

### Evidence of Reactions

Reaction of **potassium** with water:



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### Lesson Objectives

By the end of this lesson, you should be able to:

- Identify and characterize the types of reactions, including synthesis, decomposition, **combustion**, single replacement, and double replacement.
- Classify a reaction as **synthesis**, decomposition, single replacement, double replacement, or combustion.
- Use the activity series to determine whether a single replacement reaction will occur.

**Science Practice:** Predict the products of a reaction using the activity series.

**Words to Know**

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

B synthesis

C decomposition

A combustion

E single  
replacement

F double  
replacement

D activity series

A. a reaction of a substance with oxygen

B. a reaction in which two or more reactants combine to form a single product

C. a reaction in which a single compound breaks down to form two or more new substances

D. a description of the relative reactivity of elements

E. a reaction in which one ion displaces another to form a new compound

F. a reaction in which two ionic compounds exchange ions to form new products

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Lesson  
Question

What are the types of chemical reactions?

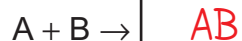
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## Types of Chemical Reactions

There are five main types of chemical reactions.

• **Synthesis:**

- Reaction in which two or more reactants combine to form a single product.

• **Decomposition:**

- Reaction in which a single **compound** breaks down to form two or more new substances.

• **Combustion:**

- Reaction of a substance with oxygen.



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**Types of Chemical Reactions**

There are five main types of chemical reactions.

- **Single replacement:**

- Reaction in which one ion displaces another to form a new compound.

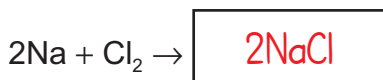


- **Double replacement:**

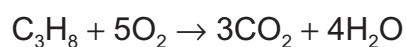
- Reaction in which two ionic compounds exchange **ions** to form new products.

**Synthesis, Decomposition, and Combustion Reactions**

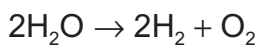
Synthesis reaction:



Combustion reaction:



**Decomposition** reaction:



If one of the reactants in a synthesis reaction is oxygen gas (O<sub>2</sub>), the reaction is also a combustion reaction.

## Instruction

## Types of Reactions

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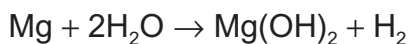
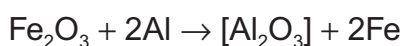
**Synthesis, Decomposition, and Combustion Reactions**

- Synthesis:
  - Multiple reactants form **one** product.
- **Decomposition**:
  - One reactant forms multiple products.
- Combustion:
  - Oxygen (**O<sub>2</sub>**) is involved as a reactant.
  - Products include the oxide(s) of the reactant.

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**Single and Double Replacement Reactions**

Single replacement:



Double replacement:



## Instruction

## Types of Reactions

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## Single and Double Replacement Reactions

- Single replacement:
  - One reactant is an **element**; one reactant is a **compound**.
  - One product is an element; one product is a compound.
  - The **reactant** element is part of the compound product.
- Double replacement:
  - Reactants and products are **ionic** compounds.
  - The same ions are present in reactants and products.

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## How to Predict Outcomes of Reactions

**Activity series**: description of the relative reactivity of elements

Li > K > Ba > Sr > Ca > Na > Mg > Al > Mn > Zn > Cr > Fe > Cd >  
Co > Ni > Sn > Pb > H > Sb > Bi > Cu > Ag > Pd > Hg > Pt > Au

**F<sub>2</sub>** > Cl<sub>2</sub> > Br<sub>2</sub> > **I<sub>2</sub>**

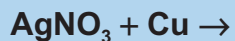


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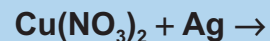
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**Predictions Using the Activity Series**

Which of the following reactions will take place?



or



- Identify the relative positions of metals in the activity series.

**Li > K > Ba > Sr > Ca > Na > Mg > Al > Mn > Zn > Cr > Fe > Cd > Co > Ni > Sn > Pb > H > Sb > Bi > Cu > Ag > Pd > Hg > Pt > Au**

- Cu > Ag
- Cu **more** reactive than Ag
- Predict whether the reaction will occur.
  - If more reactive element is reactant, reaction will occur

# Summary | Types of Reactions

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## Lesson Question

What are the types of chemical reactions?

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## Answer

(Sample answer) The five types of chemical reactions are synthesis, decomposition, combustion, single replacement, and double replacement reaction.

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## Types of Chemical Reactions

- Synthesis:  $A + B \rightarrow$  AB
  - Multiple reactants form one product.
- Decomposition:  $AB \rightarrow A + B$ 
  - One reactant forms multiple products.
- Combustion:  $A +$   $O_2$   $\rightarrow$  oxide of A
  - An element or compound reacts with oxygen.
- Single replacement:  $AB + C \rightarrow CB + A$ 
  - One element replaces another in a compound.
- Double replacement:  $AB + CD \rightarrow AD + CB$ 
  - Two ions replace each other.

# Summary | Types of Reactions

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## The Activity Series

- The activity series describes the **relative** reactivity of elements.
- The activity series for metals is  $\text{Li} > \text{K} > \text{Ba} > \text{Sr} > \text{Ca} > \text{Na} > \text{Mg} > \text{Al} > \text{Mn} > \text{Zn} > \text{Cr} > \text{Fe} > \text{Cd} > \text{Co} > \text{Ni} > \text{Sn} > \text{Pb} > \text{H} > \text{Sb} > \text{Bi} > \text{Cu} > \text{Ag} > \text{Pd} > \text{Hg} > \text{Pt} > \text{Au}$ .
- The activity series for **halogens** is  $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$ .
- The more reactive an element is, the more likely it is to form compounds, and the less **stable** it is as a pure element.
- The activity series can be used to predict the outcome of a single-replacement reaction.

*Use this space to write any questions or thoughts about this lesson.*