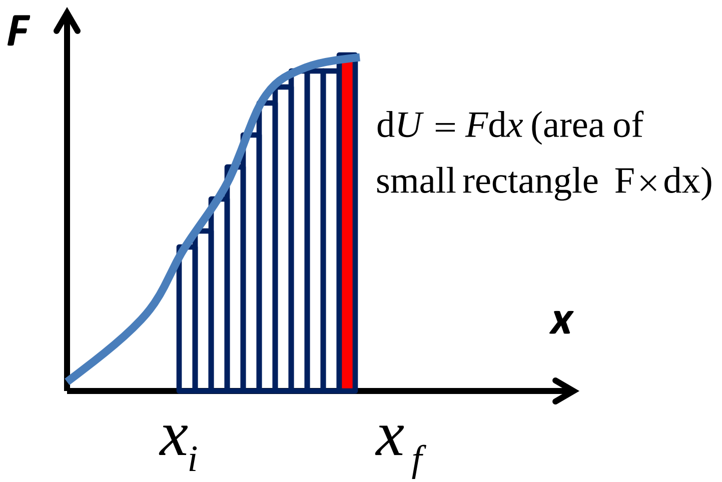
Potential Energy = Integral of Force

Let us calculate the work done ***against*** the force.
This work is stored as potential energy:

$$\Delta U = W = \int_{x_i}^{x_f} F(x)\,\mathrm{d}x$$



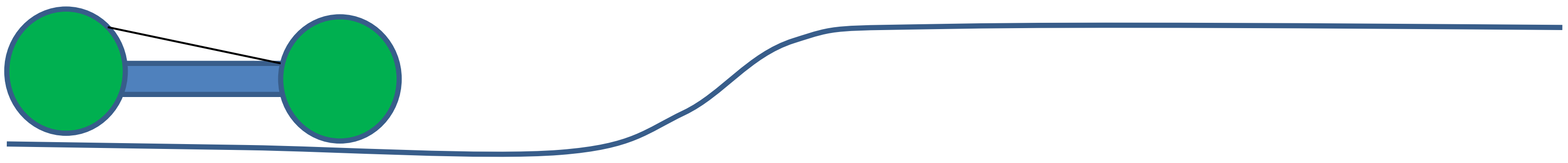
Type of force	F	U
Gravity (on Earth surface)	mg	mgx
Hooke's Law (spring force)	kx	$\frac{kx^2}{2}$
Newton's Law of Gravity	$F = \frac{Gm_1m_2}{r^2}$	$U = -\frac{Gm_1m_2}{r}$

Homework

Problem 1

A toy car is powered by a rubber band with spring constant k=20 N/m. At initial moment, the band is stretch by amount x=0.3m. The car is released, and get accelerated by the rubber band.

a) What will be the eventual speed of the car, if no energy is lost? Mass of the car is 0.2kg.
b) Once released, the car climbs up the ramp of the height h=15 cm (0.15 m). What will be the speed of the car on the top of the ramp?



Problem 2

Electricity pioneers Nicola Tesla and George Westinghouse have built the first hydroelectric plant in 1895, on Niagara Falls. Its power was 37 megawatt (could light about a million light bulbs) .
How much power they could get, if all energy of Niagara Falls could be converted to electricity? In average on Niagara, 2,000 cubic meters of water fall from the height of 50 m every second. Remember that 1Watt = 1Joule per second.