

Work



Chemical energy stored in the body is converted into external mechanical work as well as into life-preserving functions.



The external work (ΔW) is defined as a force (F) moved through a distance (Δx),

$$\Delta W = F \cdot \Delta x$$



Power



The rate of doing work is the power (P) and is given as:

$$P = \Delta W / \Delta t = F \cdot \Delta x / \Delta t = F \cdot v$$



where $v = \Delta x / \Delta t$ is the velocity.



Obviously



External work is done when a person is climbing a hill or walking up stairs.



Work done is calculated by multiplying the person's weight (mg) by the vertical distance (h) moved, i.e.

$$\Delta W = mgh$$



The efficiency of the human body

- The total food energy consumed can be calculated since 4.8 to 5.0 kcal are produced for each liter of oxygen consumed.
- The efficiency of the human body as machine can be obtained from the usual definition of the efficiency (ϵ) as
- $\epsilon = \text{work done} / \text{energy consumed}$



A dramatic photograph of a volcanic eruption at night. A large, dark, conical volcano is the central focus, with a massive, bright orange and yellow plume of fire and ash rising from its summit into a dark, starry sky. The foreground shows the dark, rocky slopes of the volcano, illuminated by the intense light of the eruption. The overall scene is one of raw power and heat.

Heat Losses

Heat Losses and temperature regulation



Animals are divided according to body temperature

homothermic (warm-blooded)

- Animals have mechanisms to keep their body temperature constant despite fluctuations in the environmental temperature
- ex. birds and mammals

poikilothermic (cold-blooded)

- Animals have a variation in body temperature according to the environment, i.e. have a higher body temperature on a hot day and visa versa
- ex. frog and snake



Body temperature

Constant body temperature permits metabolic processes to proceed at constant rates and these animals to remain active even in cold climates.

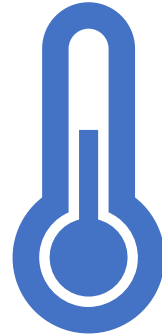
Because the body is at a constant temperature it contains stored heat energy that is essentially constant if they are alive.

However, when metabolic activity stops at death, the stored heat is given off at a predictable rate until the body cools to the surrounding temperature.

The body temperature can thus be used to estimate how long a person has been dead.



Fluctuations in the temperature of the body



- In order the human body has a constant temperature, there are small fluctuations in the temperature of the body.
- **The temperature of the body depends upon:**
- (1) the time of the day (lower in the morning)
- (2) the temperature of the environment
- (3) the amount of recent physical activity
- (4) the amount of clothing
- (5) the health of the individual



Hypothalamus

The hypothalamus of the brain contains the body's thermostat

- High body temperature

- If the core temperature rises, for example, due to heavy exertion,
- the hypothalamus initiates sweating and vasodilatation, which increases the skin temperature.
- Both reactions increase the heat loss to the environment.
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- Low body temperature

- If the skin temperature drops,
- the thermo-receptors on the skin inform the hypothalamus and it initiates shivering,
- which causes an increase in the core temperature

