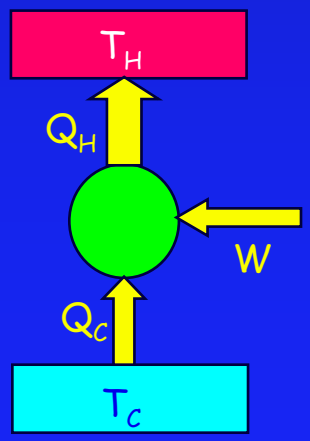
Example

Consider a hypothetical refrigerator that takes 1000 J of heat from a cold reservoir at 100K and ejects 1200 J of heat to a hot reservoir at 300K.

1. How much work does the refrigerator do?
2. What happens to the entropy of the universe?
3. Does this violate the 2nd law of thermodynamics?

Answers:
200 J
Decreases
yes



Q_C = 1000 J
Q_H = 1200 J

Since $Q_C + W = Q_H$, W = 200 J

$\Delta S_H = Q_H/T_H$ = (1200 J) / (300 K) = 4 J/K

$\Delta S_C = -Q_C/T_C$ = (-1000 J) / (100 K) = -10 J/K

$\Delta S_{TOTAL} = \Delta S_H + \Delta S_C$ = -6 J/K ➔ decreases (violates 2nd law)