Impacts

Supplies per table:

in the stockroom	*in the classroom*
box of sand	ruler
2-meter stick or two 1-meter sticks	compass
three ball bearings of different masses	calculators
	flashlights (astro supplies)

Supply for everyone:
digital scale to measure the ball bearing masses (in the stockroom)

Teaching points:

- ergs vs. other measures of energy (1 erg = a grasshopper pushup)
- General energy discussion (types of energy)
- Write energies in scientific notation (makes graphing easier)
- Measure heights from the **top** of the sand! (since that's where it impacts)
- How to measure craters (make sure get full diameter; measure peak to peak)
- best fit line (if not already covered)
- DON'T DO 2 METERS
- NO HUMAN ERROR (I like to give the example of getting on the wrong bus in the morning – yes it's human error, but not relevant. Be precise!)
- Many have never seen log-log paper. Tell them to ask you for help when they get to the graphing portion. Walk them through one of the data points
- transferring the line (this is the major source of error)
- Make sure that the students are thinking of physical reasons why their answer is different at the end in addition to measurement errors or experimental errors.
- Use flashlights from the side to make shadows so can see the crater better
- Things that can go wrong:
    - using crater diameter to calculate the PE
    - drawing the best fit line
    - transferring the line
    - giving a "push" or "pull" to the ball as they drop it
    - dropping from the wrong height
    - difficulty measuring the crater size (measure crest to crest, use a compass to find the largest diameter then measure with the ruler.)
    - crater is not circular (means they pushed/pulled it to the side)
- Differences with the geologists' prediction:
    - Hitting rock vs. sand (less important than you'd think)
    - Other energy transfers (melting; sound; kinetic moving of earth; etc.)
    - Asteroid coming in with initial KE instead of from zero KE (biggest one)
    - Burning up in atmosphere
- Last 2 questions:
    - What is speed? (distance/time). How long take to go around once? How far is it? (you want them to get circumference eqn, and that r = 1 AU)
    - If you have them use the geologists # for energy, all answers are the same