Gravitational Energy

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By Evan Dicks, Bibi Esmael, and Evelyn Masson

Science for the Demonstration

Project Scope

The live demo is set up based on the comparison of stored potential energy (PE) between gravity and a compresses spring. Using a spring allows an enhanced visual understanding of the storing and release of this energy.

Potential Energy can be modeled using the following equations

Gravity	Spring
$PE = m * g * h$	$PE = 1/2 * k * x^2$

where

m = mass (kg)

g = gravity (m/s^2)

h = height (m)

k = spring constant (N/m)

x = compression length (m)

From the equations, we can easily calculate the distance needed to compress the spring by choosing a mass and height to represent, and plugging in the spring constant. For instance, a 75 kg (165lb) person at 2 meters high represents about 1470 J of potential energy. To achieve this energy, our spring, with a k = 12.5 lb/in constant, would need to be compressed about 45.6 inches. Because the spring itself is only 5.5 inches, we used a 1/20 scale, meaning the spring is compressed 2.28 inches to represent 1470 J of energy.

To represent a human bone, we were looking for a material appropriately scaled down to the size of the model. We used balsa wood, which has a shear strength of about 450 psi compared to a human femur that has a shear strength of about 9500 psi.