06-10 Entropy *Name: _____*

Objective:

- Demonstrate entropy.

Materials:

- 5 Four-sided Dice (D4)

Procedure:

Entropy is the measure of the amount of energy unavailable to do work. Since energy is always lost in any process, the entropy always increases. Boltzmann suggested that entropy is a measure of the disorderliness of the universe. This is because disorder is far more probable than order when there is randomness.

Two Dice

1. Let us define the most ordered result of rolling dice is that all the dice have the same number (like 1 and 1).
2. If you roll two dice, how many ways can all the dice have the same number? _____
3. How many results are possible? _____
4. What is the probability of rolling all the same number? _____
5. What is the probability of rolling different numbers? _____
6. Roll your dice 100 times and record how many times you rolled both dice with the same number. _____
7. Calculate the %error with the theoretical. _____

Three Dice

1. If you roll three dice, how many ways can all the dice have the same number? _____
2. If you roll three dice, how many ways can two of the dice have the same number, but the 3rd number different? _____
3. How many results are possible? _____
4. What is the probability of rolling all the same number? _____
5. What is the probability of rolling only two of the same number? _____
6. What is the probability of rolling different numbers? _____
7. Roll your dice 100 times.
    a. How many times did you roll all the dice with the same number? _____
    b. How many times did you roll only two of the dice with the same number? _____
    c. How many times did you roll all different numbers? _____

Five Dice

1. If you roll five dice, how many ways can all the dice have the same number? _____
2. How many total ways can all the dice be rolled? _____
3. What is the probability of rolling all the same number? _____
4. What is the probability of rolling not all the same number? _____
5. Roll your dice 100 times.
    a. How many times did you roll all the dice with the same number? _____
    b. How many times did you roll not all the same number? _____
6. Calculate the %error with the theoretical. _____, _____

Conclusions

1. For the two and three dice, we looked at all the possibilities. What was more likely, the ordered result of all the same, or all different? _____
2. For the five dice, we only looked at two possibilities. What was more likely, the order result of all the same, or the disordered different? _____
3. If you consider molecules, atoms, or particles to have different states such as location or temperature like the dice have different faces, what would you expect to have occur more, all the same or all different? _____ That is why gasses spread out in their container (all different locations) and temperatures reach equilibrium (the particles with high temperatures spread the energy to all different locations instead of all in one spot).