Power

When you think of what it means to be 'powerful' you think of... strength

But in physics, power is the rate at which work is done

Power can be calculated using: $P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$

A powerful lineman is both **STRONG** (applies a big force) and **FAST** (displaces objects in small times).

Where P = power, measured in W (watts)
W = work, in J
t = time, in s

↑ don't confuse the unit, W, with work!

(historically 1 horsepower (hp) = 750 W)

Example: A physics student is setting up a wicked body slam on a biology student. He lifts the 75 kg student clear over his head to a height of 2.2 m in 0.675 s. How much power did the physics student generate?

Given: $m = 75\text{kg}$, $h = 2.2\text{m}$, $\Delta t = 0.675\text{s}$ Need: P

$$P = \frac{W}{\Delta t} = \frac{mg\Delta y}{\Delta t} = \frac{75\text{kg} \cdot 9.8\frac{\text{m}}{\text{s}^2} \cdot 2.2\text{m}}{0.675\text{s}}$$

$= 2396\text{ W} \approx \boxed{2400\text{ W}}$

Example: While cruising along level ground in a one horse open sleigh at 4.0 m/s, Mrs. Welter cracks the whip and speeds up to 12.0 m/s in 4.5 s. If the sleigh has a mass of 850 kg, how much power did it generate? Ignore friction.

Given: $v_i = 4.0\text{m/s}$, $v_f = 12\text{m/s}$, $\Delta t = 4.5\text{s}$, $m = 850\text{kg}$ Need: P

$$P = \frac{W}{\Delta t} = \frac{\frac{1}{2}m(v_f^2 - v_i^2)}{\Delta t}$$

$$= \frac{\frac{1}{2}(850)(12^2 - 4^2)}{4.5\text{s}}$$

$= \boxed{112{,}000\text{ W}}$

When velocity is constant, power can be calculated from:

$P = \frac{W}{\Delta t} = \frac{F\Delta d}{\Delta t}$ if $\vec{v}\left(\frac{\Delta d}{\Delta t}\right)$ is constant then $\boxed{P = Fv}$