

Big Buck Bunny—Projectile

Big Buck Bunny is about an overgrown and very sensitive bunny that takes vengeance on the forest bullies, who are led by a cruel flying squirrel. This movie is created by the Peach Open Movie Project, which offers this movie at www.bigbuckbunny.org.

In this scene, one of the rodent bullies is launched by one of Big Buck Bunny's booby traps. The rodent appears to be airborne for about 5 seconds. Assuming the angle to be such for maximum range ($\theta=45^\circ$), have the students calculate the maximum y- and x-displacement.

First, the y-velocity (v_y) at the top of the trajectory is 0 m/s; the time at this point is $5/2=2.5$ s. Then, the initial velocity can be found:

$$v_{top} = v_0 \sin(\theta) + a_y \frac{t}{2}$$

$$v_0 = \frac{v_{top} - a_y \frac{t}{2}}{\sin \theta} = \frac{0 - (-9.8 \frac{m}{s^2}) \frac{5s}{2}}{\sin 45^\circ} = 35 \frac{m}{s}$$

Note that this is equal to about 78 mph.

Now, to find the x-displacement:

$$x = x_0 + v_0 \cos(\theta) t + \frac{1}{2} a_x t^2 = v_0 \cos(\theta) t = 35 \frac{m}{s} \cos(45^\circ) (5s) = 123 m$$

Ask the students if this seems to agree with what they see in the video (I think the video has the rodent going a bit further than this.)

Finally, the maximum height is:

$$y_{top} = y_0 + v_0 \sin(\theta) \frac{t}{2} + \frac{1}{2} a_y \left(\frac{t}{2}\right)^2 = 0 + 35 \frac{m}{s} \sin(45^\circ) (2.5 s) + \frac{1}{2} \left(-9.8 \frac{m}{s^2}\right) (2.5 s)^2 = 30m,$$

Which I think is what the video depicts.

If these calculations are too involved for the students, have them use the PHET simulator for projectile motion at:

http://phet.colorado.edu/simulations/sims.php?sim=Projectile_Motion