Worksheet for Exploration 7.2: Choice of Zero for Potential Energy
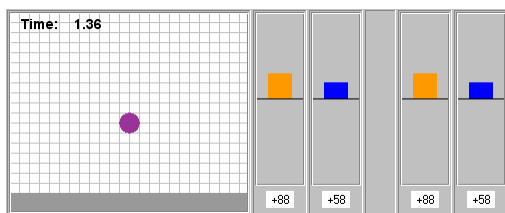

The animation depicts a ball being dropped from y = 15 m onto the ground 15 meters below at y = 0 m **(position is given in meters and time is given in seconds)**. For this animation we will assume that the ball undergoes a very hard collision with the ground, which also conserves energy. Also shown are two pairs of bar graphs representing the different types of energy associated with the ball: the kinetic energy (orange) and the gravitational potential energy (**blue**). The bar graphs on the left show the kinetic energy and the potential energy as measured from y_{ref} = 0 m. The bar graphs on the right show the kinetic energy and the potential energy with a varying zero potential energy point. You can vary the zero point from -15 m < y_{ref} < 15 m by changing the value in the text box and clicking the "set value and play" button. Restart.

Change the zero point for the potential energy from zero to a variety of positive values and a variety of negative values. Answer the following questions about the animation.

a. For zero points that are less than zero, does the gravitational potential energy shift up or down?
    i.   Set the zero point position to say, -5, -10, and –15 m respectively. For each position measure initial potential energy of the ball for each case (BOTTOM OF THE BALL).

    ii.

$y_{zero\ point}$	$y_{initial}$	PE_{left}	KE_{left}	PE_{right}	KE_{right}

    iii. What is the total energy for each case?

    iv.
        $E_{tot\ 0}$=_____

        $E_{tot\ -5}$=_____

        $E_{tot\ -10}$=_____

        $E_{tot\ -15}$=_____

    v. What is the mass of the ball?

b. Is all of this energy (the total energy) accessible to the ball? In other words can it all be converted to kinetic energy?
   i. Find the position where the PE is minimum. For each set of bar graphs, how much of the initial energy can become KE?

c. For zero points (reference positions) that are greater than zero, does the initial gravitational potential energy shift up or down?
   i. Fill out the table again for zero point positions of +5, +10, +15m. The values are measured initially.

$y_{zero\ point}$	$y_{initial}$	PE_{left}	KE_{left}	PE_{right}	KE_{right}

   ii. What is the total energy for each case?

$E_{tot\ 0} =$ _____

$E_{tot\ 5} =$ _____

$E_{tot\ 10} =$ _____

$E_{tot\ 15} =$ _____

   iii. Write out a general equation for potential energy as measured from the zero point position.

d. For y_{ref} = -15 m, how much PE does the ball start out with? How much does it have when it hits the ground? What is the change in potential energy? (If you have not already considered this above).

PE_{-15}=_____ PE_0=_____ ΔPE=_____

e. For y_{ref} = 15 m, how much PE does the ball start out with? How much does it have when it hits the ground? What is the change in potential energy?

PE_{15}=_____ PE_0=_____ ΔPE=_____

f. How do your answers for (d) and (e) compare? Why?