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.

This scene offers two examples of freefall, so it is a good opportunity to show students how to work the same problem when different physical quantities are know.

First, when the squirrel lands on a tree branch, an apple falls to the ground and sets off Big Buck Bunny's elaborate set of traps. The apple appears to fall in slow motion, though, so any information about its freefall time is lost. However, assuming the distance to be 20 m (65 ft), it is quite easy to determine the time in freefall and the final velocity.

We begin with this basic kinematics equation:

$$y = y_0 + v_0 t + \frac{1}{2}at^2$$

For this scenario, $y = 0m$, $y_0 = 20m$, $v_0 = 0\frac{m}{s}$, and the acceleration due to gravity is -9.8 $\frac{m}{s^2}$. Then, the solution for t is:

$$t = \sqrt{\frac{-20m}{-9.8\frac{m}{s^2}\left(\frac{1}{2}\right)}} = 2\ seconds$$

Then, the apple's final velocity is:

$$v_f = v_0 + at = 0\frac{m}{s} + \left(-9.8\frac{m}{s^2}\right)(2\ s) \cong -20\,\frac{m}{s}$$

The second occurrence of freefall occurs when the squirrel's trajectory is interrupted by the tree branch, and he plummets towards Buck Bunny's trap. In this case, the fall seems to occur in real time, so the time can be observed in the clip. The squirrel is in freefall for approximately 4 seconds, which is twice the time that the apple was in freefall.

At this point, ask your students to determine the distance and final velocity based on the above calculations. If the time is doubled, is the distance doubled as well? Is the final velocity twice that of the apple? (No and Yes.) Allow the students some time to determine the solution in this way.

Without the prior knowledge of the apple's fall, to find the distance and final velocity, do the following:

$$y = y = y_0 + v_0 t + \tfrac{1}{2}at^2 = 0\ m + 0\tfrac{m}{s}\,(4s) + \tfrac{1}{2}\left(-9.8\tfrac{m}{s^2}\right)(4s)^2 \cong -80\ m,$$

Which is 4 times the distance the apple fell.

$v = v_0 + at = 0\frac{m}{s} + \left(-9.8\frac{m}{s^2}\right)(4s) \cong -40\,\frac{m}{s}$,

Which is twice the final velocity of the apple.

In a more general sense, use this clip to introduce freefall motion. Ask your students some of these questions:

- What happens to the speed of the apple/squirrel as it drops?
- What is the effect of air resistance (esp. on the flying squirrel)?
- What causes the acceleration?
- What would happen to the squirrel if the force due to gravity went away?