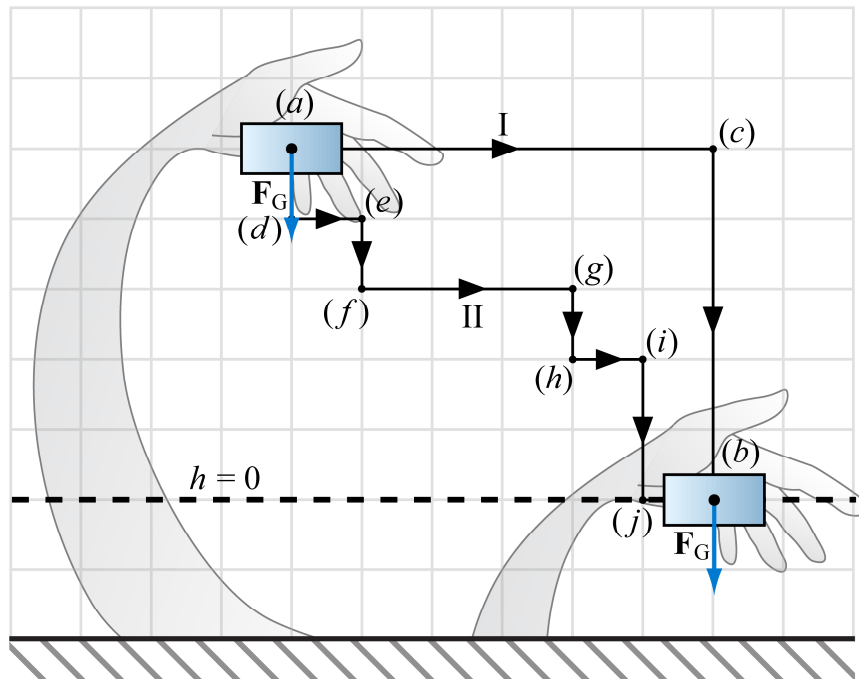


Potential energy

When the relative spatial arrangement of a collection of objects is changed, the total work performed by a given collection of third-law force pairs might or might not depend on the specific paths objects take to get from old to new positions. If this total work is **path-independent** for all combinations of initial and final positions in a domain of interest, we call this total work the negative of the change in the **potential energy** associated with the given collection of third-law force pairs.

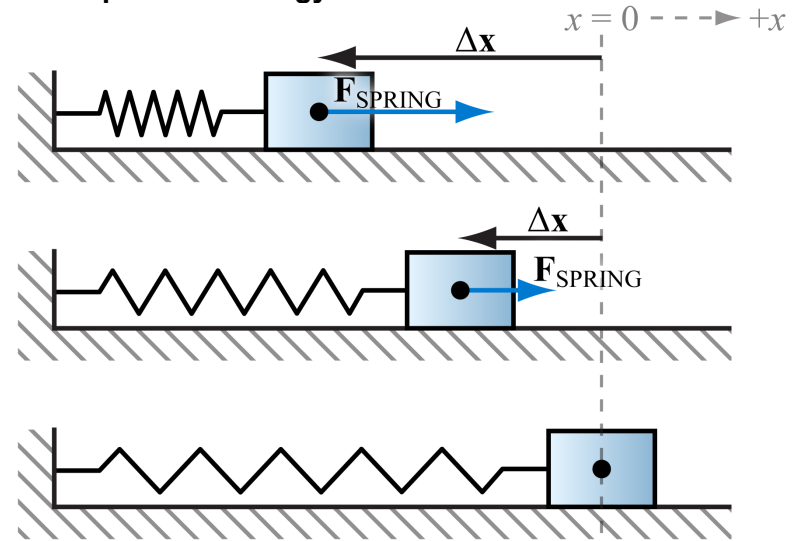
$$-\Delta U_{F,1\dots N} := \Delta W_{F,2 \text{ ON } 1} + \Delta W_{F,1 \text{ ON } 2} + \dots + \Delta W_{F,N-1 \text{ ON } N}$$

Gravitational potential energy near the surface of the Earth



$$\Delta U_G = mg\Delta h$$

Elastic potential energy



Consider the work that the spring force would perform while pushing back from an initial distance of $|\Delta\vec{x}|$ to a final distance of $|\Delta\vec{x}| = 0$.

$$|\vec{F}_{\text{SPRING}}| = k|\Delta\vec{x}|$$

$$\Delta U_S = \frac{1}{2}k(\Delta x)^2$$

