



Inquiry Activity for Balancing Equations

Sarah Toman

Western Michigan Christian High School
Target Inquiry, Grand Valley State University
misstoman@wmchs.net

Western MI Christian High



Why Balancing Equations?

- “See” bonds break and form

Boo, H.K. (1998). Students' understanding of chemical bonds and the energetic of chemical reactions. *Journal of Research in Science Teaching*, 35, 569-581.

- Distinguish between subscripts and coefficients

Mulfurd, D.R, Robinson, W.R, (2002). An inventory for alternate conceptions among first-semester general chemistry students. *Journal of Chemical Education*, 79(6), 739-744.

- Shows reactions can reverse direction

Van Driel, J. (1998). Developing secondary students' conceptions of chemical reactions: the introduction of chemical equilibrium. *International Journal of Science Education*, 20(4), 379-392.



What have the students studied?

- Matter
- Dimensional Analysis
- The Atom
- Nomenclature
- Percent Composition
- The Mole



What do the students know?



- Guided Inquiry
- Introductory Activity
- Students Construct Knowledge

Pre-Lab

What happens when . . .

- You leave an iron nail outside in the rain?
- You pour hydrogen peroxide (H_2O_2) on a cut?
- You put sodium in water?
- You mix vinegar ($\text{HC}_2\text{H}_3\text{O}_2$) and baking soda?
- You burn natural gas (CH_4) to heat your house?

Lab Activity 1

- Ex: $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
- List the color used for each element
 - H_2 is blue
 - O_2 is red
- Draw and note # of the reactants built
 - 1 H_2 molecule 
 - 1 O_2 molecule 

Lab Activity 1

○ Ex: $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$


○ Draw and note # of the products built

● 1 water molecule



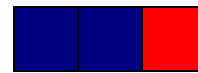
○ Students Realize:

More H_2 is needed to use up all the O_2

○ So, another H_2 is built. 

Lab Activity 1

- Now, show the number of molecules used in the balanced equation

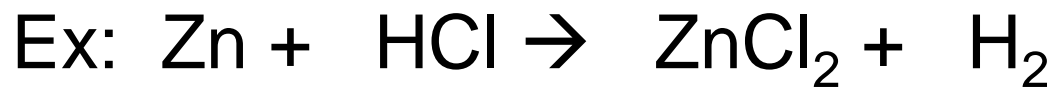


Lab Analysis 1

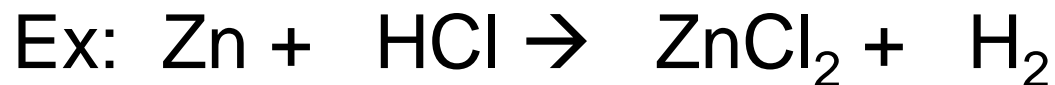
- Compare the # of elements on each side of the reaction.
- Is this consistent with the Law of Conservation of Mass? Why?
- Did you notice a pattern within a set?
- Label the reaction type.

Lab Activity 2

- Using your observations and data from the 10 reactions you chose, write 10 balanced equations.
- Balance the following reaction. See if you can do it without using the kit.



Lab Activity 2



- Would the reaction change if you had 3 Zn on the reactant side? If so, how?

- Why does changing one substance affect the others?

Lab Activity 3



Reactants	Products
_ Nitrogen	2 Nitrogen
_ Oxygen	4 Oxygen

Reaction Type _____

Lab Analysis 3

- What do the subscripts (small numbers) tell you?
- What do the coefficients (large numbers) tell you?
- How do you calculate the number of oxygen atoms in 2NO_3 molecules?

Lab Analysis 3

- What happened to the bond between Zn and OH?
- What happened to the bond between S and O in SO_4 ?

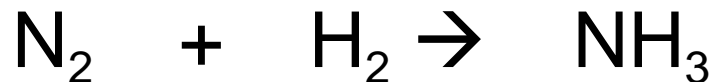
Reflection

- What happens to the reactants and their bonds?
- What happens to the products and their bonds?
- Did all of the bonds break? Explain.
- Can chemists predict what products will form? Explain.

Going Further

The Haber process was developed by Fritz Haber in World War I to help the Germans make their explosives. It combines nitrogen and hydrogen to make ammonia at a very high temperature and pressure.

Balanced Reaction



Type



Comments

- We had a fabulous moment early on in the lab when one group was working on set 2 and said something like, all of these bonds are breaking down!
- This has really shown me that students don't understand the concept of balancing equations.

Comments

- Now that we are doing reaction prediction, all of my students understand diatomic molecules.
- I loaned another teacher my Unifix cubes for the activity and she loved it.

Acknowledgements

- Dr. Deborah Herrington
- Dr. Ellen Yeziarski
- Target Inquiry Colleagues
- The Camille and Henry Dreyfus Foundation
“2005 Special Grant Program in the Chemical Sciences”
- National Science Foundation (ESI-0553215)



**GRAND VALLEY
STATE UNIVERSITY**
DEPARTMENT OF CHEMISTRY



Questions???
