

### What is an acid?

- A compound that dissolves in water and produces **hydronium ions (H<sub>3</sub>O<sup>+</sup>)**.

$$\text{Acid} + \text{Water} \rightarrow \text{H}_3\text{O}^+ + \text{ions}$$

- Comes from the Latin word *acidus* that means "sharp" or "sour"
- Example:  $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{Cl}^- + \text{H}_3\text{O}^+$

What an acid does in water

### 1. Introduction to Aqueous Acids

Introduction to Aqueous Acids

### Strong vs. Weak acids

- As an acid dissolves in water, its molecules break apart & produce H<sup>+</sup> (or H<sub>3</sub>O<sup>+</sup>)
- If **ALL** of the molecules break apart, the acid is considered a **strong** acid.
  - Examples of strong acids are sulfuric acid, nitric acid, hydrochloric acid.
- If only **a few** of the molecules break apart, the acid is considered a **weak** acid.
  - Examples of weak acids include acetic acid, citric acid, carbonic acid

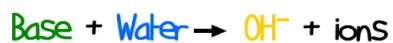
### Acidic Properties

- pH **less** than 7
- Taste **sour**
- May change the color of certain compounds
- React with metals to produce hydrogen gas (H<sub>2</sub>)
- Can be very **corrosive**, meaning they may destroy metals & burn skin

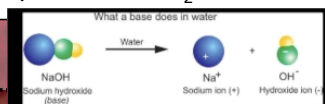
### Examples of Acids

## What is a base?

- A compound that dissolves in water to produce **hydroxide ions (OH<sup>-</sup>)**.



- Another word for base is **alkali**.
- Example:  $\text{NaOH} + \text{H}_2\text{O} \rightarrow \text{Na}^+ + \text{OH}^-$



## 2. Introduction to Aqueous Bases

### Introduction to Aqueous Bases

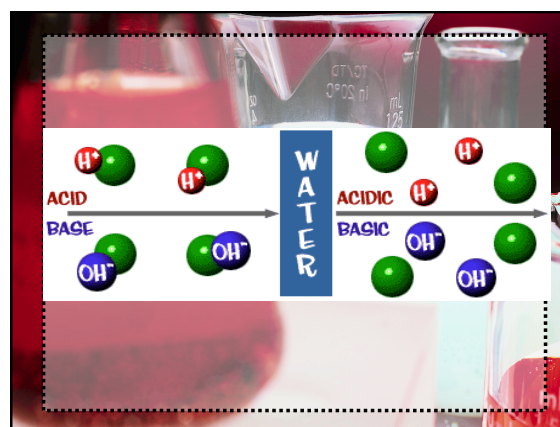
## Strong vs. Weak Bases

- As with acids, when **ALL** of the molecules break apart in water to produce OH<sup>-</sup>, the base is called a **strong** base.
  - Examples of strong bases are sodium hydroxide, calcium hydroxide, potassium hydroxide.
- If only a **few** of the molecules break apart, the base is called a **weak** base.
  - Examples of weak bases include ammonia, magnesium hydroxide, aluminum hydroxide.

## Basic Properties

- pH **greater** than 7
- Taste **bitter**
- Feel **slippery**, like soap
- May change the color of certain compounds
- Can be very **corrosive**, meaning they may destroy metals & burn skin

## Examples of Bases



## ACIDS AND BASES

- Look around. Every liquid you see will probably be either an acid or a base.
- The only exception would be distilled water.
- Distilled water is just water. That's it.
- But what about baking soda? Vinegar? Scientists use something called the "pH" scale to measure how acidic or basic a liquid is.



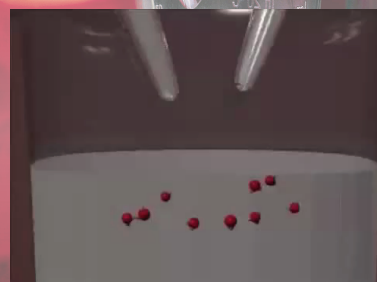
## Acids + Bases = ?

- What do you think happens if you add acids & bases together?
- They **neutralize** each other!
- These reactions occur when the positive ions from the base combine with the negative ions from the acid.

## Acids + Bases = ?

- This reaction is really important - without it, the acid in your stomach would eat away your entire digestive tract.
- As the fluids & acids leave your stomach, the pancreas & liver produce bicarbonate (a base) to neutralize the stomach acid.

## 3. Acids + Bases= Neutralization



## Acids & Bases Unite!

- In fact, there's a little more to it than that.
- When acids & bases combine, the positive hydrogen ion ( $H^+$ ) from the acid combines with the negative hydroxide ion ( $OH^-$ ) from the base.
- This forms water ( $H_2O$ ) and a salt with the remaining ions.



- Example:  $HCl + NaOH \rightarrow H_2O + NaCl$

## Acids & Bases Unite!

- Picture this...
- It's summertime & very hot outside, but you're out swimming in the beautiful warm ocean.
- Suddenly, OUCH.
- A giant jellyfish stings your leg.
- What do you do?
- Well, besides screaming like an idiot, you run (or rather hop) to the lifeguard for help.
- What do they do?
- Pour vinegar on the sting.
- Why do they do this???


And now Tim & Moby:

- Acids & Bases... it's in your Cabbages in Chemistry Packet
- [Click here](#)

**BrainPop: Acids and Bases**

- Which of the following substances is acidic?  
a. Baking soda b. **Lemon-lime soft drink** c. Distilled water d. Bar of soap
- What happens immediately after you dissolve acid in water?  
a. **Positively charged hydrogen atoms are released**  
b. Hydronium ions are released  
c. Negatively charged hydrogen atoms are released  
d. Neutrally charged hydrogen atoms are released
- Acids are caustic to the touch. In this context, what does "caustic" mean?  
a. **Stinging or burning** b. Pleasant c. Sarcastic d. Gentle
- A hydronium ion is like a(n) \_\_\_\_\_ molecule with an extra hydrogen atom.  
a. Acid b. Base c. **Water** d. Vinegar
- What substance would do the best job of cleaning pots and pans?  
a. A substance with a pH of 7 b. A substance with a pH of 2  
c. A substance with a pH of 4 d. **A substance with a pH of 8**
- What is a property of bases?  
a. **Slippery touch** b. Sour taste  
c. Ability to dissolve metal d. Ability to form hydronium ions
- How do acidic solutions taste?  
a. Delicious b. Sweet c. Bitter d. **Sour**
- Which of the following substances is basic?  
a. Apple juice b. Ginger ale c. **Baking soda** d. Distilled water
- pH stands for:  
a. Potency of hydrogen b. Plurality of hydrogen  
c. **Potential of hydrogen** d. Pleusny of hydrogen
- What do acids and bases have in common?  
a. They both eat away at metal  
b. **They can both conduct electricity**  
c. They both have a sour taste  
d. They both form positively charged ions when dissolved in water

**ACIDS AND BASES and the pH scale**



**The pH Scale**

- The scale goes from "0" to "14".
- Distilled water is 7 (right in the middle).

**pH Scale**

Acidic			Neutral		Basic										
[H <sub>3</sub> O <sup>+</sup> ]	10 <sup>0</sup>	10 <sup>1</sup>	10 <sup>7</sup>	10 <sup>14</sup>	10 <sup>8</sup>	10 <sup>9</sup>	10 <sup>10</sup>	10 <sup>11</sup>	10 <sup>12</sup>	10 <sup>13</sup>	10 <sup>14</sup>				
	Lemon Juice (pH 2.2-3.4)	Soft Drinks (pH 2.5-3)	Milk (pH 6.4)	Baking Soda (pH 8.0-9.4)	Household ammonia (pH 11.5)										
	HCl (1.0 M) (pH 0.0)	Vinegar (pH 2.4-3.4)	Blood (pH 7.4)	NaOH (1.0 M) (pH 14.0)											
	Stomach Acid (pH 1.0-3.5)	Sawtooth (pH 7.0-8.3)	Milk of Magnesia (pH 10.5)												
pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

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**ACIDS AND BASES**

pH	ACIDIC				NEUTRAL		BASIC				
	Strong	Weak		Neutral		Weak	Strong				
1	2	3	4	5	6	7	8	9	10	11	12

When you start looking at the pH of chemicals the numbers go to the extremes.

**ACIDS AND BASES**

- If you ever go into a chemistry lab, you could find solutions with a pH of "1" and others with a pH of "14".
- Those chemicals are very dangerous.
- There are pH values higher than 14 and lower than 0, but let's just start with 0-14.



## 4. Properties of Acids & Bases



- pH measures the **acidity** of a solution,
- or how many **hydronium ions** are in the solution.
- The pH scale ranges from **0-14**. A pH of 7 is **neutral**.
- Neutral** means the solution is neither acidic nor basic, like distilled water.

Substance	pH
Acid mine runoff	0.8 - 1.0
Battery acid	0.5
Gastric acid	2.0
Lemon juice	2.4
Cola	2.5
Vinegar	2.9
Orange or apple juice	3.5
Beer	4.5
Acid Rain	<5.0
Coffee	5.0
Tea	5.5
Milk	6.5
Pure water	7.0
Healthy human saliva	6.5 - 7.4
Blood	7.34 - 7.45
Sea water	8.0
Hand soap	9.0 - 10.0
Household ammonia	11.5
Bleach	12.5
Household lye	13.5

### Definitions to Know:

- ACID:** A solution that has an excess of **H<sup>+</sup>** ions. It comes from the Latin word "acidus" which means "sharp".
- BASE:** A solution that has an excess of **OH<sup>-</sup>** ions. Another word for base is **ALKALI**.
- NEUTRAL:** A solution which has a pH of 7. It is neither acidic nor basic. (the neutral range is: **6.5-8.5**)

### Definitions to Know:

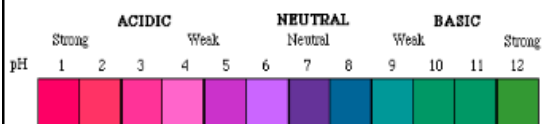
- STRONG ACID:** An acid which has a very low pH. (**0-4**)
- STRONG BASE:** A base which has a very high pH. (**10-14**)

### Definitions to Know:

- WEAK ACID:** An acid that only partially ionizes in an aqueous solution.
- That means not every molecule breaks apart.
- They usually have a pH closer to 7 (**4-6**)
- WEAK BASE:** A base that only partially ionizes in an aqueous solution.
- That means not every molecule breaks apart.
- They usually have a pH close to 7 (**8-10**)
- AQUEOUS:** A solution which is mainly water. Think about the word aquarium. **AQUA** means water.


### What is pH?

- Acids** have a pH less than 7
  - Strong acids: very low pH, 0-4
  - Weak acids: low pH, 4-6
- Bases** have a pH greater than 7
  - Strong bases: very high pH, 10-14
  - Weak bases: high pH, 8-10




## ACIDS AND BASE

additional info- no notes needed!




## ACIDS AND BASES



- Acidic bee stings (pH 5.0-5.5) can be soothed, i.e. neutralized by calamine lotion, which is a mild alkali based on zinc oxide
- and you can also use baking soda ('bicarb of soda' = sodium hydrogen carbonate, another mild alkali).

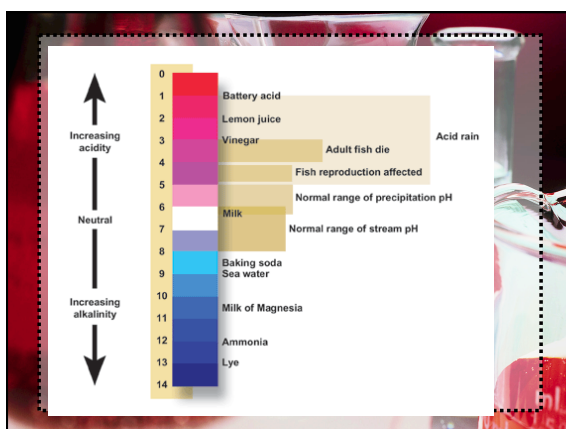
## ACIDS AND BASES



- Wasp stings, supposed to be alkaline, but apparently not! - are almost neutral at pH 6.8-6.9 but are 'traditionally' treated with vinegar which is a weak acid (and then calamine too!).

## ACIDS AND BASES

- This may be "folklore", however, what is known is that bees and wasps have glands that can secrete either acids or alkalis
- and ants sting venom often contains methanoic acid ('formic acid') with a pH of 3
- and is presumably 'soothed' by mild alkalis and just further confuse matters, many people claim the 'folklore' remedies work!



## What is an indicator?

- Certain chemicals turn different colors at different pH.
- These chemicals are called **pH indicators** and they are used to determine pH.
- Red cabbage juice is an indicator you can make at home.
- Red & blue litmus papers are also used to test pH.

Dronehtymol Blue													
Litmus													
Methyl Orange													
Methyl Red													
Phenolphthalein													
Phenol Red													
Thymol Blue													
	0	1	2	3	4	5	6	7	8	9	10	11	12
	pH												





## Acids, Bases, & YOU!

- The level of acidity in our stomachs is necessary to break down the protein molecules in food so they can be absorbed.
- A mucus lining in the stomach protects it from the acid produced.

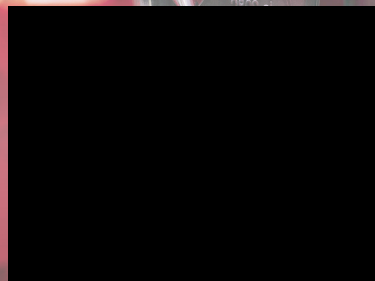
## Acids, Bases, & YOU!

- Very spicy foods, stress, or poor diet can cause the stomach to produce too much acid, or allow stomach acid to escape from the stomach.
- An **ulcer** may occur when the mucus lining of the stomach is damaged.
- Stomach acid can then attack the more sensitive tissues of the stomach itself.

## Acids, Bases, & YOU!

- The uncomfortable condition called heartburn is caused by excessive stomach acid backing up into the esophagus.
- Eating very large meals can lead to heartburn because an overflowing stomach pushes acid up into the esophagus.

## 5. Summary: Acids, Bases & You



## Acid & Base Review

1. Acids release positively charged **hydrogen** atoms when they are dissolved in water. When those hydrogen atoms combine with **water** molecules, hydronium ions form.
2. The pH scale gives you a measure for identifying acids & bases. pH stands for **potential of hydrogen** and the scale ranges from 0 to 14.
3. A substance with a pH of exactly 7, like distilled water, is called pH **neutral**.
4. Bases also contain hydrogen, but they form **hydroxide** ions when they dissolve in water.

## 6. It's all about the song...

### The Bromthymol Blues

Music & Lyrics © 2005, Mark Rosengarten



