THE DEMONSTRATION CORNER

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This is the second appearance of this column, which has been prompted by the great popularity of the demonstration sessions at our annual conference. Submissions describing demonstrations will be gladly received by the editor.

The Belt-Hanger

One category of good physics demonstrations involves the "disorientation" or "disequilibrium" of students. The demonstrations in this category cannot be explained by most students, and thus serve to disorient the students and put them into a state of disequilibrium from which they wish desperately to escape.

Such demonstrations pique the students' curiosity and gain their attention. Some students have been known to throw up their hands and say that these demonstrations can be explained only by magic. At this point, the students are like putty in the teacher's hands — they are eager to learn the real explanation.

The belt-hanger described below is a nice disorientation demonstration, and it is cheap to make and easy to use.

Fig. 1 shows a belt-hanger in (full-size) cross-section, and can be used as a pattern from which to make your own belt-hanger. It can be made from a variety of materials: wood, metal, thick cardboard, etc. The ideal thickness is about 1 cm (the aluminum one I have currently is 9 mm thick).

Once the belt-hanger has been made, position it on the end of a fingertip as shown in Fig. 2. It is unstable in this position and falls to the floor.

Now remove your belt or have a student remove his/her belt (teachers who are "hams" can embellish this step in various ways — music, clapping, etc.). A firm leather belt with a reasonably large buckle is best. Fasten the belt buckle so that the belt forms a closed loop, and place the belt on the hanger (on your fingertip) as shown in Fig. 3, with the buckle at the bottom of the belt.

Instead of the hanger and belt falling to the floor, the entire system is quite stable! For added effect, you can place the hanger (and belt) on the edge of a table or on the top of a door frame instead of on your fingertip.

Students are surprised that the hanger is unstable by itself, but stable when the belt is hung on it.

HOW IT WORKS — If an object (which is free to rotate) is to be in stable equilibrium, the centre of mass (CM) of the object must be below the pivot point.

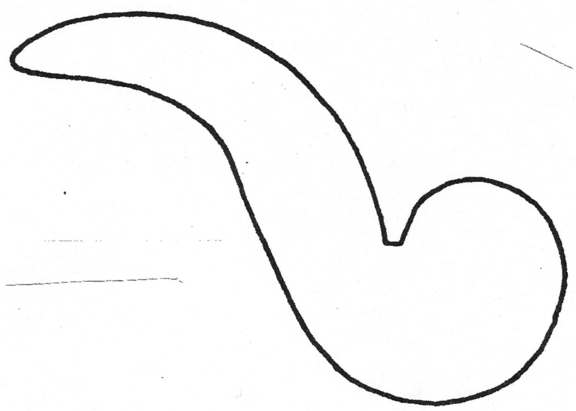
When the hanger alone is placed on a fingertip, it is impossible for the CM to be positioned below the pivot point without the hanger sliding from the finger and falling. (The pivot point is just the contact point between the hanger and the finger.)

When the belt is on the hanger, the CM of the system (hanger + belt) is now positioned somewhere in the middle of the loop formed by the belt, and it is "easy" for the CM to be under the pivot point, with stable equilibrium being the result.

WHY DO IT? — First, it engages the students' minds in attempting to explain a physical phenomenon. Second, although centre of mass is not a topic which is taught in detail at the high school level, it is useful to point out to students that the acceleration a in Newton's Second Law ($\Sigma F = ma$) is the acceleration of the CM of the object, and it is then nice to have at least one demonstration related to CM.

At the university level, the topics of CM, torque, stable and unstable equilibria are considered in detail, and CM demonstrations related to equilibrium are very useful.

WANT MORE CM DEMONSTRATIONS? — refer to an article "Centre of Mass Revisited" in *The Physics Teacher*, January 1983.



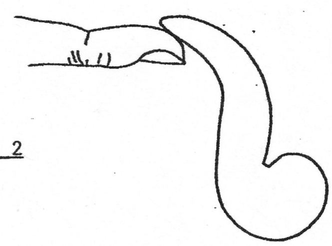


Fig. 2

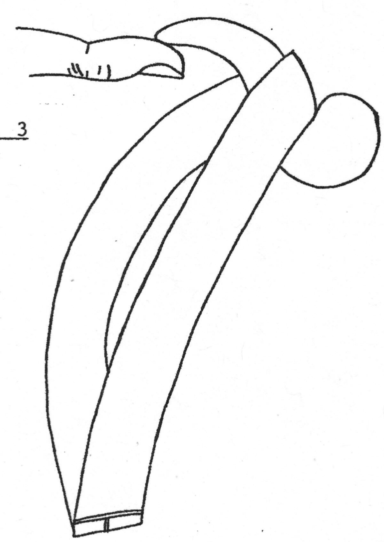


Fig. 3