its round end, and try and make it so it doesn't fall down.

*Student: "Spin it!"*

Oh, okay. Well, you do that. We'll give you test tubes and you can do whatever you feel like to them to make them balance.

*[Instructor passes out test tubes and CDs. Students push the round end of the test tube through the hole in the CD and spin it, trying different techniques to make it spin faster and longer. They are also given permanent markers to identify their top.]*

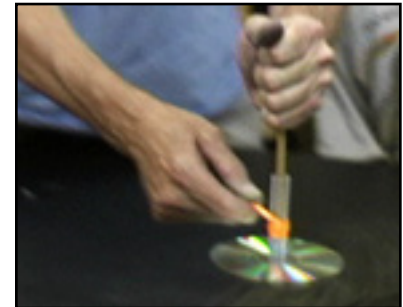
*[After several minutes] I'm going to show you something. If you want to do it, you can do it, if you don't want to do it, you don't have to do it.*

*[Instructor brings out a top that he has previously wound with curling ribbon, with a pencil in the test tube to hold it in place. He quickly places the top on the table, before the students can get a good look at how it's set up.] Ready, get set, go. [He pulls the ribbon like a ripcord, pulls out the pencil, and the top spins quickly and smoothly.]*

I'll give you a pencil and a ribbon, and you've got to figure it out. *[Students try various ways of winding and pulling the ribbon to make the top spin.]*



Just push it through a CD and spin it!



A pencil in the test tube and a ripcord made of curling ribbon.



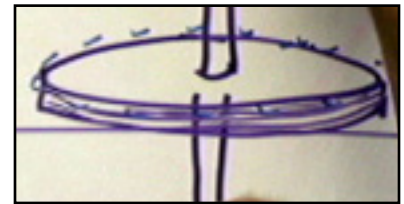
Students try to make the ribbon work.

## End of Story

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

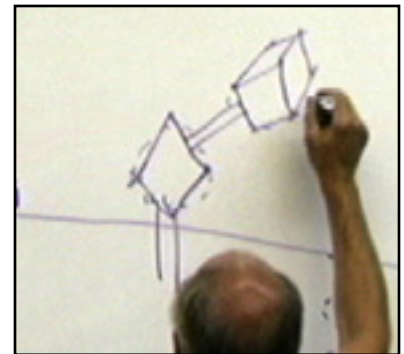
So Evil Mister Fred had a huge earthquake scheduled to come by at midnight. Jack and Jill found out about it from a little tiny bird that talked to Jill. They said, "What are we going to do?" And Jack said, "I've got an idea. Let's put helium balloons in all the buildings! And then when the earth shakes, the helium balloons will hold them up. And Jill said, "I think that would take a lot of balloons." And Jack said, "How about jet engines? We'll put jet engines on them, and turn them on full blast. And after the earthquake is done, they'll set down gently." And Jill said, "Good idea, but can you do it before midnight?" And Jack said, "Aww, I don't know."

And Jill said, "I have an idea." And she went *[whistles]*, and she called all the birds in the whole planet. She said, "Hey, birds, we need you to all sit on the edges of everything that's round." And the birds went up there -- thousands, and millions, and billions, and trillions of birds. And they settled down, and they all faced the same way. And Jill said, "Wait til midnight, and just before midnight, everybody start flapping their wings."



The birds sat on the edges of the buildings.

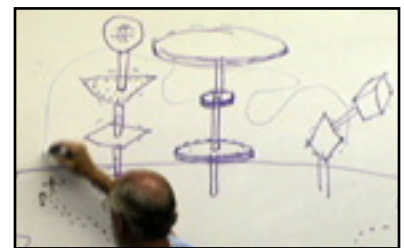
And it became 11:55 at night. And Jill said, "Go!!" And all the birds started going flappy, flappy, flappy, flappy, flappy. And they held on with their tiny feet. And as they flapped their wings, the buildings started to slowly spin in circles. *Student points to a non-symmetrical building:* "What about that one?" That one's not going to work too good.



The lopsided building lifted off the ground.

And they started spinning faster and faster and faster and faster and faster. But this building *[points to non-symmetrical building]* wasn't spinning. It's all lumpy and lopsided. And it had birds all over it, too. And they were flapping their wings, and it started to rip itself off the ground.

And then the earthquake came. And the buildings bounced up into the air and spun, but none of them fell over. The one that was all weird shaped, it was kind of going woa-woa-woa *[mimics lopsided spinning]*. And the birds were strong, they lifted it clear off the planet. And it flew through the air and accidentally crashed right on top of Evil Mister Fred's castle.



The lopsided building landed on Evil Mister Fred's castle.

And everyone 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.***