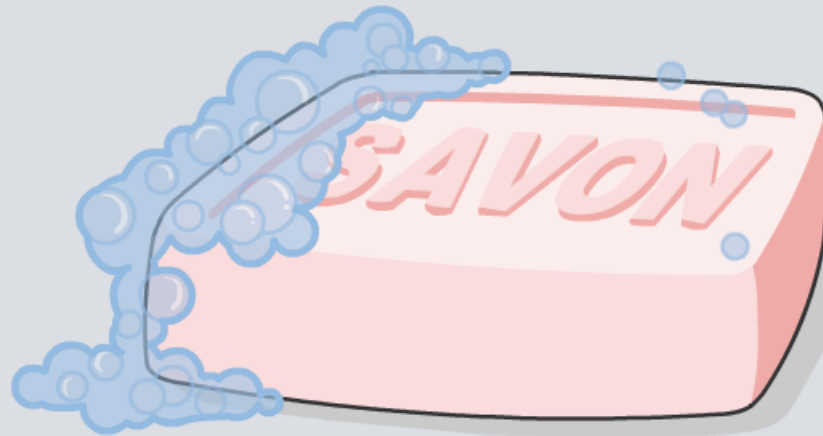


## pH and Indicators

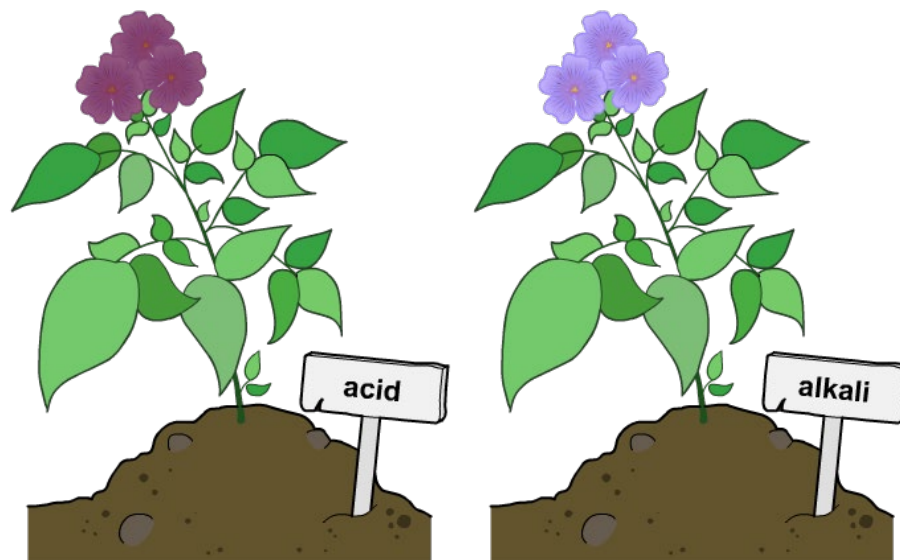


# What are indicators?

**Indicators** are chemicals that change color in the presence of an acid or an alkali.

There are many different indicators. Lots of them come from plants, like red cabbage. Different indicators turn different colors.

Geranium plants grown in acidic soil have red flowers, while geraniums grown in alkali soil have blue flowers.



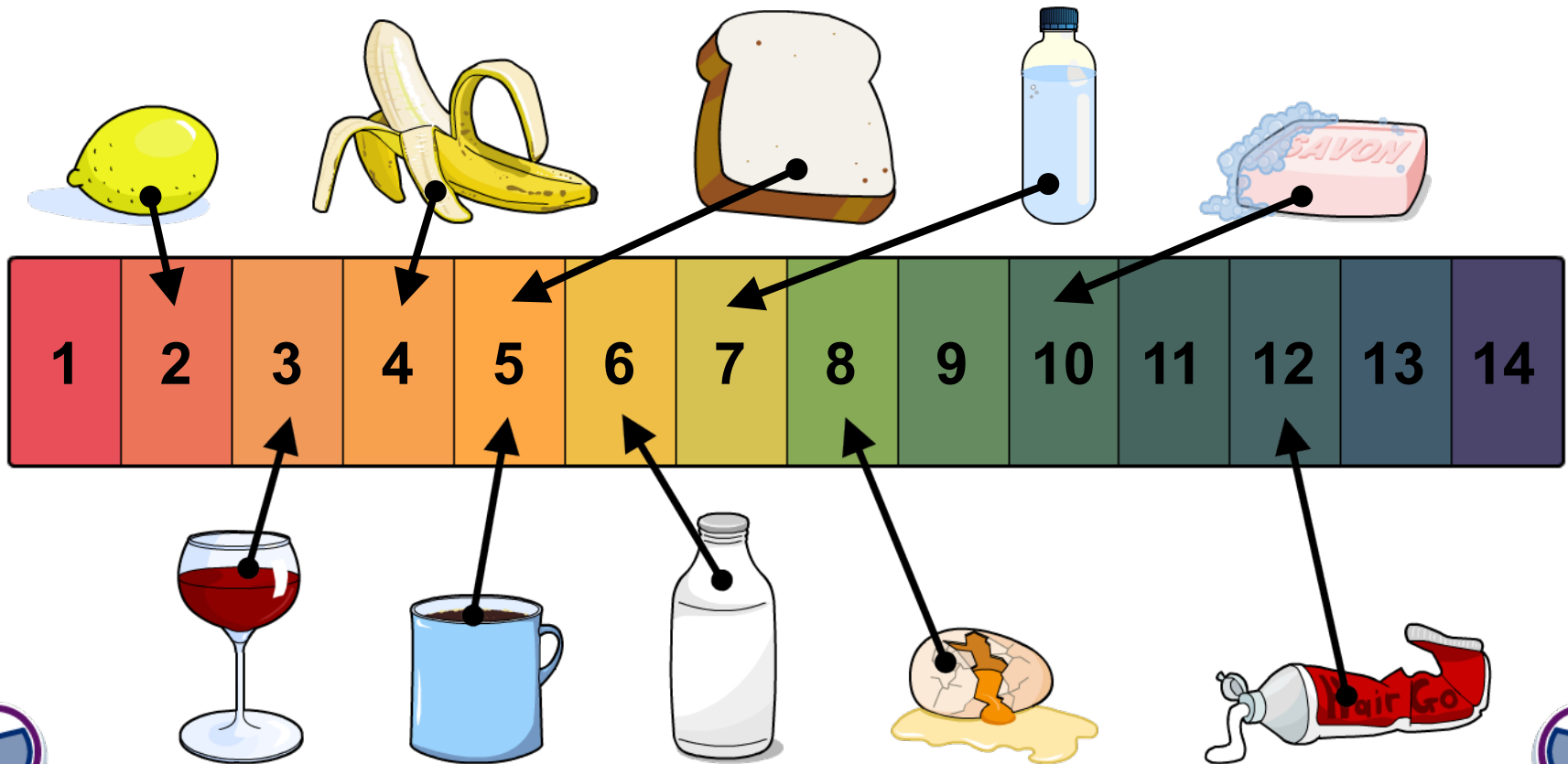
**Universal indicator** is a mixture of indicators. It is useful because it shows a range of colors from pH 1 to pH 14.



# What does the pH scale show?

The pH scale runs from 1 to 14. The numbers 1 to 6 represent acidic conditions, and 8 to 14 represent alkali conditions. A pH value 7 is neutral.

What are the pH values of some everyday items?



# What is the order of pH?



## What is the order of pH of these items?

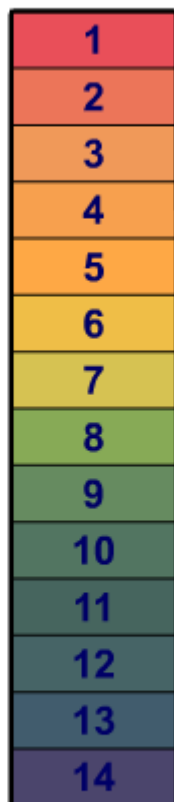
strong acid



neutral



strong alkali



sodium hydroxide

lemon juice

toothpaste

water

stomach acid

sulfuric acid

ammonia



solve



# What are acids?

Acids are substances that:

- have a pH below 7 and turn universal indicator yellow, orange or red
- turn litmus red
- form solutions containing hydrogen ions ( $\text{H}^+$ ).

Hydrochloric acid is a strong acid.

Ethanoic acid (vinegar) is a weak acid.



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Acids can be **strong** or **weak**.

Strong acids **dissociate** fully into solution, so that all their  $H^+$  ions are released into the mixture.

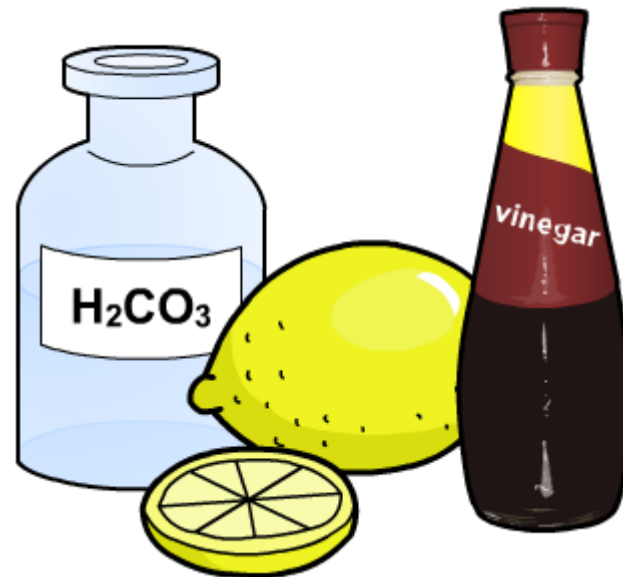


Hydrochloric acid is a typical strong acid, so the dissociation reaction is complete:



Weak acids do not dissociate fully; some of their  $\text{H}^+$  ions stay attached to the acid molecule.

The dissociation of a weak acid in water is a reversible reaction:



Ethanoic acid is a typical weak acid, with its ions in **dynamic equilibrium** with the un-dissociated acid. The reaction is moving both directions at the same rate.



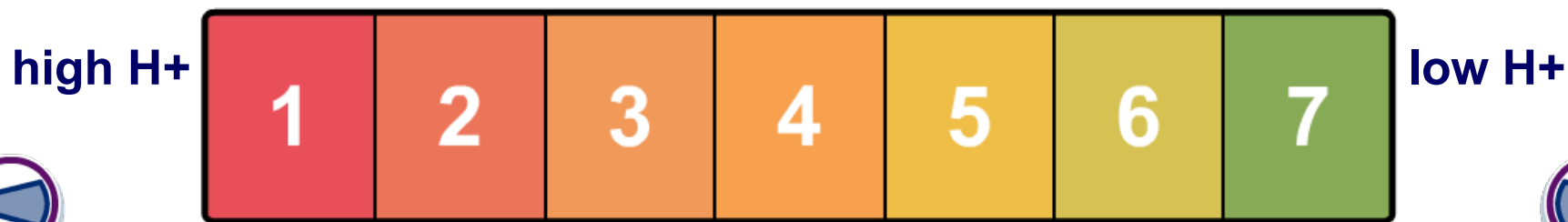
# pH of strong and weak acids

pH is a measure of the number of  $H^+$  ions in solution, with a lower pH meaning more  $H^+$  ions.

Because strong acids dissociate fully in solution, they contain more  $H^+$  ions per molecule of acid, producing a lower pH.

Compared to weak acids of the same concentration, strong acids:

- have lower pH values
- are better conductors of electricity
- react more quickly.





# What are alkalis?

Alkalis are substances that:

- have a pH above 7 and turn universal indicator blue or purple
- turn litmus blue
- can neutralize acids
- form solutions containing hydroxide ions (**OH<sup>-</sup>**).

Sodium hydroxide is a strong alkali.

Ammonia is a weak alkali.

When ammonia is dissolved in water, it forms ammonium hydroxide ( $\text{NH}_4\text{OH}$ ), a fertilizer.

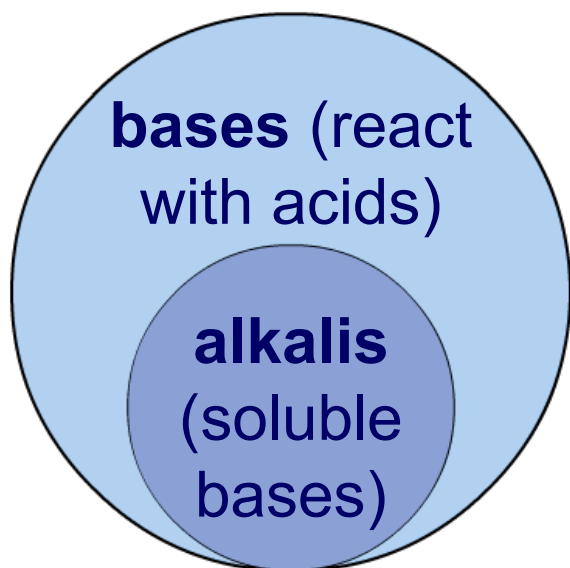


# What are bases?

All alkalis are **bases**. Bases are substances that react with acids by absorbing hydrogen ions ( $\text{H}^+$ ).

The oxides, hydroxides and carbonates of metals, such as sodium hydroxide, are bases.

Ammonia is a base that does not contain a metal.



Some bases are soluble in water – these are called **alkalis**.

All alkalis contain hydroxide ions ( $\text{OH}^-$ ). The more  $\text{OH}^-$  ions in the solution, the stronger the alkali.



# Properties of strong and weak alkalis

Alkalis can be classified as strong and weak in the same way as acids. A strong alkali, such as sodium hydroxide, fully dissociates in solution.



A weak alkali, such as ammonia, does not fully dissociate, and some of the  $\text{OH}^-$  ions are not released into solution.



Comparable levels of ion dissociation mean that strong and weak alkalis have similar properties to strong and weak acids.



# Acids and bases – true or false?

