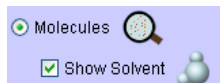


Name: \_\_\_\_\_

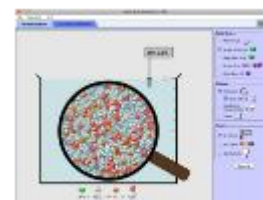


## Introduction to Strong and Weak Acids and Bases PhET Lab (rvsd 5/2011)

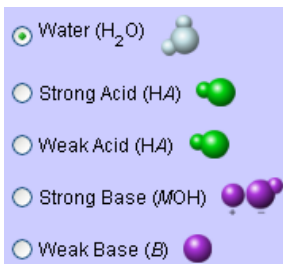
*How does the strength of an acid or base affect conductivity? pH?*

### Introduction:

When you test your pool's pH, what are you those little vials or paper strips telling you? When you hear an acid called "strong" or "weak", what do those terms refer to? In aqueous solutions, compounds can exist as molecules (*undissociated*) or ions (*dissociated*). When an acid or a base exists in solution nearly completely as dissociated ions, we refer to that acid or base as *strong*. A *weak* acid or base will donate ions to the solution, but will remain primarily as undissociated molecules.



Acid-Base Solutions



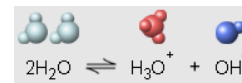
### Notation:

**Acids** are abbreviated **HA**, with the **H** representing the proton (**H<sup>+</sup>**) the acid donates to the solution. The **A** is referred to as the acidic anion (**A<sup>-</sup>**) that is left in solution as the proton is donated.  $HA \rightleftharpoons H^+ + A^-$

**Strong Bases** are abbreviated **MOH**, with the **OH** representing the hydroxide ion (**OH<sup>-</sup>**) the base donates to the solution. The **M** is cation (**M<sup>+</sup>**) that is left in solution as the hydroxide is donated.  $MOH \rightarrow M^+ + OH^-$ .

### Autoionization:

Even without any acid or base added a very small number of water molecules will form protons (H<sup>+</sup>) and hydroxide ions (OH<sup>-</sup>). The protons will then form **hydronium ions**, the acid ion.

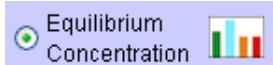


**Procedure:** *PhET Simulations* → *Play With Sims* → *Chemistry* → *Acid-Base Solutions* → [Run Now!](#)

The concentration of the acids and bases used in the [Introduction](#) at 0.010 (10<sup>-2</sup>) Molar.

- Begin with a **strong acid** and lower the pH probe into the beaker. What is the pH of this solution?
- Test this strong acid with both pH paper and the conductivity probe. What color does the pH indicator become? Is this strong acid an electrolyte? Does current travel through this solution?
- Repeat the above tests with the weak acid, the strong base, and the weak base, and water. Collect your observations in the table below:

	Strong Acid	Weak Acid	Strong Base	Weak Base	Water
pH meter read (value)					
pH paper (color)					
Conductivity (bright/dim/none)					

**Procedure:** Custom Solution

This simulation allows you to change the concentration of a strong and weak acid and base.

Complete the table below for some strong acids and bases and weak acids and bases by adjusting the concentration.

**Strong Acids**

Strength	Initial Acid Concentration (mol/L)	[HA] (mol/L)	[A <sup>-</sup> ] (mol/L)	[H <sup>+</sup> ] (mol/L)	pH
Strong	.010 M				
Strong	.050 M				
Strong	.100 M				
Strong	1.00 M				

**Weak Acids**

Strength	Initial Acid Concentration (mol/L)	[HA] (mol/L)	[A <sup>-</sup> ] (mol/L)	[H <sup>+</sup> ] (mol/L)	pH
Weak	.010 M				
Weak	.50 M				
Weak	.100 M				
Weak	1.00 M				

**Strong Bases**

Strength	Initial Acid Concentration (mol/L)	[MOH] (mol/L)	[M <sup>+</sup> ] (mol/L)	[OH <sup>-</sup> ] (mol/L)	pH
Strong	.010 M				
Strong	.050 M				
Strong	.100 M				
Strong	1.00 M				

**Weak Bases**

Strength	Initial Acid Concentration (mol/L)	[B] (mol/L)	[BH <sup>+</sup> ] (mol/L)	[OH <sup>-</sup> ] (mol/L)	pH
Weak	.010 M				
Weak	.050 M				
Weak	.100 M				
Weak	1.00 M				

**Conclusion Questions:**

1. A strong acid is *very concentrated* / *exists primarily as ions*. (circle)
2. A weak base is a *nonelectrolyte* / *weak electrolyte* / *strong electrolyte*.
3. A strong base is a *nonelectrolyte* / *weak electrolyte* / *strong electrolyte*.
4. At the same concentration (Molarity) a strong acid will have a *higher* / *lower* / *the same* pH as a weak acid.
5. As concentration of a weak acid increases, the pH *increases* / *decreases* / *remains constant*.
6. As concentration of a weak base increases, the pH *increases* / *decreases* / *remains constant*.
7. As the concentration of a weak acid increases, the **number of ions** *increases* / *decreases* / *remains constant*.
8. As the concentration of a weak acid increases, **conductivity** *increases* / *decreases* / *remains constant*.
9. As the strength of a weak acid increases, the **proportion of ions to molecules** *increases* / *decreases*.
10. As the strength of a weak acid increases, the **conductivity** *increases* / *decreases* / *remains constant*.

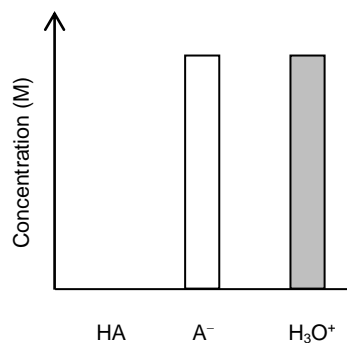
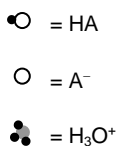
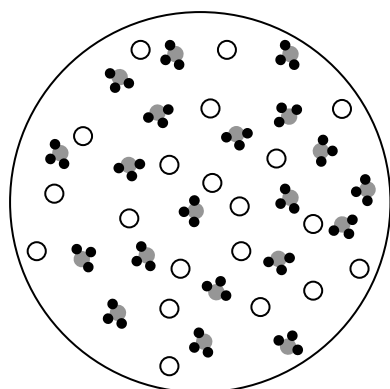
## Strong and Weak Acids

Open the simulation on your computer. Use the 1<sup>st</sup> tab to explore how *strong* and *weak* acids **differ**. List two ways below:

1. \_\_\_\_\_
2. \_\_\_\_\_

*NOTE: In the representations below, HA denotes a generic acid, and the water molecules are not shown.*

**2a.** This picture/graph depicts a **strong acid** solution.



How would the picture/graph change for a **weak acid** solution? *How would the pH change?*

\_\_\_\_\_

**2b.** Draw picture/graph that depicts a **weak acid** solution.

Use the 1<sup>st</sup> tab of the computer simulation to check your understanding.

## Concentration and Strength

How would the picture/graph change for a more dilute **strong acid** solution? *How would the pH change?*

---

**3a.** Draw picture/graph that depicts a more dilute **strong acid** solution.

How would the picture/graph change for a stronger **weak acid** solution? *How would the pH change?*

---

**3b.** Draw picture/graph that depicts a stronger **weak acid** solution.

Use the 2<sup>nd</sup> tab of the simulation to explore the concepts of strength and concentration. How do they compare?

---

How can a *weak acid* solution have the **same pH** as a *strong acid* solution?

---