# Energy and the Coefficient of Restitution Activity
Background

The "coefficient of restitution," C_R , is the ratio of impact velocity with a surface and the rebound velocity. (The "impact velocity" is the velocity the ball hits the floor with. The "rebound velocity" is the velocity the ball has when it bounces off the floor.) The coefficient of restitution is unit-less.

$$C_R = \frac{\upsilon_{REBOUND}}{\upsilon_{IMPACT}}$$
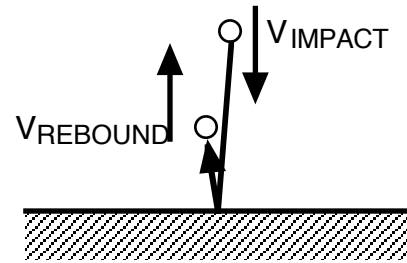
Procedure

1. Drop the ball from a height of exactly 0.50 m. Measure the rebound height. Repeat this process until you have a reliable rebound height measurement. Write your answer on the math sheet.

2. On the math sheet, <u>use energy methods</u> to calculate the impact and rebound velocities.

3. On the math sheet calculate the coefficient of restitution.

4. Drop the ball from a height determined by you. The height must be higher than 1.5 meters but less than 2.0 meters. Measure how much <u>time</u> the ball is in the air before it bounces on the floor again. Record this time on the math sheet.

Drop

Measure the time the ball is in the air for bounce #1 only.
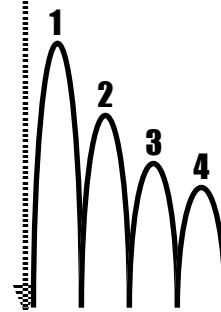
5. Using projectile motion methods determine the initial velocity of the ball when it rebounds off the floor on the first bounce.

6. Use the previously calculated coefficient of restitution to predict how fast the ball was traveling when it hit the floor after being dropped.

7. Use energy methods to determine the height it was dropped from.

8. Find the percent difference in the height it was actually dropped and the predicted height it was dropped from.

$$\% \text{ differrence} = \frac{\left|\text{Predicted value - actual measured value}\right|}{\text{actual measured value}} \times 100$$

Energy and the Coefficient of Restitution Activity   **Math Sheet**

Name _____

(1) Measured Rebound Height:	
(2) Impact velocity from energy relationships	Rebound velocity from energy relationships

(3)

Coefficient of Restitution;

(4) Time in the air between bounces:

(5) Calculated initial velocity from projectile motion methods.
 (This is the rebound velocity after the bounce.)

Drop height: _____

Time in the air: _____

(6) Predicted impact velocity from the coefficient of restitution:

(7)

Calculated original drop height using energy methods:

(8)

Percent Error