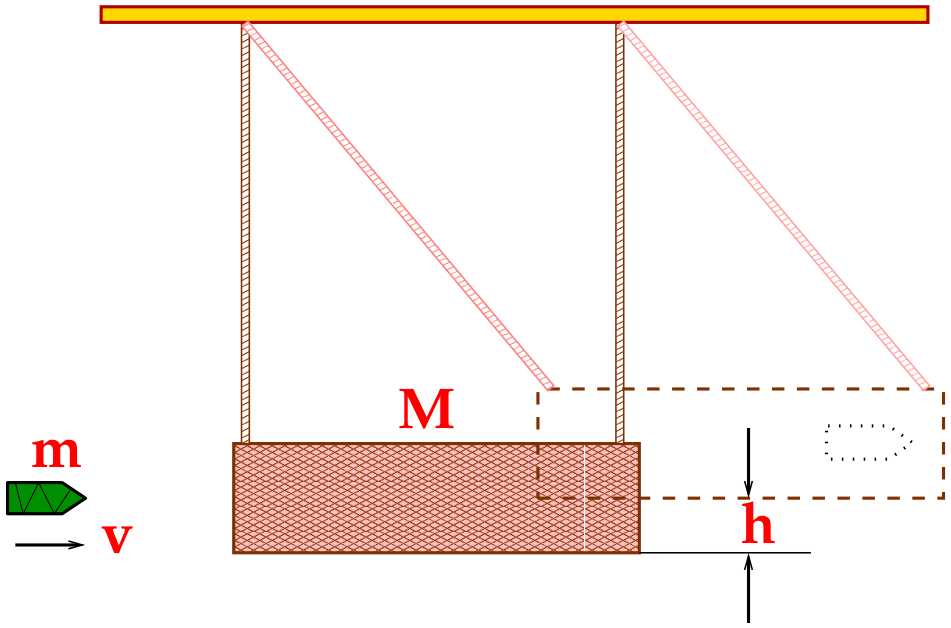
Ex : Consider a device called a **ballistic pendulum**. This device was used to measure the speeds of bullets.



Consider **M= 5.4 kg** and **m = 9.5 gm**

If the block/bullet system swings upward **h = 6.3 cm**, what was the speed of the bullet just prior to the collision?

◦ First recognize this collision as completely inelastic. After the collision the block + bullet are 'stuck' together.

$$\Rightarrow \qquad mv = (M + m)V$$

◦ As the collision is inelastic, kinetic energy is **NOT** conserved. But *after* the collision, mechanical energy *is* conserved.

Conservation of mechanical energy after the collision tells us:

$$\frac{1}{2}(M+m)V^2 = (M+m)gh$$

Now we can solve for v (the initial speed of the bullet) using the expression from momentum conservation to give us V.

$$v = \frac{M+m}{m}\sqrt{2hg}$$

$$= \left(\frac{5.4\ kg + 0.0095\ kg}{0.0095\ kg}\right)\sqrt{2(9.81\ m/s^2)(0.063\ m)} = 630\ m/s$$