

Watts in the bag?

Or What's a watt

By Eric Muller

Introduction:

The term watt is used a lot. This activity shows what a watt (and a joule) really is.

Materials:

- A small, high quality re-sealable plastic bag (i.e. Ziplocs or glad bag)
- String
- Water in a ½ or 1 liter bottle
Or water and a liquid measuring device
- Meter stick (or other metric measuring device)

Assembly:

1. Measure out 100 ml of water. If using a ½ -liter bottle, fill up the bottle only 1/5 full (likewise use only 1/10 of the contents of 1-liter bottle).
2. Open the bag and pour in the water
3. Squeeze of the excess air and seal the bag.
4. Tie a line of string around the middle of the bag. Make sure the knot is tight enough to not let the bag slip out.
5. Measure 1 meter of string from the knot on the bag and cut.
6. This is your 1-watt device.
The water and bag will act as your mass*
and the 1 meter long string will act as your meter stick.

*Note:

Since water has a density of 1gram per milliliter and the bag and string weigh pretty much nothing.... your bag has a total mass of about 100 grams.

Set-up:

1. Place the bag of water on the ground next to a wall (using the wall helps in figuring out necessary heights).
2. Hold the free end of the string 1 meter above the bag.
3. Press your finger against the string and onto the wall at this height. This is your 1-meter mark.

To do and notice:

1. Lift the bag from the ground to the same height as the mark.

You had to use energy to lift the bag. You used 1 joule of energy!

2. Now, lift the bag from the ground to the same height as the mark, but do it in one second.

You used 1 watt of power!



What's going on?

Earth is attractive. So much so that things are accelerated towards the ground at a rate of about 10m/s^2 . This is also known as the acceleration due to gravity.

Force is defined as mass multiplied by acceleration and is measured in "Newtons."

Energy (or "work") can be defined as force multiplied by distance. The unit of energy is in "Joules."

Power is energy per unit of time. The unit of power is in "Watts."

So, in the case above:

Force = mass x accelerations = $.1\text{kg}$ (100gram bag) x 10m/s^2 = 1 Newton

Energy = Force x distance = 1 Newton x 1 meter = 1 Joule

Power = Energy / time = $1\text{Joule}/1\text{ second}$ = 1 Watt

Do more:

You can model the power consumptions of various electrical devices around your house.

For example:

You can model the power needs of various bulbs:

60 watt incandescent (which uses 60 watts)

Lift 3 liters in 1 second

60 watt equivalent CFL (which only uses 15 watts)

Lift 1.5 liters in 1 second

60 watt equivalent LED (which only uses 6-10 watts)

Lift 6 to 10 "Watt's in the Bag bags"

See Don Rathjen's article below

So...If some one asks what's in the bag....you can say, "Watt's in the bag."

Resources:

Watt's a Joule by Don Rathjen

<http://www.exploratorium.edu/theworld/energy/joules.html>