

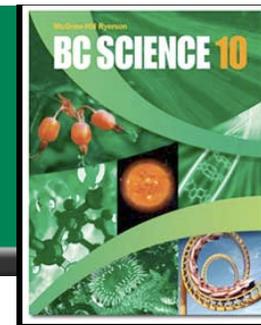
These notes are posted on my site for the following reasons:

- for students to copy in their own hand-writing
 - ◆ in order to complete their class notes
 - ◆ if student did not have enough time in class
 - ◆ if student was away and missed this section
- for assistants and tutors to follow progress of the concepts taught

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5.1 Acids and Bases



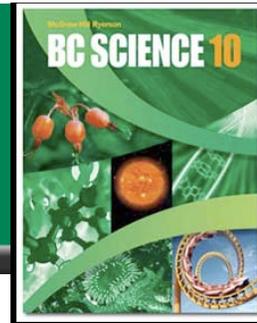
- **Acids and bases are very common.**
 - ◆ Many familiar compounds are acids or bases.
 - ◆ Classification as acids or bases is based on chemical composition.
- **Acids and bases can be very dangerous!**
 - ◆ Both can be very corrosive.
 - NEVER try to identify an acid or base by taste or touch!
- **The strength of acids and bases is measured on the pH scale**
 - ◆ pH below 7 = acidic, pH above 7 = basic, pH 7 = neutral
 - ◆ **0 1 2 3 4 5 6 7 8 9 10 11 12 13 14**
Acids Neutral Bases
 - ◆ Each decrease of 1 on the pH scale indicates 10X more acidic
 - For example, pH 4 is ten times more acidic than pH 5
 - pH 3 is 1000X more acidic than pH 6



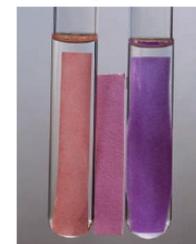
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pH Indicators



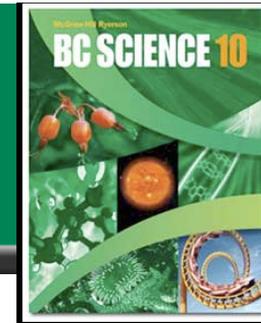
- **The pH of acids and bases cannot be determined by sight.**
 - ◆ Instead, pH is measured by other chemicals called indicators, or by a pH meter that measures the electrical conductivity of the solution.
- **pH indicators change colour based on the solution they are placed in.**
 - ◆ Litmus is the most common indicator, used on litmus paper.
 - Two colours of litmus paper: Blue = basic and Red = acidic.
 - Blue = pH above 7, Red = pH below 7
 - ◆ Universal indicator contains many indicators that turn different colours at different pH values (can be in liquid form, or on paper strips like litmus)
 - ◆ A pH meter uses electrical probes to measure how solutions conduct electricity
 - ◆ Indicators change colour at different pH values, so different indicators are used to identify different pH values
 - Bromothymol blue for pH 6 - 7.6, phenolphthalein for pH 8.2 - 10
 - Many natural sources, such as beets and cabbage, are also indicators



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Acids



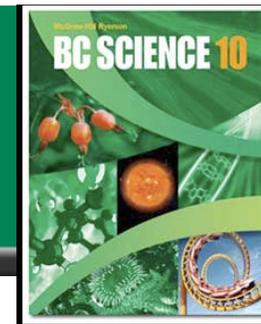
- If you know a compound's chemical formula, you may be able to identify it as an acid.
 - ♦ Acids often behave like acids only when dissolved in water
 - ♦ Therefore, acids are often written with subscript (aq) = aquatic = water
- The chemical formula of an acid usually starts with Hydrogen (H-).
 - ♦ Acids with a carbon usually have the C written first.
 - $\text{HCl}_{(aq)}$ = hydrochloric acid, $\text{HNO}_{3(aq)}$ = nitric acid, $\text{CH}_3\text{COOH}_{(aq)}$ = acetic acid
- Naming acids
 - ♦ Hydrogen + ...-ide = Hydro...ic acid
 - $\text{HF}_{(aq)}$ = hydrogen fluoride = hydrofluoric acid
 - ♦ Hydrogen + ...-ate = ...ic acid
 - $\text{H}_2\text{CO}_{3(aq)}$ = hydrogen carbonate = carbonic acid
 - ♦ Hydrogen + ...-ite = ...ous acid
 - $\text{H}_2\text{SO}_{3(aq)}$ = hydrogen sulphite = sulphurous acid



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Bases



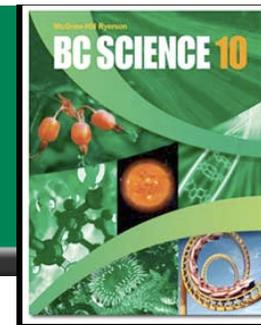
- If you know a compound's chemical formula, you may be able to identify it as a base.
 - ♦ Bases, like acids, often behave like bases only when dissolved in water
 - ♦ Therefore, bases are often written with subscript (aq) = aquatic = water
- The chemical formula of a base usually ends with hydroxide (-OH).
- Bases can be gentle or very caustic
- Examples of common bases

- ♦ $\text{NaOH}_{(aq)}$
- ♦ $\text{Mg}(\text{OH})_{2(aq)}$
- ♦ $\text{Ca}(\text{OH})_{2(aq)}$
- ♦ $\text{NH}_4\text{OH}_{(aq)}$

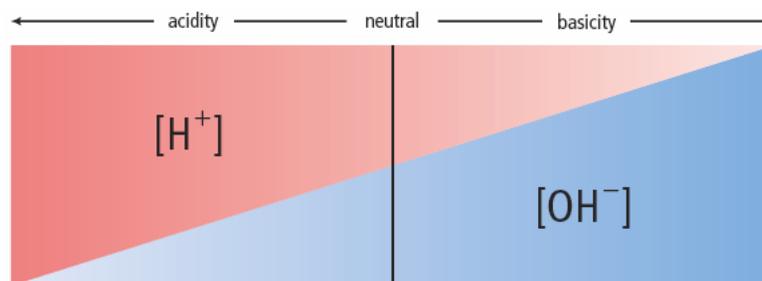


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Production of Ions



- **Acids and bases can conduct electricity because they release ions in solution.**
 - ◆ Acids release hydrogen ions, $\text{H}^+_{(aq)}$
 - ◆ Bases release hydroxide ions $\text{OH}^-_{(aq)}$
- **The pH of a solution refers to the concentration of ions it has.**
 - ◆ Square brackets are used to signify concentration, $[\text{H}^+_{(aq)}]$, $[\text{OH}^-_{(aq)}]$
 - High $[\text{H}^+_{(aq)}]$ = low pH, very acidic
 - High $[\text{OH}^-_{(aq)}]$ = high pH, very basic
 - ◆ A solution cannot have BOTH high $[\text{H}^+_{(aq)}]$ and $[\text{OH}^-_{(aq)}]$; they cancel each other out and form water. This process is called neutralization.
 - ◆ $\text{H}^+_{(aq)} + \text{OH}^-_{(aq)} \rightarrow \text{H}_2\text{O}_{(l)}$



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Properties of Acids and Bases

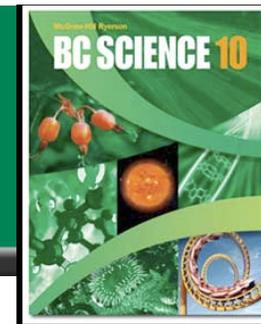


Table 5.6 Properties of Acids and Bases

Property	Acid	Base
Taste CAUTION: Never taste chemicals in the laboratory.	<ul style="list-style-type: none">• Acids taste sour. Lemons, limes, and vinegar are common examples.	<ul style="list-style-type: none">• Bases taste bitter. The quinine in tonic water is one example.
Touch CAUTION: Never touch chemicals in the laboratory with your bare skin.	<ul style="list-style-type: none">• Many acids will burn your skin. Sulphuric acid (battery acid) is one example.	<ul style="list-style-type: none">• Bases feel slippery.• Many bases will burn your skin. Sodium hydroxide (lye) is one example.
Indicator tests	<ul style="list-style-type: none">• Acids turn blue litmus paper red.• Phenolphthalein is colourless in an acidic solution.	<ul style="list-style-type: none">• Bases turn red litmus blue.• Phenolphthalein is pink in a basic solution.
Reaction with some metals, such as magnesium or zinc	<ul style="list-style-type: none">• Acids corrode metals.	<ul style="list-style-type: none">• no reaction
Electrical conductivity	<ul style="list-style-type: none">• conductive	<ul style="list-style-type: none">• conductive
pH	<ul style="list-style-type: none">• less than 7	<ul style="list-style-type: none">• more than 7
Production of ions	<ul style="list-style-type: none">• Acids form hydrogen (H^+) ions when dissolved in solution.	<ul style="list-style-type: none">• Bases form hydroxide (OH^-) ions when dissolved in solution.

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[Take the Section 5.1 Quiz](#)