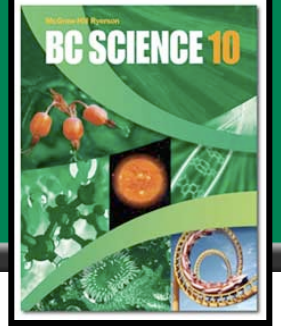
5.1 Acids and Bases



- **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!**

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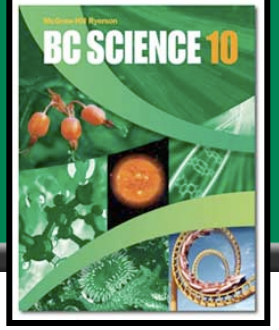

- The strength of acids and bases in measured on the pH scale.
  - pH below 7 = acidic, pH above 7 = basic, pH 7 = neutral
  - 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

    Acids *Neutral* *Bases*
  - Each decrease of 1 on the pH scale indicates 10× more acidic
    - For example, pH 4 is 10 times more acidic than pH 5.
    - pH 3 is 1000 times more acidic than pH 6.

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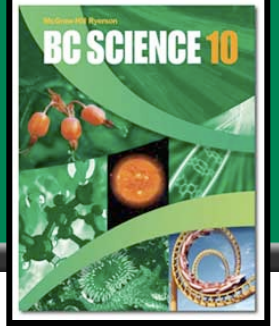
pH Indicators



- 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.

Litmus paper

- pH indicators change colour based on the solution they are placed in.
  - Litmus is the most common indicator, and is 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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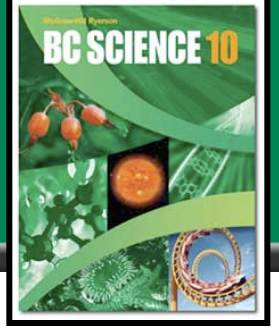
Acids



- If you know a compound's chemical formula, you may be able to identify whether it as an acid.
  - Acids often behave like acids only when dissolved in water.
  - Therefore, acids often are written with symbol (aq) = aqueous = water.
- The chemical formula of an acid usually starts with hydrogen (H).
  - Acids with a carbon usually have the C written first.
    - $HCl_{(aq)}$ = hydrochloric acid, $HNO_{3(aq)}$ = nitric acid, $CH_3COOH_{(aq)}$ = acetic acid
- Classifying acids:
  - Binary Acids usually contain only two elements
    - E.g. HF
  - Oxy Acids contain oxygen as part of a polyatomic ion
    - E.g. H_2SO_4

Sulfuric acid is used in batteries.

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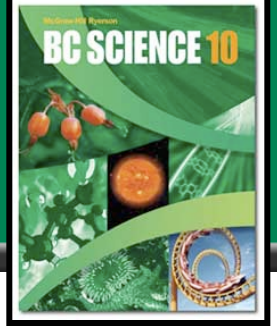
Naming Acids



- **Naming Binary Acids**
  - **Hydrogen + …*-ide* = hydro…*ic* acid**
    - **$HF_{(aq)}$ = hydrogen fluoride = hydrofluoric acid**

- **Try: Write the name or the formula of the acids listed below:**
  - **HCl**
  - **HI**
  - **HCN**
  - **Hydrobromic Acid**

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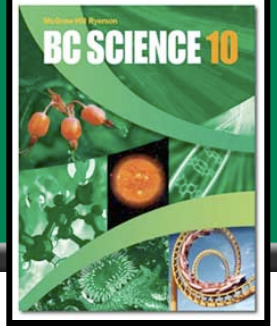

- **Naming Oxy Acids**
  - Hydrogen + …*-ate* = …*ic* acid
    - $H_2CO_{3(aq)}$ = hydrogen carbonate = carbonic acid
  - Hydrogen + …*-ite* = …*ous* acid
    - $H_2SO_{3(aq)}$ = hydrogen sulphite = sulphurous acid

- **Try: Write the name or the formula of the acids listed below:**
  - H_2SO_4
  - HNO_3
  - HNO_2
  - Phosphoric acid
  - Chlorous acid

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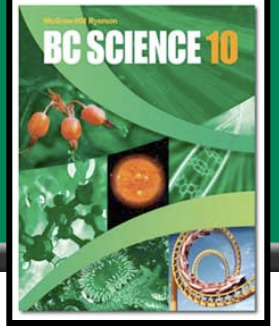
Bases



- If you know a compound's chemical formula, you may be able to identify it as a base.
  - Bases often behave like bases only when dissolved in water.
  - Therefore, bases are often written with the symbol (aq) = aqueous = water.

- The chemical formula of a base usually ends with hydroxide (OH).
- Bases can be gentle or very caustic.
- Examples of common bases:
  - $NaOH_{(aq)}$
  - $Mg(OH)_{2(aq)}$
  - $Ca(OH)_{2(aq)}$
  - $NH_4OH_{(aq)}$

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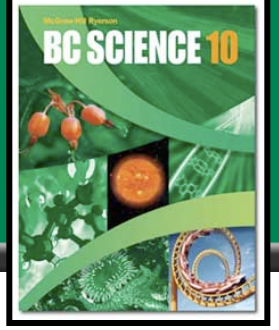
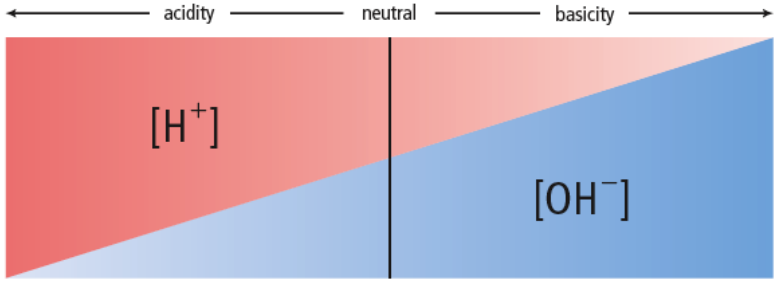
Production of Ions



- **Acids and bases can conduct electricity because they release ions in solution.**
  - **Acids release hydrogen ions, H^+.**
  - **Bases release hydroxide ions OH^-.**



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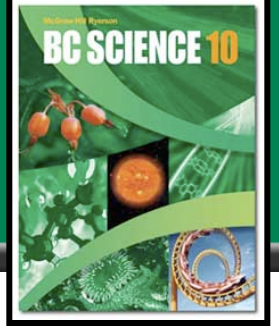
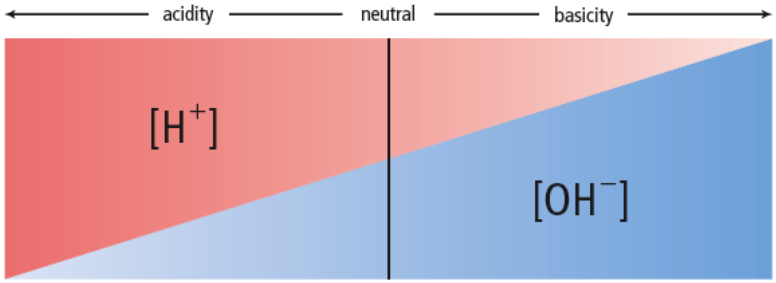


- **The pH of a solution refers to the concentration of ions it has.**
  - Square brackets are used to signify concentration, $[H^+]$, $[OH^-]$
    - High $[H^+]$ = low pH, very acidic
    - High $[OH^-]$ = high pH, very basic
  - A solution cannot have BOTH high $[H^+]$ and $[OH^-]$; they cancel each other out and form water. This process is called neutraliztion.
  - $H^+ + OH^- \rightarrow H_2O$



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Properties of Acids and Bases

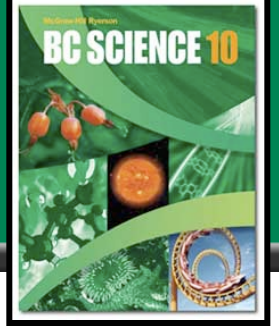

Table 5.6 Properties of Acids and Bases

Property	Acid	Base
Taste CAUTION: Never taste chemicals in the laboratory.	• Acids taste sour. Lemons, limes, and vinegar are common examples.	• Bases taste bitter. The quinine in tonic water is one example.
Touch CAUTION: Never touch chemicals in the laboratory with your bare skin.	• Many acids will burn your skin. Sulfuric acid (battery acid) is one example.	• Bases feel slippery. • Many bases will burn your skin. Sodium hydroxide (lye) is one example.
Indicator tests	• Acids turn blue litmus paper red. • Phenolphthalein is colourless in an acidic solution.	• Bases turn red litmus blue. • Phenolphthalein is colourless in slightly basic solutions and pink in moderate to strongly basic solutions.
Reaction with some metals, such as magnesium or zinc	• Acids corrode metals.	• No reaction
Electrical conductivity	• Conductive	• Conductive
pH	• Less than 7	• More than 7
Production of ions	• Acids form hydrogen (H^+) ions when dissolved in solution.	• Bases form hydroxide (OH^-) ions when dissolved in solution.

Take the Section 5.1 Quiz

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