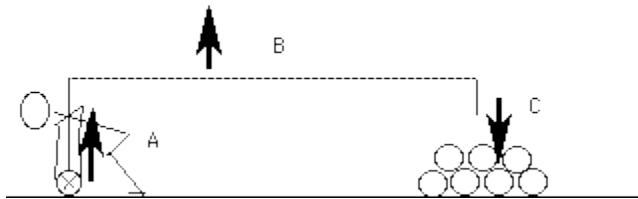


## WORK, ENERGY & POWER

Work is a very normal term, usually one we dislike; "clean up your room !", "mow the lawn !" etc. This word of "work" brings to mind pushing, pulling, walking back and forth. The very unusual thing about the day-to-day usage is that it is almost identical to the Physics usage of the term.

"The **WORK** done on an object, is the product of the average force on it and the distance travelled in the direction of the force."

Notice; the work is done on an object, like a lump of wood during wood stacking, by something which exerts a force (you on the wood ). This force must then proceed to move it through a **distance** in its direction.



You are stacking wood.

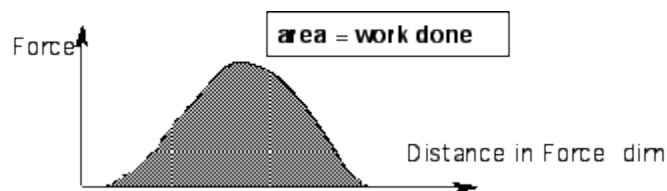
In section A, lifting the wood, you are doing work on the log as the force you exert is in the same direction as the distance travelled.

In section B, apart from a slight amount of force to start moving it along the dotted line, you are doing very little work **on the log** as the lifting force you exert is not in the direction of travel.

In section C, gravity does work on the log.

The unit of work in the modern system is the **joule J** .

### GRAPHICALLY



**Work has no sense of direction.** We do not ascribe arrows to work or energy.

Distance is used rather than displacement in the simple definition because the force acting may take a windy path. You are literally doing work on the pen when you push it writing. The total path taken which is important is the distance rather than the displacement.

**"ENERGY is the ABILITY of an object to do work for whatever reason."**

This again sounds like common sense, but stored energy in whatever form has the same units as work and can do, numerically, that amount of work.

**Energy comes in various forms;**

- **chemical** eg nitroglycerine, or food - indeed the amount of energy involved in exothermic reactions is measured in joules as is nutritional energy values of foods.
- **heat** - both the heat associated with water and the radiation heat associated with the warm sunlight.
- **motion** - a ball thrown hard onto your flesh certainly exerts a force into your skin through a distance. This particular energy is easy to measure and is called kinetic energy.
- **"hidden"** energies called potential energies. A spring in a set mouse trap has one such energy, as has an old tree limb waiting to fall down on someone's head.

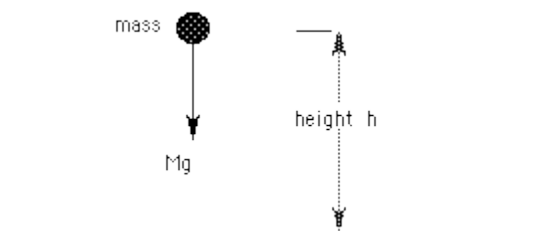
**Interchangeability of the energies ;**

Like momentum, the work-energy idea turns out to be a conservation law. Whenever a process occurs, energy does work and turns into a new form of energy or energies. When all the forms of energy before and after any process are added we find exactly the same number.

**PRINCIPLE OF CONSERVATION OF ENERGY; " In any closed system, the total amount of energy remains constant regardless of any process which takes place."**

Again, physicists would like to know why, - it is linked to momentum and mass is also a form of energy. (OK - what is energy ? )

**GRAVITATIONAL POTENTIAL ENERGY;**



In falling through a height "h" which is in the same direction as the force, the work done by gravity is

**work done = force x displacement = mgh**

thus **Gravitational Potential Energy = mgh**

This is a stored energy available to be converted into movement energy on release. The Hydro uses this energy in the form of stored water which is released, converts first to kinetic energy then to electrical energy which is distributed around the State.

**KINETIC ENERGY; " Energy available because of the object's motion".**

Consider a mass, m, which is moving with a speed , v, and does work which brings it to rest.

**KE = Kinetic Energy =  $\frac{1}{2} mv^2$**

## **POWER**

"Power is the rate of doing work or changing energy."

**$P = \frac{\text{Work Done}}{t} = \frac{\Delta \text{Energy}}{t}$**

A powerful person is capable of doing the same work as a less powerful person in a shorter time.

The unit of power is the **watt, W** which is the J/s