Interactive Notes-"Forces & Newton's 3 Laws"

Student Materials (per group of 4 students):

Demo 1	1-ping pong ball 1-golf ball
Demo 2	1-plastic ring 1-penny 1-bottle -to catch the penny
Demo 3	1-styrofoam plate with removable wedge 1-marble
Demo 4	1-small plastic or paper cup 1-"flippy board"
…and	4-note sheets (see last page)

Additional Teacher Materials:

PowerPoint (see last page)
1 beaker of water- to pour water into the little cups in demo #4
1-mop and some towels- for spills during demo #4
1-tennis ball, tennis ball on a string, and bowling ball (optional, but very helpful for further illustrations. Use the bowling ball whenever referring to massive objects.)

Beforehand:

- Insert page and paragraph numbers from relevant pages in your textbook at the bottom of slides 1 and 2 if you choose to have the class read from it together. This is a good way to connect with your textbook as well as transition into the next demo. You can also delete these page inserts, or Copy and Paste them onto later slides if needed.

- Keep an extra set of materials up front so you can show students how the demos work. It's much easier to *show* them what to do than just tell them.

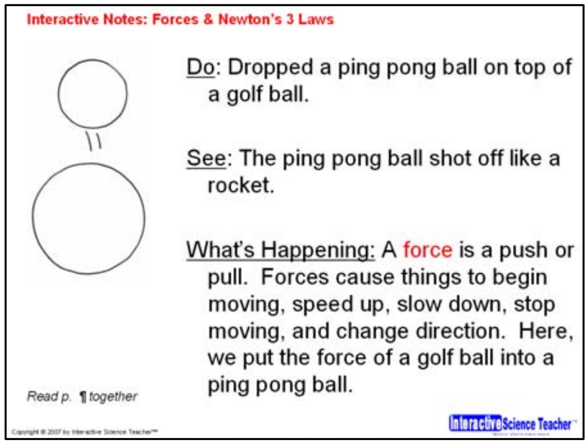
- Demos 2-4 require some building and cutting. Do all this well a week or so in advance so you're finished early and have time to play around with them yourself.

- As with any other demonstration, try these out ahead of time for yourself so you know how they work best and so you know what to expect. Practicing will also help you decide what to say and how to say it. There is plenty of room for other anecdotes and explanations, like roller coasters and planets.

- Print extra copies of the notes pages on paper for yourself, students that are slow writers or can't see well, and for absentees. Click "File" → "Print" → then where it says "Print what:" select "Handouts" → and then "OK".

- If you've never taken the time to put a tennis ball on a string, you'd be surprised how often you'd use it if you had one. Drill a hole in a tennis ball just big enough to slip the "V" end of a toggle bolt through. Tie a string securely to the screw head, and you're in business.

1.



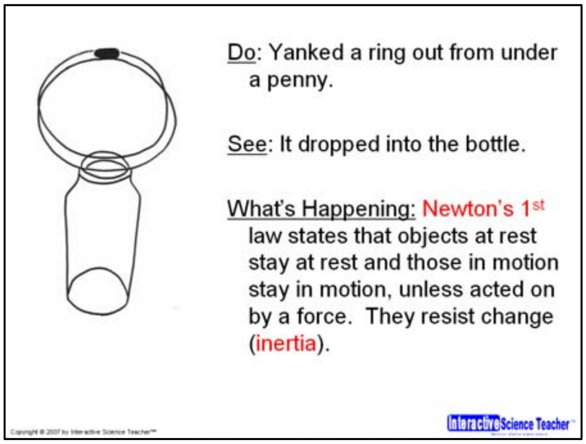
Ask student #1 to drop the ping pong ball by itself on the table a few times and watch how it rebounds (it bounces about halfway back, losing that energy into the table). Then have them drop the golf ball by itself and observe what it does.

Now have the student drop the two stacked together with the ping pong on top of the golf ball (demonstrate how to hold). If the balls land just right they'll observe an "explosive" event as the ping pong ball shoots off across the room!

The reason for this lies in the difference in mass between the 2 balls. The golf ball is more massive than the ping pong ball, so it requires more energy to lift and has more energy when it falls. To make this point more dramatically (and memorably) you can set a bowling ball next to your ping pong ball and ask which requires more energy to move. When the golf ball and ping pong ball are dropped together and hit the table, some energy is transferred from the golf ball to the ping pong ball. To prove this point watch again how the golf ball bounces by itself compared to when the ping pong ball is on top of it- it bounces much less high the second way. That missing energy is what went into the ping pong ball. But why did it shoot off? The balls are deceiving you. Remember how much more massive the golf ball is compared to the ping pong ball. They do not have them same amount of energy- the golf ball has more because it is more massive. And that "more" transferred is what created your rocket.

If you're looking for more excitement, a tennis ball dropped on top of a basketball (outside, of course) is the best combination.

2.



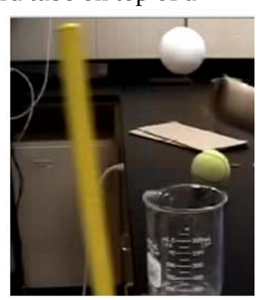
Tell student #2 to stand the ring up on its end on top of the bottle and put the penny on top of the ring, as shown in the picture (demonstrate this). Announce that the trick is to strike the ring in such a way the penny on top of it falls into the bottle. Students may accidentally get it to drop into the bottle at first, but probably won't really know what they did. True mastery comes when they can do it 5 times in a row.

The flexible plastic rings are made from 2-liter soda bottles. Mark rings at every 2 centimeter increments down the bottle. Connect the marks with a marker then cut each 2cm section into little bands using scissors.

Here's the secret to this trick: your finger coming at the ring must hit the far side (the second side). That causes the flexible ring to flatten, leaving the penny behind for gravity to do its work. If the first side is struck the ring will bow up, launching the penny off.

The extra photo at the bottom of the slide shows the penny a fraction of a second after the ring supporting it had been jerked out. It shows the penny's little bit of inertia fighting gravity with all it's got trying to overcome it's "at rest" state. To help students appreciate this, tell them that if they understand what they're looking at, which is a penny sitting motionless in mid-air, held by nothing. They should be astounded. And even more so on the next slide (read on).

The next slide shows another inertia demo where there is an egg on top of a cardboard tube on top of a cardboard square on top of a beaker. Just out of sight in the picture on the left is a broom with its bristles stepped on and the handle pulled back, so that when released it will snap forward, hitting the cardboard square and taking with it the tube. The egg, being a little more massive than the penny, puts up a slightly stronger fight and stays longer (by another hundredth of a second or so). But its fate was worse than the penny's because the egg cracked when it resisted the forces that brought it to a sudden stop.



If you're doing this for real, make sure that 1.) your beaker is well off the table edge so the broom won't strike it (a flying beaker is cool to watch fly, but when they land they make an awful mess; believe me) and 2.) the cardboard square protrudes out towards the side the broom comes in on, so you'll make good contact.

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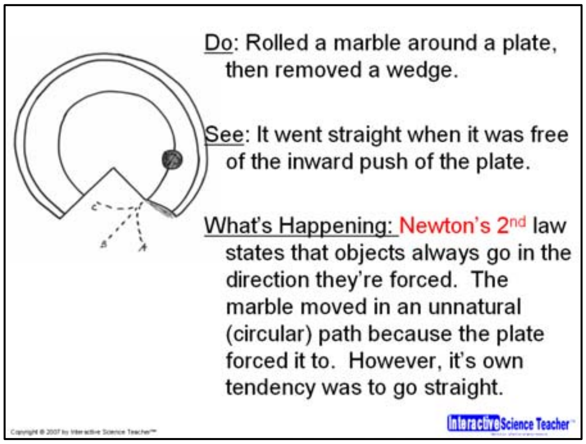
3.

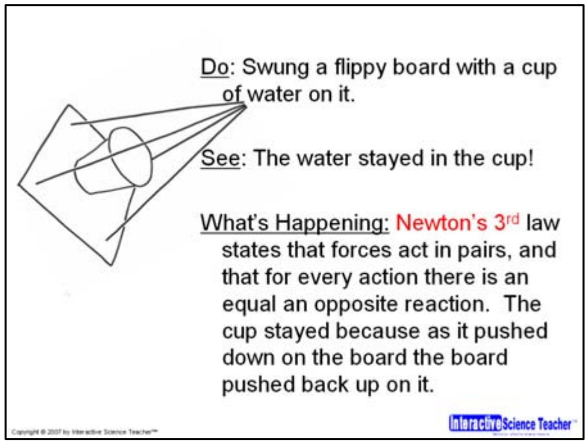


Have student #3 begin by batting the marble around on the table to see what its tendencies are before we start playing with it on the plate (notice it goes straight and in the direction pushed). With that thought planted, now put the marble on the plate (with strict instructions NOT to remove the wedge until told to do so). Watch it roll around and around and around…. Then show the picture that presents the 3 options of what the marble can do. As you go through them you can even ask students for a reason why that could happen. Give student time to choose which they think will happen (it will usually be evenly split between all 3), then allow then to remove the wedge and see what it actually does (option "B"- straight).

Use small styrofoam dessert plates for this demo. Cut the wedge wide enough (about a ¼ of it) so that when the marble rolls off, it won't bump into the other side of the plate, making students wonder if it's trying to get back on the plate. Use a piece of masking tape underneath to hold on the wedge. Make extras because students do tear them up, sometimes unintentionally. At the end of the day, replace the piece of tape holding on the wedge.

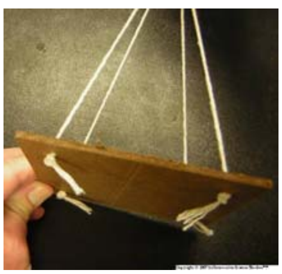
As students are taking notes for this demo, pick up your tennis ball on a string and swing it around. Ask what would happen if the string snapped. Would the ball keep going in a circle? Would it take a curved path and fly out the door? Or would it just go straight. (Had you done this 5 minutes ago you would have eliminated the need for the marble on the plate demo, and all the confusion.) It's the exact same question they just wrestled with the marble and plate.

4.



Tell student #4 to place the little cup (without water at first) on the "flippy board" and start swinging it around until it's going in full circles, using just wrist motion. After they've got that down, have each of them bring the little cup to you so you can put in a little water. Then brace yourself for a crazy minute or two as they get it going on the boards and then realize they don't know how to stop!

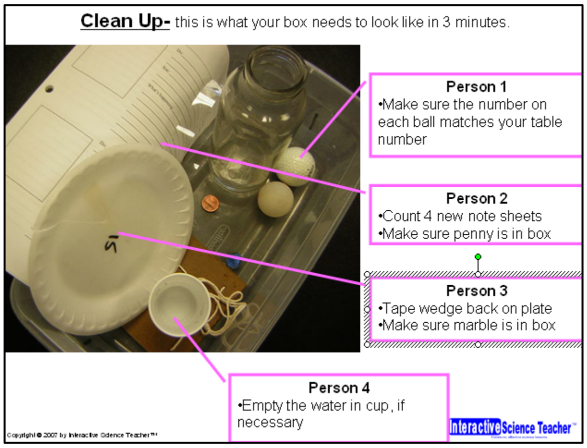
Flippy boards take some time to build, but once you have them they will become one of your students' most memorable activities this year. Pick up a 4' (foot) by 8' sheet of hardboard (also called "masonite") from you local home center. It's a 1/8 inch thick board that has many uses. A sheet costs around $10. It's usually stocked near things like wood paneling and peg board. Cut it into as many 4 inch by 4 inch squares as you need using a jigsaw (ideally) or a circular saw. Then drill holes in the corners of each little square for the strings. When you drill your first hole, make sure it's big enough that the string slips through, but not too easily. Then cut four 18-inch pieces of string for each flippy board. Don't use super cheap string that will break easily. Poke a string through each hole from top side first, pull it through below, and tie knots on the underside to keep each end from coming through the hole (this is why the hole you drilled shouldn't be too big). When all 4 strings have been knotted, hold the 4 string tops together and knot them together.



What can you do with all that left over hardboard? How about a huge flippy board that holds a bucket of water? Or just leave it lying around and within a month or two you'll use it for something.

By the way, while you're at the home center, look at the tile board, which is right next to the hardboard. Tile board (which is used as shower wall) is what dry erase boards are made of. A 4' x 8' sheet is also around $10. Pick one up if you could use more writing board space in your classroom. Tile board also doubles nicely as a screen you can project onto.

Have towels and mop handy for spills.



Leave refills of the note sheets in the back of your room.

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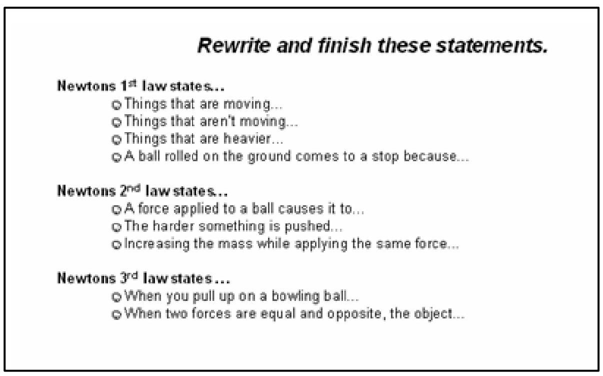
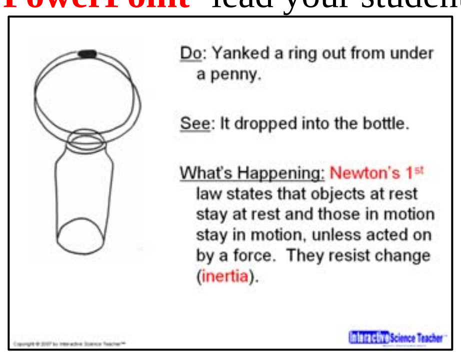
To help you with clean up, have your last science class take everything out of the boxes and put them in like piles in the back of your room.

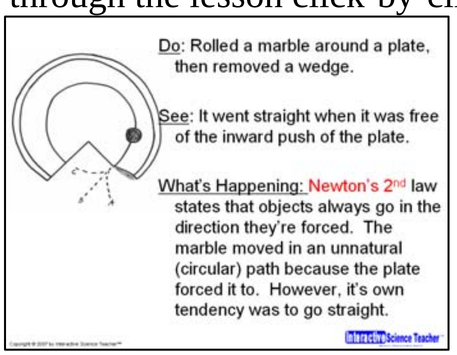


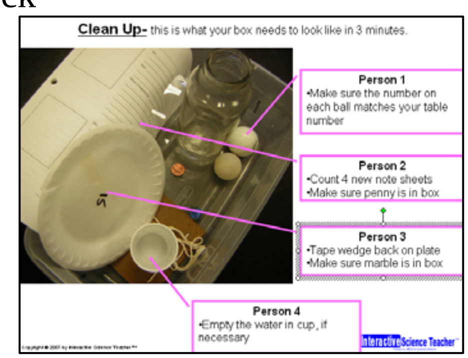
This is an optional homework assignment.

Come back and visit InteractiveScienceTeacher.com to upgrade this lesson with:

PowerPoint- lead your students through the lesson click-by-click







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Student Handout

Topic: ______________________________ Date: ___/___/___

Do: ______________________________

See: ______________________________

What's happening: ______________________________

Do: ______________________________

See: ______________________________

What's happening: ______________________________

Homework-Finish The Statements

Rewrite and finish these statements.

Newtons 1st law states…
- Things that are moving…
- Things that aren't moving…
- Things that are heavier…
- A ball rolled on the ground comes to a stop because…

Newtons 2nd law states…
- A force applied to a ball causes it to…
- The harder something is pushed…
- Increasing the mass while applying the same force…

Newtons 3rd law states …
- When you pull up on a bowling ball…
- When two forces are equal and opposite, the object…

Homework-Drop Test

<u>Forces</u> move things. Gravity, the one we always forget about, is always active. But is it fair to all objects? At home tonight drop a heavy and lightweight unbreakable object at the same time from the same height, and record what happens. Don't forget to predict what you think will happen before starting.

My heavy object is a ______________________

My lightweight object is a ______________________

I predict that when both are dropped at the same time from the same height…
- ☐ The heavy one will land first
- ☐ The light one will land first
- ☐ They will both land at the same time
- ☐ Other guess: ______________________

Results- check which hit first for each drop

	Heavy	Light	Tie
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

And the winner is ______________________ !!!!!

Comments, Thoughts- What are you thinking right now?