

Acids and Bases

PART I: THE BASIC SCIENCE

When you dissolve sugar, salt, or lemonade in water, you've made a *solution*. In a solution, one substance (a solute) is dissolved in another one, the solvent. In living things, the solvent is usually water.

An *acid* is a special type of solution. Acids have a sour taste. If you put an acid on a cut, it will sting. Stronger acids can cause burns, and even dissolve metals. Almost all fruit juices and sodas are acidic. Sulfuric acid and hydrochloric acid are two strong acids that you might have heard of.

A *base* is another type of solution. Bases taste bitter. Strong bases have a soapy feel when you touch them. Unlike acids, bases don't dissolve metals, so they can be used to unclog pipes by dissolving the hair and other material that might be clogging them, without dissolving the pipe. Many bleaches and cleaning agents are bases. The word "alkaline" means the same as "basic."

What causes a solution to be acidic or basic? A water molecule, or H_2O , can *dissociate*, or fall apart, to form two charged particles, or *ions*. One ion is called a "hydrogen ion," written as H^+ (pronounced "H-plus"). An H^+ is simply a proton, floating around in a solution. The other ion is written as OH^- (pronounced as "O" "H" minus). The OH^- ion is also called "hydroxide."

Diagram showing dissociation of water into OH^- and H^+



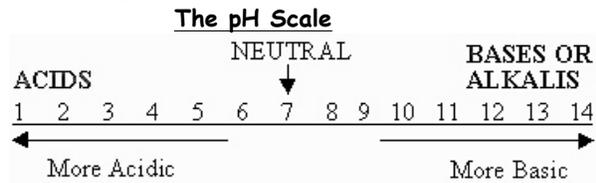
If dissolving something in water causes it to have **more H^+ than OH^-** , then the solution is **acidic**. If the solution has **more OH^- than H^+** , it's a **base**. If the amount H^+ is equal to OH^- , then the solution is *neutral*. Pure water has a pH of 7, but what comes out of the tap is usually a weak acid.

Acidic and basic solutions are measured on the pH (pronounced "P" "H") scale. In the pH scale, the strongest acids are at 1. The strongest bases are at 14. A neutral liquid is 7.

The scale works by powers of 10, so a solution with pH 5 is 10 times more acidic than a solution that is pH 6. A solution that is pH 12 is 10 times more basic than a solution that is pH 11.

Acids and bases are incredibly important to understanding how living things work. One of the most important aspects of homeostasis in any organism is keeping the pH in a cell's cytoplasm, outside the cell, and or in a body compartment (the stomach, or the inside of a blood vessel) within a very specific range. Exceeding that range, even by a little bit, can be harmful or fatal.

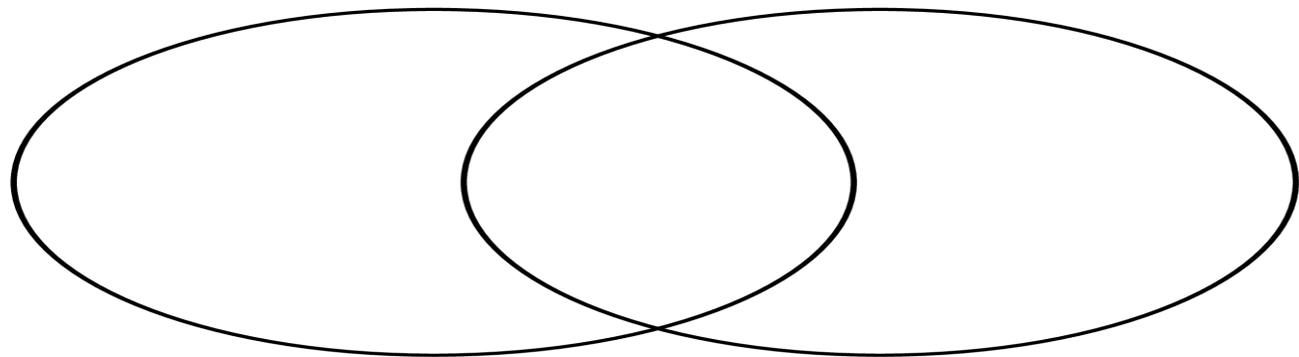
During digestion, the pH of the digestive fluids can vary widely. The stomach's pH can be as low as 1.0: a perfect pH for killing bacteria, and for digesting proteins. In the intestine, pH shifts to slightly basic (about 8).



Part 2: Checking Understanding

1. If it tastes bitter, it's an _____. If it tastes sour, it's a _____.
2. _____ have more H^+ than OH^- . _____ have more OH^- than H^+
3. A solution that could burn your skin and dissolve a paper clip would have to be a (n) _____.
4. A solution that could be used to unclog a metal pipe would be a _____.
5. A solution with pH 4 is a(n) _____.
6. A solution with pH 11 is a (n) _____.
7. A solution with pH 2 is _____ times _____ acidic than a solution with pH 3.
8. Which is a stronger acid: one with pH 4 or one with pH 6? _____
9. The connection between acidity and homeostasis is _____

Part 3: Organize Your Understanding: Complete a Venn Diagram Comparing and Contrasting Acids and Bases



Part 4: Acids, Bases, and pH Lab

Instructions: How to test a solution's pH.

1. Take a small piece of pH indicator paper out of the plastic bag. Tear it in half (you only need a few millimeters of test paper to do the test).
2. Use tweezers to dip the paper into the solution that you're testing.
3. Compare the color to the color index chart to find the pH. *Do not remove the color index card from its protective plastic bag.*
4. Put the used piece of pH in the waste dish.

This is a station lab. Stations with different liquids are arrayed around the room. With your partner, you move to any open station. Move safely and carefully. Avoid spills.

Type of Acid or Base

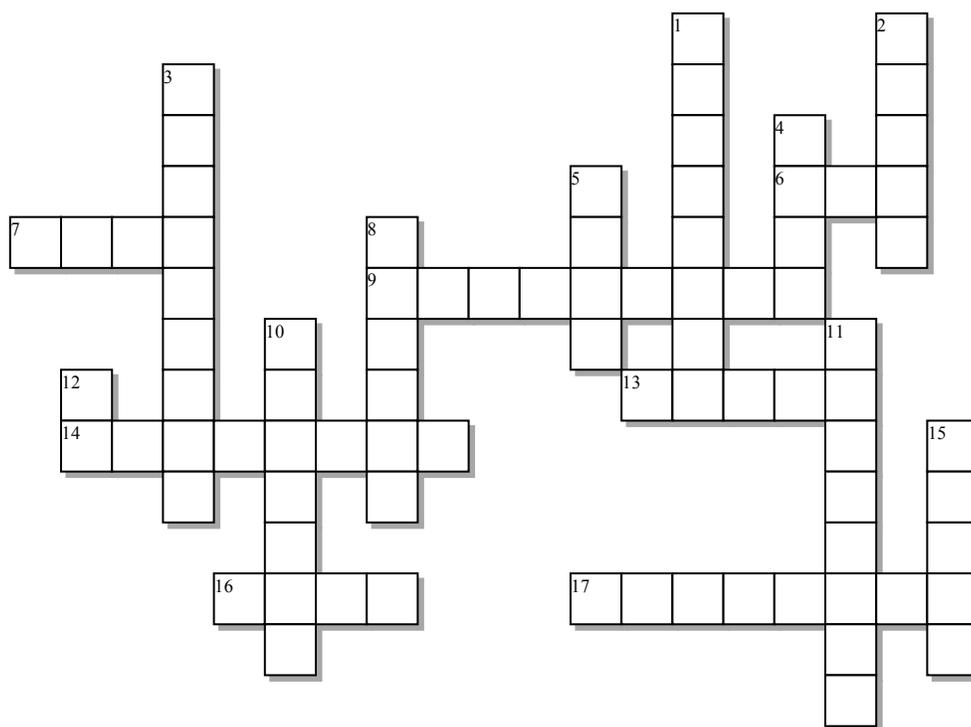
pH	Description	pH	Description	pH	Description
1 - 2	Very acidic	7	Neutral	8-9	Weakly basic
3 - 6	Weakly acidic			10 - 14	Strongly basic

Substance	pH	Label the solution as "strongly acidic", "weakly acidic," "neutral," "weakly basic," "strongly basic"	Does this solution have "More H ⁺ " or "More OH ⁻ "
1. Soapy water			
2. Milk			
3. Club soda/bubbly water			
4. Lemon juice			
5. Coca cola			
6. Vinegar			
7. Baking soda			
8. Tap water			
9. Windex			
10. Ammonia			
11. Salt water			
12. Hydrochloric acid (HCl)			
13. Lye (NaOH), sodium hydroxide			
14. Coffee			
15. Tea			
16. Yogurt (dilute)			

True or False . If the statement is true, mark it as "T". If it's false, mark it as "F," then change it so that it's true.

1. _____ Acids have more hydroxide ions than hydrogen ions
2. _____ If my pipes are clogged, I can pour acid down the drain to solve the problem
3. _____ A solution with pH 7 is more basic than a solution with pH 6.
4. _____ A solution with pH 10 is 2 times more basic than a solution with pH 8.
5. _____ Things that taste bitter are acidic.
6. _____ Most fruit juices are acidic.

Acids, Bases, and the pH Scale



Across:

- 6 - A very strong acid would have this pH
7 - The way acidic drinks taste
9 - A long, tube-shaped organ with a slightly basic pH
13 - This can be dissolved by acids, but not bases.
14 - H⁺: the positively charged ion that results when water dissociates
16 - tastes sour, has a pH below 7
17 - A very strong base would have this pH

Down:

- 1 - Another word for basic.
2 - A substance that is pH neutral has this pH
3 - OH⁻: the negatively charged ion that results when water dissociates.
4 - Acids have _____ hydrogen ions than hydroxide ions.
5 - tastes bitter, has a pH above 7
8 - How basic foods taste.
10 - An organ filled with acid for digesting food.
11 - How bases feel on your skin.
12 - The scale used to measure acids and bases.
15 - What an acid feels like if you get it on a cut.

Possible Answers:

acid, alkaline, base, bitter, fourteen, hydrogen, hydroxide, intestine, metal, more, one, pH, seven, slippery, sour, sting, stomach