

Hit the Cup – Teacher Guide

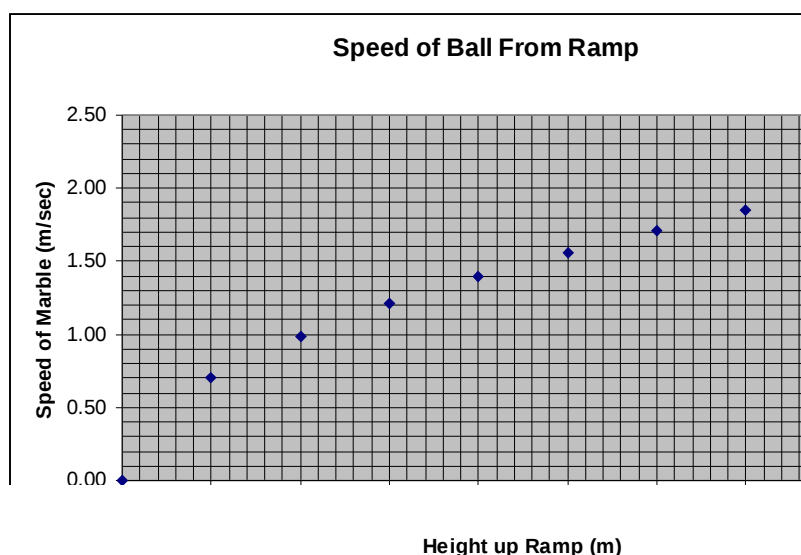
The Handout: **Hit the Cup Project** contains a graph that works well in providing marble speeds for ramp heights up to 25 cm. It has been tested for solid 3/4 inch PVC pipe and for the flexible insulation pipe shown in the photograph. This chart works well for both “ramps.” If the PVC pipe is used, there is a tendency for the marble to bounce upon leaving the tube which could produce an “effective launch angle”. A few pieces of paper at the end of the tube will reduce the bounce to a minimal value.

Theory: Setting the Distance

If no energy were lost to friction, the velocity of a rolling solid sphere should follow the formula $v = \sqrt{10gh/7}$ where sqrt is the square root of the items in the parentheses. In practice, the speed obtained from that formula will be about 18–20% high. This has been checked to ramp heights of 0.5 m reliably. It is suggested that in choosing values for the project “range to the cup” that the distance be less than the range of a ball set on the ramp at a height of 25 cm. For a 1 meter high table, this corresponds to an approximate time of flight of 0.45 seconds, with a speed of 1.5 m/s **or a distance of 0.67 m.**

Launch Tube Details

The tube in the video and in the picture of the **Hitting the Cup** document is the insulator tube for small (3/4 inch) pipes and is found in hardware stores in 3 foot lengths or longer. A pair of scissors will easily cut the tube in half creating two trough shaped ramps. It is important that the marble leave the ramp horizontally.



Classroom Protocol: Practice Time

Distribute the Handout: **Hit the Cup Project** and the materials for that activity. If your “project rules” permit, allow the students to perform trial runs with the equipment used in the real projectile event. Since the distance to the cup will be unknown until the last minute, the learning will be more complete and such things as clearing the lip of the cup will be integrated into the plan.