



Teacher's Guide for:  
**Oscillating Pendulums**

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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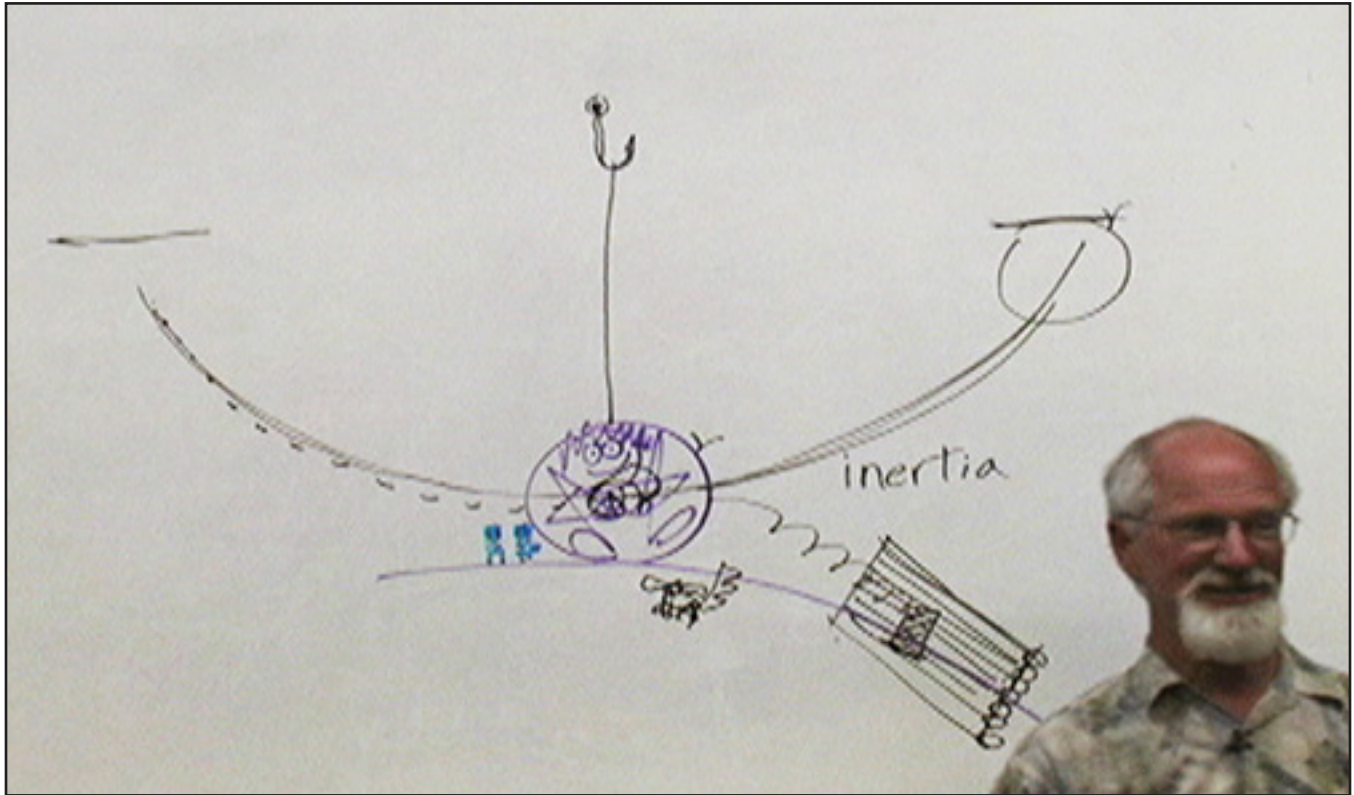
Oscillating Pendulums  
A Rock-it Science Lesson  
Filmed March, 2013

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## Intro Quick Recap:

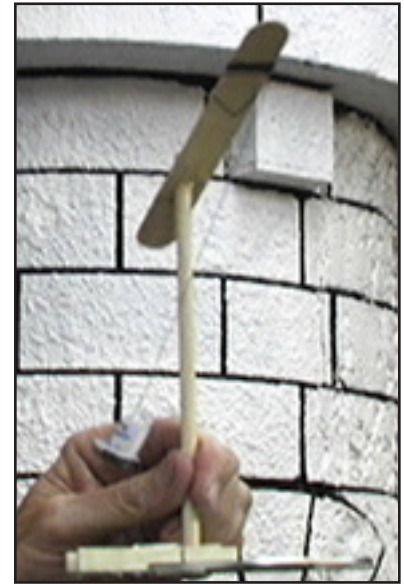


- Your parents put you inside a giant ball, put it at the top of a hill near the ocean, and give it a push.
- You start rolling down, and your dog, Fido, wants to stop you.
- If he gets in front of you, will that stop you?
- What if Fida made a fence out of telephone poles? Would that stop you?
- When a ball is rolling like that, it has stored energy, inertia.
- We want it to have inertia, but not rolling down a hill. We want it to hang from a hook.
- So the ball is hanging from a hook in the sky, and bird comes and pulls the ball way up.
- If it lets go, will you stop when you get to the bottom?
- If you keep going, will you stop when you get to the other side?
- Will you get as high on that side as you were on the first side?
- There's friction in the system, so you don't go as high when you swing back and forth.
- If you had swallowed a big magnet, would that make a difference?
- What if somebody put a big magnet in the ground?
- Today we're going to find out.

## Experiment Quick Recap: "Oscillating Pendulums"

### Part One: Demo -- How to build the pendulum

- Instructor demonstrates how to build the pendulum before students do it.
- Start with a CD.
- Add a tower made of craft sticks.
- Clip a plastic clothespin to the bottom of the stick and glue it to the CD, off-center.
- Glue a lid from a canning jar onto the CD.
- Add a "minion" hanging from a thread, suspended from the tower.
- Glue a magnet to the minion's feet. Let the minion swing a little bit.
- Tell students about how cowboys used to shoot at someone's feet to make him "dance."
- Tell students that after they build this part, we'll give them some other pieces to make the minion dance.



Minion swinging on string.

### Part Two: Students build their pendulum

- Pass out supplies and have students build their pendulum.
- Then give them each a second magnet to put on the jar lid (DO NOT glue it on).
- Let them see how the minion moves when it swings back and forth. They can try making the string different lengths and see if that makes a difference.
- Give students a third magnet, then a fourth, and see how many magnets make the minion dance best.

## Equipment List: "Oscillating Pendulums"

### Items needed for Instructor:

- Scissors to cut thread

### Items needed for Students:

#### Consumables:

- CD
- Craft stick, large, with 1/4" hole
- Dowel, wooden, 1/4" x 8"
- Canning jar lid (use insert only, not rim)
- Clothespin, plastic
- String, about 18"
- "Minion" (Ours was a manufacturing castoff. You can use a small plastic building brick, a plastic gummy toy -- anything that's small and light.)
- Magnet, disc, 1/2"

#### Other (per student):

- Glue guns & glue sticks



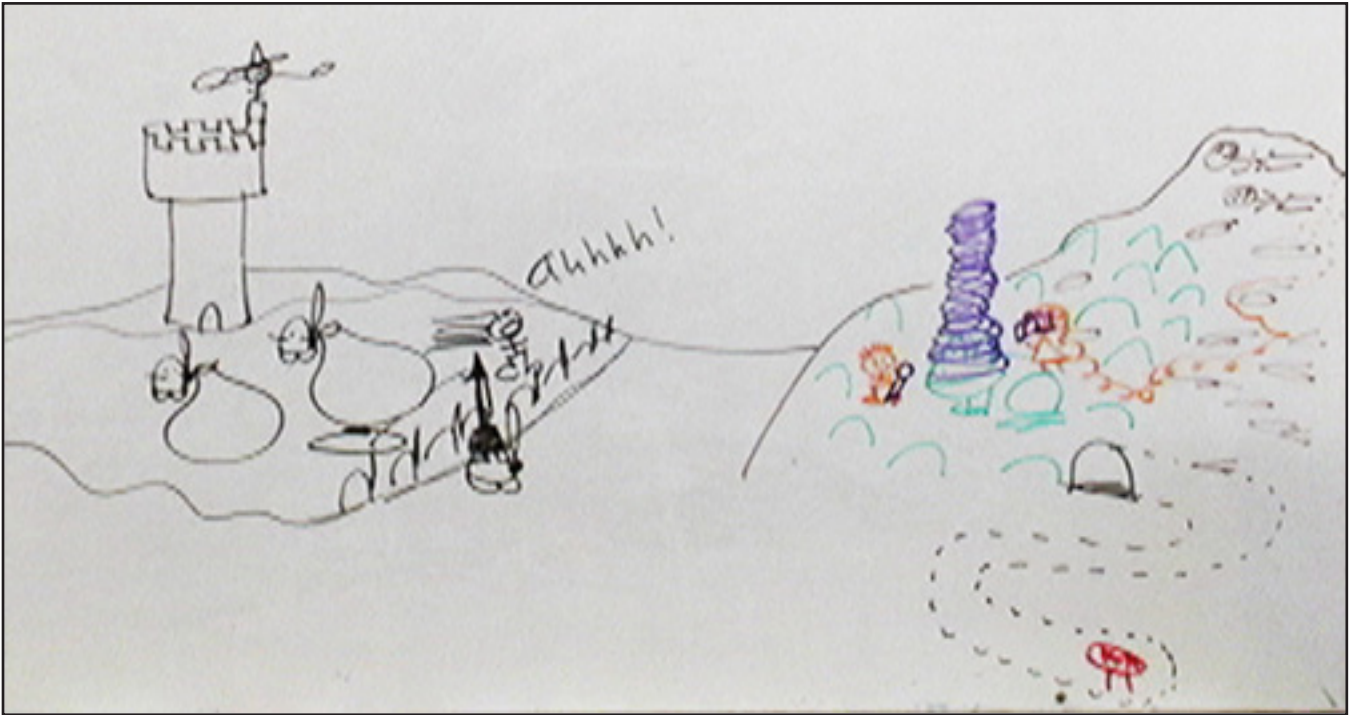
Canning jar lids (use only the insert, not the rim).

### Prep Work:

- Drill a 1/4" hole through the craft stick, about a third of the way down. *[NOTE: Since this video was made, we've changed the construction. We now use two clothespins, one at the bottom and one at the top, so we don't need to drill the hole.]*



## Story Recap: "Secret Frogs of the Himalayas"

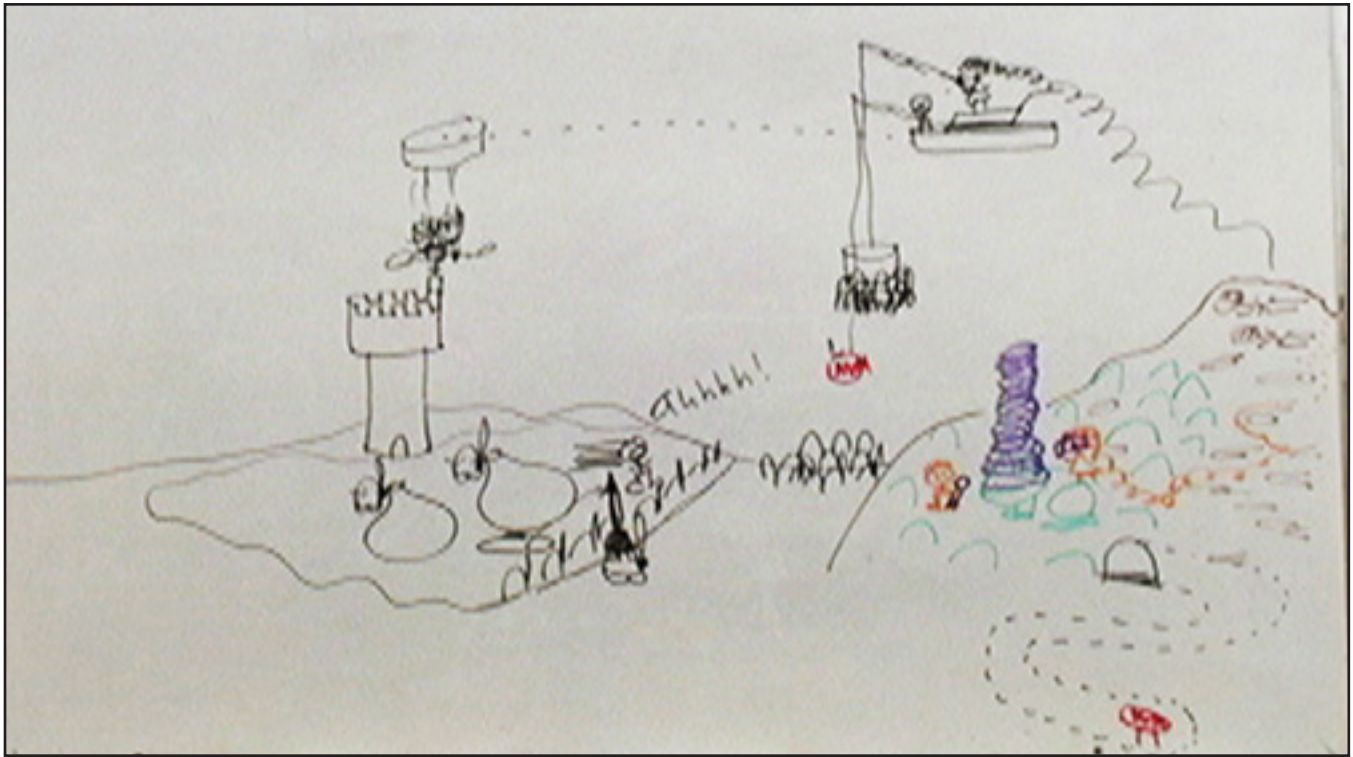


### Part 1:

- There were a bunch of hermit frogs living in the Himalayas.
- They're called the Himalayas because a long time ago, a bunch of guys fell asleep in a big pile and they got squished together to form a mountain thirty thousand feet tall.
- The frogs are guarding a cave, and they never let anyone go in.
- At the bottom of the cave is a giant red M&M that gives superpowers to anyone who holds it for ten minutes. Bullets will bounce off your chest, you'll have x-ray vision, and you'll be able to fly.
- The frogs are guarding it so nobody will get that power.
- Jack & Jill are interviewing the frogs, who live for a thousand years. Even the frogs aren't allowed to touch the red M&M, because they might misuse their powers.
- Evil Mister Fred built a castle nearby and told his minions to dig a tunnel into the cave.
- He gave them each a bag and told them to put the big M&M into their bag without touching it and bring it back. He didn't want the minions to get superpowers.
- The minions hit the ground with the baseball bats, trying to dig a hole, but then just woke up some of the Himalaya guys, who ran screaming. Evil Mister Fred could see his plan wouldn't work.
- He gathered the minions into a huge army.
- Jack & Jill saw them coming. They ordered metal helmets for the minions from the Acme Store of Everything. So now the minions had helmets with spikes on top. They liked that.
- Jack warned Jill that the minions would run toward the frogs and spike them with their helmets.



## Story Recap (cont.): "Secret Frogs of the Himalayas"



### Ending:

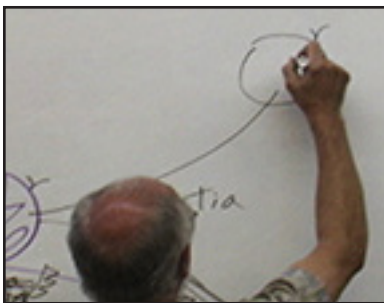
- The minions started marching across the field toward the frogs.
- Jack & Jill called the Acme Store of Everything and ordered a fishing boat.
- Jack lowered his hook with M&Ms on it for bait. The minions all started jumping, trying to reach the hook.
- Jill put a big magnet on her hook and lowered it right next to Jack's M&Ms.
- When the minions jumped up, they got stuck on the magnet.
- This was an electromagnet, and when Jill turned off the power, the minions fell and landed head first with their spikes sticking into the ground.
- Then Jill lowered her magnet, picked the minions up again, cruised the boat over to the castle, and dropped the minions onto Evil Mister Fred. They landed on him spike end first.

## Transcript: Intro

What if you're sleeping at night, minding your own business, and your parents come in and put you inside of a round ball, and stick you inside, and then they take you outside? Here you are, all squished up inside of a round ball. There's your legs and your feet and your hands. There, that's you, all squished in there. And they take you outside, and they find a nice hill to roll you down. There, like that. And the ocean is out there, there's ships out on the ocean, with sails, there. And your parents are kind of small. That's your dad, that's your mom. There, like that. And you've got a little dog named Fido, with big ears. There, there's Fido.

And your parents say, "Have a nice ride!" and they dump you off the top of the hill. So now you're going, "Yahhhhh!" -- bumpity, bumpity, bump, rolling over buildings and stuff that's down there. And Fido wants to stop you. So Fido goes, "Barkity, barkity, barkity, barkity, bark!" He's running down there, and he gets in front of you and decides to try to stop you. Is he going to be successful? *[Students: "No."]*

What if Fido ran and started ripping telephone poles out of the ground, because Fido's pretty strong, and Fido put the telephone poles in your way? You know, he could make a wall out of telephone poles. There. Fido could glue them together with bubble gum, because Fido chews bubble gum. Would a wall of telephone poles stop you? *[Students: "Maybe."]*



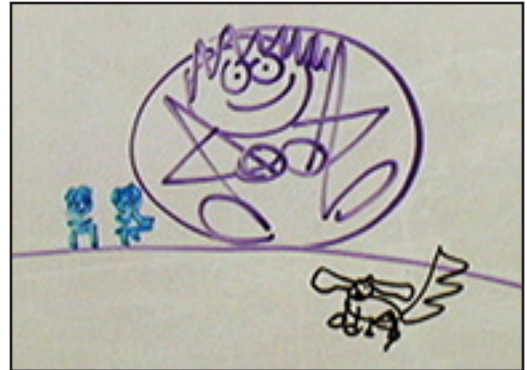
Ball swings up.

Well, when a ball is rolling like that, it has a lot of something that we call inertia, stored energy. We want something to have inertia, but we don't want to roll it down a hill. We want to hang it from a hook. There. So now you're still in the same ball, and you're hanging from a hook. And a bird comes along and lands on it. There's a bird. And the bird flaps its wings -- flappity, flappity, flappity, flap -- and pulls you waaaay up here. And now you're up here.

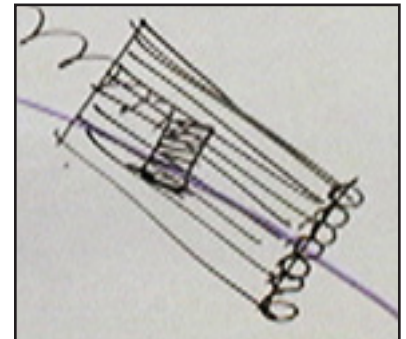
"Ahhhhhh!" Will you stop when you get down there? *[Students: No.]* What will happen? *[Students give ideas.]* Okay, you'll go to the other side. Will you get as high on this side as you were over here? *[Students: No.]* No! Yeah, you're good. Yeah, because there's friction in the system, so you swing over there, and back and forth you go.



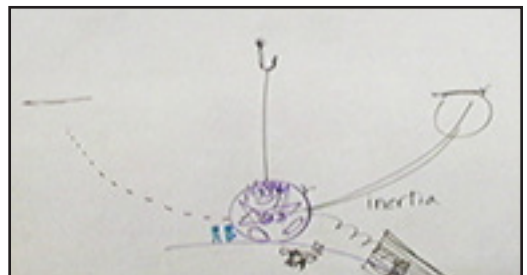
You inside the ball at the top of a hill.



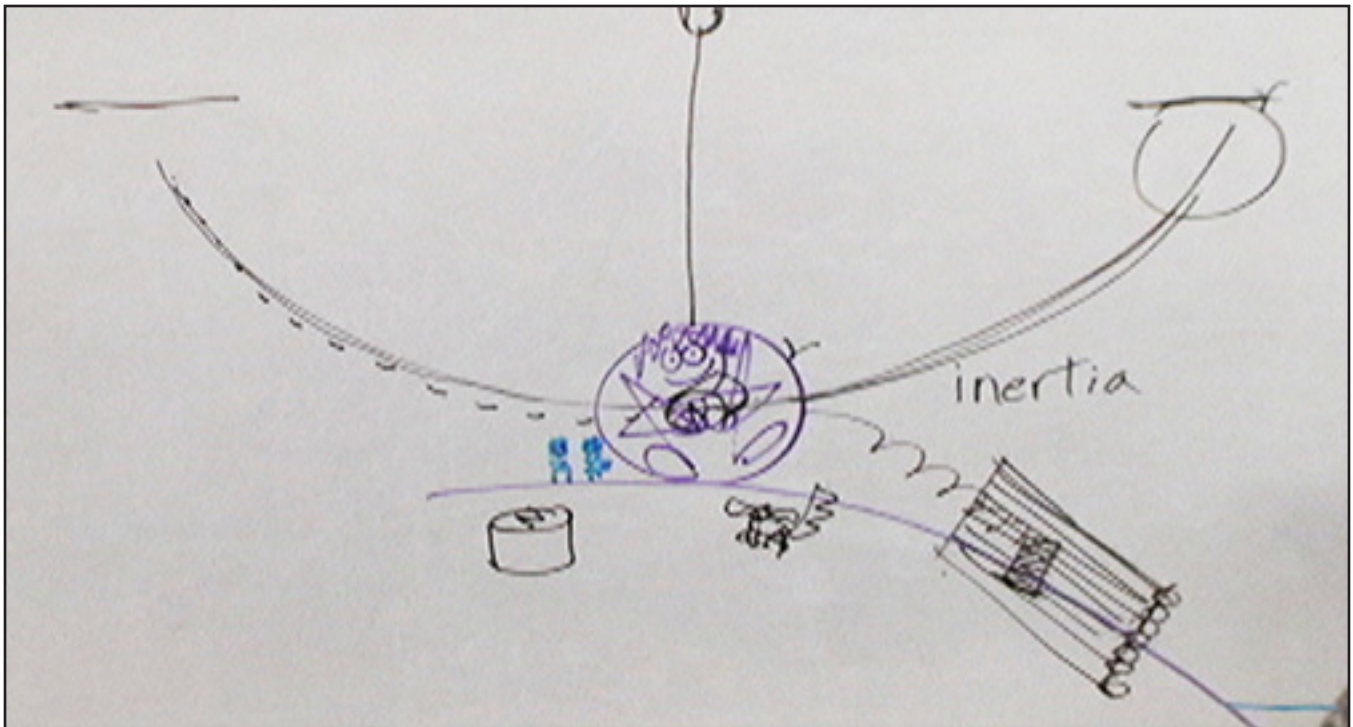
Parents and Fido.



Wall of telephone poles.



Swinging both ways.



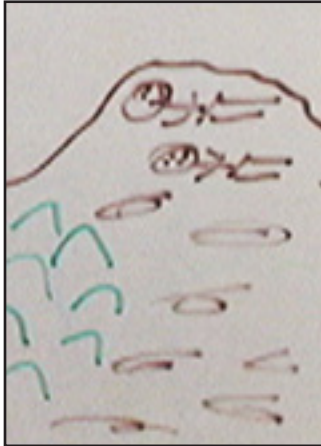
Magnet in your stomach and another under the ground.

What if you had just swallowed a big magnet, so now there's a magnet in your stomach? Would that make any difference? *[Student: Yes.]* What would it do? *[Students give ideas.]* What if somebody else put a big magnet in the ground? *[Students respond.]* Would it just get stuck and stop? What if the magnet in the ground had a big N on the top and yours had a big N on the bottom? *[Students respond.]* Well, we want to find out. We're going to do that today. We're going to put you all in a big ball, make you swallow a big magnet, put magnets in the ground, and swing you back and forth. Or, we'll think of something else. But first, we need a crazy story.



## Story: "Secret Frogs of the Himalayas"

Once upon a time, there were some hermit frogs, and they wore towels on their heads. Because if you're a hermit, you've got to wear a towel on your head so you look smart. I wonder what color towel they would wear. Maybe purple towels. There. They wore towels on their heads. And there was a bunch of these hermit frogs all over the place -- frogs, frogs -- and they were living on Mount Everest. In the Himalayas.



Himalayas

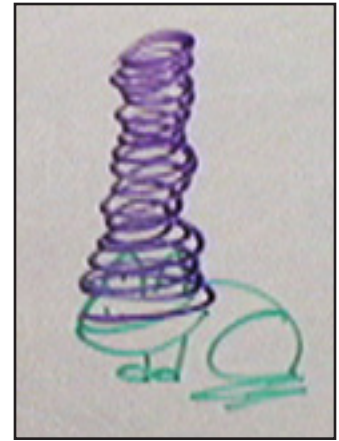
Do you know why they call them the Himalayas? It's because a long, long time ago a bunch of guys fell asleep in a big pile, and they were all asleep in there. So they're laying down sleeping. And they got squished together to form a mountain thirty thousand feet tall. That's why they call it the Himalayas. Now you know.

And the frogs are guarding something. Something extremely valuable. There's a cave where the frogs are, and the frogs never let anyone go in the cave. Because if they did, they might follow the path of the

cave, down and down and down, into the deepest part. And there, if they happen to find it, they would discover something that has super powers. Sitting on a pedestal is a giant red M&M. If you hold that M&M for ten minutes, you just developed super powers that'll last you for ten hours. You'll be able to have bullets bounce off your chest, you'll have x-ray vision, you'll be able to fly through the air. All the Superman powers will be yours if you hold that M&M for ten minutes. And the hermit frogs are guarding it so nobody gets that power.

Well, it just so happened that Jack and Jill were there interviewing the frogs. There they go. There's Jack and Jill interviewing the frogs. And they discovered that these frogs live for a thousand years, and that nobody has ever gone down into that cave except for frogs. And Jack and Jill said, "But you guys ever touched the big M&M?" And the frog said, "No, no, no! We're not allowed. We don't want to become super-frogs, because then we might misuse our powers. We just make sure nobody touches the M&M."

Well, you can guess that there is someone who really, really wants to touch that M&M. Evil Mister Fred. And he built a castle nearby, and his plan was to have the minions dig a tunnel over to where the frogs were, attach his tunnel to their tunnel, and steal the big M&M.



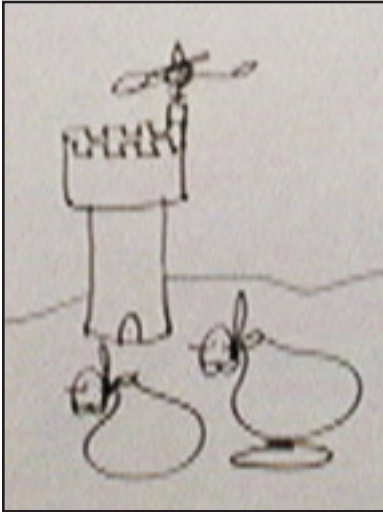
Hermit frog.



Giant M&amp;M at bottom of cave.



Jack &amp; Jill interviewing frog.

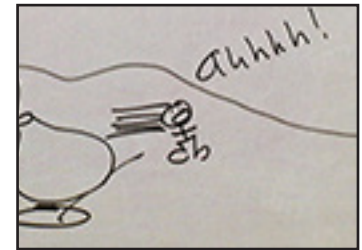


Evil Mister Fred and minions with bags and hole.

So here's all the minions, and Evil Mister Fred knows that minions love M&Ms. And so it was not hard for him to convince them that they had to go and find the giant red M&M. And he told them whatever they did, when they found the giant red M&M, they were never to touch the M&M. He didn't want to have a super-powered minion on his hands. So he gave the minions a bag and told them if they find the giant red M&M, to put it in the bag without touching it and bring it back. So all the minions had bags.

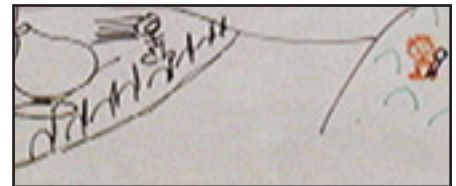
So, of course, the minions started banging on the ground to make a hole. They're banging on the ground with their baseball bats, trying to make a hole. And they woke up some of the hims from the Himalayas, and the him guys ran out screaming, "Aaaaaaahhhh!" -- because they just got

woken up -- "Aaaaaahhh!" There. And Evil Mister Fred could see this was not going to work. It's really hard to dig through a bunch of guys.



Him running from hole.

So the minions all gathered together and they formed this huge army of minions. And Jack and Jill knew that they were coming because they saw them. And Jack said, "Jill, what are we going to do? Look at all the minions. If they storm this place, we're in trouble." And Jill said, "Yeah, you're right. We're in trouble. But you know what? Those poor minions. Look at them out there. They don't look like an army. They don't have uniforms on." And Jack said, "Who cares?"



Minion army facing the frogs.



Minion helmet.

And Jill said, "I think they should have helmets, at least." So she called the Acme Store of Everything and ordered about ten thousand helmets. And she ran over to the minions and said, "Minions, here, have a helmet!" And the minions said, "Oh, thanks!" And they got these really nice steel helmets with a big spikey thing on the top. There, like that. And the minions said, "Whoa, this is cool!" Whoosh, whoosh, whoosh. "We got helmets, yeah, yeah, yeah." And Jack said, "Oh, thanks, that's really helpful. Now you've got pointy-headed minions. What are we going to do now? They're going to run like this and spike our frogs."

If you were Jack and Jill, how would you stop those minions from spiking your frogs?

## 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 . . ."

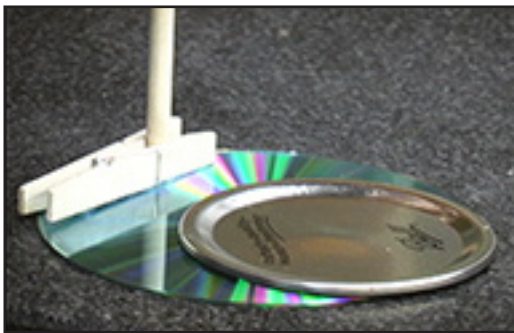
## Experiment: "Oscillating Pendulums"

### Part One: Demonstration

Well, we need to have something that moves. So we're going to start off with a CD. Here's a CD. That moves. And we want something on top of it, like a tower. So we can make a tower out of popsicle sticks. Popsicle stick tower. Here's a popsicle stick, and there's a popsicle stick. We would like that to stay there. If I let go, of course, it's just going to fall off. So we'll put a gob of glue on it. There, put a little glue on that. And we want that to stay on the stick.



Wooden dowel and craft stick.



Clothespin gripping dowel; jar lid on CD

Then we need something to hold the stick up, like, oh, do you know what this wooden thing is? A clothespin. You use it to pin your clothes, right? Why would anybody want to put a pin on your clothes? Yeah, to hang it up on a line for the clothes to dry.

You can also use it to grip a stick. It's now a stick-gripper, okay? So we could kind of hold our stick up with a clothespin, but it tips over, right? We want to glue the clothespin onto the CD. Let's put a bunch of glue on our clothespin. There.

Now we've got a thing. We can move it if we like. Now, I know you're saying to yourself, "What this really needs is a lid from a canning jar." Everybody looks at this and says, "Yeah, yeah, it's got to have a lid from a canning jar." Isn't that first thing that came to your mind when you saw this? No? So then you gush a bunch of glue onto that -- gush, gush, gush, gush -- and you stick it on here. There.

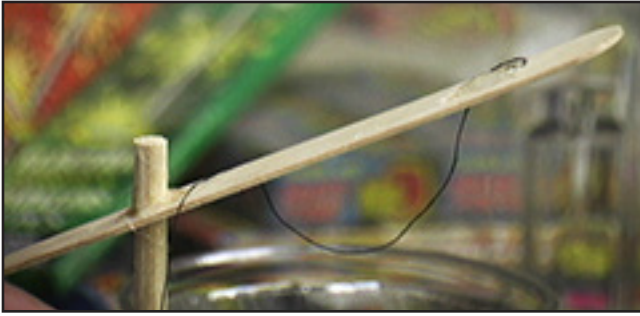
And then the next thing that you say to yourself is, "What it really needs is a minion hanging from a thread." Sure, right? Here's a spool of thread, and here's a jar full of minions. They don't look like minions? They're plastic thingies. Well somebody gave us a bunch of plastic thingies, and they've got this thing that sticks forward that looks kind of like minion feet. But it doesn't have minion eyes or a mustache, right? So we need to put some eyes and mustache on it. So we color some eyes and a mustache, and some feet. There. Minion.



Black thread stuck to minion with glue.

We're going to put hot glue on his head. I wonder if he's going to like that. They have very hard heads. So we put a glob of glue right on his head. There you go, minion, isn't that good? He's probably doing the ooh-aah-oooh-aah dance. And minions don't have hair, we're going to give him one long hair. Just one hair, that's all he gets. We stick it in the glue. There. Then we'll randomly cut off the thread and stick one end of the thread anywhere on this popsicle stick thing. There.





Other end of thread glued to craft stick.

Now, why are we gluing a minion's head to a stick? Because we like to. There, so now we've got a minion, and we can make him hang up high if we like. We can make him hang higher. He could be up there if we like. Or we could make him further down so he bangs into the ground.

You know what we're going to do next? We're going to glue a magnet to his feet. So we put some glue on his feet and stick a magnet on it. There. Now we



Magnet on bottom of minion.

have a minion with a magnet, dangling from a thread, minion hair. And he's just dangling there.

Now, in the old western movies, when a bad guy came into the saloon and he saw somebody he didn't like, he'd say, "Hey, Joe! Dance!" And he'd take out his gun and he'd go bang-bang-bang-bang-bang-bang and shoot bullets by the guy's feet. And the guy'd go ooh-ooh-aah-ooh-aah, and he'd dance like that. Well, we don't want to shoot our minion, but we want him to dance. We could swing him, and he can swing. But we want him to act weird. We want him to dance.

So first, you're going to make this part, and then we'll give you some other pieces, and you're going to try to make your minion dance.

## Part Two: Build Pendulum

*[Instructor passes out supplies to each student.]* So we're going to start off with a CD. And then you need jar lids. Then you need a minion. Stick. Then you need a popsicle stick with a hole. Then you need a clothespin. You get a choice of a plastic one or a wooden one. *[Students glue the pieces together.]* And I'm going to store the thread on your head. So when you're ready for it, you just search around through your hair and you'll find the thread. *[Instructor passes out thread and one magnet.]*



Four magnets on the jar lid.

Are you ready for second magnets? The idea is to make your minion dance with the second magnet. *[Passes out a second magnet.]* Don't glue the second one, just move it around.

Now we're going to add another magnet to that *[Passes out a third magnet.]* How many magnets will make the minion dance the best? Try putting three on your plate. *[Passes out a fourth magnet.]* Should we go for four magnets? You decide how to put them, or how many you need to make them dance the best. Does he work better if it's way up high?

So that's all the magnets you get. Be sure you put your name on it, because if somebody picks it up, they're not going to know.



## End of Story

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

So now, Evil Mister Fred has his army of minions. And they all have army helmets, and they're so proud of themselves. They've got their baseball bats, and they started marching across the field. And then Jill said, "You know what? I feel like going fishing." And Jack said, "Yeah, me too!" So they called the Acme Store of Everything, and they ordered a flying fishing boat.

If you're going to catch something, you've got to have some bait, right? They decided to use M&Ms. And Jack lowered his hook. And when he lowered the M&M, the minions said, "I smell M&Ms!" And they all started running towards it. And now they're fighting over who gets to have the M&M, jumping up in the air, trying to reach the M&M.



Jack and Jill in the boat.



Minions crowd around below the M&M, and Jill lowers her big magnet.

And Jill said, "That's pretty good, Jack. I think I'll use something other than an M&M." So Jill put a big magnet on hers. And then she lowered her magnet right next to the M&M. And the minions are jumping up and down and up and down and saying, "Hey, it's easy to jump now! What's going on?" And all of a sudden -- clanggg!! One of the minions stuck to the magnet. And the others said, "Cool!" And they all started jumping up to see if they could get their heads stuck to it, too.



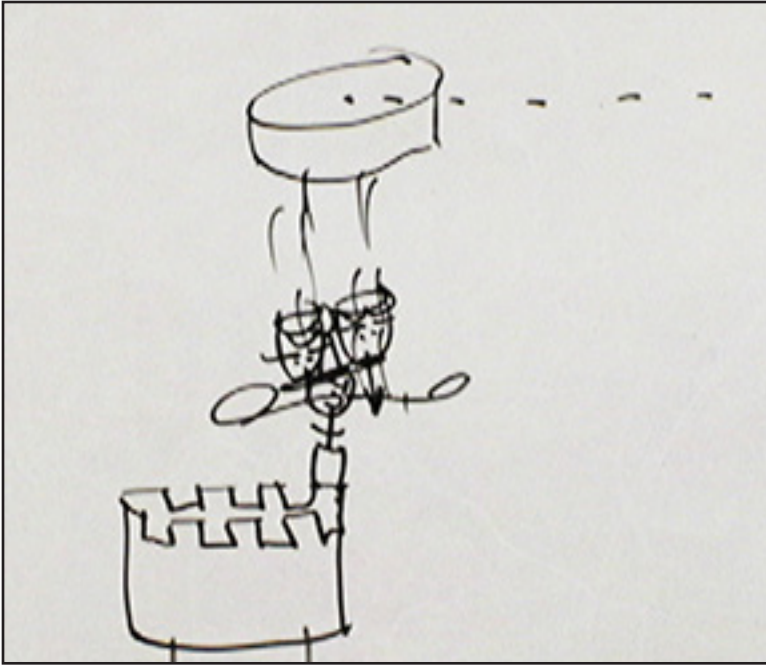
M&M on hook.

So now you've got hundreds of minions stuck on a magnet. Jack said, "What are you going to do with that?" And Jill said, "Well, this is a special magnet. It's called an electromagnet. If I flip this switch, it'll let them all go." And Jack said, "Nah, that can't be." And Jill said, "Watch." And she pushed the switch, and all the minions went, "Aaaaaaahh!" and they fell head-first and stuck into the ground.

And then Jack said, "Cool! Pick them up again." So the boat came down and Jill picked them all back up again. And Jack said, "Well, what are we going to do with a bunch of minions?" And Jill said, "Why, the only logical thing. We'll give them back to Evil Mister Fred."



Minions stuck on magnet.



Minions falling on Evil Mister Fred.

So the boat cruised over here and dropped the minions right on Evil Mister Fred. And they landed spear end first into Evil Mister Fred. And he said, "Ooh, that hurts!" 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.*