F.5 Entropy Transfer Mechanisms

There were two ways that energy could change: work and heat. Let's examine the effect that these two things have on entropy.

Work

As we can sort of observe, work does not fundamentally speed up or slow down the random oscillations of the particles in the object (the weight), and so it does not change the object's entropy.

$$\Delta S_W = 0$$

F.5 Entropy Transfer Mechanisms

Heat

definitely me

But heat *does* speed up the object's atoms' random oscillations, and so it *will* change the object's entropy. The amount it changes the entropy can be inferred from how much it changes its energy:

$$\Delta S = \int \frac{dE}{T}$$ and from 1st law:

$$\cancel{dW} + dQ = dE$$

$$dQ = dE$$

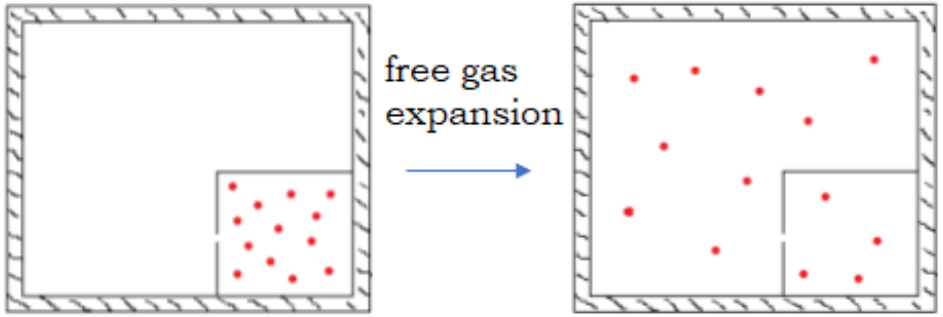
So $$\Delta S_Q = \int \frac{dQ}{T}$$

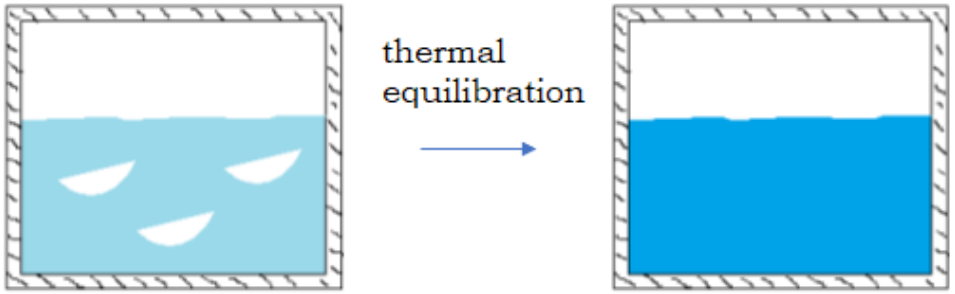
F.5 Entropy Transfer Mechanisms

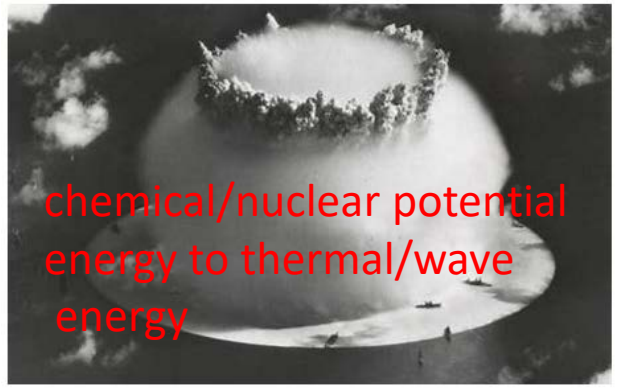
Internal Processes

But even if W = Q = 0, so that it doesn't interact with the environment at all, an object's entropy can *still* change. This is via *internal* processes. There are two kinds of internal processes:

reversible processes: ones whose reverse can readily occur.
irreversible processes: ones whose reverse cannot readily occur.





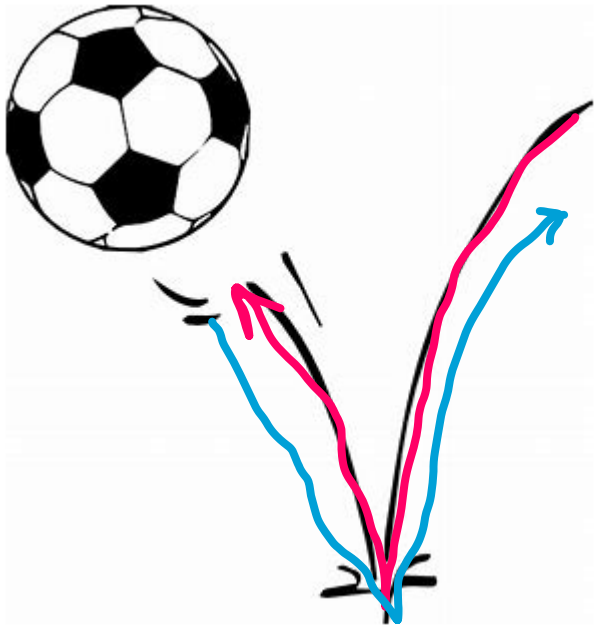


Some irreversible processes ….

F.5 Entropy Transfer Mechanisms

Internal Processes

Swinging, consisting of conversion of gravitational potential energy to kinetic energy, and vice versa.



Bouncing, consisting of conversion of gravitational potential energy to kinetic energy to elastic (spring) potential energy, and vice versa.

Some reversible processes ….

F.5 Entropy Transfer Mechanisms

Internal Processes

Irreversible processes result in entropy increase: $\Delta S_{int.} > 0$ (and actually as large as possible until object reaches equilibrium)
Reversible processes result in no entropy increase: $\Delta S_{int.} = 0$.

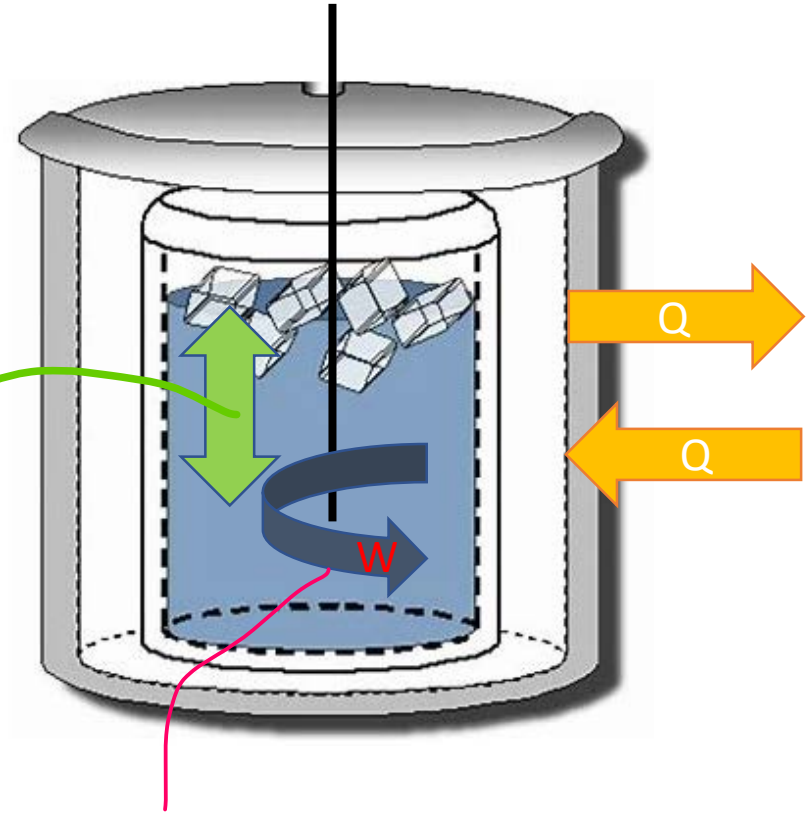
And so we can summarize with: $\Delta S_{int.} \geq 0$ (and will increase as much as possible until equilibrium is reached)

F.5 Entropy Transfer Mechanisms

Internal energy exchange between water and ice is an internal process and results in positive entropy change.

$\Delta S_{\text{int.}} \geq 0$

(and as much as possible until equilibrium is reached)



if improperly insulated then heat can be transferred from outside and entropy lost or gained.

$$\Delta S_Q = \int \frac{dQ}{T}$$

If smoothly stirring, then this work would *not* result in an entropy change.
(vigorous/chaotic stirring would be more like heat than work and would change entropy)

$$\Delta S_W = 0$$