Science Objectives

- Students will describe what "reactants" and "products" in a chemical equation mean.
- Students will explain the difference between "coefficients" and "subscripts" in chemical equations.
- Students will recognize that the number of atoms of each element is conserved in a chemical reaction.
- Students will balance a chemical equation.

Vocabulary

- reactant
- product
- combustion
- decomposition
- synthesis (combination)
- double replacement (precipitation)
- neutralization (acid-base)
- single replacement (oxidation-reduction)

About the Lesson

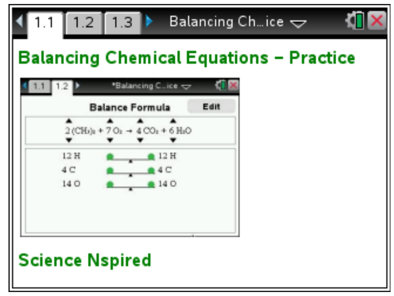
- This lesson involves students using ChemBox feature of TI-Nspire™ technology to practice balancing chemical equations
- Students will use **Edit** mode of the activity to enter given reactants and products in a chemical equation.
- Students will use **Balance** mode for visual support necessary to balance a chemical equation.
- As a result, students will:
  - Reinforce understanding that the number of atoms is conserved in a chemical reaction
  - Recognize the meaning of coefficients and subscripts in a chemical equation.

TI-Nspire™ Navigator™

- Send out the *Balancing_Chemical_Equations_Practice.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to allow students to show how they manipulate variables that effect results.

Activity Materials

- TI-Nspire™ Technology



TI-Nspire™ Technology Skills:

- Open a document
- Move between pages
- Use a minimized slider
- Insert ChemBox

Tech Tips:

Make sure that students properly capitalize the formulas and molecules on each side of the equation when using ChemBox.

Lesson Materials:

Student Activity

- Balancing_Chemical_Equations_Practice_Student.doc
- Balancing_Chemical_Equations_Practice_Student.pdf

TI-Nspire document

- Balancing_Chemical_Equations_Practice.tns

Discussion Points and Possible Answers

Move to pages 1.2 – 1.4.

Have students answer questions 1–3 on the handheld, the activity sheet, or both.

Q1. Identify the reactants and products of the reaction N_2 (g) + H_2 (g) $\rightarrow$ NH_3 (g).

<u>Answer</u>: The reactants are N_2 (nitrogen) and H_2 (hydrogen). The product is NH_3 (ammonia).

Q2. Explain the meaning of subscripts in the equation.

<u>Answer</u>: Subscripts indicate the ratio of elements in a chemical compound.

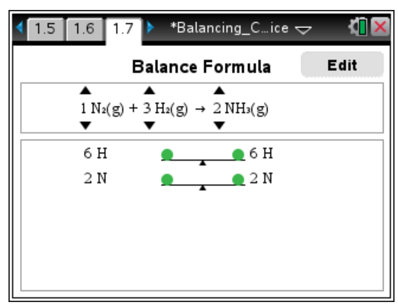
Q3. Explain whether this equation is balanced or not.

<u>Answer</u>: It is not balanced because there will be more N atoms in the reactants than in the product and there will be less H atoms in the reactants than in the product.

Move to pages 1.5 – 1.7.

Have students review the instructions given on page 1.6 and the activity sheet for using the Chemical Balance tool on page 1.7.

1. Students are to click **Balance** to balance the equation. They need to use the up and down arrows to adjust coefficients that appear in front of each reactant or product until the scales in the bottom half of the screen are green and level.



Tech Tip: In Balance Mode click the up or down arrows to adjust the coefficients of each element until the formula is balanced. If no coefficients were entered during Edit mode, Balance mode will automatically show the number 1 for each product and reactant.

Move to pages 1.8–1.10.

Have students answer questions 4–6 on the handheld, the activity sheet, or both.

Q4. How many atoms of each element are present on each side of an equation?

Answer: 2 N and 6 H are on each side

Q5. Explain the meaning of coefficients in the equation.

Answer: Coefficient represents the number of molecules of reactants or products.

Q6. Classify the reaction using the following categories. It may fall into more than one category.

Answer: Synthesis

2. For each equation given on pages 2.2 – 2.9, students are to use the Chemical Balance tool to balance the equation and record it in the table. Record the number of atoms of *each* element in the reactant (left side) and the products (right side). Classify each reaction as a synthesis, decomposition, single replacement, double replacement, acid-base reaction, or combustion. Some reactions may fall into more than one category.

Equation **Write the balanced equation below the given one.**	**Number of Atoms**		**Type**
	Reactants	**Products**	
$P_4 + O_2 \rightarrow P_2O_3$ $\mathbf{P_4 + 3\ O_2 \rightarrow 2\ P_2O_3}$	**4P, 6O**	**4P, 6O**	**Synthesis or Combustion**
$BaS + PtF_2 \rightarrow BaF_2 + PtS$ $\mathbf{BaS + PtF_2 \rightarrow BaF_2 + PtS}$	**1Ba, 1S, 1Pt, 2F**	**1Ba, 1S, 1Pt, 2F**	**Double replacement**
$CH_4 + O_2 \rightarrow CO_2 + H_2O$ $\mathbf{CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O}$	**1C, 4H, 4O**	**1C, 4H, 4O**	**Combustion**
$Na_3PO_4 + CaCl_2 \rightarrow NaCl + Ca_3(PO_4)_2$ $\mathbf{2\ Na_3PO_4 + 3\ CaCl_2 \rightarrow 6\ NaCl + Ca_3(PO_4)_2}$	**6Na, 2P, 8O, 3Ca, 2Cl**	**6Na, 2P, 8O, 3Ca, 2Cl**	**Double replacement**
$NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ $\mathbf{2\ NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O}$	**2Na, 2H, 2C, 6O**	**2Na, 2H, 2C, 6O**	**Decomposition**
$HNO_3 + Ba(OH)_2 \rightarrow Ba(NO_3)_2 + H_2O$ $\mathbf{2\ HNO_3 + Ba(OH)_2 \rightarrow Ba(NO_3)_2 + 2\ H_2O}$	**4H, 2N, 8O, 1Ba**	**4H, 2N, 8O, 1Ba**	**Neutralization or double replacement**
$Na_3N \rightarrow Na + N_2$ $\mathbf{2\ Na_3N \rightarrow 6\ Na + N_2}$	**6Na, 2N**	**6Na, 2N**	**Decomposition**
$Al + HCl \rightarrow AlCl_3 + H_2$ $\mathbf{2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2}$	**2Al, 6H, 6Cl**	**2Al, 6H, 6Cl**	**Single replacement**

3. For each word equation given on page 2.10, students are to use the Chemical Balance tool on page 2.11 to balance the equation and record it in the table. First, they need to write the balanced equation using the element symbols. Record the number of atoms of *each* element in the reactant (left side) and the products (right side). Classify each reaction as a synthesis, decomposition, single replacement, double replacement, acid-base reaction, or combustion. Some reactions may fall into more than one category.

Equation	**Number of Atoms**		**Type**
Write the balanced equation below the given one.	**Reactants**	**Products**	
Copper (s) + silver nitrate (aq) → silver (s) + copper (II) nitrate (aq) **$Cu + 2\ AgNO_3 \rightarrow 2\ Ag + Cu(NO3)_2$**	**1Cu, 2Ag, 2N, 6O**	**1Cu, 2Ag, 2N, 6O**	**Single replacement**
Hydroiodic acid (aq) + sodium hydroxide (aq) → sodium iodide (aq) + water (l) **$HI + NaOH \rightarrow NaI + H_2O$**	**2H, 1I, 1Na, 1O**	**2H, 1I, 1Na, 1O**	**Neutralization or Double replacement**
Calcium hydroxide (s) → calcium oxide (s) + water (v) **$Ca(OH)_2 \rightarrow CaO + H_2O$**	**1Ca, 2O, 2H**	**1Ca, 2O, 2H**	**Decomposition**
Cesium (s) + bromine (l) → cesium bromide (s) **$2\ Cs + Br_2 \rightarrow 2\ CsBr$**	**2Cs, 2Br**	**2Cs, 2Br**	**Synthesis**
Sulfuric Acid (aq) + potassium hydroxide (aq) → potassium sulfate (aq) + water (l) **$H_2SO_4 + 2\ KOH \rightarrow K_2SO_4 + 2\ H_2O$**	**2K, 6O, 4H, 1S**	**2K, 6O, 4H, 1S**	**Neutralization**
Hydrogen (g) + chlorine (g) → hydrogen chloride (g) **$H_2 + Cl_2 \rightarrow 2\ HCl$**	**2H, 2Cl**	**2H, 2Cl**	**Synthesis**
Magnesium chlorate (s) → magnesium chloride (s) + oxygen (g) **$Mg(ClO_3)_2 \rightarrow MgCl_2 + 3\ O_2$**	**1Mg, 2Cl, 6O**	**1Mg, 2Cl, 6O**	**Decomposition**
Benzene (C_6H_6) (l) + oxygen (g) → carbon dioxide (g) + water (v) **$2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$**	**12C, 12H, 30O**	**12C, 12H, 30O**	**Combustion**

Move to pages 3.1 – 3.7.

Have students answer questions 7–13 on the handheld, the activity sheet, or both.

Q7. Identify the reactants in the chemical equation $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.

Answer: A. CH_4 and B. O_2

Q8. Select all statements that are true.

Answer: A. The type and number of atoms must be the same on both sides of the equation.
C. The mass of the reactants and the mass of the products are the same.
D. An equation is balanced by writing whole numbers before a chemical symbol or formula.

Q9. Select all equations that are NOT balanced.

Answer: B. $C_2H_6 + 5O_2 \rightarrow 6H_2O + 2CO_2$

Q10. Balance the equation $Fe + H_2SO_4 \rightarrow Fe_2(SO_4)_3 + H_2$.

Answer: $2\ Fe + 3\ H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3\ H_2$

Q11. Write a balanced equation for the chemical reaction below.

Potassium (s) + water (l) → potassium hydroxide (aq) + hydrogen (g)

Answer: $2\ K + 2\ H_2O \rightarrow 2KOH + H_2$

Q12. The chemical reaction $2\ C_6H_6 + 9\ O_2 \rightarrow 6CO_2 + 6H_2O$ can be classified as:

Answer: C. combustion

Q13. The chemical reaction $HNO_3 + LiOH \rightarrow LiNO_3 + H_2O$ can be classified as:

Answer: D. neutralization

TI-Nspire™ Navigator™ Opportunities

Allow students to volunteer to be the Live Presenter and demonstrate how to adjust the coefficients in the equation in order to balance it. Use Quick Poll to check for understanding during the course of the activity.

Wrap Up

When students are finished with the activity, collect Balancing_Chemical_Equations_Practice.tns file using TI-Nspire™ Navigator™. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Answers to questions are written into the student worksheet.
- Assessment consists of eight questions in the Balancing_Chemical_Equations_Practice.tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.