

Reinforcing Mathematical Concepts in the Chemistry Classroom

By Peter Hoffman

Why do this?

- **Supporting theme 1: The Mathematical World**
“Students should apply mathematics in scientific contexts and understand that mathematics is a tool used in science to help solve problems, make decisions, and understand the world around them.”
- **Supporting theme 2: Scientific Thinking**
“There are certain thinking skills associated with science, mathematics, and technology that young people need to develop during their school years. These are mostly, but not exclusively, mathematical and logical skills that are essential tools for both formal and informal learning and for a lifetime of participation in society as a whole.”

Three Possible Methods

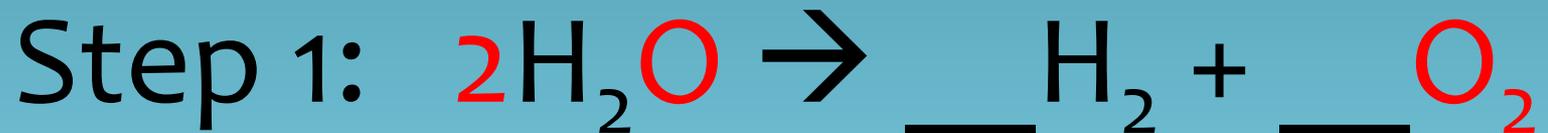
- **Balancing Equations** (C.1.9)
 - Algebra – on level
 - Matrices – advanced students
- **Data Analysis** (Sci. Thinking theme, etc.)

Easy balancing problem

Balance this equation



Traditional Solution



Another Example



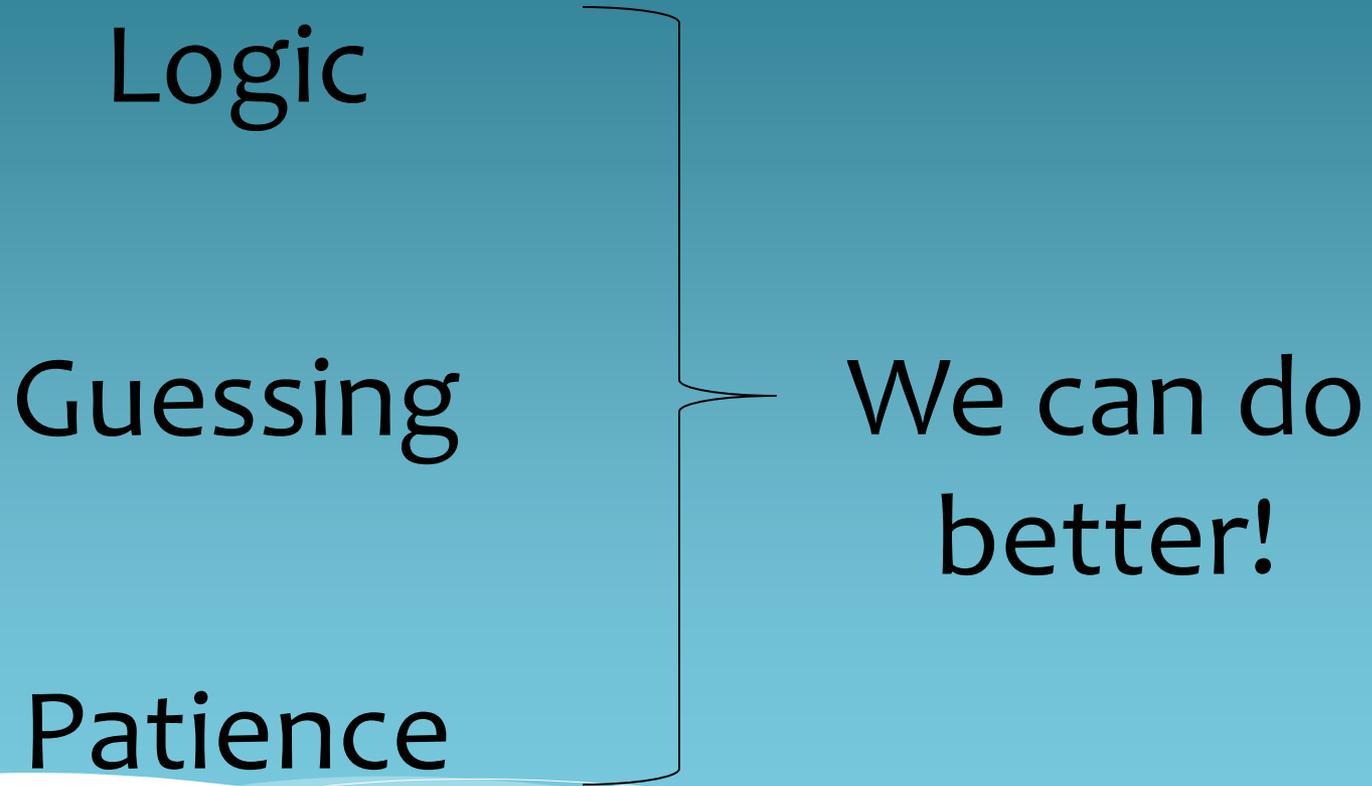
What are we reinforcing?

Logic

Guessing

Patience

We can do
better!



Algebra Method



Set up a set of algebraic formulas for each element:

$$\text{H: } 2a = 2b$$

$$\text{O: } 1a = 2c$$

Algebra Method Continued

$$\begin{array}{l} \text{H: } 2a = 2b \\ \text{O: } 1a = 2c \end{array} \left. \vphantom{\begin{array}{l} \text{H: } 2a = 2b \\ \text{O: } 1a = 2c \end{array}} \right\} \begin{array}{l} \text{Let } a = 1 \\ b = 1 \text{ and } c = 1/2 \end{array}$$

$\{1, 1, \frac{1}{2}\}$ now eliminate your fractions: $\{2, 2, 1\}$



SOLVED!

Algebra reinforced in chemistry class

Why is this important?

Chemistry Student math
background:



Lesson Plan Ideas

1) Assign students some of the more difficult balancing problems

http://www.chemistry-drills.com/balance.php?rxn_drill=balance_expert

2) Split students into groups and have some use algebra method and some use the guessing method to display the effectiveness

3) Have students explain how to balance using each of the different methods.

Differentiated instruction



$$\text{H: } 2a - 2b - 0c = 0$$

$$\text{O: } 1a - 0b - 2c = 0$$

$$\text{Let } a = 1$$

$$\begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix} \begin{matrix} -2 \\ -1 \end{matrix}$$

A^{-1}

B

$$\begin{bmatrix} -0.5 & 0 \\ 0 & -0.5 \end{bmatrix} \begin{matrix} -2 \\ -1 \end{matrix} = \begin{matrix} 1 & b \\ .5 & c \end{matrix}$$

Lesson Plan Ideas

1) Use a computer classroom and go to an online matrix calculator
<http://www.bluebit.gr/matrix-calculator/>

2) Use graphing calculators to calculate the answers

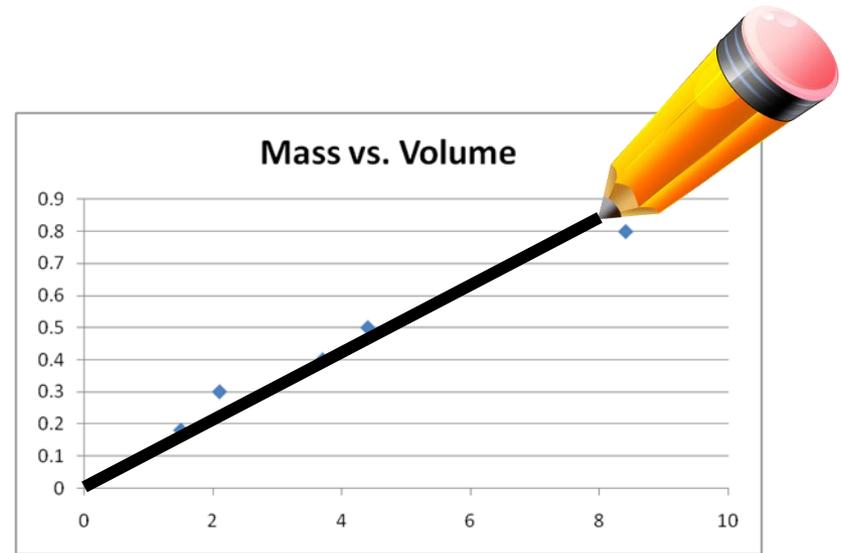
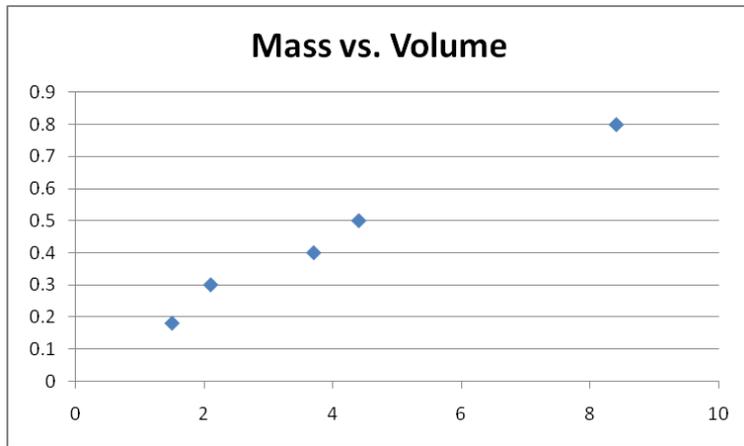
3) Matrix math app on ipod touch

<http://itunes.apple.com/us/app/matrix-calculator/id296095374?mt=8>

Data Collection

Line of Best Fit

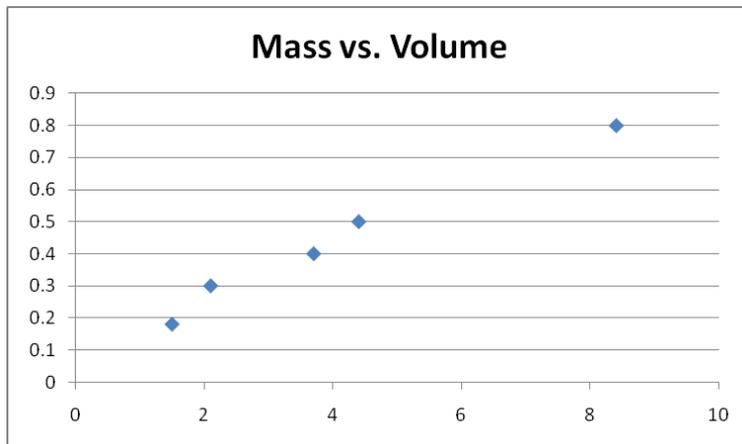
Example of student data:



Data Collection

Least Squares Regression

Example of student data:



mass	volume
2.1	0.3
8.4	0.8
1.5	0.18
3.7	0.4
4.4	0.5

$$y = 11.42x - 0.96$$

Lesson Plan Ideas

- 1) Use with a density lab
- 2) Lab journal entry on why it is better for everyone in the class to use the same method for data analysis.
- 3) Compare and contrast the benefits of line of best fit with regression (discuss importance of the origin, coefficient of determination)
- 4) Use in physics with distance vs. time, velocity vs. time

Summary

Not teaching math, but...

Teaching chemistry though applying math

Hitting the Standards

Chemistry: Supporting themes 1-3, C.1.9

Numbers and Quantity: N-Q 1-3, N-VM 6

Algebra: A-CED 2-3, A-REI 4,8-9

Statistics: S-ID 6-8

Sources/Listed websites

- * **Graduating from public high schools to get harder with class of 2012**
<http://www.indianaeconomicdigest.net/main.asp?SectionID=31&SubSectionID=81&ArticleID=56776>
- * **Chemistry I Standards**
<http://dc.doe.in.gov/Standards/AcademicStandards/PrintLibrary/docs-science/2006-science-chemistryi.pdf>
- * **Linear least squares regression line calculator**
http://www.neoprogrammics.com/linear_least_squares_regression/index.php/
- * **Online matrix calculator**
<http://www.bluebit.gr/matrix-calculator/>
- * **Matrix Calculator**
<http://itunes.apple.com/us/app/matrix-calculator/id296095374?mt=8>



1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uub	Uuc	Uuq					



Math & Science

