Straw Lab: Introduction to Equilibrium

Procedure:

Get: two 50 mL graduated cylinders, 2 large straws, small straw, eyedropper, beaker with tap water

Part 1:

1. Use the beaker to place 50 mL of tap water into one graduated cylinders; leave the second empty.
2. Place a large straw in each of the graduated cylinders.
3. This step requires two people – one person for each straw. Ensuring that your straw is touching the bottom of the cylinder, cover the straw with your finger to trap the water (this works best if you hold the straw with one hand, and use a wetted finger on your other hand to seal the straw at the top).
4. Simultaneously, transfer the contents of the straws (be careful not to let any water spill).
5. Record the new volumes in the graduated cylinders (use Table 1 below).
6. Return your empty straw to its original cylinder. Repeat steps 3 – 5 until the volumes stop changing.

Part 2: Repeat Part 1, this time using a large straw for the cylinder that starts with 50 mL of water and a small straw for the cylinder that starts empty. Record your data in table 2.

Part 3: Repeat Part 2 with the following changes:

1. Start with 20 mL of water in the graduated cylinder with the large straw and 30 mL in the graduated cylinder with the small straw.
2. After two successive transfers in which the volume readings remain constant, add 5 mL to the cylinder with the large straw. After adding the 5 mL, record the new volume in the same box as your last reading (thus one box will have two volume values).
3. Continue the transferring procedure until you again reach a point where volumes are stable over two readings. After two transfers in which the volume readings are the same, remove 10 mL from the cylinder with the large straw. Again, you will have two volume readings for one of the boxes.
4. Continue the transferring procedure until the levels stabilize. Clean up.

Table 1: Volume after x transfers (2 large straws)

x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mL	50																				
mL	0																				

Table 2: Volume after x transfers (1 large straw, 1 small straw)

x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mL	50																				
mL	0																				

Table 3: Volume after x transfers (1 large straw, 1 small straw)

x	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
mL	20																				
mL	30																				

Questions: (**read 14.1** – starting on pg. 551)

1. Draw two lines across a piece of graph paper, dividing it into three equal areas. Plot three graphs – one for each table. Note that ‘number of transfers’ is the independent variable (i.e. it goes on the x-axis). Connect values so that there are two continuous lines on each of the three graphs (note: sequential data points should be connected with straight lines).
2. Assuming that Part 1 simulates the reaction $\boxed{\text{A (reactant)} \leftrightarrows \text{B (product)}}$ what do these represent: i) volume of water in cylinder #1 (50 mL to start), ii) volume of water in #2, iii) transferring water from #1 to #2, iv) transferring water from #2 to #1, v) number of transfers, vi) diameter of straws
3. What are the two important defining characteristics of a dynamic equilibrium? How can you tell by looking at your graphs when equilibrium has been established?
4. How can you tell by looking at a graph which reaction (forward or reverse) is favored (i.e. faster when the concentrations of reactants and products are equal)?