Balance Lab Worksheet

Balancing chemical equations · Logical Home Schooling

Name: _____ **Date:** _____ **Period:** _____

In this lab you will use the Balance Lab game to practice balancing chemical equations and to explain why balancing is required by the law of conservation of mass.

Game link: www.logicalhomeschooling.com/balance-lab.html

Objectives

By the end of this lab you will be able to:

- State the law of conservation of mass and connect it to balanced equations.
- Tell the difference between a coefficient and a subscript, and explain why only coefficients may change.
- Count the atoms of each element on both sides of an equation, including atoms inside parentheses.
- Balance synthesis, decomposition, replacement, and combustion equations using a consistent strategy.
- Write coefficients in the lowest whole-number ratio.

Materials: a computer or tablet with the game open, a pencil, this worksheet. Time: about 50 minutes.

Part 1: Pre-lab (before you open the game)

Background. The law of conservation of mass says atoms are not created or destroyed in a chemical reaction. They only rearrange. So every atom on the reactant side must show up on the product side. A balanced equation shows this with **coefficients**, the large numbers in front of each formula. A **subscript** is the small number inside a formula. It tells you how many atoms are in one molecule or formula unit.

Example: in $3H_2O$, the coefficient is 3 and the subscript on H is 2. That means 3 molecules of water, which contain 6 H atoms and 3 O atoms.

1. In your own words, state the law of conservation of mass.

   _____

   _____

2. Fill in the table. The first row is done for you.

Formula as written	Coefficient	Atoms of each element (total)
$3H_2O$	3	H = 6, O = 3
$2CO_2$		
$4NH_3$		
$Ca(OH)_2$		
$2Al_2(SO_4)_3$		

3. H_2O is water. H_2O_2 is hydrogen peroxide. Use these two substances to explain why you may never change a subscript to balance an equation.

4. Prediction: In the equation $H_2 + O_2 \rightarrow H_2O$, which element is unbalanced, and by how many atoms?

Part 2: Guided play (Levels 1–19)

Open the game and make sure the **Levels** tab is selected. Do the steps in order.

1. Open Level 1, *Making water*. Before touching anything, look at the **Atom ledger** below the equation. Write down how many H and O atoms are on each side.

   Reactants: H = _____ O = _____ Products: H = _____ O = _____

2. Click on the small 2 in O_2 (the subscript). Copy the message the game shows you, in your own words.

3. Use the **+** and **–** buttons to balance Level 1. Watch the ledger bars as you go. Do not use a hint.

4. Now try to "over-balance" a level: on Level 2, set the coefficients to 2, 6, 4. What does the game tell you, and why?

5. Balance every level in the table below. Write the balanced equation with coefficients, then record hints and stars. You may play the other levels too, but these are required.

Level	Reaction	Balanced equation (with coefficients)	Hints used	Stars
1	Making water			
5	Decomposing potassium chlorate			
7	Rusting iron			
8	Zinc in hydrochloric acid			
13	Aluminum displaces copper			
15	Neutralizing sulfuric acid			
18	Iron(III) hydroxide precipitate			

Questions about Part 2

6. In Level 7 (Rusting iron), which element did you balance first? Why was that a good choice?

7. In Level 13, the sulfate ion (SO_4) appears unchanged on both sides. How did treating SO_4 as one unit make the level easier?

8. Describe what the ledger bars look like when an element is unbalanced and when it is balanced.

Part 3: Combustion and challenge (Levels 20–30)

In a combustion reaction, a fuel containing carbon and hydrogen reacts with O_2 to make CO_2 and H_2O. Use the strategy card in the game: C first, then H, then O last.

1. Balance Level 21, *Propane grill*, and fill in the ledger counts once it is balanced.

Element	Reactant atoms	Product atoms
C		
H		
O		

2. Open Level 24, *Burning ethane* (C_2H_6). Balance C and H first, with O_2 still at 1. How many O atoms are on the product side now? Is that number odd or even?

3. Explain why an odd number of O atoms on the product side is a problem when the only oxygen source is O_2. What did you do to fix it?

4. Balance Level 25, *Gasoline engine* (C_8H_{18}). Write the balanced equation.

5. Choose **two** levels from the Challenge tier (26–30). Balance them and record your work.

Level	Balanced equation	Which element did you balance last?	Hints used

6. Challenge-tier equations often have one element that appears in three or more substances. Name one such element from a level you played. Why does it make sense to balance that element last?

Part 4: Rapid round

Click the **Rapid round** tab. You have two minutes to balance as many equations as you can. There are no hints, and skipping costs 5 seconds. Play twice and record your results.

Trial	Equations balanced	Score	Longest streak
1			
2			

1. Did your score improve on the second trial? What did you do differently?

2. Which type of reaction slowed you down the most during the rapid round? Why?

Part 5: Your equation

Click the **Your equation** tab. Type each equation below exactly as shown, then click **Load equation** and balance it in the game. Write subscripts as plain numbers (for example, type Fe2O3).

Unbalanced equation (type this)	Balanced equation
Al + HCl -> AlCl3 + H2	
C4H10 + O2 -> CO2 + H2O	
NaHCO3 -> Na2CO3 + CO2 + H2O	
Fe2O3 + CO -> Fe + CO2	

1. Now type this equation into the game: Fe + O2 -> FeO3H. What message does the game show? Explain what is wrong with this equation.

2. Pick one unbalanced equation from your textbook or class notes. Write it here, then balance it in the game.

   Unbalanced:

   Balanced:

Part 6: Comprehension and analysis

Answer these **without** the game. Show your atom counts where asked.

1. A student balances $H_2 + O_2 \rightarrow H_2O$ by writing $H_2 + O_2 \rightarrow H_2O_2$. Every element now has the same count on both sides. Is the equation correct? Explain.

2. Which equation is balanced **and** written in the lowest whole-number ratio? Circle one.
   a. $4Na + 2Cl_2 \rightarrow 4NaCl$
   b. $2Na + Cl_2 \rightarrow 2NaCl$
   c. $Na + Cl_2 \rightarrow NaCl_2$
   d. $Na + Cl \rightarrow NaCl$

3. Balance these by hand. Make a small atom ledger for each in the space provided.
   a. ___ K + ___ $H_2O \rightarrow$ ___ KOH + ___ H_2

   b. ___ C_5H_{12} + ___ $O_2 \rightarrow$ ___ CO_2 + ___ H_2O

   c. ___ $Ba(NO_3)_2$ + ___ $Na_3PO_4 \rightarrow$ ___ $Ba_3(PO_4)_2$ + ___ $NaNO_3$

4. Look at the balanced equation $2H_2 + O_2 \rightarrow 2H_2O$. Count how many **molecules** are on each side, and how many **atoms** are on each side. Which of these must be equal, and why?
   Molecules: left _____ right _____ Atoms: left _____ right _____

5. If 4 g of H_2 react completely with 32 g of O_2, what mass of water forms? Which law lets you answer without any calculation?

6. The game lists a strategy: metals first, then other nonmetals, then H, then O last. Explain in two or three sentences why O and H are usually saved for last.

Conclusion

Write 3 to 5 sentences explaining what a balanced chemical equation tells you and how it shows the law of conservation of mass. Use the words **coefficient**, **subscript**, and **atom** in your answer.

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