Mass and Particle Relationships

Name_____ Lab Section_____

Log on to the Internet. Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/SRGM1.htm

This will load a Particulate Simulation. Once you have the simulation running your screen will look like what is shown in Figure 1 below. If you haven't already done so, read the Particulate Simulation section of the Introduction to MoLEs Activities to learn how to use the simulation.

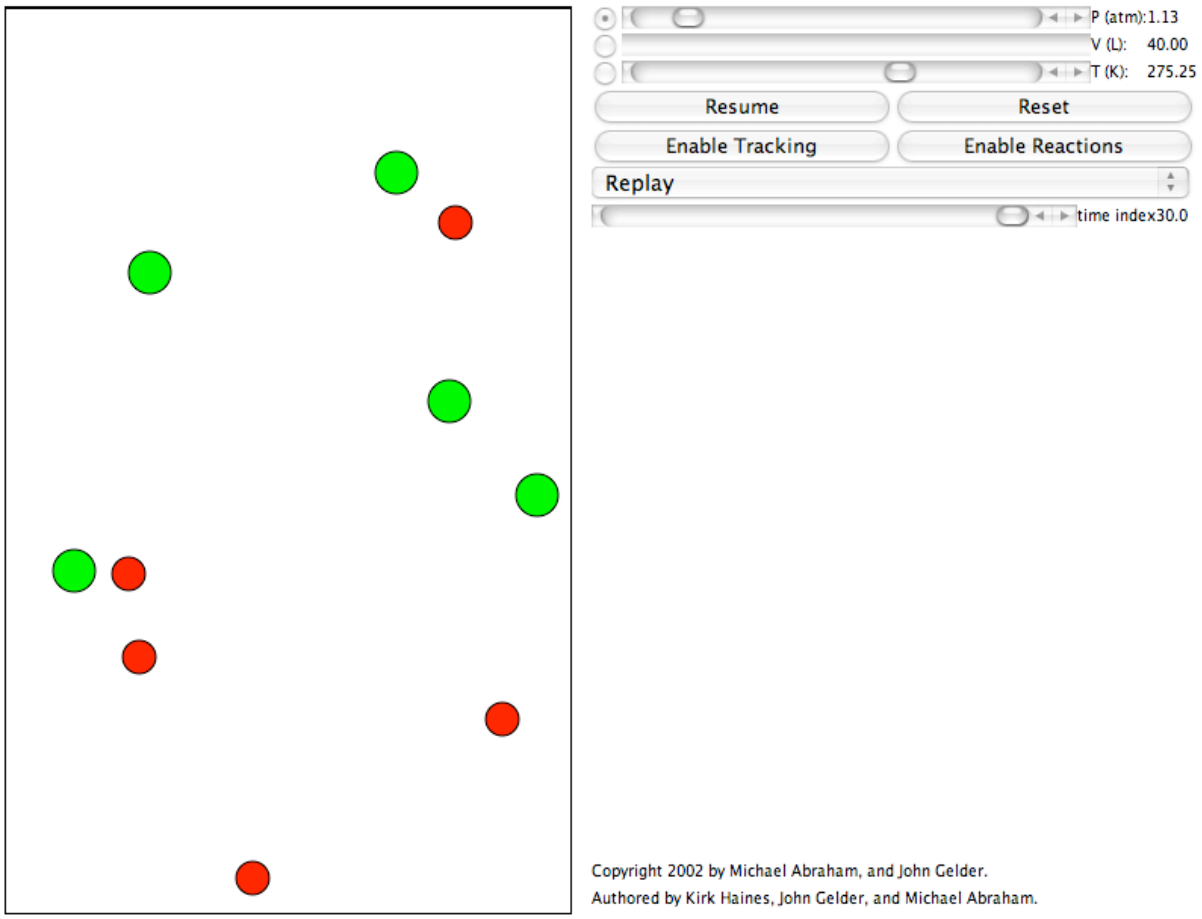

Figure 1.

Problem Statement: How are the numbers of atoms and molecules, and their masses related in a chemical reaction?

I. Data Collection:

A. Click on the Resume button and then the Enable Reactions button and allow the simulation to run. Record your observations of what is happening. Use some or all of the following terms in your description: atom, molecule, particle, collision, speed, energy, reactants, and products. What is (are) the reactant(s) in this reaction? What is (are) the product(s) in this reaction?

B. Reset the simulation. Based on what you observe in the sample region and control bar region of the screen, record the number of particles of R, G, and RG in the table below. A mole is defined as a large (6.02×10^{23}) number of particles. Record the number of moles of R, G, and RG in the table below.

C.

	R	G	RG
# of Particles			
# of moles			
Mass/mole			
Mass			

D. If you observe the particles in the sample region you will notice that the G particles are larger than the R particles. This is because a G particle has twice the mass of an R particle. If one mole of R particles has a mass of 1.00 gram (called the molar mass – in unit of g/mol), what is the molar mass of G and of RG? What is the mass of R, G, and RG present in the control bar region of the simulation? Record these values in the table above.

E. Click on the Enable Reaction button. Allow the simulation to run until no more changes occur. Click on the Pause button and record your observations in the table below.

	R	G	RG
# of Particles			
# of moles			
Mass/mole			
Mass			

II. Data Analysis and Interpretation:

A. In the boxes below, draw a picture representing the before (reactant) and after (product) state of the chemical reaction you are studying. Be sure to clearly label each particle.

Before (Reactants) After (Products)

B. Write a balanced chemical equation for the reaction you have observed in this simulation. Do this by writing an algebraic-like equation with the reactant particles on the left and the product particles on the right, separated by an arrow (instead of an equals sign) pointing toward the product side of the equation. Simplify the equation so that no common particles are on both side of the equation and it represents the lowest ratio of whole numbers of particles.

C. How did you decide that the reaction had reached completion?

D. The chemical equation is balanced by specifying the number of particles or moles of particles that are found as reactants and products. Do these balancing number (coefficients) also represent numbers of grams? Why or why not?

III. Data Collection:

A. Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/SRGM2.htm

Before starting the simulation, fill in the table below with the information requested.

	R	G	RG
# of Particles			
# of moles			
Mass/mole			
Mass			

B. Click on the Resume and Enable Reactions buttons. Allow the simulation to run until no more changes occur. Click on the Pause button and record your observations. Fill in the table below with the information requested.

	R	G	RG
# of Particles			
# of moles			
Mass/mole			
Mass			

C. Write a balanced chemical equation for the reaction you have observed in this simulation.

IV. Data Analysis and Interpretation:

A. Compare your observations from this experiment with the one you did in section I. How were the reactions similar and how were they different?

B. Compare the equation you wrote for III.C. with the one you wrote for section II.B.

C. Predict what would happen if you started the reaction with 5 R particles and 7 G particles.

D. Compare the total amounts of atoms, molecules, and masses for the reactants with the total amounts of atoms, molecules, and masses for the products. Which of these factors are conserved as the reaction proceeds from reactants to products?

E. What is the ratio of reacting particles in this reaction? What is the ratio of reacting masses in this reaction? How are these ratios related to each other?

F. If 15 moles of R are combined with 15 moles of G, how many moles of RG will be formed?

G. If 15g of R are combined with 15g of G, how many grams of RG will be formed?

V. Data Collection:

Open the molecular simulation SG2B2M:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/SG2B2M.htm

A. Click on the Resume button and then the Enable Reactions button and allow the simulation to run. Record your observations of what is happening. Use some or all of the following terms in your description: atom, molecule, particle, collision, speed, energy, reactants, and products. What is (are) the reactant(s) in this reaction? What is (are) the product(s) in this reaction?

B. Using the procedure you used to study the chemical reaction in the previous sections, fill in the table below with the information requested for this new chemical reaction. B particles have a molar mass of 1.500 grams per mole.

Reactants	G_2	B_2	G_2B
# of Particles			
# of moles			
Mass/mole			
Mass			

Products	G_2	B_2	G_2B
# of Particles			
# of moles			
Mass/mole			
Mass			

C. Write a balanced chemical equation for the reaction you have observed in this simulation.

VI. Interpretation and Conclusions:

A. Write a rule for determining the molar mass of a molecule.

B. What quantities are conserved in a chemical reaction?

C. A limiting reagent is defined as a reactant in a chemical reaction that limits or controls the amount of product that is formed. What was the limiting reagent in each of the reactions you studied in this activity?

Reaction (Section #)	Limiting Reagent
II.B.	
IV.B.	
V.C.	

D. If 20 moles of G_2 are reacted with 10 moles of B_2, how many moles of G_2B will be formed?

E. If 20g of G_2 are reacted with 10g of B_2, how many grams of G_2B will be formed?

VII. Data Collection:

Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/SRGN.htm

This will load a Graphic Simulation. Once you have the simulation running your screen will look like what is shown in Figure 2 below. If you haven't already done so, read the Graphic Simulation section of the Introduction to MoLEs Activities to learn how to use the simulation.

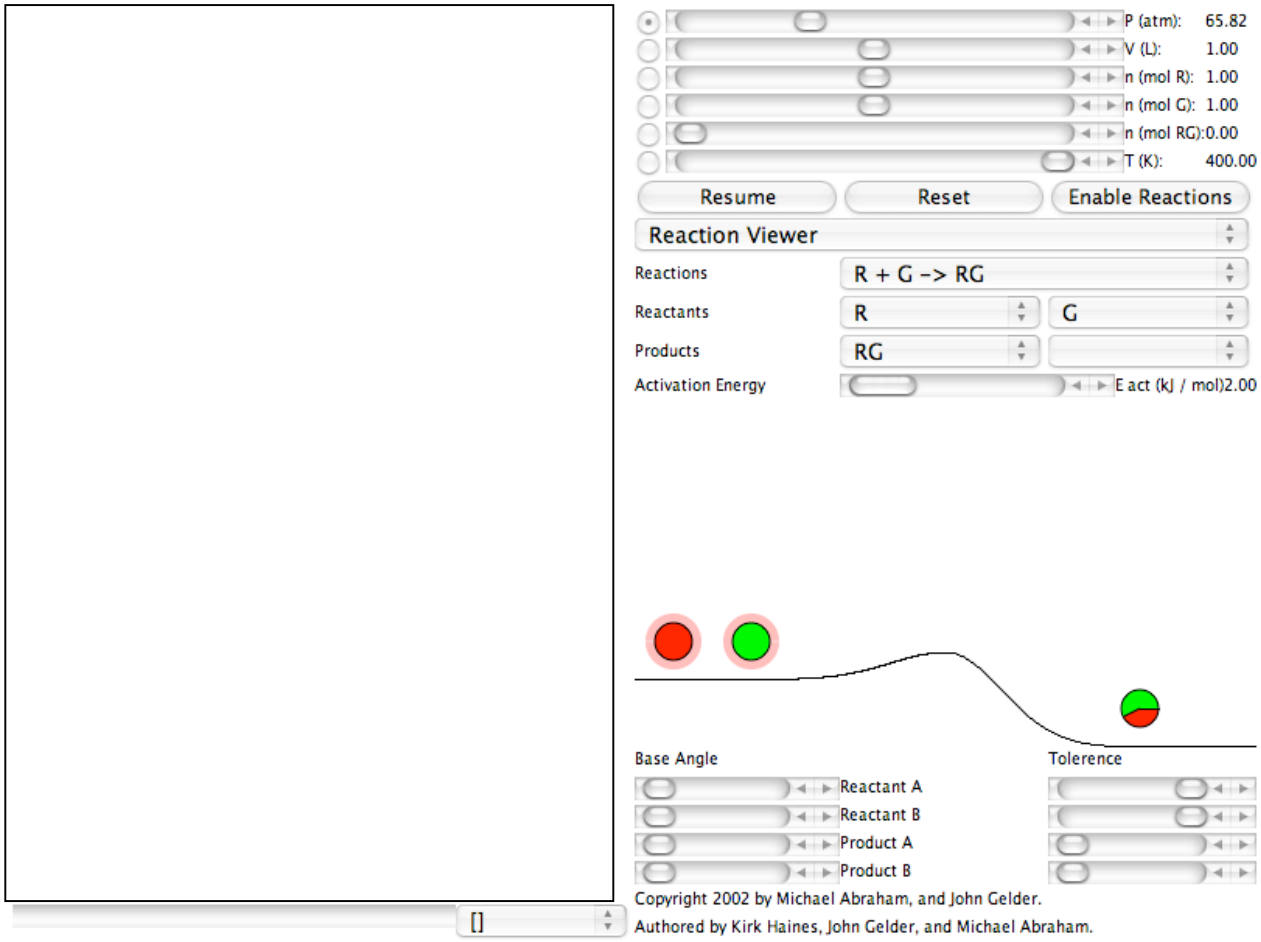

Figure 2.

A. Using the data from the Control Bar Region, enter the initial amounts (moles) of each substance in the equation into the table (called an ICE table) below.

	R + G → RG		
Initial Amount (moles) – I	___	___	___
Change (moles) – C	___	___	___
Ending Amount (moles) – E	___	___	___

B. Click on the Resume and then the Enable Reactions buttons to begin the reaction. When the reaction appears to be complete, click Pause to stop the action. Record the values of the ending concentrations in the table in Section A. Calculate and record the change in numbers of moles of each of the substances in the reaction. In the space below, draw the appearance of the strip chart and label the axes. If necessary, use the scrollbar located under the strip chart to move the chart back to the beginning of the reaction. Identify the chemical substance that corresponds to each of the colored lines.

C. The molar masses for the atoms in this activity are: R = 1.00g, G = 2.00g, and B = 1.50g. Use this information to convert the molar data from the previous sections to fill in the ICE table below with masses of the reactants and products in grams.

	R + G → RG		
Initial Amount (grams) – I	___	___	___
Change (grams) – C	___	___	___
Ending Amount (grams) – E	___	___	___

VIII. Interpretation and Conclusions:

A. Explain what is happening to each of the reactant and product substances over time. How does the strip chart illustrate the changes you observe?

B. How can you tell when the reaction is complete? What substances are present when the reaction appears to be complete?

C. Identify the limiting reagent for the reaction. What reagent is in excess and how much excess is there?

D. Consider the reaction you studied in section V. between G_2 and B_2. If 5.0g of G_2 are combined with 5.0g of B_2, how many grams of G_2B is formed? Set up an ICE table like the ones used in previous sections. Identify any limiting reagents present and the number of grams of any reactants that are left in excess. Open the molecular simulation SG2B2N: http://cheminfo.chem.ou.edu/~mra/CCLI2004/SG2B2N.htm to confirm your conclusions.