

# Naming Acids

What makes an acid unique and how are acids named?


## Why?

A variety of acids are used in foods, industry, and research. Acids are covalently bonded molecules, but when they are put into water they produce ions. One of the ions produced is always  $H^+$ , which immediately combines with a water molecule to form the hydronium ion ( $H_3O^+$ ). The  $H_3O^+$  ion is what defines the acidic properties of a substance. Because of their special classification, acids have a naming system different from ionic or other molecular (covalent) compounds.

## Model 1 – Binary Acids

Acid	Name of acid in aqueous solution	Cation (+)*	Anion (-)
HCl	Hydrochloric acid	$H_3O^+$	$Cl^{1-}$
HBr	Hydrobromic acid		
$H_2S$	Hydrosulfuric acid	$2H_3O^+$	$S^{2-}$
HF	Hydrofluoric acid		

\*Hydrogen ions ( $H^+$ ) join with water molecules in solution to form hydronium ions,  $H_3O^+$ .

1. Complete the cation and anion columns of the table in Model 1. Be careful to show the charges on the ions.
2. Why does hydrosulfuric acid contain two hydrogens?
3. Look at the formulas and names of the binary acids in Model 1.
  - a. What prefix is used at the beginning of the name for all binary acids?
  - b. What suffix is used at the end of the name for all binary acids?
4. The prefix “bi” means “two.” Propose a reason that the acids in Model 1 are all referred to as “binary” acids.
5.  Write a rule for naming binary acids.



## Model 2 – Ternary Acids (Oxyacids)

Acid	Name of Acid in Aqueous Solution	Cation (+)	Polyatomic Anion (-)	Polyatomic Anion Name
$\text{HClO}_3$	Chloric acid	$\text{H}_3\text{O}^+$		
$\text{H}_2\text{SO}_3$	Sulfurous acid			
$\text{H}_2\text{SO}_4$	Sulfuric acid			Sulfate
$\text{H}_3\text{PO}_3$	Phosphorous acid	$\text{H}_3\text{O}^+$		Phosphite
$\text{H}_3\text{PO}_4$	Phosphoric acid		$\text{PO}_4^{3-}$	
$\text{HNO}_3$	Nitric acid			
$\text{HNO}_2$	Nitrous acid		$\text{NO}_2^{1-}$	Nitrite
$\text{H}_2\text{CO}_3$	Carbonic acid			

6. Look at the formulas of the ternary acids in Model 2.
- How are ternary acids different from binary acids in their structure?
  - What number do you think the prefix “ter-” refers to?
7. When ternary acids are mixed with water, ions will form. Fill in the table above with the formulas and names of the anions.
8. Examine the pairs of ternary acids in Model 2 that contain sulfur, phosphorus, and nitrogen. Each pair has one acid that ends in “-ic” and another that ends in “-ous.” These endings are related to the name of the polyatomic anion found in the acid (“-ate” or “-ite”). Complete the statements below with the correct acid name ending.
- Polyatomic anion ending is “-ate” → acid name ending is \_\_\_\_\_.
- Polyatomic anion ending is “-ite” → acid name ending is \_\_\_\_\_.
9. If the prefix “hydro-” were used to name a ternary acid, what problem would this create when naming  $\text{HClO}_3$ ?



10. Write a rule for naming ternary acids.

11. Predict the formula for chlorous acid.

12. Circle the acid(s) below that would be named beginning with the prefix “hydro-.”



## Extension Questions

### Model 3 – Halogen Oxyacid Acid Families

Acid	Name of Acid	Cation (+)	Anion (-)	Anion Name
HClO <sub>4</sub>	Perchloric acid			Perchlorate
HClO <sub>3</sub>	Chloric acid	H <sub>3</sub> O <sup>+</sup>		
HClO <sub>2</sub>	Chlorous acid			Chlorite
HClO	Hypochlorous acid			
HBrO <sub>4</sub>				Perbromate
HIO <sub>3</sub>				
HFO <sub>2</sub>				
HIO			IO <sup>-</sup>	Hypoiodite

- Write the formulas of the cations and anions for each acid in the table in Model 3.
- Consider the names of the oxyacids in Model 3 that contain chlorine. All halogens form similar oxyacids that use the same naming convention. Fill in the names of the halogen oxyacids to complete the table.
- The table below includes both binary and ternary acids. Using what you have learned in this activity, fill in the missing formula and name for the anion in each acid, and give the formula of the acid.

Acid name	Anion	Anion Name	Acid Formula
Hydroiodic acid			
Chlorous acid			
Hypobromous acid			
Phosphoric acid			
Sulfurous acid			