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Subject taught: AP chemistry

Topic: Relationships in chemical equilibriums

Objectives:
Students will be able to describe a dynamic equilibrium exists regardless of concentration levels.

Key Ideas and standards:
Chemical equilibrium exists when there is no longer a change in concentration. Many students confuse equilibrium with the concept of equal concentrations. If reactant A is needed to form product B and product B is needed to run backwards to form reactant A, an equilibrium will be established when A forms B at the same rate that B forms A. This will not necessarily lead to equal concentrations.

If equilibrium exists in a fish tank which leaks into a cup. The fluid levels in the tank and the cup may never be the same, but overtime, the cup must be dumped (or pumped) back into the tank. Equilibrium occurs when it is pumped back into the tank at the same rate the tank leaks.

To model this, we could use yellow and blue agents. As the animation takes place, the yellow agent takes on 20 % chance of turning blue. The blue agent has a 60% chance of turning yellow. Over time, we expect that an equilibrium will develop regardless of initial conditions. It may start off all blue and quickly turn to yellow or start off all yellow and turn blue. Either way, the equilibrium point is established by the probability that one color will turn into another. Obviously, if there is no blue, the blue cannot make any yellow and vice-versa.

Materials:
Agents sheets software.

Description
Make an agent sheet with two agents – a blue and a yellow. Adjust the behavioral conditions for each agent so that whenever a blue agent is next to a yellow one, the agent has a 60% chance of turning into the yellow agent. Make the yellow agent have a 20% chance to turning blue. Start with a variety of starting positions. Make half yellow, half blue, 100 % yellow, 100 blue and so forth. Run the simulation until it reaches equilibrium. If the agents are small enough the yellow and blue make form the same shade of green. With bigger agents, you should find equilibrium when the color changes occur constantly but produce no “net result”

Questions to answer:

1) How is the time it takes to reach equilibrium affected by the initial condition? Does it reach equilibrium faster when it is 100 % yellow or 100% blue.
2) At what size agent is it hard to tell when equilibrium occurs?
3) Several measures indicated that unless you have 10 x as many of one color molecule than the other, it is difficult to tell which molecular form predominates. Does it appear that same argument is true for agents?

4) In molecular terms, why is it impossible to have equilibrium established when the concentration of one of the reactants is zero?
5) When the concentration is of a reactant or product is given in an equation as (X – 0.07)M, what is the largest value of X possible? Likewise , sometimes you solve (X + 0.006)M, for concentration. What is the limit on X in this case?

Assessment and evaluation

5 points	3 to 4 points	1 to 2 points
Student completes the simulation with all questions answered properly in clear, coherent english	Student completes approximately 75 % of the agent with partial answers to all questions.	Student attempts to make the agentsheet without results. Does few or not questions.