60 Demonstrations

Joe Rowing

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Contents

60+ Science Demonstrations and Observations

Introduction:

Science is full of everyday curiosities just waiting to be explored - and there's no better way to learn than by doing simple hands-on demonstrations. In the collection that follows, you'll find over sixty physics-based experiments designed to spark curiosity, encourage playful discovery, and solidify fundamental scientific principles. I've collected these demos from all sorts of sources over the years. I ***highly*** recommend the work of David Featonby who often has a piece on one of these demos, or similar at the end of Physics Education, still more can be found in places like "The resourceful physics teacher" by Keith Gibbs, a book I think ought to be required reading on any teacher training programme.

This collection of demos is worth plumbing anytime: Caltech Physics Demonstration Archive

From basic buoyancy tests and inertia tricks to surprising magnetic effects and optical illusions, each demonstration invites you to observe and question what's happening behind the scenes. You don't need advanced equipment or specialized laboratories: most setups use everyday items like cups, bottles, balloons, eggs, and simple household objects. The key is that each activity showcases a specific concept, whether it's gravity, forces and motion, electric charge, magnetism, or properties of fluids.

By rolling, dropping, balancing, lighting, spinning, and observing, your students get an engaging starter and gain intuitive insights into how the physical world really works. Each demo includes a concise explanation of the "why" behind the "wow" - perfect for educators looking to inspire students, parents seeking fun science projects, or curious individuals wanting to understand the principles in action. Dive in, experiment boldly, and be prepared for plenty of "aha!" moments along the way!

1. Two martini glasses

Setup: Fill two martini glasses to 1/2 their volume full of water or any other liquid. They will look 3/4 full.

Question: What will happen when one is emptied into the other?

Answer: The glass fills exactly to it's full height - a very suprising lesson in shape volume.

2. Filling or Spilling Bottles

Setup: Take a selection of bottles and/or beakers. Fill one of them.

Question: Will the liquid fill or spill from the others?

Discussion: This can lead to a conversation about packaging and bottle shapes that make one think they're getting more or less volume than is actually there.

3. Floating Orange

Setup: Float an orange in water.

Question: What happens once it is peeled?

Answer: The peeled orange sinks, it's more dense without the aerated peel.

4. Floating Various Fruits

Experiment: Float different fruits (lemon, lime, apple). Observation:

Apples float, Lemons float (thick skin, more pith),

Limes sink (thin skin, little pith).

5. Floating Egg in Saltwater

Setup: Float an egg in water.

Question: What happens when a large amount of salt is dissolved in the water?

Answer: The egg floats in the salty water. The salt water is more dense. Compare with the Dead Sea or Blue Lagoon, Iceland.

6. Floating Coke vs. Diet Coke

Setup: Take new, unopened cans of Coke and Diet Coke. Float them in a large tank of cold water.

Question: What will happen?

Answer: The Diet Coke floats higher, the sugar in the non-diet version increases the density.

7. Cartesian Diver

Setup: An individual sauce packet is balanced with paperclips so that it just floats in a 2L pop bottle filled with water. Screw the top on and squeeze the bottle.

Question: What happens?

Answer: The diver sinks - Squeezing the bottle compresses the pocket of air in the packet, thereby increasing the density.

8. Dancing Sultanas in Lemonade

Setup: Use a cheap, fizzy lemonade. Drop sultanas in it.

Observation: They sink, then bubbles form on their surface making them rise, the bubbles pop at the surface, and they sink again. The cycle repeats.

9. Grapes in Lemonade

Setup: Drop a peeled and an unpeeled grape into lemonade.

Observation: The peeled grape stays at the bottom; the unpeeled grape rises and falls - the surface acts as nucleation sites for the formation of bubbles.

10. Burning Tea Bag

Setup: Use a cylindrical teabag. Unfold, remove the staple, empty its contents. Stand the bag on its end (square-based cylinder).

Question: What happens when it's set on fire?

Answer: The tea bag burns down to the bottom, then the final ashes rise up with the convection currents established by the small fire.

11. Three Candles

Setup: Arrange 3 candles of different lengths so they fit inside an inverted glass jar. Light them (tallest first), then invert the jar.

Question: Which candle goes out first?

Answer: The tallest candle goes out first. Though Carbon dioxide is heavy, *hot* carbon dioxide is less dense than air and displaces the air and oxygen.

12. Inertia with a Toy Truck

Setup: Place an egg on top of a toy truck. Push the truck against a barrier so it stops suddenly.

Question: What happens to the egg?

Answer: It keeps moving forward if not secured... - Newton's first law.

13. Spinning Eggs

Setup: Spin a hardboiled egg and a raw egg horizontally on a table. Touch each to stop it, then release.

Observation: The hardboiled egg stops; the raw egg restarts spinning due to the fluid inside continuing to rotate and dragging on the inside of the shell.

14. Tablecloth Trick

Setup: Pull a cloth away sharply from under crockery and a teapot on a table.

Question: Will the objects stay put?

Answer: Yes, they stay put if the cloth is pulled quickly -due to their inertia.

15. Lifting a 1kg Mass with Rope on a Cylinder

Setup: Tie a 1kg mass (or tin of beans) to thick string. Wrap the string a few times around a rolling pin (or wine bottle).

Question: What happens when the rod is lifted?

Answer: A few turns of rope hold the mass without slipping - this leads onto the next one beautifully...

16. The Falling Cup

Setup: About 1m of string is placed over a pencil with a china cup at one end, close to the pencil. The other longer end is tied to a cork. The string is held just below horizontal.

Question: Will the cup reach the ground when released?

Answer: It stops before it reaches the ground, if the string is measured just right. Conservation of inertia causes the cork to increase in angular velocity as the string shortens. The increased velocity causes the cork to wrap the string round the pencil and thereby provide the friction to slow and stop the cup's descent.

17. Ball Drop Test

Setup: Drop a table tennis ball and a golf ball.

Question: Which hits the ground first?

Answer: Both at the same time. Unless you drop them from high enough that the lower terminal velocity of the table-tennis ball can come into play.

18. Coin and Paper Drop

Drop separately, then drop with paper side-on and next to coin, finally drop with coin on top of paper, but close.

Observations:

a) Coin lands first - it has a higher terminal velocity.

b) Both land together, if paper continues to fall edge-on.

c) Coin first, paper slips off.

19. Water Jet in Free Fall

Setup: A plastic bottle with a hole, water issuing from it. Throw it in the air.

Observation: The jet stops in mid-air because the water and the bottle are falling together.

20. Straw in a Sealed Bottle

Setup: A plastic bottle with a screw top, a vertical straw. Blow air in so the liquid rises in the straw.

Question: What happens when you jump off a chair holding the bottle?

Answer: The water shoots out of the straw. The weight of the water is no longer balanced by the force from the compressed the air in the bottle so the water is propelled out of the straw.

21. Groan Tube Drop

Setup: Drop a groan tube vertically and catch it.

Observation: It stops groaning as it falls, then restarts when caught because the tube and the "groan" part fall together - just how weightlessness in orbit works.

22. Slinky Spring Drop

Setup: Hold a slinky vertically and drop it. Observe the lowest part. Observation: The lowest link remains stationary for a moment. The centre of mass of the slinky falls at g but the ends are being drawn into the CoM - the top falls faster!

23. Tennis Ball on a Basketball

Setup: Place a tennis ball on top of a basketball and drop both together.

Observation: The tennis ball rebounds very high - The basket ball bounces and meets the tennis ball as it's still falling so the second collision happens at twice the velocity. The basket ball transfers energy to the tennis ball and it appears to shoot into the air. There's a great toy that makes use of this called the "Astroblaster". The analysis is a great Y12 momentum piece.

24. Two Metre Rules with Weights

Setup: One metre rule has a heavy weight at the upper end, another at the centre. Hold both at the same angle and drop.

Question: Which reaches the ground first?

Answer: The one with the weight at the centre reaches first. This is another Centre of mass trick - see below;

25. Comparing Weighted and Unweighted Rules

Setup: Again let two rods fall together, one with a weight at the centre, the other with no extra weight.

Question: Which reaches the ground first?

Answer: They land at the same time, relating to the equal acceleration concept.

26. Broom Handle on Fingers

Setup: Rest a broom handle horizontally on your fingers, one finger about 1/4 along its length, the other near the opposite end. Move your fingers toward the centre.

Observation: They meet at the centre of mass - the friction is linked to the reaction force, which is smaller in one contact point if it is further from the centre of mass.

27. Shifting the Centre of Mass

Setup: Repeat #26 but tie a weight to one end of the broom handle.

Observation: Fingers now meet at the new centre of mass.

28. Throwing a Raw Egg at a Sheet

Setup: A vertical sheet is held by two people, with a lip at the bottom to catch bits. Throw a raw egg hard at the sheet.

Question: Will the egg break?

Answer: No, if you hit the sheet. The egg decelerates too gently.

29. Spinning a Cadbury's Cream Egg

Setup: Spin it fast horizontally on a rough surface.

Observation: It rises up onto one end as it spins, similar to a "tippe top". see (Why does a spinning egg rise? - IOPscience)

30. Newspaper and Thin Wood Snap

Setup: Place a sheet of newspaper on a table covering a half-metre length of thin wood, with one end protruding. Strike the protruding end sharply.

Observation: The wood snaps if it's thin enough and the strike is hard enough. The force required to change the momentum of the air above the paper is significant. Compare $F = ma$ and $F = \Delta mv/t$.

31. Blowing Between Paper Strips

Setup: Hold two strips of paper vertically at top and bottom. Blow between them.

Observation: They move together. The faster moving air is at a lower pressure - the net movement reduces the number of collisions per second on the paper. (Students can find this very conceptually challenging - there're some great videos that animate and explain it well)

32. Newton's Cradle Variations

Question: What happens when a piece of metal is placed between stationary balls? Or when one end is struck with a small hammer heavier than all the balls?

Answer: If the hammer's mass is greater, all the balls move.

33. Newton's Cradle with Bowling Balls

Setup: Use "spent" bowling balls, e.g., 3 $\times$6lb balls plus assorted heavier ones. Roll an 8lb ball into the three 6lb ones, etc.

Observation: A single 6lb ball moves away with the 8lb ball; two move with the 12 and 14lb ones.

34. Waddling Animal on a Slope

Question: What happens to the animal's speed if an extra mass is added? Does placement matter?

Answer: Yes, it matters. You can speed it up or slow it down depending on where you place the mass.

35. Wine Glass and Cork

Setup: Half a cork inside a wine glass. Blow sharply over the top.

Observation: The cork jumps out. This is another Bernoulli/Venturi demo.

36. Soap-Powered Boat

Setup: Shape half a lolly stick into a boat hull. Place it in still water. Drop grains of soap powder on the stern.

Observation: The "boat" chugs forward across the water. The soap reduces the surface tension on the rear of the vessel.

37. Cocktail Sticks and Soap

Setup: Arrange 5–6 cocktail sticks in a circle like radii. Touch the centre with absorbent paper, then touch with soap.

Observation: They move inwards first as a little water is absorbed causing the shift in the surface layer, then outwards, as the soap causes the surface tension to lessen and equilibrium to occur at wider radius.

38. Knees Bend Against a Wall

Setup: Stand with heels against a vertical wall. Try to bend down.

Observation: You fall over - your centre of gravity moves forward.

39. Breaking a Suspended Tin of Beans

Setup: Tie thread around a tin of beans (one thread on top, one below). Suspend it from the upper thread. Pull the lower thread sharply.

Observation: The lower thread breaks if pulled quickly. The upper if pulled slowly - Great demo for demonstrating the importance of time in acceleration.

40. Burning a Candle at Both Ends

Setup: Put a needle through the centre of a long candle. Shave both ends. Balance it, then light both ends.

Observation: It rocks up and down like a seesaw - a lovely little moments demo.

41. Mirror Writing (TOM, DICK, HARRY)

Setup: Write the names under a mirror. Observe their reflection.

Observation: Only "DICK" seems unaltered. Obviouslt just a trick of shape but suprising how much confusion it causes. A nice one to add to the "how does the mirror know" meme reposts. (How Can A Mirror See An Object That Is Hidden By A Piece Of Paper? | IFLScience)

42. The Big Circuit

Setup: Arrange a circuit so wires run from a power pack to the back of the room to a bulb, and return.

Question: Does the bulb come on immediately when switched on?

Answer: Yes, despite the long wires. The filament heating is the main delay, but electrically it's almost instantaneous. There's potential here to expand into calculating just how long it would take if the wires went round the Earth. Some interesting comparisons with high frequency trading and where to build the computer that's making the purchase and sale requests.

43. Whacking a Suspended Broom Handle

Setup: Suspend a broom handle horizontally by two thin threads at its ends. Whack the centre with another broom handle.

Question: Which breaks: one thread, two threads, or the handle?

Answer: Another lovely inertia demo this - It's the broom handle that breaks, if hit hard enough. Beware of fragments.

44. Ice Blocks on Different Surfaces

Setup: Place identical ice blocks on a plastic box (warm to touch) and an upturned thick frying pan (cold to touch).

Question: Will one melt faster?

Observation: Ice on the metal melts very quickly, within a minute or so thanks to the thermal conductivity.

45. Neodymium Magnet on a Japanese Yen

Setup: Place a medium-sized neodymium magnet on top of a few yen coins.

Question: What happens if you lift the magnet quickly?

Answer: The yen are lifted along with the magnet. - A great Lenz's law demo.

46. Suspended Yen on a Thread

Setup: Stick a thread to a yen coin and suspend it. Move a neodymium magnet toward the yen.

Observation: The yen moves away. Lenz's law again

47. Floating a Yen on Water

Setup: "Float" a yen on still water using surface tension. Add drops of water to the top of the coin till it sinks will allow the surface tension to be measured. a drop of soap added will lessen the surface tension and the coin immediately sinks

48. Two Test Tubes

Setup: Obtain two test tubes, one just fitting inside the other. Fill the larger with water, float the smaller inside, then invert them.

Observation: The smaller tube rises.

49. Glass Rod vs. Aluminium Foil Rod Near Magnet

Setup: Suspend a small glass rod (3cm) and a rolled foil rod on threads. Hold them beside a strong neodymium magnet.

Observations: The glass rod orients at right angles to the magnetic field.

The aluminium foil rod lines up along the field lines.

50. Magnet Rolling on a Slope in N–S Direction

Question: What happens when a small but strong cylindrical magnet is rolled down a gentle slope north-to-south?

Answer: The path is not straight; it curves in a circular arc(!)

51. "Eclipse of Mars" Afterimage

Setup: Stare at a red disc for 20+ seconds (projected on a screen).

Observation: When you look away or the disc is reduced, it appears with a cyan border - afterimage effect.

52. Barbeque Skewers Through a Water-Filled Bag

Setup: Fill a plastic bag with water and carefully push barbeque skewers or a sharp pencil through it.

Observation: It self-seals, so water doesn't leak. Great trick over someone's head!

53. Elastic Band Temperature

Setup: Take an elastic band. Feel its temperature, then stretch and hold it.

Observation: The stretched rubber is warm. After a while, let it retract; it cools. Great demo to use when talking about material structure.

54. Two Balloons Connected

Setup: Inflate two identical balloons, one fairly large, the other just started. Connect them via tubing with taps/clips and a T-piece.

Question: When air flows, does the big balloon inflate the small one or vice versa?

Answer: The small balloon blows up the bigger one - counterintuitive until you consider the behaviour of a baloon when you're trying to blow it up. It comes down to force per unit area on the inner surface and how this balances, or not, with the tension in the material surface of the latex.

55. Blowing Up Balloons Simultaneously

Setup: Connect two balloons to a tube and T-piece. Attempt to inflate them at the same time.

Observation: Usually one balloon inflates more; the other remains small for the same reasons as above.

56. Floating Beaker in a Bottle

Setup: Float a beaker containing a weighty object in a 2L lemonade bottle of water. Then remove the weight and place it in the bottle.

Observation: The water level falls when the weight is placed separately.

57. Removing a Sealed Glass Jar from a "Boat"

Setup: Float a boat with an empty sealed jar in a bowl of water. Then remove the jar and float it separately beside the boat.

Observation: No change in water level.

58. Paper Clip on Thread Near a Magnet

Setup: Lower a paper clip on a thread toward a strong magnet.

Observation: It spins one way when lowered, another when raised.

59. Measuring Cylinders of Different Diameters

Setup: Two measuring cylinders, one with twice the diameter of the other. Pour a certain volume from the larger into the smaller.

Question: How high will the liquid be in the smaller cylinder?

Answer: 4 times higher, if diameter ratio is 2:1. - Great for pointing out the use of ratio and fractions even in qualatative questions.

60. Balancing Tin Cans on a Metre Rule

Setup: Fix two tin cans to a metre rule so it balances horizontally.

Question: What happens when you lower your finger into one of the cans of water?

Clue: Discuss buoyancy, displacement, and the reaction on the can.

61. Dropping Paper and Book

Setup: Drop a small piece of paper and a larger book separately. Then drop them simultaneously with the paper:

Just below the book

On top of the book

Question: What happens? Discussion: Air resistance and relative motion.

62. Ball in a Whirled Bucket

Setup: Use a clear polythene bucket part-filled with water. Float a ball on the surface. Whirl the bucket in a vertical circle.

Question: Does the ball stay on the surface or "sink" during the rotation?

63. Floating Orange in a Beaker on Scales

Setup: Balance a beaker of water on scales with an orange beside it.

Question: What happens to the reading if the orange is then placed in the water to float?

64. Elastic Collision with Bowling Balls

Setup: Place one bowling ball on rails. Roll another into it. The collision is nearly elastic.

Question: What happens to the first ball?

Answer: It starts rotating and follows the second ball.

65. Magnet Falling in Copper Pipe

Setup: Compare a magnet falling down a copper pipe vs. wooden dowel. Observation: The magnet's fall is slower (eddy currents), while the wood just drops.

66. Candle in Water

Setup: Place a candle in a beaker, fill with water just up to the top of the candle without wetting the wick. Light it.

Observation: The candle continues to burn down into the wax, creating a wall that keeps water out.

67. Vanishing test-tubes

Setup: Place a small test-tube inside a large beaker. Fill the beaker with baby oil to above the level of the top of the test-tube and it will appear to vanish due to the refractive index matching. I like to set this up beforehand and call it a glass restorative. It's an easy sleight of hand to lower a broken testtube into the vessel and retreive the intact one. Done with a bit of style this can really cause a headache to your students.

68.Balancing a coin on a £5

Setup: You need a reasonably new banknote and a coin.

Challenge the students to balance the coin on the edge of the note without folding it. It's almost impossible, but if you have steady hands you can gently bend the note, enough to easily balance the coin, and then straighten out the note. Similar to the broomstick on finger trick, the coin will balance itself.

69. The freefall paradox

Arrange a ball and cup on a stick as below. With the right placement, and if the cup isn't too tall, the ball will land in the cup every time the apparatus is allowed to fall.