THE DEMONSTRATION CORNER

Sand and Soup

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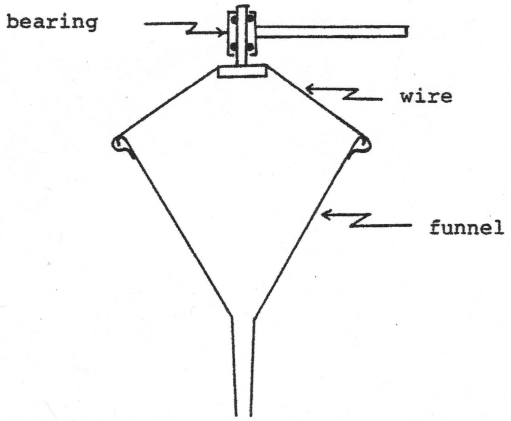
Materials

Funnel, small bearing, fine sand, two coffee tins, wire

Our funnel is metal with a large lip, and we used soft solder to fasten the wire to the funnel and the bearing. Make sure that the axis of the bearing lines up with the axis of the funnel.



Method

Put your fingers over the top of the funnel and pour in some sand from a coffee tin. As you let go, rotate the funnel. As the sand falls inside the funnel, it is forced inwards towards the centre. To conserve angular momentum, the funnel and the sand inside it speed up. At a sufficiently high speed, the friction forces on the grains of sand are large enough to prevent the sand from falling. Friction in the bearing gradually slows the rotation until more sand slides down the walls of the funnel. As it does so, the system speeds up again because angular momentum must be conserved. The cycle repeats until all the sand has fallen from the funnel.

We originally saw this demonstration written up in The Physics Teacher[1]. Our contribution was to use a good quality bearing to support the funnel. This is essential for a good demonstration. It is also important to use very fine sand. Be careful when you pour in the sand not to pour it over the bearing and cause it to seize up. Catch the sand in the second coffee tin.

Soup

How can you tell the difference between a can of chicken soup and a can of mushroom soup if the labels have been removed? Roll them down a gentle slope and see which one wins! I have just been playing on my kitchen counter, which is not quite level, and the difference is very obvious. We have also filled two transparent plastic bottles with water and put some crumpled plastic sheeting into one of them. As with the soup cans, one rolls much faster than the other.

The speed at which things roll down slopes depends how the initial potential energy at the top of the slope is shared between the translational kinetic energy and the rotational kinetic energy at the bottom. Spheres beat cylinders, which beat hoops. The chicken soup beats the mushroom soup because the chicken soup does not rotate inside the can, so the kinetic energy is mostly translational.

[1]David L. Mott, The Physics Teacher 22, 391, 1984.

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Submissions describing demonstrations will be gladly received by the column editor.