

# 'DOUBLE DISPLACEMENT REACTION' IS A MISNOMER IN CHEMISTRY

**Renu Parashar**

Associate Professor,  
Department of Chemistry,  
Hansraj College, University of Delhi

**R. K. Parashar**

Professor, Department of Education in  
Science and Mathematics,  
NCERT, New Delhi

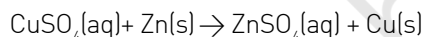
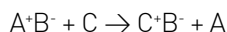
The introductory science curriculum deals with physical and chemical changes. Under the chemical changes, various chemical changes/ reaction types, including single displacement and double displacement, are discussed separately. However, on keen observation and analysis, one can conclude that both types can be termed as simply displacement/replacement reactions.

**Keywords:** School science curriculum, misconception, types of chemical reactions, single and double displacement/replacement, precipitation, neutralization, gas formation

## Introduction

School science curriculum worldwide generally includes chemical reactions in which combination, decomposition, displacement (single and double), combustion, etc., are explained. (Soult A, 2020; Encyclopedia.com, 2022)

Single displacement reaction is usually generalized as



In this reaction, reactants contain  $Cu^{2+}$ ,  $SO_4^{2-}$  ions and  $Zn(s)$  and products  $Zn^{2+}$  and  $SO_4^{2-}$  and  $Cu(s)$ . Here only one new product i.e  $Cu(s)$  is formed and  $SO_4^{2-}$  ion is common in both reactants and products, hence justify the term 'Single-displacement' reaction.

Now let us consider double displacement reaction which is generalized as



If we take the following example



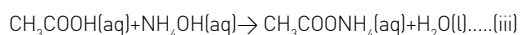
Here reactants and products both contain  $Na^+$ ,  $NO_3^-$ ,  $K^+$  and  $Cl^-$  ions. Hence this is not an example of chemical reaction at all but it's a mixture of ions. In some references (Shriver, 1998; Flexbooks 2.0, 2022) double-displacement/replacement is further classified into the following three types:

### 1) Precipitation reaction



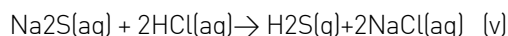
In this reaction, a new product, i.e.,  $BaSO_4(s)$ , is formed by replacing the  $Cl^-$  ion of  $BaCl_2$  with  $SO_4^{2-}$  ion from  $Na_2SO_4$ . Here  $Na^+$  ions and  $Cl^-$  ions are present both in the reactants and products. So it should be taken as the example of single displacement/replacement only.

### 2) Neutralization reaction



In reaction (iii), reactants contain undissociated  $\text{CH}_3\text{COOH}$  /  $\text{NH}_4\text{OH}$  along with  $\text{CH}_3\text{COO}^-$ ,  $\text{OH}^-$ ,  $\text{H}^+$ , and  $\text{NH}_4^+$  ions. Products contain  $\text{CH}_3\text{COO}^-$ ,  $\text{NH}_4^+$  ions, and undissociated  $\text{H}_2\text{O}$ . So only one new product, i.e.,  $\text{H}_2\text{O}$ , is formed. So again, it should be taken as the example of single displacement / replacement only. Similarly, for reaction (iv), only one new product,  $\text{H}_2\text{O}$ , is formed by a single displacement/ replacement process, and  $\text{Na}^+$ ,  $\text{Cl}^-$  ions are common in both reactants and products.

### 3) Gas formation reaction



In this reaction too  $\text{Na}^+$  and  $\text{Cl}^-$  are common

to both reactants and products. A new product  $\text{H}_2\text{S}(\text{g})$  is formed by the displacement  $\text{Cl}^-$  by  $\text{S}^{2-}$  ions.

## Conclusion

Looking back to examples (i)-(v), it is clear that all the examples are given under the terminology 'double-displacement/ replacement' are basically examples of single displacement/ replacement reaction. Therefore, it is recommended that the term double-displacement/replacement not be used as basic chemical terminology; instead, simply displacement/replacement reaction suffices the purpose.

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