PEER-LED TEAM LEARNING DISSEMINATION

MODELING AS A LEARNING TOOL: CHEMICAL KINETICS

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PLTL workshop sessions open up multiple dimensions in exploring learning materials. One dimension that is particularly suitable is what can be termed the kinesthetic or haptic dimension, utilizing physical models that involve the sense of touch and that are visual. These examples are not normally accessible through computer animation, which precludes three-dimensional touch. Such models lend themselves to small group exploration, and in the process of manipulating the models, students can obtain an intuitive understanding and feeling for the constraints, interactions, and dynamics of systems that are in many cases difficult, even for experts, to intuit from equations or visual representations alone. The use of physical models has played a significant role in scientific thought and discovery. The following is taken from *General Chemistry* (2006; 2nd Ed.; David Gosser, Victor Strozak, and Mark Cracolice; Pearson Prentice Hall).

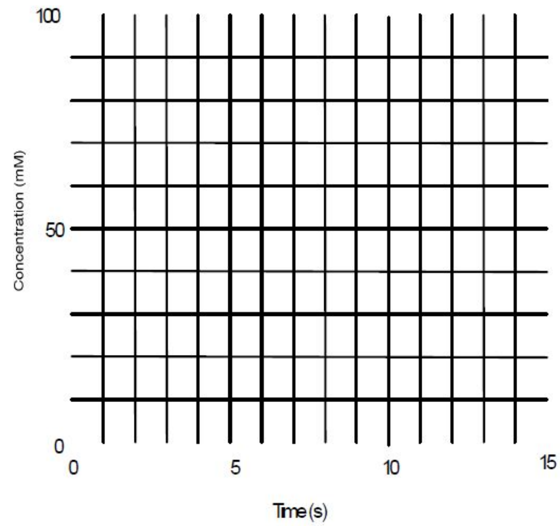
Workshop on Chemical Kinetics

Have everyone in the group involved and everyone keeps score, using a "Round Robin" technique, or work in groups of threes and have one person dedicated to "scorekeeping."

1. Consider a simple chemical reaction, A->B, that follows a first-order rate law, rate = k [A]. You will model this reaction with wrapped pieces of candy (or paper clips, or pennies). Start with 100 pieces of candy, which will represent the initial concentration of A, 100 mM. Each piece will therefore represent 1 mM. Student A (SA) will represent the concentration of A, and Student B (SB) will represent the concentration of B. We will represent the reaction of A to form B by passing pieces of candy from SA to SB. Each exchange will represent one second of time. Student C will ask each student for the observed results and record it. We will model a reaction in which 10% of the concentration of A reacts per second. Thus for each exchange (each second), SA should transfer 10% of his/her candies to SB. Round fractions to the nearest whole number. Continue this exchange for 15 seconds. Record concentrations of A and B (number of candies) each second (after each exchange step) in the left-hand table.

Time (s)	[A] (mM)	[B] (mM)
0	100	0
1	90	10
2	81	19
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

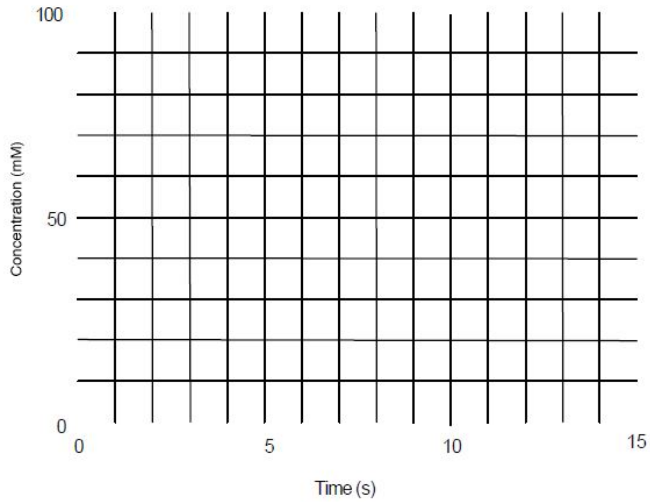
After Step 15 of the exchanges, plot the concentration of A versus time on the graph below. You might use a different color to plot the concentration of B versus time on the same graph.



2. Let's apply the modeling technique developed in Question #1 to a reversible reaction, A<=>B. In each second (exchange step), allow 10% of A to react to form B, and allow 10% of B to react to form A. Record the results in the first two columns of table below.

	10%	10%
Time (s)	[A] (mM)	[B] (mM)
0	100	0
1	90	10
2	82	18
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Plot the concentration of A versus time for the 10%/10% reaction on the graph below. Compare this graph to the irreversible reaction A->B, in Question #1.



3. Consider the reversible case, A<=>B , in each second (exchange step), allow 10% of A to react form B, and allow 5% of B to react to form A. Predict the position of equilibrium (i.e. the equilibrium number of candies). Will A or B be greater? Perform the simulation with candies to confirm your prediction.

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