

entropy

Image credit: Kyle Szostek referenced at <http://csidsocialmedia.github.io/2014/06/07/Entropy-and-the-world-in-our-eyes.html>

Laws of Thermodynamics

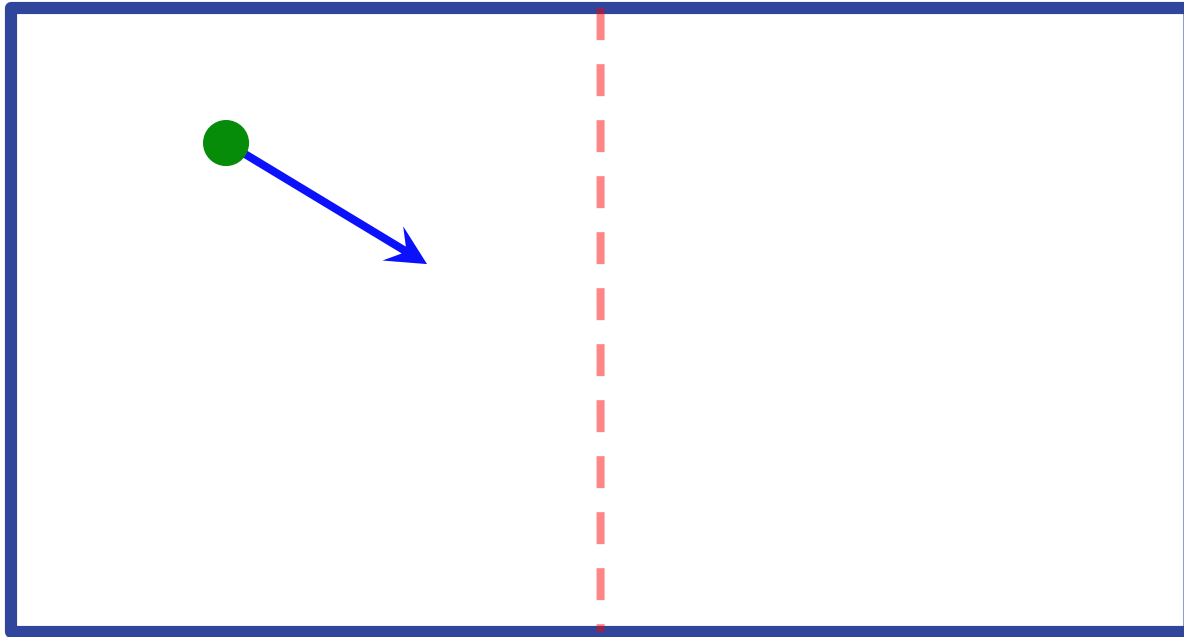
Zeroth law of thermodynamics: If two systems are in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

First law of thermodynamics: When energy passes into or out from a system, the system's internal energy changes in accord with the law of conservation of energy.

Second law of thermodynamics: In a natural thermodynamic process, the sum of the entropies of the interacting thermodynamic systems increases.

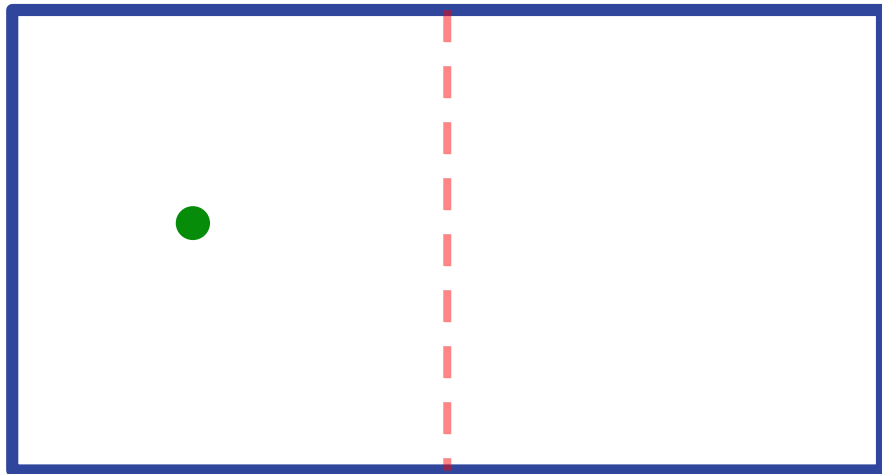
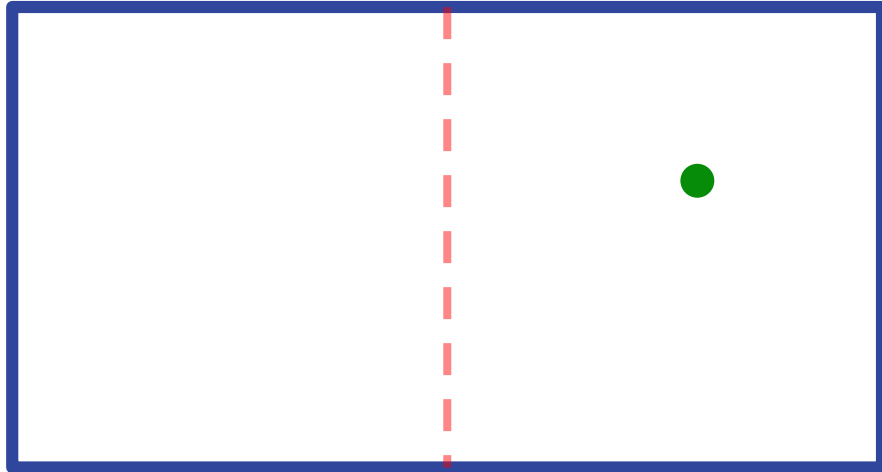
Third law of thermodynamics: The entropy of a system approaches a constant (usually zero) value as the temperature approaches absolute zero.

Molecule in a box



How many molecules in the left half?

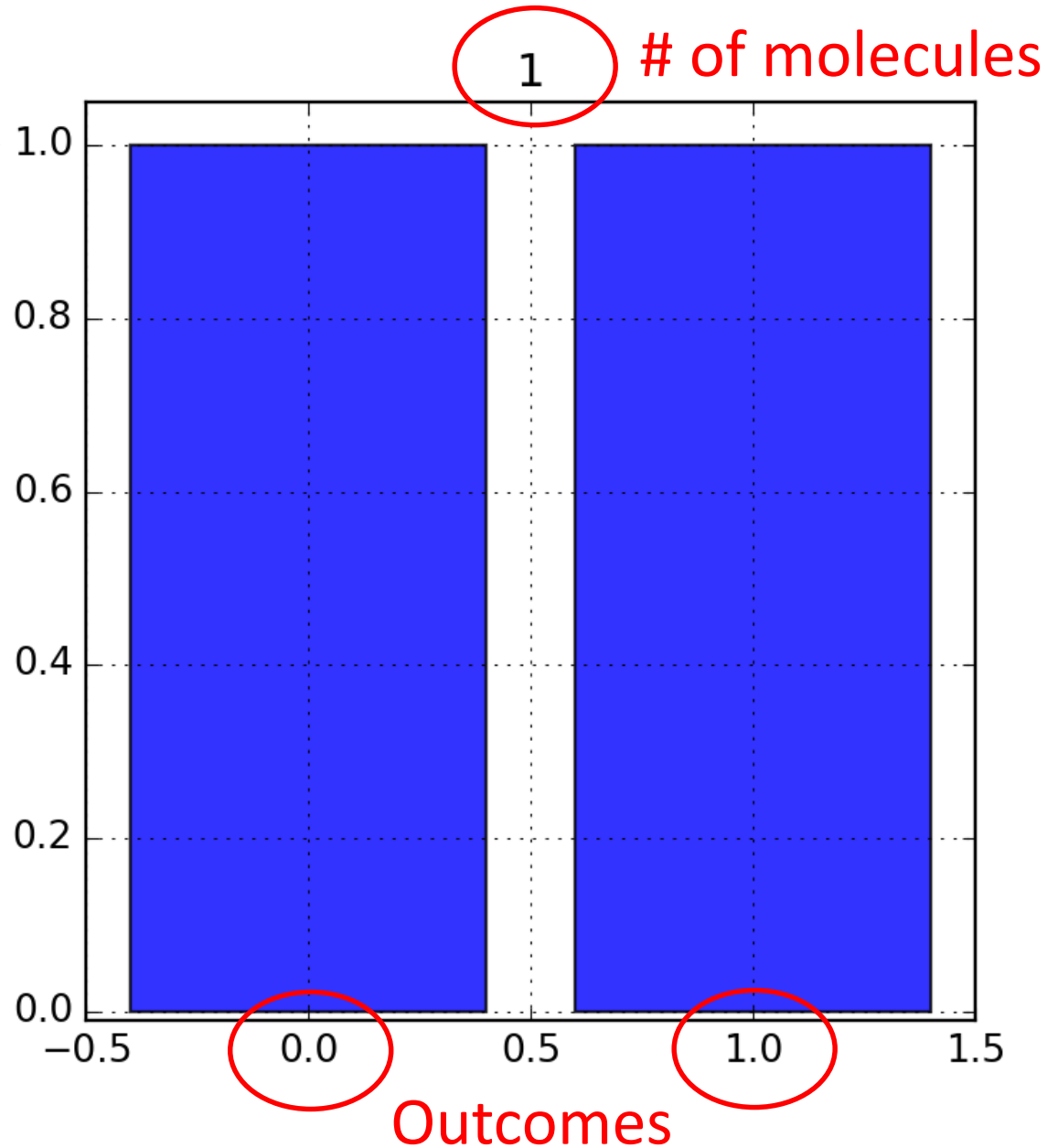
Outcomes
$R = 0$
$L = 1$



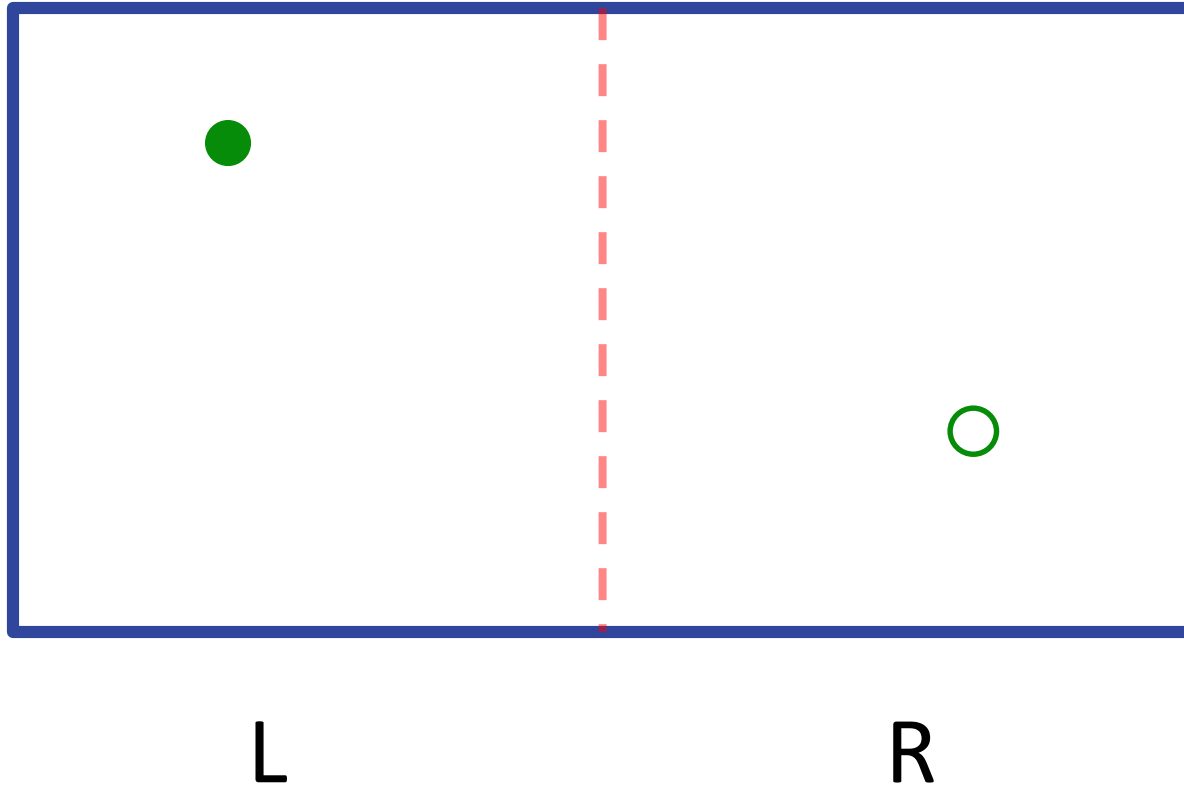
Number of molecules on the left half of the box

of ways to achieve outcome

Outcomes
R: 0
L: 1

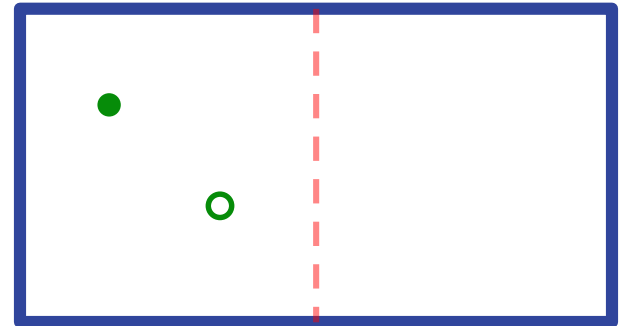
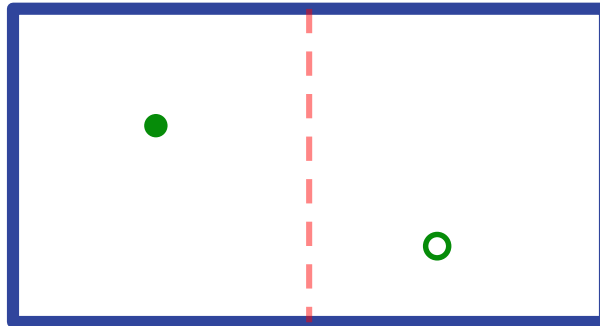
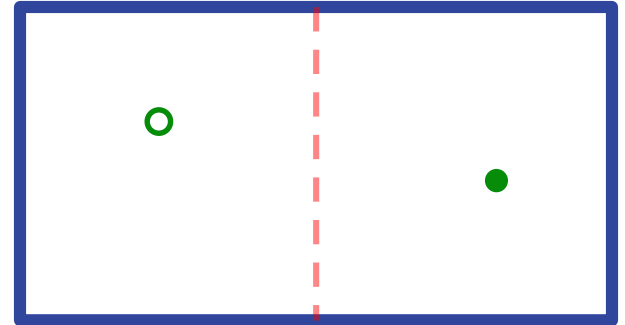
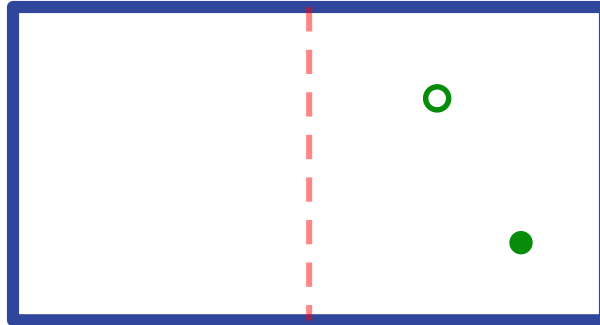


Two Molecules in a box



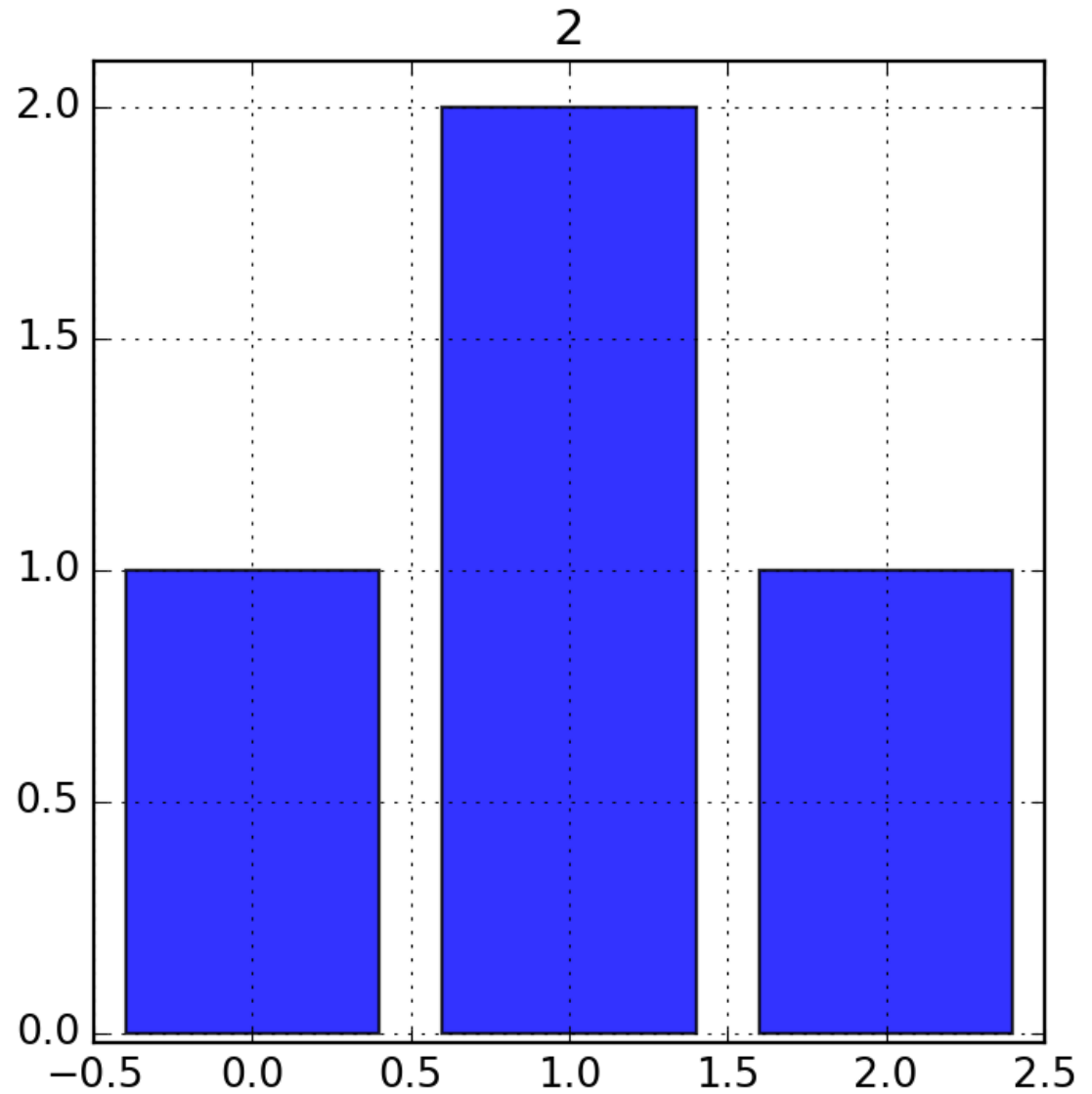
How many molecules in the left half?

Outcomes
RR = 0
RL = 1
LR = 1
LL = 2



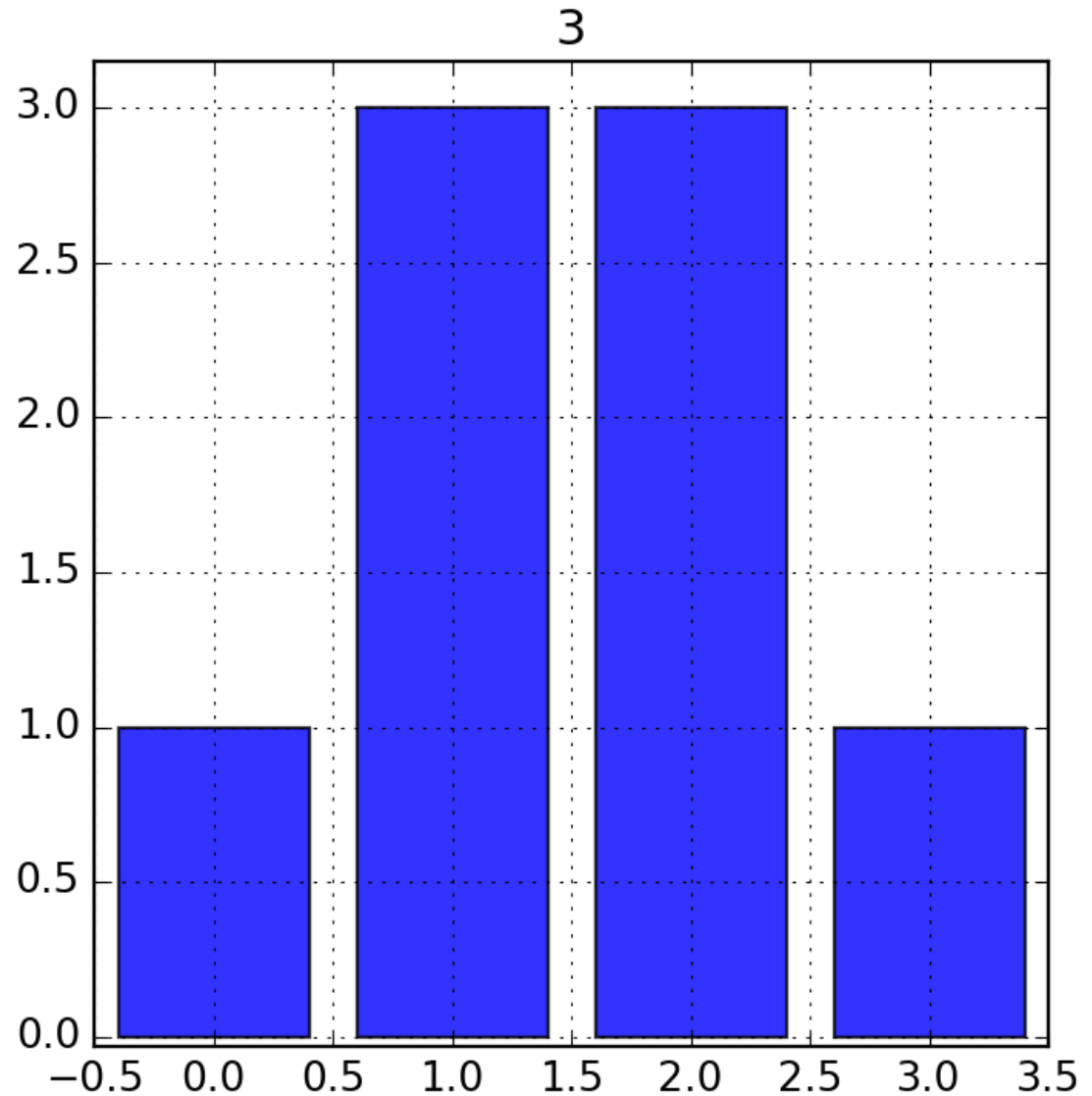
Number of molecules on the left half of the box

Outcomes
RR = 0
RL = 1
LR = 1
LL = 2

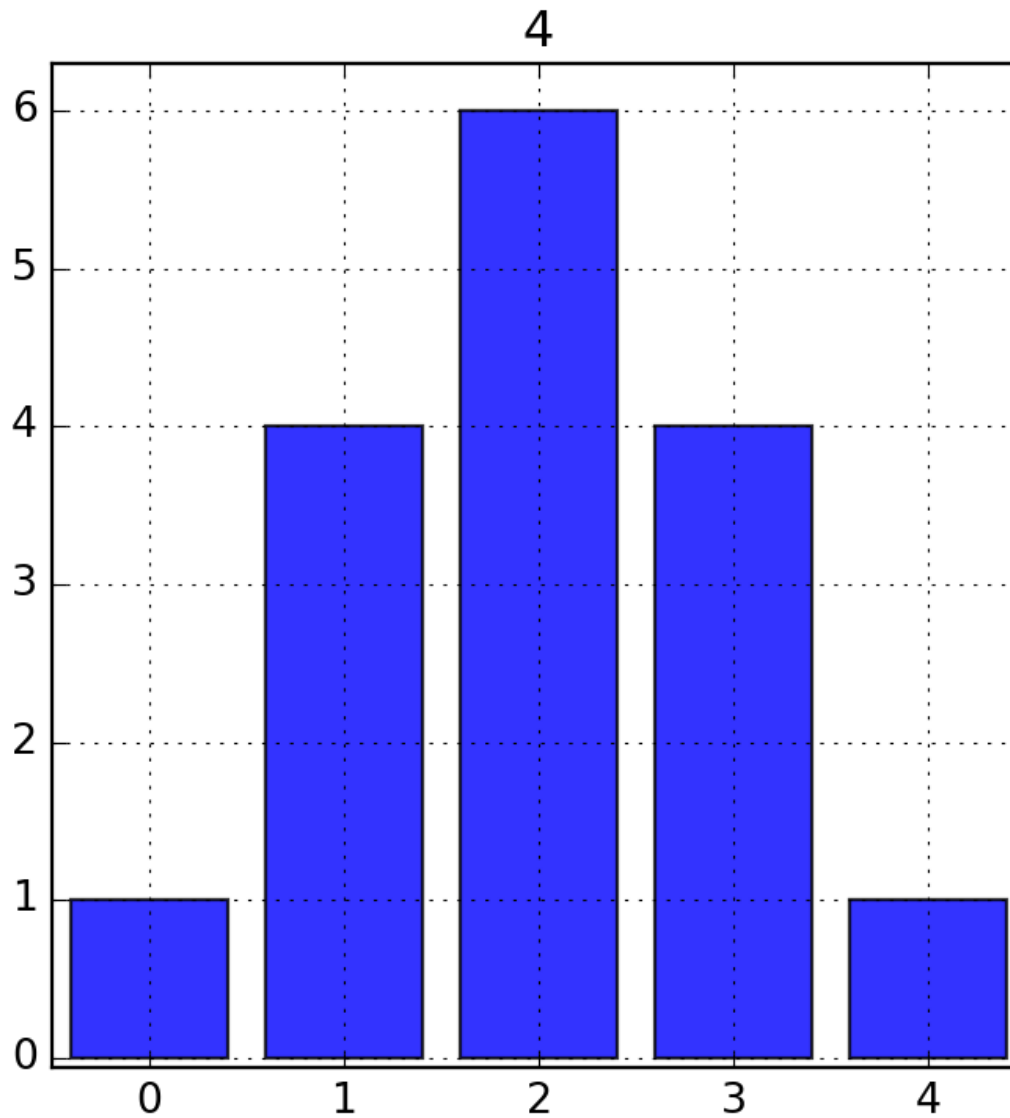


Number of molecules on the left half of the box

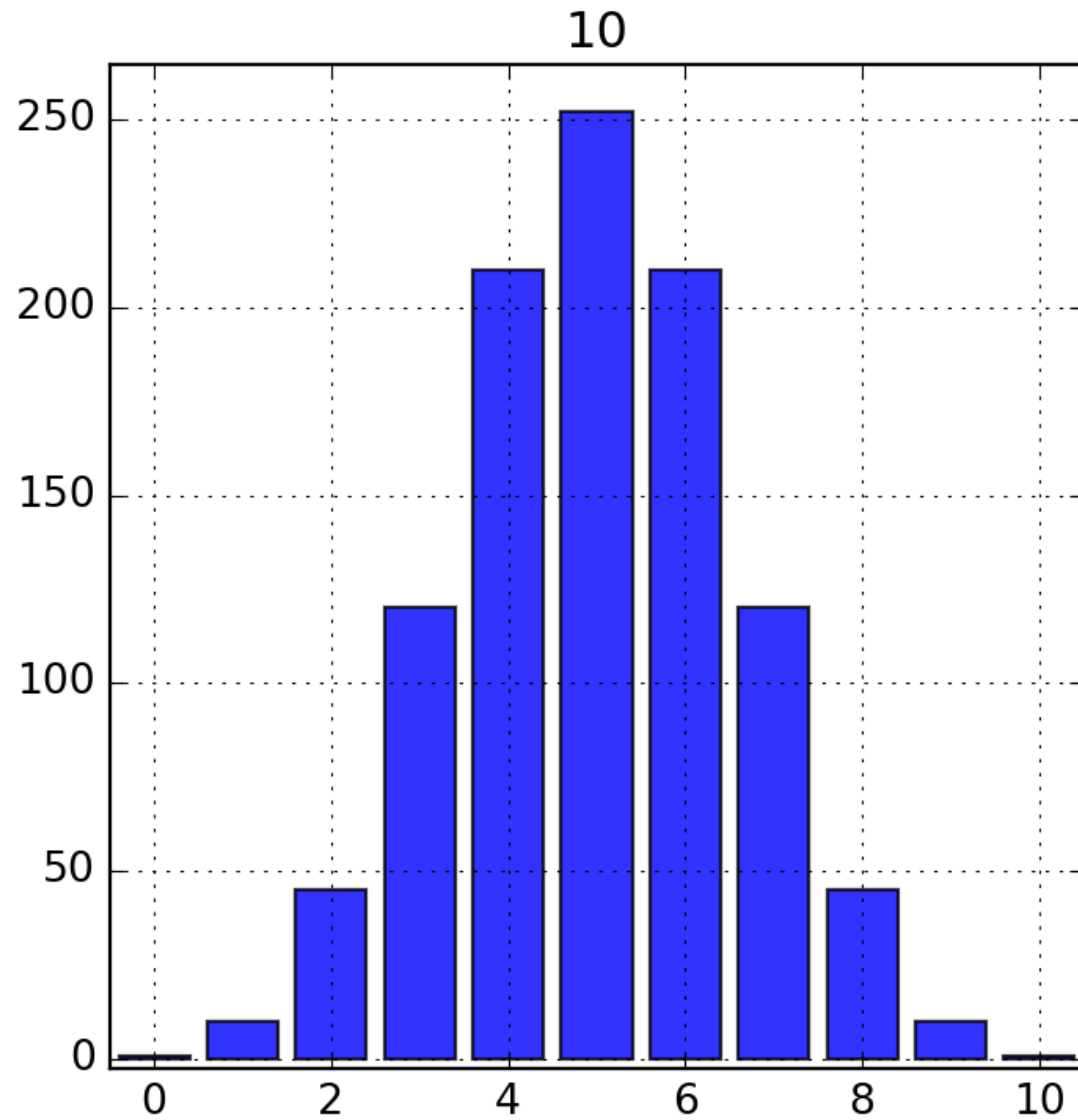
Outcomes
RRR = 0
RRL = 1
RLR = 1
RLL = 2
LRR = 1
LRL = 2
LLR = 2
LLL = 3



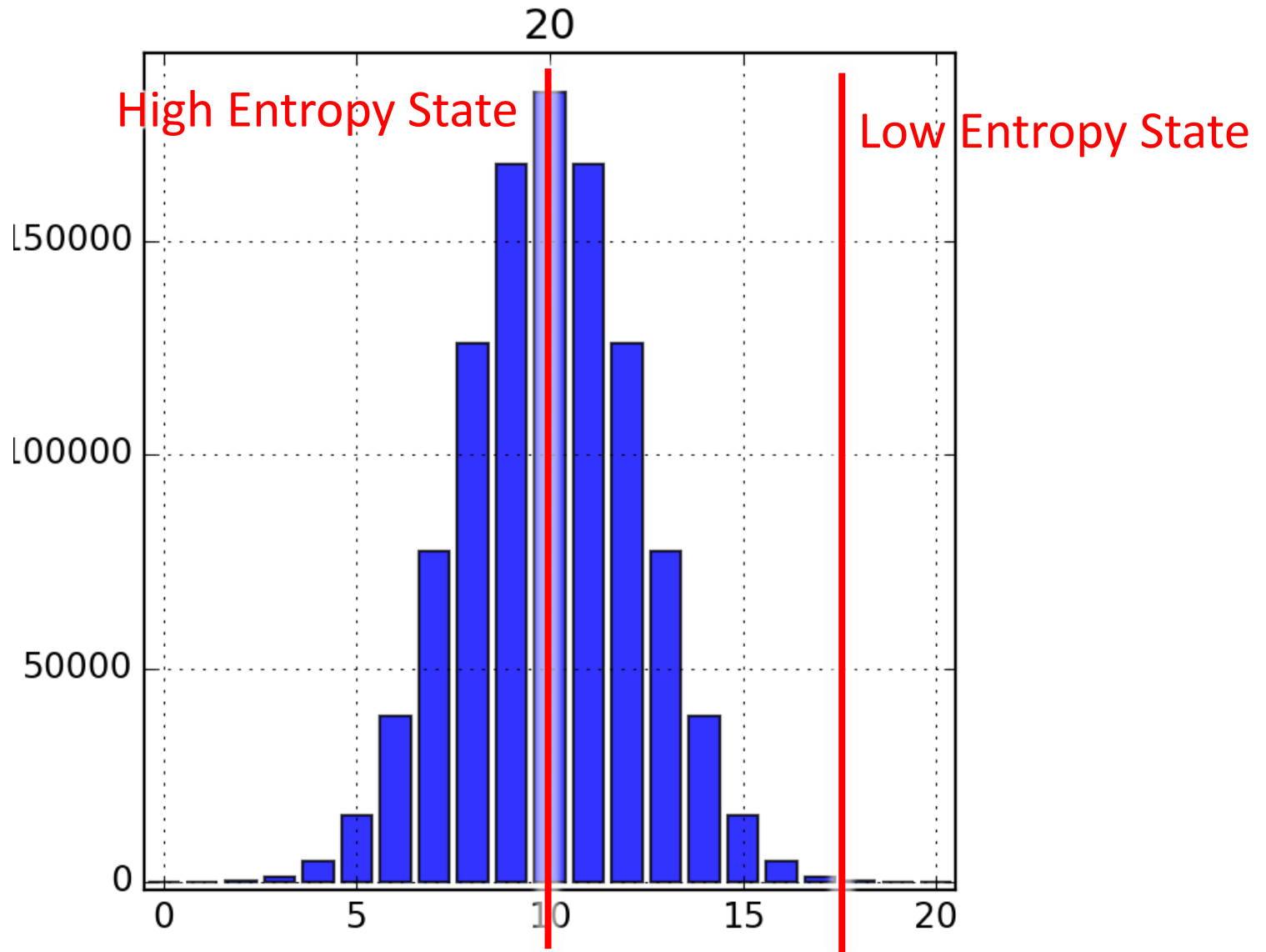
Number of molecules on the left half of the box



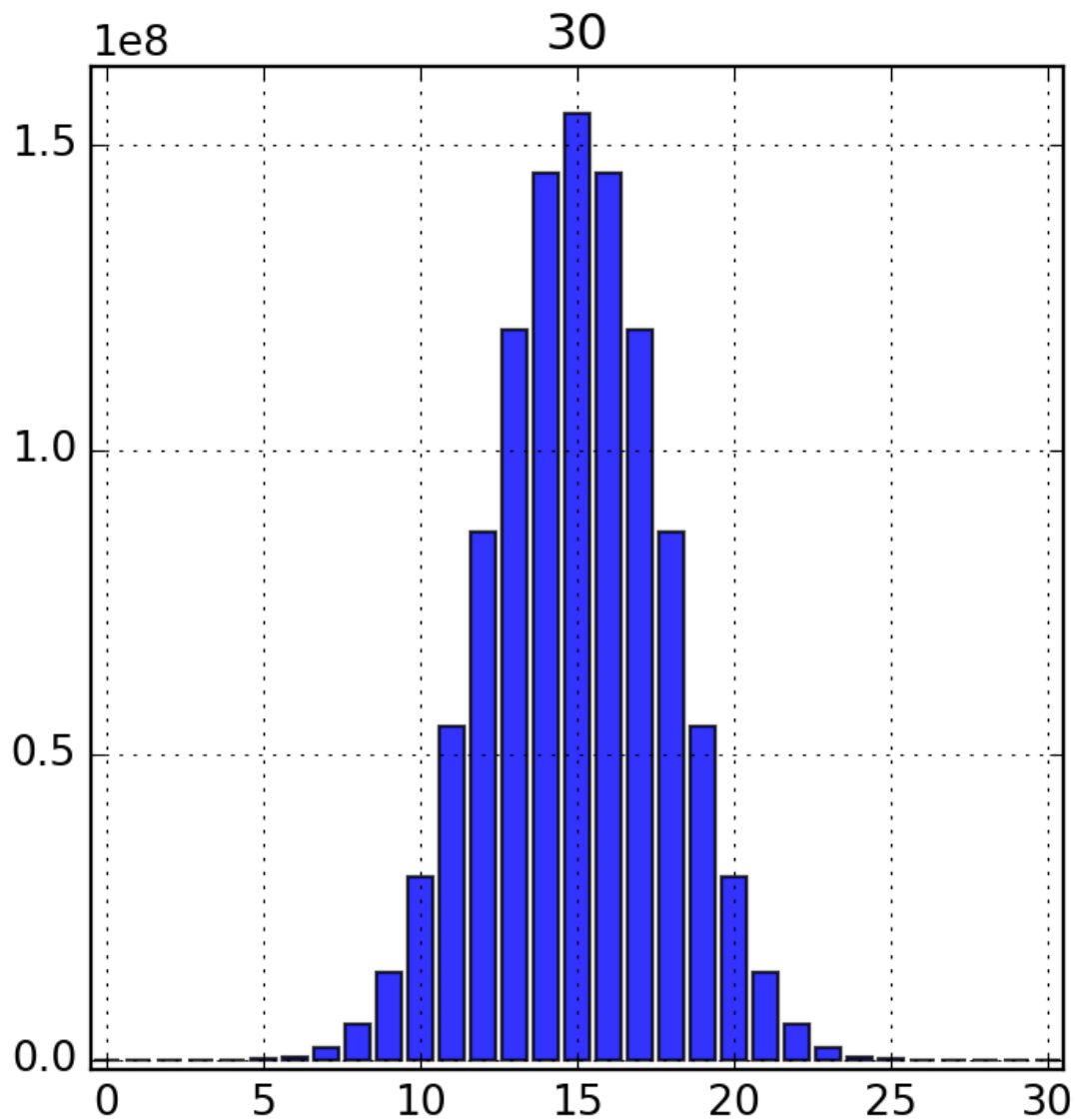
Number of molecules on the left half of the box



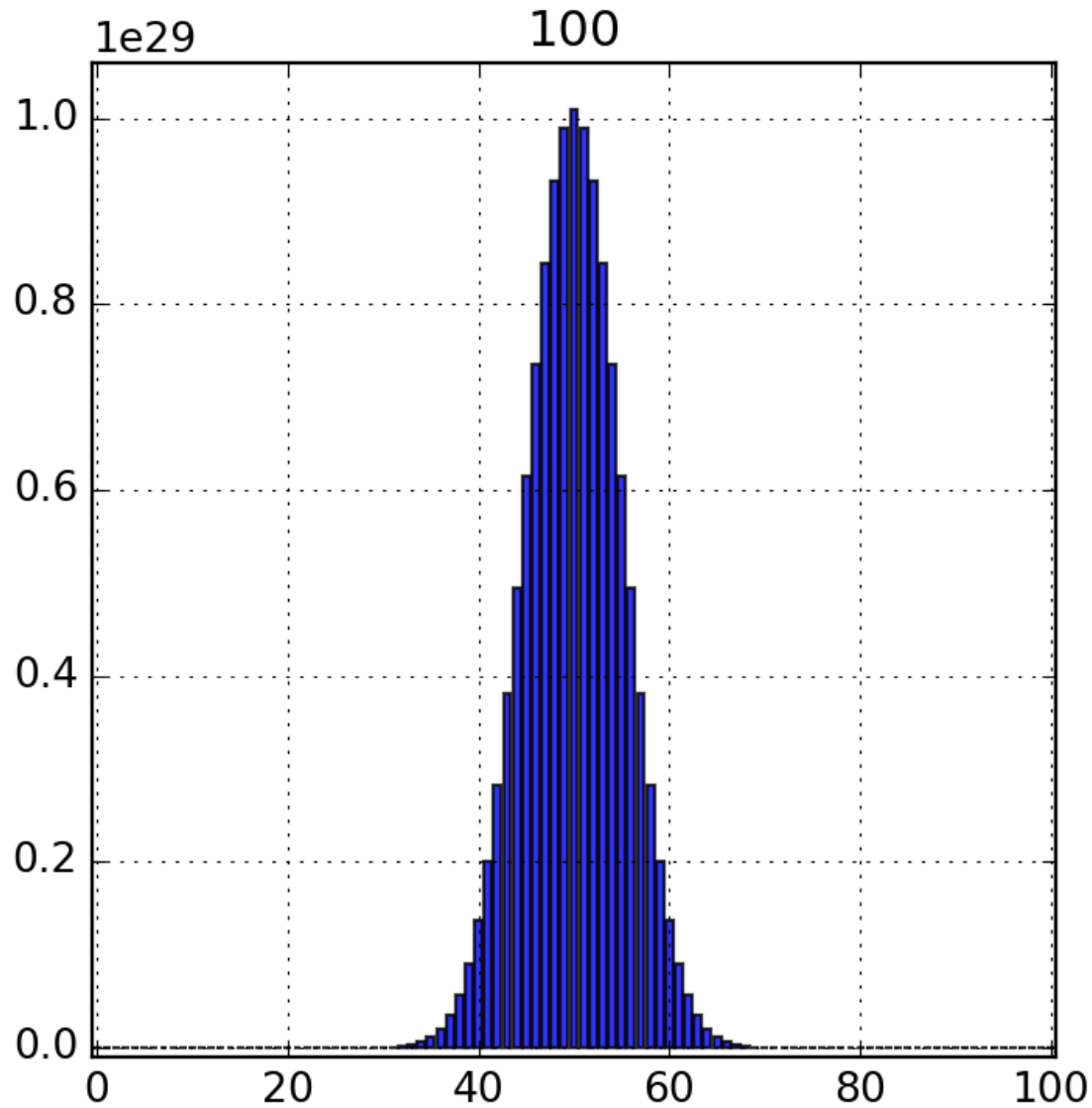
Number of molecules on the left half of the box



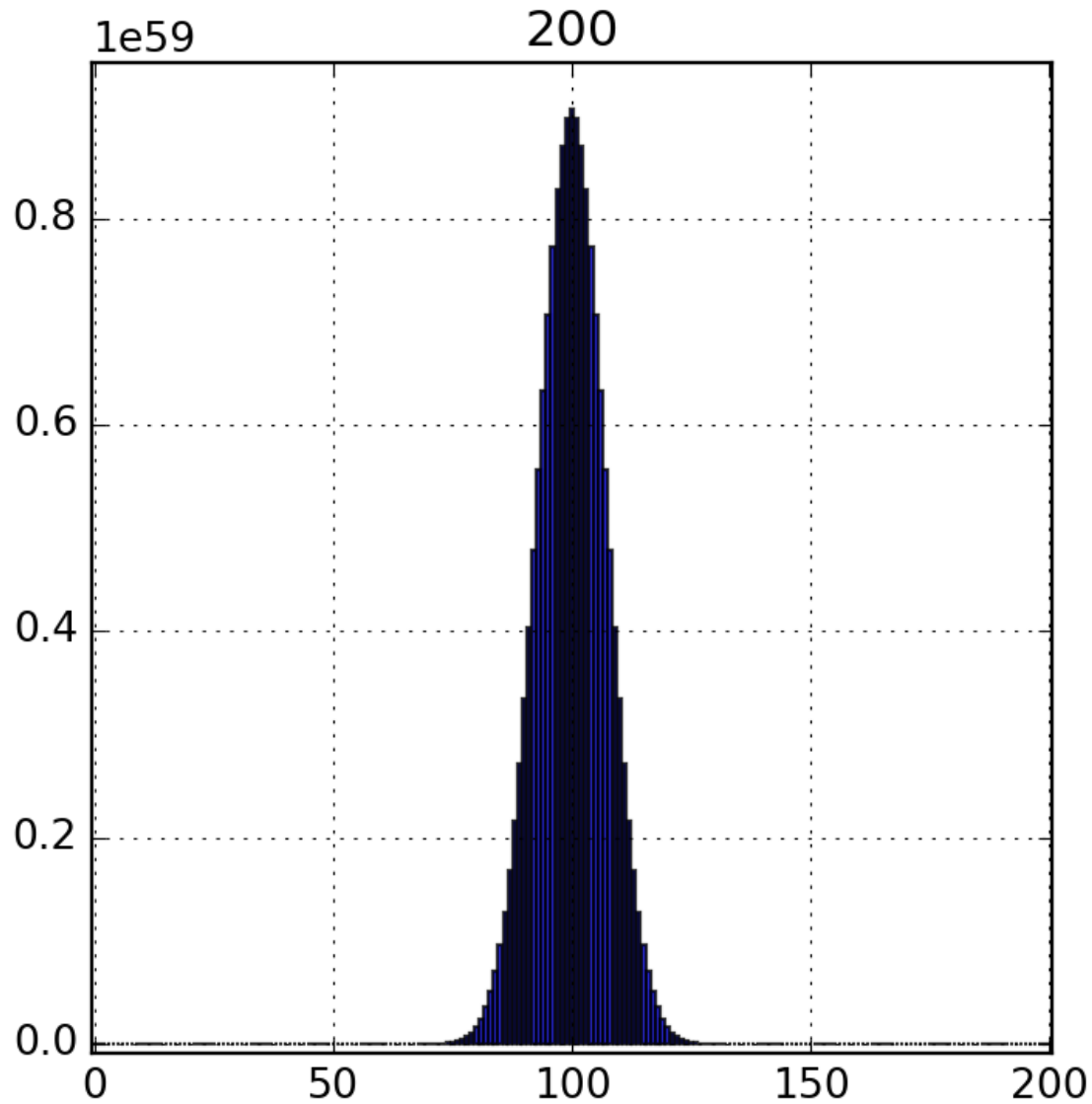
Number of molecules on the left half of the box



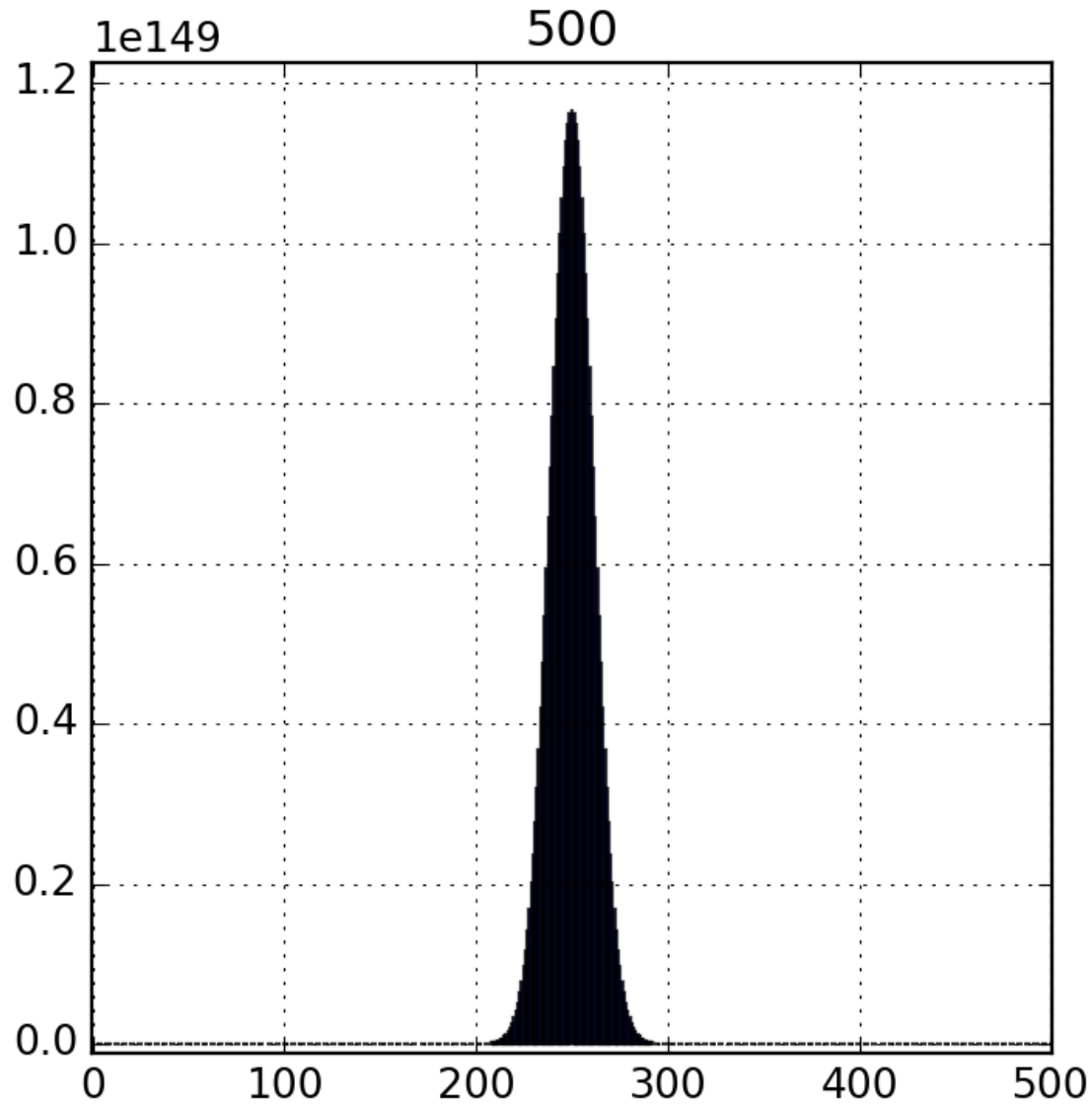
Number of molecules on the left half of the box



Number of molecules on the left half of the box

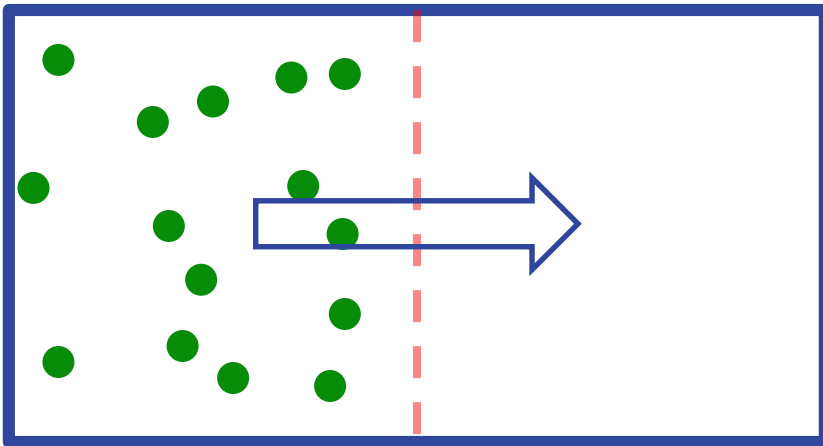
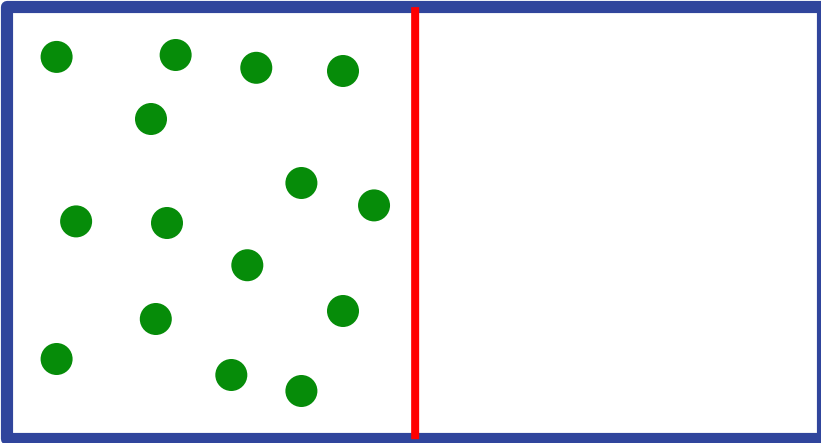


Number of molecules on the left half of the box

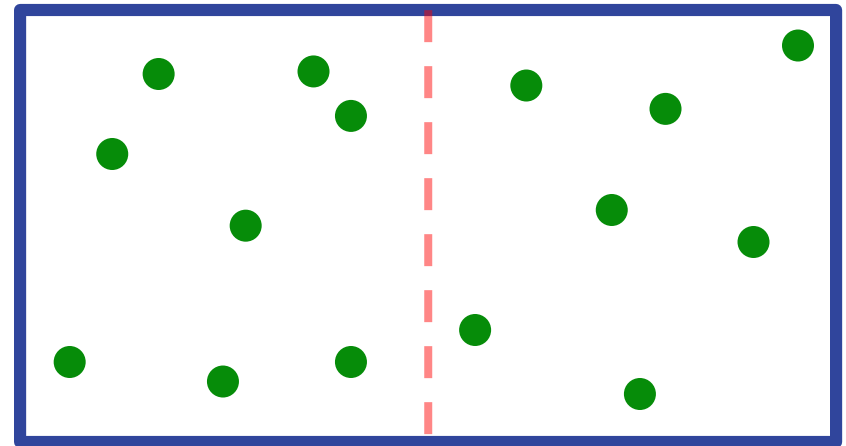


Entropy as a measure of likelihood

Low Entropy State

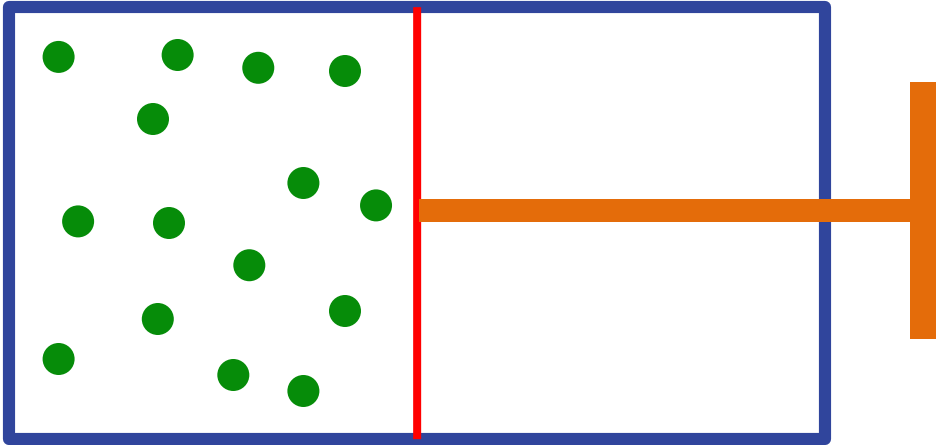


High Entropy State



Extracting Useful Energy while increasing Entropy

Low Entropy State



Increasing Entropy

