Rate and Equilibrium Activity

LEARNING OBJECTIVES:
• Demonstrate the difference between zero order and first order rates
• Demonstrate a dynamic equilibrium
• Demonstrate how a perturbation affects an equilibrium

Materials
• 30 balls per group
• 2 boxes per group
• stopwatch

Directions
1. Count 20 balls into your container. When we begin, toss a ball from your reactant container into the product container. Toss an additional ball every 5 seconds.

   (a) How long does it take for the reaction to go to completion?

   (b) Graph the results. Is it linear? How would you describe the shape?

   (c) What type of reaction does this model?

2. Count the balls in your container. When we begin, toss a ball from your reactant container into the product container.

   19-16 balls  every 2.5 seconds
   15-7 balls   every 5 seconds
   6-4 balls    every 10 seconds
   3-1 balls    every 20 seconds

   (a) How long does it take for the reaction to go to completion?

   (b) Graph the results. Is it linear? How would you describe the shape?

   (c) What type of reaction does this model?
3. Groups will have different equilibrium ratios of reactants and products (1:1, 1:2; 1:3; 1:4). One person should take charge of the reactants and one of the products. Count the number of balls in your box at the beginning of a 10 second period. When we begin, toss the appropriate number of balls into the other box.

   equilibrium + 1,   toss 4
   equilibrium         toss 2
   equilibrium – 1 (or less)   toss 1

(a) Describe what happens.

(b) Does the reaction reach completion?

(c) How long does it take for the reaction to reach equilibrium?

4. We add a quantity of balls to either reactant or product. Calculate the new number of reactant and product balls at the given equilibrium. Proceed as in part 3. Describe what happens in the space below.

5. How could we represent the approach to equilibrium at a higher temperature?

6. Does the position of equilibrium change when the temperature increases?