

Forces & Motion

Introduce ourselves and what Fermi does and what physics is

Key people: Galileo (1564 – 1642) and Newton (1643 – 1727)

Key concepts: inertia, forces, gravitational force, symmetry, energy

What to take out of the box:

Big ramps, skateboards, bricks, coffee cups, tablecloth, little blue ball, bocci ball, feather, pile of padding for floor, solid and hollow steel and Al cylinders, spinning floor disk, two hand weights, some kind of scale, small ladder.

Also bring: 2 bottles of water, one about 1/3 full, the other totally full

Optional extras: Newtonian demonstrator, the bicycle wheel

Presentation – Demonstrations, cues and questions

1) Inertia (1st law): a body at rest tends to stay at rest – tablecup & coffee cups which have no energy (they are sleeping)

2) Forces (2nd law): to make it move, you have to push on it [explain: put energy into it] – throwing a ball, catching it

- 3) Inertia: a flying ball in motion tends to stay in motion – notice that it curves
- 4) Notice that the ball pushes back on your hand – equal and opposite forces
- 5) Two kids of same size on skateboards and push off each other – both move about the same amount – comes out the same because they are about the same [symmetry]
- 6) A big kid and a little kid – which one moves more? Some things have more inertia than others. Again, where does the energy come from?
- 7) Does it pull on a heavy object more than a light one? Two water bottles, bocci ball and feather; the NASA movie from the moon.
- 8) The ramp: it needs a few practice starts. Energy is needed – and will be different depending on where you put the bricks on the board!
 - a. Low slope, 1 brick, 2 bricks.
 - b. Two slopes, no bricks. Because gravity has a direction and now you let the skateboard go in that direction [Vectors and Scalars]
- 9) Solid and hollow cylinders
 - a. Do solid Al vs solid steel after weighing them
 - b. Do hollow Al vs hollow steel – again, weigh

- c. The inertia is more spread out in the hollow cylinders (spin around axis)
- d. The pseudo-skater - has a lot of energy when it is spread out and spinning slowly; or if it is scrunched up and spinning quickly
- e. Run the hollow and the solid Al, then maybe the steel also

10) If there is time, do conservation of angular momentum with spinning bike wheel and floor disk.