SCAAPT Fall Meeting
*A "toy" model*
November 5

Like many times in physics, it is worth playing with a system that is simpler than reality so we can become familiar with the ideas and terminology.

Find four small markers that you can place on the page. Pennies work. If you're short on change, you can cut out the penny pictures below. Personally, I like a few M&M's, Skittles or other candy. Why? I get to reward myself when I'm done with a few treats and… there is a wonderful symbolism to using food. (Oooo… foreshadowing.) (Grapes, blueberries and other fruits are always a good thing, except here… they roll around too much. We need something that will stay put.)

☞ Describe, and count, all of the ways you can place the four markers in the four boxes shown below. Don't worry about differences in the markers (heads or tails is you're using coins, color if you're using candies, etc.); *treat all markers as identical*. (Blue, red & green in A1, with yellow in B1 is the same as Blue, yellow & red in A1 and green in B1. The markers are to be treated as if they were interchangeable.

Of course, you must always use all of the markers; all four must be in one of the four boxes.

| A1 | A2 |
|---|---|
| | |

| B1 | B2 |
|---|---|
| | |

SCAAPT Fall Meeting
*"Toy" model tally*
November 5

To help you keep track of the different configurations, you might want to use the following tables.

Number of markers in:

| A1 | A2 | B1 | B2 |
|---|---|---|---|
| | | | |

| A1 | A2 | B1 | B2 |
|---|---|---|---|
| | | | |

Did you find all of the configurations? There are quite a few.

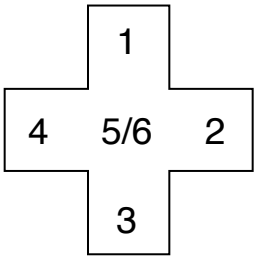
☞ How many did you find? _____

SCAAPT Fall Meeting
*Marching toward equilibrium*
November 5

In this activity we want to see what is most likely to happen when we allow quanta of energy (aka M&M's) to move between cells. Given some initial configuration, what will be the next configuration after one "turn" (short time interval)? We'll randomly select a number to determine how a quantum of energy should move.

The Rules:

- Move each quanta according to the die of the same color.
- If a 1 is shown on the die, then move the quanta up one cell. Move the quanta one cell to the right if a 2 is shown, one cell down if a 3 is shown and one cell to the left if a 4 is shown. If a 5 or 6 is shown, the quanta does not move.
- If a quanta cannot make the prescribed move, then the quanta remains in place. For example, it is in a cell on the left side (A1, A4, B1 or B4) and a 4 is selected.




After we have gone through each of the quanta, the turn is up and we determine the system's macrostate (how many quanta of energy are in solid A). The system is then reset back to the original configuration so the experiment can be repeated.

| | | |
|---|---|---|
| A1 | A2 | A3 |
| A4 | A5 | A6 |
| B1 | B2 | B3 |
| B4 | B5 | B6 |

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Group tally:

| | |
|---|---|
| $E_A$=0 | |
| $E_A$=1 | |
| $E_A$=2 | |
| $E_A$=3 | |
| $E_A$=4 | |
| $E_A$=5 | |
| $E_A$=6 | |
| $E_A$=7 | |
| $E_A$=8 | |