Local “reversal of gravity” can be simulated with an inverted pendulum whose pivot is made to oscillate vertically. A beautiful demonstration of this surprising effect can be found in Ref. 1. In this case, the pendulum is a piece of plastic straw and its pivot pin is fixed at the end of a plastic ruler that is made to oscillate vertically by a small eccentric motor. A theoretical treatment of this inverted pendulum may be found in Ref. 2.

Since each point of a vibrating string can be viewed as a harmonic oscillator, we have decided to exploit standing waves to simulate “antigravity.” If the pivot of an inverted pendulum were attached to the string, the pendulum could, in principle, become vertically stable at resonance. We have noticed, however, that the oscillation of the string becomes unstable and does not remain restricted to a vertical plane. This can be easily verified by looking at it from the side and from the top. We bypass this instability problem by replacing the string with a strip of plastic 1.5 cm wide, 0.4 mm thick, and about 50 cm long. Another possibility is placing a vertical slit (“polarizer”) at an antinode of the standing wave to eliminate the lateral oscillation of the string. However, in this case only the antinodes of higher modes can be used for producing local “reversal of gravity.” Our inverted pendulums are pieces of plastic straw 7 cm long with pivots made of thin wire. To attach one end of the plastic straw to the pivot, we punch two holes all the way through from one side of the straw to the other. The pivot is then glued to the strip as shown in the picture (see inset in Fig. 1). To produce standing waves, one end of the strip is kept

Fig. 1. Setup for producing standing waves using a strip of plastic. In the inset is shown one of the inverted pendulums glued in the strip.

Fig. 2(a). In the first mode (around 30Hz) all three pendulums can surf the standing wave.

Fig. 2(b). In the second mode (around 60Hz) the central pendulum falls down, whereas the other two pendulums, located at antinodes, can further surf.
fixed and the other end is attached to a mechanical
vibrator connected to an audio generator, as shown in
Fig. 1. Figures 2(a) and (b) illustrate local “reversal of
gravity” using three pendulums whose pivots are glued
at different points of the strip. Notice that when the
pivot is at a node, the inverted pendulum becomes
unstable, whereas when it is located close to an anti-
node the pendulum is able to surf the standing wave.

References
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