Home School Series

Homeschool Teacher's Guide for:

Sumo Robots

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.

Title Page of Video

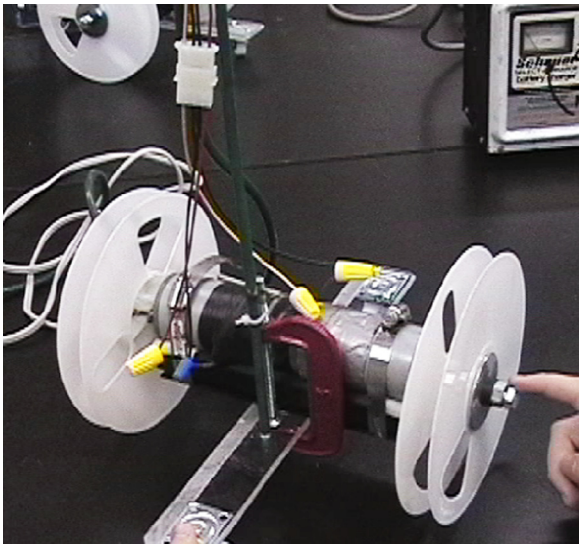
(Numbers in the text are **time codes,** so you can refer back to the video.)

[00:03;09]

Sumo Robots
filmed January, 2010

For Rock-it Science Internal Use Only

Students' images in this video should not be used publicly unless their nametags are rendered unreadable and their names are bleeped from the audio track.



Robot Platform

Introduction

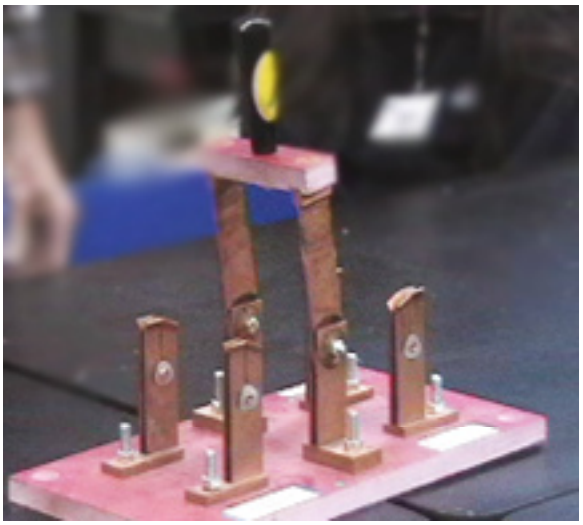
[01:00:11;02] Intro

It's hard to get robots to do what you want them to do. Almost all robots use electricity to make them go. They almost all use DC motors to make them go. Some of them use pressurized air or hydraulic systems that are really, really powerful. So, like if you're in an army situation and you have a robot and you want to go lift up big bombs that didn't go off, you'd probably want a hydraulic one, because it can lift up thousands of pounds. And if you shoot it with bullets and things, it's really hard to mess up the hydraulics.

We're going to be using one that is electric. This is the simplest kind of robot base. There's a motor there and a motor there. If you've never turned on a DC motor before, you put it onto a battery, and usually it spins real fast -- takes off. And your robot scoots across the floor and smashes into the wall. Well, these motors, luckily, come with a gear box built in, so when you turn them on, they just mmmmm-- they go slow enough so you have some control.

It's got a couple of switches that you'll be able to figure out when you try it out. They call it a platform. It's the simplest platform that we can get. And then people will add computers to it (our battery is not going to be on the platform), and they give it sensors so it can wander around. Nowadays, you could mount an iPhone on there and you can do all kinds of cool things with an iPhone -- tell your computer what your robot is doing. And with a bluetooth connection, you could make a robot without all the wires and stuff. You've just got your iPhone on there, and you could have it sneak around in your house, and

it's got a camera on it. So you can sneak around and take pictures of stuff.


Big Switch

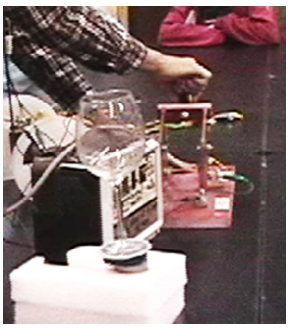
In some classes, we let you figure out how to make the switch. But it takes a whole hour just to make the switch. I had one that was donated by a local company *[brings out a big switch]*. This is the kind of switch that's in these boxes. I like this because you can use it for frankenstein movies and things. You know, you put a hundred thousand volts on there and you pull it apart, arcs jump across from one place to another. But we can show you easily how that works. *[Brings out a wine glass attached to a base with a motor in it.]* There's a motor in there. You want to hook up your motor to this *[indicates big switch],* and you want to hook up some power to it so that when you do this *[throws the switch],* the wine glass goes one direction. And when you do that *[throws the switch the other way],* it goes the other direction. And when you do that *[pulls the switch upright]* it stops.


Wine Glass on Motorized Base.

So, we need some power *[brings out a battery charger]*. You use these to charge the battery on your car. I just modified it so that we can use it in this. It makes twelve volts. Twelve volts, unfortunately, isn't enough to make your eyes light up. There's twelve volts on there -- doesn't do anything to you. Takes forty volts to get through your skin. If I touch these guys onto those wires sticking out the top *[connects alligator clips from the wine glass motor to the battery charger terminals],* ta-da -- the wine glass goes round and round. And then if I switch them, the wine glass goes the other way.


Battery Charger.

I'm going to have to switch those to make my robot go, because you're going to be fighting one robot against another, and you don't want to have your buddy there switching wires to make the motors go. So you're going to hook them up, one on there, and one on there *[hooks alligator clips to big switch]*. There. Now when I touch this to that *[throws the switch],* if there was power here it should turn off. So we'll put some power there. We can put one to that guy, and one over to that guy *[connects alligator clips from battery charger to big switch, then flips switch and wine glass turns]*. It works!


Switch makes wine glass spin either way.

So if you only wanted your robot to go frontwards, you can do it with that kind of a switch. Now we want him to go backwards. You can do it with two more wires. How shall I do it to make him go backwards?

[Student: I think you can just hook the wires up in the other direction.]

Hook the wires up in the other direction. Yeah, I could take those off and hook them up --

[Student: I mean wires like the other one of those.]

Oh, okay. All right, so we'll put one here *[hooks clip to switch]* and make it the opposite of that one. So this guy went here *[indicates connection on charger],* so we'll put this green guy over there, and we'll put the yellow guy over to the other side *[hooks up clips from charger to switch]*. There. Now they're going to work. So now we go *[flips switch one direction and glass turns],* and *[flips switch in other direction and glass turns other way]*. And you can make your robot do whatever you want.

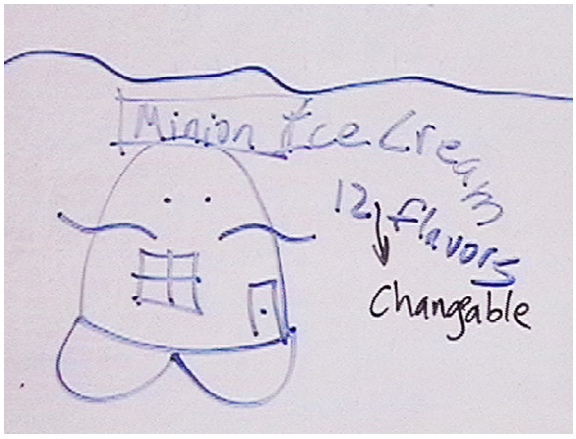
That kind of a switch is in here *[indicates robot control box]. There's one on this side and one on that side, so that when we hook our robot up to it [connects control box to charger]* . . . Now we've got him so that . . . *[uses control box to make robot platform move around].*

Now, you're going to be crashing your robots into other robots with the objective of pushing them off of the edge of a rink, or a rectangular surface. But first, we need a crazy story.

Story: *"Jack & Jill and the Minion Ice Cream"*

[01:07:33;17] *[Student: Is Evil Mister Fred going to have an army of robots?]*

Well, yeah, he's got to have something like that because it's all about robots. He's got dumb minions. You could take out the minion brains and put in something else that's smarter than a minion.



Minion Ice Cream in 12 Changeable Flavors.

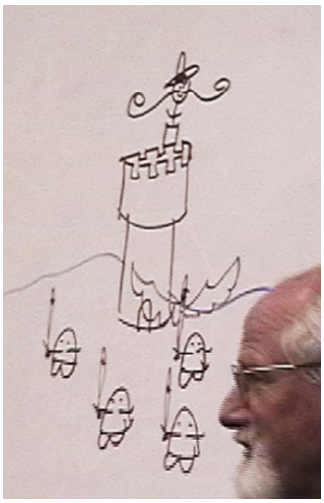
So Evil Mister Fred has discovered that people like ice cream. After how many years? How old do you suppose Evil Mister Fred is? Okay, he's three hundred forty-two years old, and he's finally figured out that people like ice cream. And he thought, "Well, if I can make people so uncaring, so complacent, that they don't stop me, I'll take over their country. I think ice cream is the perfect lever. So Evil Mister Fred opened his own ice cream stores, and they were in the shape of giant minions with a door somewhere on it, like that. And it says, "Minion Ice Cream." That's the way he made the signs because they never plan ahead. Twelve flavors, like that. And he established the franchise of Minion Ice Cream all over the country. He'd sell his ice cream really cheap. He bought all this ice cream in some country like Chile or some place like that so he could get cheap labor to make cheap ice cream. And to make the ice cream even better, he put drugs in it. So you'd eat your ice cream and then you'd all of a sudden be real happy. But then, after awhile, the happiness would wear off, and you'd have to buy more ice cream.

And he had different flavors -- there's blueberry flavor ice cream, strawberry flavor ice cream, he had singing ice cream, he had dancing ice cream, every ice cream you could imagine. There are twelve changeable flavors. So you might start off thinking it's strawberry, but after a few licks it turns into something else. And it keeps changing around.

And all the people started buying his ice cream. They said, "Whoa, this is great -- love this ice cream!" They're spending all their money and all their time eating ice cream. And Evil Mister Fred said, "Ah, this is great! The people are addicted to ice cream. Now I can do anything I want." So he called Washington, D.C., and nobody answered the phone. And he said, "Ah! Wonder where they are?" And of course, they were all out eating ice cream. He went into the Pentagon, walked in the front door. There were all these security guards there with the scanners and everything, and they weren't paying attention. They were all just sitting there eating ice cream, and he walked right on by with no one to stop him. The guys watching the security cameras were asleep.

So Evil Mister Fred went to the local TV station, stood in front of the camera, said, "Hello, America! By the way, I'm now in charge. Anything you want, you gotta ask me first. And my first rule is: Taxes will be raised. Whatever you make, send it." So Evil Mister Fred became really, really rich. And he said, "You know, sooner or later, somebody's going to wake up and they're going to challenge me. So I need a good army."

And he called his minions together and said, "Minions, you're going to have to practice to become good army guys so that if these guys ever wake up, you guys can defeat them. And the minions were all going, "Uhh, uhh, uhh . . ." They'd been eating ice cream. Minions love ice cream, too. So Evil Mister Fred called the Acme Store of Everything, and he ordered a pill that he gave to the minions so that whenever they ate ice cream they would throw up. Every morning he'd put the pill in their breakfast cereal, and the minions would eat their cereal, and then if they ate ice cream -- blechhh! -- they wouldn't get drugged from it.



Minions with high-tech baseball bats.

Then he decided, well, he needed to give them a high-tech baseball bat. Now the business of just an ordinary baseball bat wasn't going to cut it if the other guys sent an army after them. So he gave them a baseball bat with a brain. And he put an accelerometer in it, and a camera in it, and he made it so the bat had wings, and fangs. So they're truly "bat" bats. And now the minions could wander around with these bats. And even if the minion didn't know what he was supposed to do with it, the bat would go crash on somebody, or suck their blood out, or whatever. It made them into a better army.

But Evil Mister Fred said, "We've got to practice. I think you guys are invincible, I think nobody can stop you now, but we need a practice spot." So he got a bunch of people in Happyville -- really Happyville -- and he changed their ice cream so there's no drugs in it, so they were aware of what was going on. And Jack and Jill happened to live in that town, and they said, "Hey! I feel different. What's going on here?" And they realized that the whole country was drugged. And they said, "We've got to stop this. We've got to warn the president, we've got to call out the army." And they happened to look out their

Jack and Jill in Happyville.

windows, and here came an army of minions with bats. And Jack and Jill said, "Uh oh. Minions. Now what have they got? Flapping wings on their bats."

Now if you were Jack and Jill, and you see an army like that, and you know the rest of the country is all drugged, what would you do?

Imagination and Brainstorming Time

[01:15:09;02] *[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.)

Okay, we'll leave this "To be Continued . . ."

Experiment Part 1: *"Build a Fighting Sumo Robot"*

Items needed for Demo:

- Robot platform on wheels (pre-built)
- Robot Controller Box
- Car Battery Charger
- Large Electrical Switch
- Wine Glass on Motorized Base
- 24" insulated Connecting Wires with Alligator Clips

Items needed for Students:

- Robot platform on wheels (pre-built)
- Robot Controller Box
- 24" insulated Connecting Wires with Alligator Clips
- Miscellaneous materials for modifying the robots: sheets of cardboard and plastic, craft sticks, rubber bands, etc.
- Glue Guns
- Glue Sticks
- Masking Tape
- Package Sealing Tape
- Extension Cords
- Boards with two parallel strips of 1/4" Copper Tubing attached to them
- Mats for competition area

[01:15:58;22] Now, up in San Francisco, they used to have robot wars, and one of the guys on Myth-Busters won one of the robot wars that they had. They have a pit and a platform, and these two robots would be out there, radio-controlled, and they'd be maneuvering them around. And you'd try to push

the other robot into the pit. And if you succeeded, flames would shoot out of the pit, you know, and the guy's robot would get wrecked. And most robots, after a few years of doing this, discovered that wedge shapes are good, because if another robot tries to push you, if you're wedge-shaped, they just ride right up over the top of you. And so a lot of wedge-shaped robots showed up.

Then another guy said, "Well, okay, wedge shapes are fine." One guy put a chop-saw on his robot. That's an abrasive blade, it spins at about five thousand rpm. And you'd sneak up on a wedge-shaped guy and go bzzzzzz! and cut him in half. Another guy got a jackhammer, you know, he put a jackhammer on the front of his, so when he got up to the other guy, just a few shots of blade and his jackhammer would put a hole in his armor, and then he could just shove the blade of the jackhammer in, lift the robot up -- now his wheels are spinning in mid-air -- and drag him over to the pit and crash! -- drop him in the pit.

Part of making it is making your robot as invincible as you can, but there's a lot of strategy. If you can make your robot fast and light, the other guy can't catch you. And there's some manual dexterity involved. These guys are running joysticks. So if you're quick, and you've got this little robot that seems kind of vulnerable, you can zoom around the other guy. And you zoom right near the edge of the pit, and he's coming to get you, and just at the last second you zoom out of the way and over the edge he goes into the pit.

So it's part strategy and part engineering that will give you success with these things. And a lot of luck, actually, because, you know, you're not going to get much time to practice. You've got these switches, and if the robot happens to be turned around, so you're looking at the back, what you thought was the front, and you push the switches to go forward, oops! -- and the robot goes backwards? Yeah, you could lose.

So, for the first part, you're going to work in groups of two or three. . . . There are robots over there. Get one and bring it over to the table, and unwind it.

[Students hook up their robots and practice using the controls, then disconnect the power supply.]

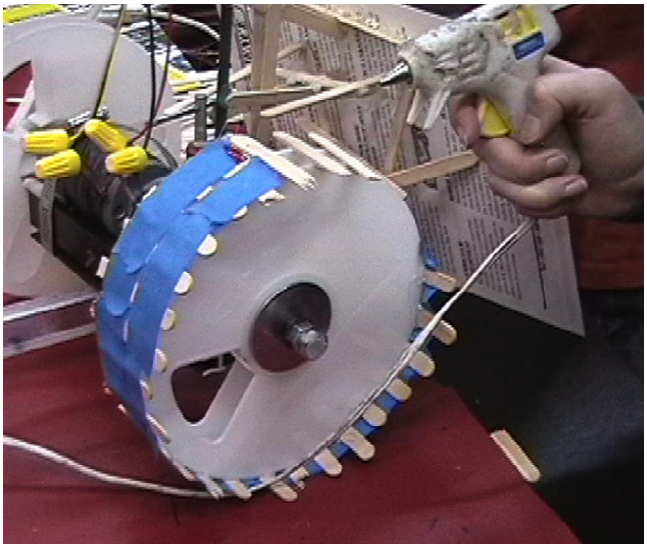
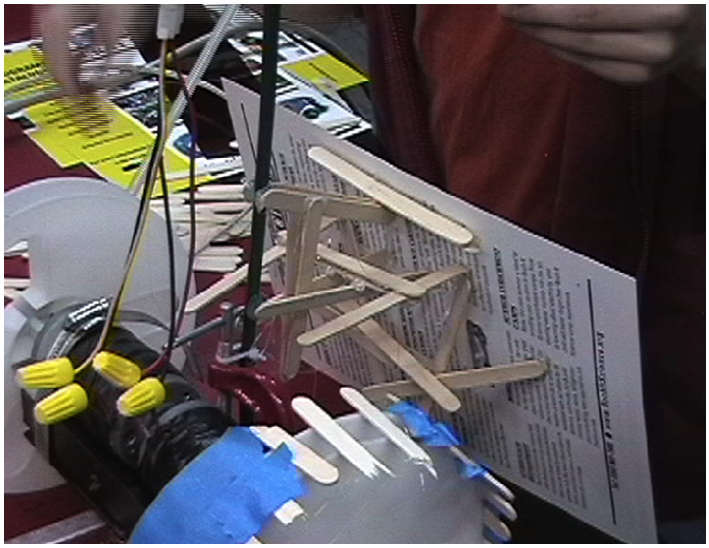
There are two classes that are going to use these robot bodies. The wheels come off easily, so you can do whatever you want to the wheels of your robot. You might have noticed that they spin out on the table. You can add whatever you want to give them more friction. You can add more weight, but whatever weight you add you have to be able to take off, so the Thursday class can use it again. You can add a frame to your robot, but what ever frame you add, you have to be able to lift off. The supplies are all sorts of cheap plastic, some thick, some thin. There's all sorts of old Rock-it Science brochures that are printed on pretty nice slippery cardboard. There's popsicle sticks, there's some broken rubbery things, and -- got any glue guns? If there's anything you think you might need, maybe we have it. There's one roll of duct tape.

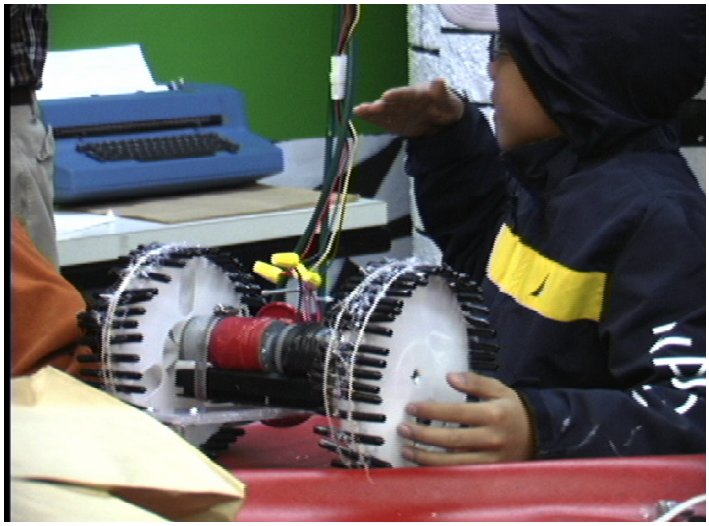
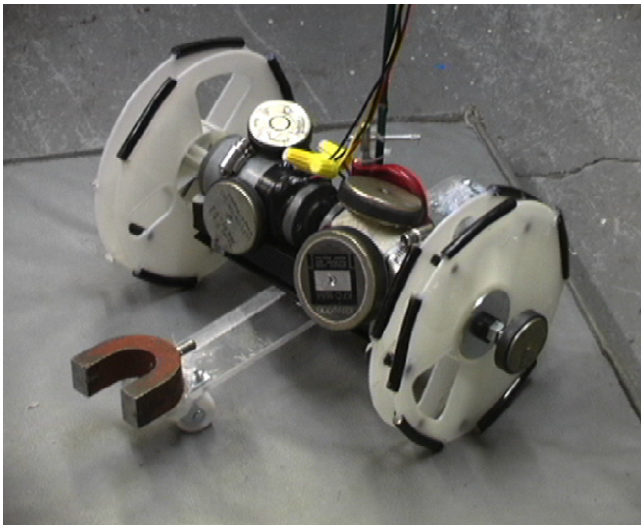
So you want to do something to your robot so that you have an unfair advantage over the other guys. At the end of the day, you have to be able to lift it off of your robots.

And as usual, you can always encourage your opponents to do something foolish so their robot will fail.

[Students attach stuff to their robot platforms.]

Examples of Modifications:

Experiment Part 2: *"The Competition"*

(filmed with a different class group)

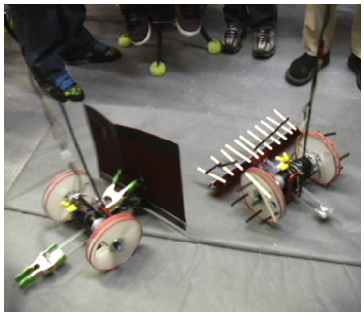
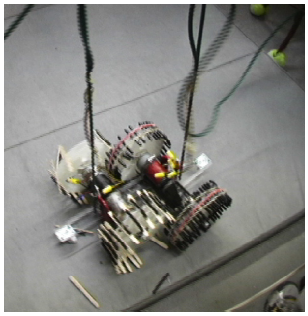
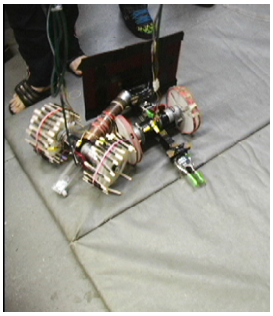
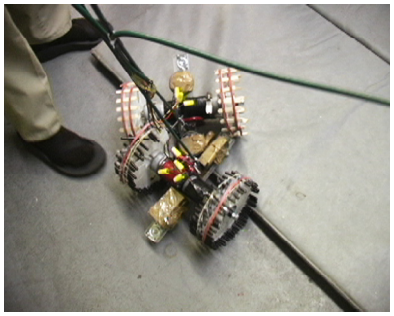
[02:00:05;06] In Tuesday's class I noticed that the students were all decorating their robots and weren't trying them against each other. So I forced them to have battles with their robots. And then they started doing really well, because pieces got knocked off, and they discovered what worked and what didn't work. One group came up with a design that defeated all the others with such great ease, they were cheering with joy and everybody else was crying big tears.

So today you need to have a plan so that you can run your robot against every other robot at the table at least once. If I see you sitting there just decorating your robot, I will say ten, nine, eight, seven, six, five, and when I get to zero, whatever you've got, you've got to put it down there and run it against somebody else. When you're doing it, you're going to put your wires on one of the power supplies that are down there. It might be backwards. And you can either adjust yourself and turn your controller around, or you can switch the wires to make them frontwards again. To win, it's usually the best two out of three. To win, you've got to shove the other guy's robot enough so that at least one wheel falls off of the edge of the mat. But sometimes it's more fun to just shove the entire robot off.

If you're a spectator, you don't get to use your feet to help one of the guys. In last week's class, we had a story going. Do you remember anything about the story? *[Students indicate they don't remember.]* Okay, that way I can put on any ending I want to.

So, the robots are over there. You can choose any robot you want, bring it over here, put the wheels on. Remember that there's a nail that goes through the shaft and through a slot in the back of the wheel. If you forget the nail and tell your robot to go forward, the shaft will spin really good, but the wheel won't turn. Go!

[Students get their robots and prepare for combat.]

End of Story

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

[02:45:23;14] *[This class ran overtime, so there was no ending given to the story.]* The way the story was going to end was Jack and Jill were going to use a clever strategy to get Evil Mister Fred to have his robots attack himself.

End of Lesson