

Balancing Chemical Equations

Note: Each slide has audio that begins automatically when the slide begins.

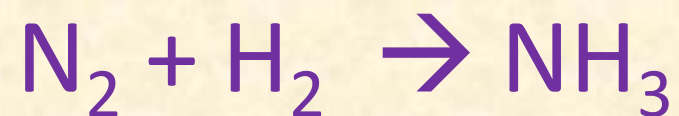


A chemical equation displays the chemical formulas of the atoms and molecules involved in a reaction, with the reactants on the left and the products on the right, separated by an arrow. When there are unequal numbers of atoms of elements between the products and reactants, the equation is “unbalanced”.

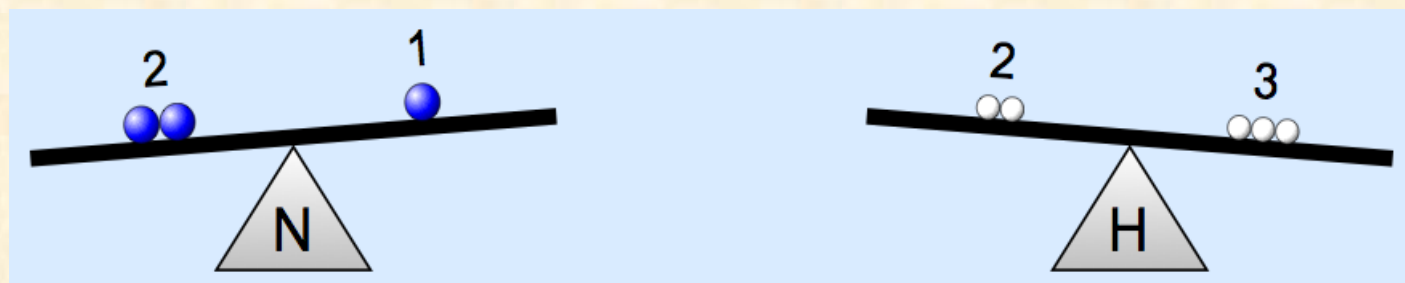
[Click to See an Example of an Unbalanced Equation](#)



When there are unequal numbers of atoms of elements between the products and reactants, the equation is “unbalanced”. For example an unbalanced reaction between hydrogen and nitrogen gas to produce ammonia could look like this:



On the reactants side, there are 2 N and 2 H. However on the products side, there is 1 N and 3 H. Therefore the equation is unbalanced.

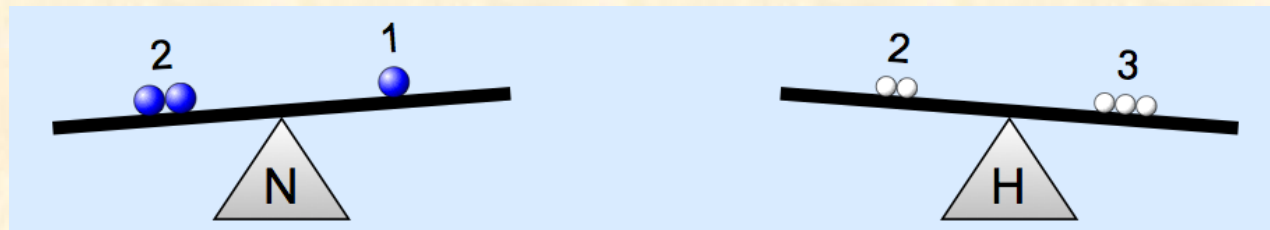
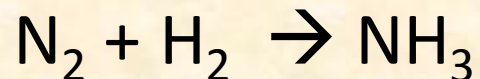


[Click to See the Balanced Version of this Equation](#)



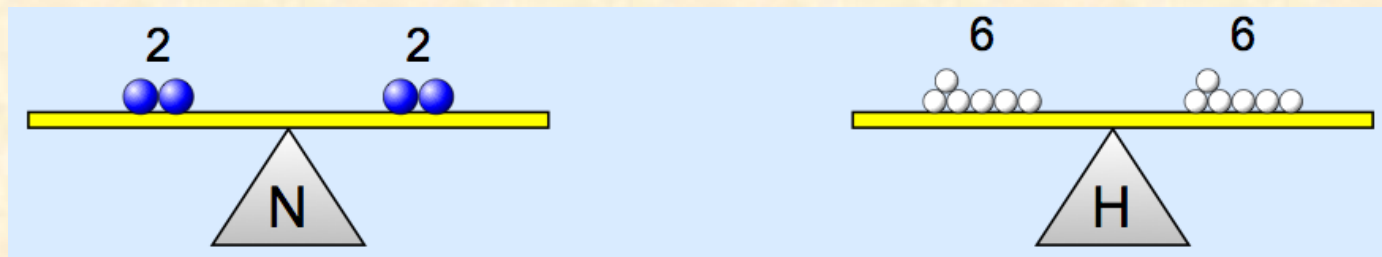
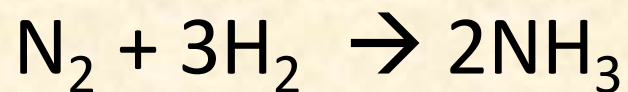
A balanced chemical equation will have the same total number of atoms of each element in the reactants as in the products.

Unbalanced:



When a reaction has been successfully balanced, there will be an equal number of each type of atom in the reactants and products.

Balanced:



Reactants:

- 2 N (1 x 2 = 2)
- 6 H (3 x 2 = 6)

Products:

- 2 N (1 x 2 = 2)
- 6 H (3 x 2 = 6)



Balancing chemical equations is a process involving adjusting the coefficients in front of different molecules and atoms. It often takes going back and forth, adjusting the coefficients until a fully balanced equation is achieved. The step-by-step process is as follows:

1. For each element, count the number of atoms on each side of the arrow.
2. Identify any unbalanced elements.
3. Multiply the chemical formulas by appropriate coefficients. Keep checking and adjusting the coefficients until all of the elements are balanced. This may take some trial and error.
Note: You cannot adjust the subscripts.
4. Check to make sure the equation is balanced.
5. Write the final chemical equation.



Balance the following equation: $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$

1. For each element, count the number of atoms on each side of the arrow.

Show Results



Balance the following equation: $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$

1. For each element, count the number of atoms on each side of the arrow.

Reactants:

- 2 N
- 2 H

Products:

- 1 N
- 3 H

2. Identify any unbalanced elements.

Both the N and the H are unbalanced as there are unequal numbers of both on either side of the arrow.

Next Step





Reactants Products

- 2 N
 - 2 H
- 1 N
 - 3 H

3. Multiply the chemical formulas by appropriate coefficients. Keep checking and adjusting the coefficients until all of the elements are balanced. This may take some trial and error.

Since we have 2 N on the left, we need 2 N on the right. If we add the coefficient 2 in front of NH_3 , this will give us 2 N on the product side.

Click to Adjust the
Coefficient



Since we have 2 N on the left, we need 2 N on the right. If we add the coefficient 2 in front of NH₃, this will give us 2 N on the product side.



Reactants:

- 2 N
- 2 H

Products:

- 2 N (2 x 1 = 2)
- 6 H (2 x 3 = 6)

The nitrogen atoms (N) are now balanced. However, the equation is still not balanced, because the hydrogen (H) atoms are unbalanced. Therefore, we must adjust the coefficients again. By multiplying the number of H₂ molecules on the left by 3 this will balance out the H atoms.

Click to Adjust the
Coefficient





Reactants:

- 2 N
- 6 H (3 x 2 = 6)

Products:

- 2 N
- 6 H

There are equal numbers of nitrogen atoms and hydrogen atoms on each side of the equation. Therefore, the balanced chemical equation for the production of ammonia from hydrogen and nitrogen is:



Test Your Understanding



Test your understanding. Balance the following equation which shows the combustion of methane gas.



[Click for Solution](#)





Reactants:

- 1 C
- 4 H
- 2 O

Products:

- 1 C
- 2 H
- 3 O

There are 4 H on the left and 2 H on the right. Therefore if a coefficient of 2 is added to the H₂O molecule, the H is balanced.

Next Step





Reactants:

- 1 C
- 4 H
- 2 O

Products:

- 1 C
- 2 H
- 3 O

There are 4 H on the left and 2 H on the right. Therefore if a coefficient of 2 is added to the H₂O molecule, the H is balanced.



Reactants:

- 1 C
- 4 H
- 2 O

Products:

- 1 C
- 4 H
- 4 O

The C and H are now balanced, but the O is unbalanced. If a coefficient of 2 is added to the O₂ molecule on the left, the O will balance out.

Next Step





Reactants:

- 1 C
- 4 H
- 2 O

Products:

- 1 C
- 2 H
- 3 O

There are 4 H on the left and 2 H on the right. Therefore if a coefficient of 2 is added to the H₂O molecule, the H is balanced.



Reactants:

- 1 C
- 4 H
- 2 O

Products:

- 1 C
- 4 H
- 4 O

The C and H are now balanced, but the O is unbalanced. If a coefficient of 2 is added to the O₂ molecule on the left, the O will balance out.



Reactants:

- 1 C
- 4 H
- 4 O

Products:

- 1 C
- 4 H
- 4 O

Next Step



Therefore, the balanced equation for the combustion of methane is:



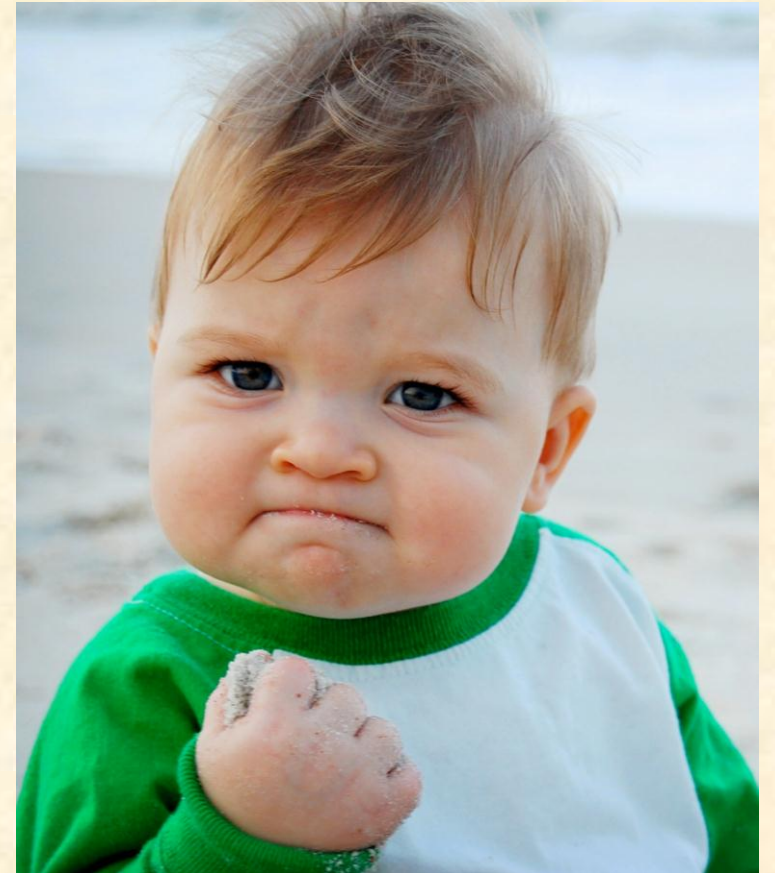
Reactants = Products:

1 C	1 C
4 H	4 H
4 O	4 O



Success!

You have reached the end of this activity. You will know that you have achieved the goals for this activity when you can successfully balance chemical equations.



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