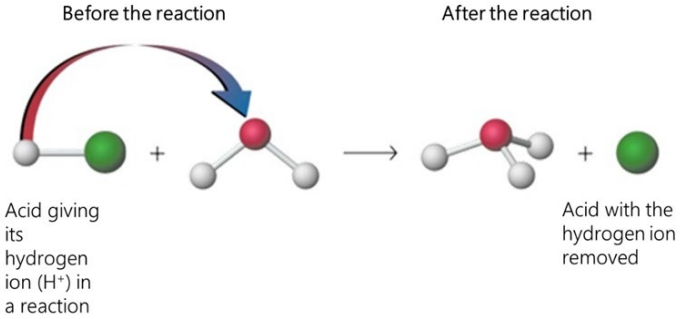
Acids – their characteristics

Acids are a family of substances which all show **acidic characteristics** or properties. These properties relate to how the acids react with other chemicals. They have a **sour taste** and react with metals. Acids can be found in nature and called **organic acids** or manufactured in the laboratory and called **mineral acids**.

Name	Chemical formula
Hydrochloric Acid	HCl
Sulfuric Acid	H_2SO_4
Nitric Acid	HNO_3



All acids contain hydrogen. When an acid reacts, it gives away its **Hydrogen ion** (H^+), which is just a proton, and the electron remains behind.

Bases – their characteristics

Bases are a family of Chemicals that have hydroxide ions present (OH^-). They have opposite properties from acids. Common Household bases include floor clearers and antacid tablets to fix indigestion. A Base that dissolve into water is called an **alkali**.

Name	Chemical formula
Sodium Hydroxide	NaOH
Calcium carbonate	$CaCO_3$
Ammonia	NH_3
Potassium hydroxide	KOH

Bases include metal oxides (MO), metal hydroxides (MOH), metal carbonates (MCO_3) and metal hydrogen carbonates ($MHCO_3$) with M = metal

Indicators determine whether substances are acid, base or neutral.

Indicators can be used to determine the pH of a solution by the colour change. An indicator is a large organic molecule that works like a "colour dye". They respond to a change in the hydrogen ion concentration. Most of the indicators are themselves weak acids. The most common indicator is found on **litmus paper**. It turns/remains red for acid and turns/remains blue for a base. **Universal Indicator**, which is a solution of a mixture of indicators that provide a full range of colours for the pH scale.

Red and Blue Litmus paper works as an indicator

Added to...	Blue Litmus	Red litmus
Acid solution	Turns red	Stays red
Base solution	Stays blue	Turns blue
Neutral solution	Stays blue	Stays red

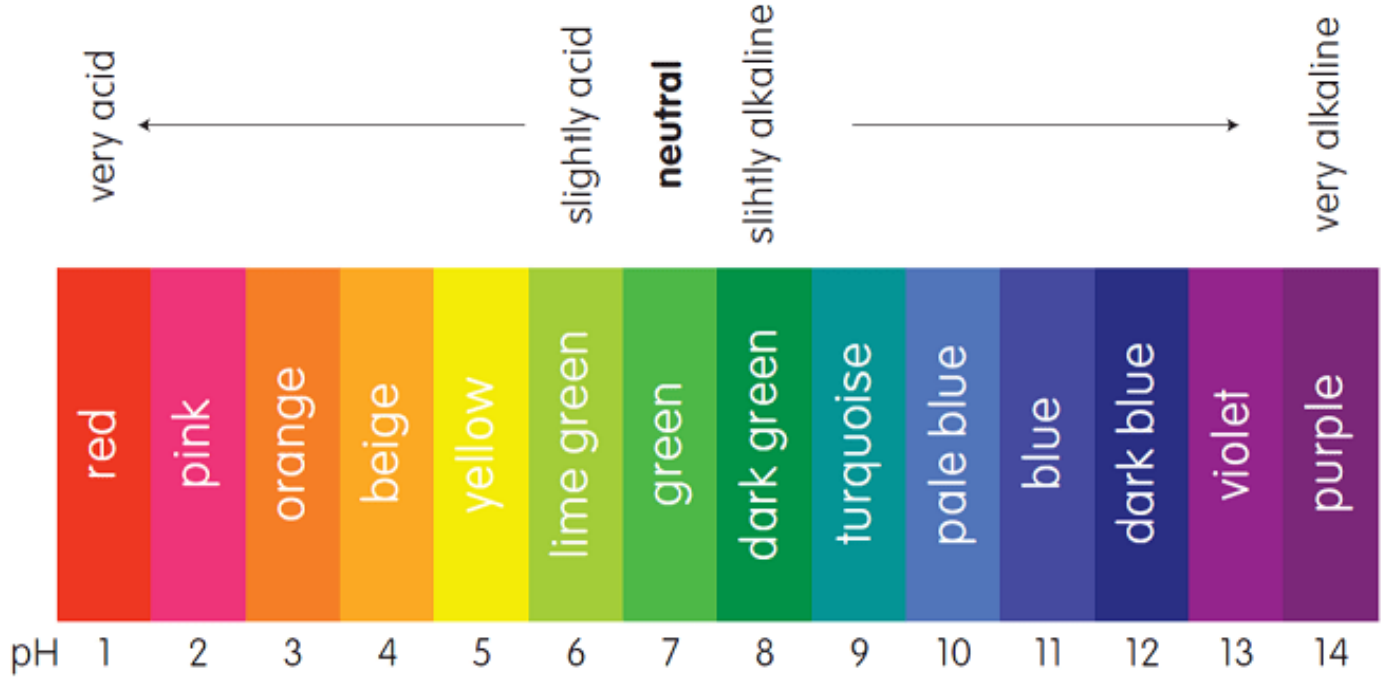
Blue litmus paper turning red in acid

Red litmus paper turning blue in base

Universal Indicator is used to give the strength of the acid or base

The Universal Indicator is like the Litmus paper in that acid turns the indicator mostly red and the bases turn the indicator mostly blue.

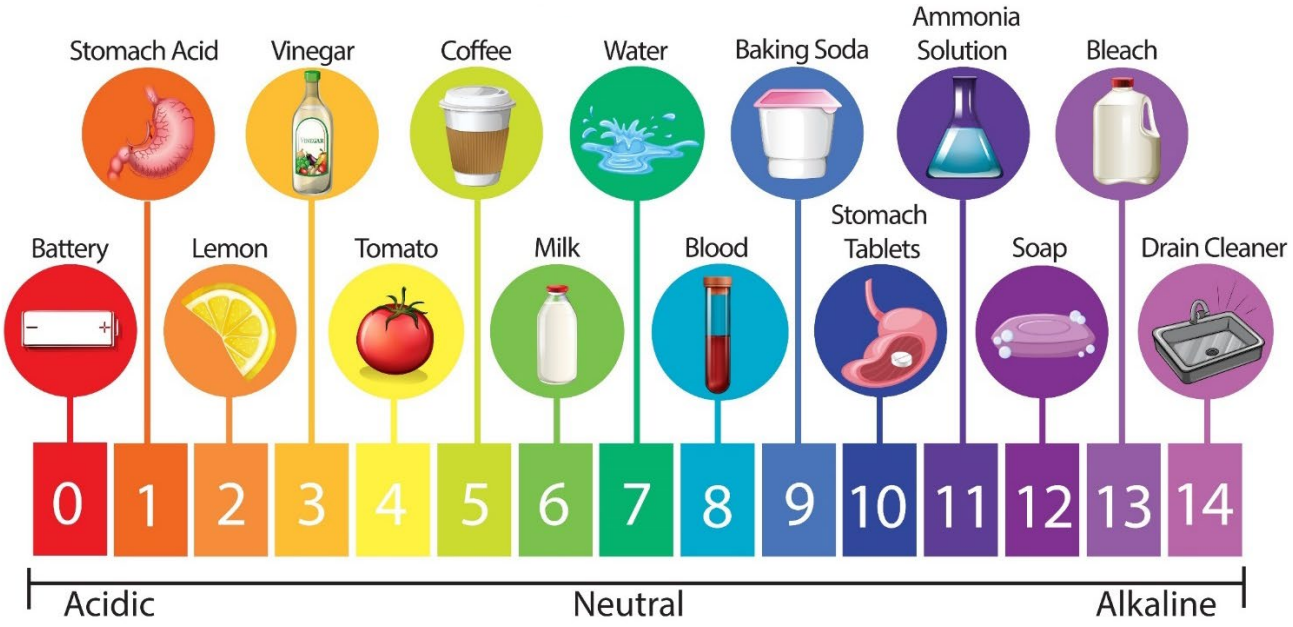
It does have an advantage over the litmus paper, as it shows neutral by having a green colour and has different colours for weak acids and weak bases.



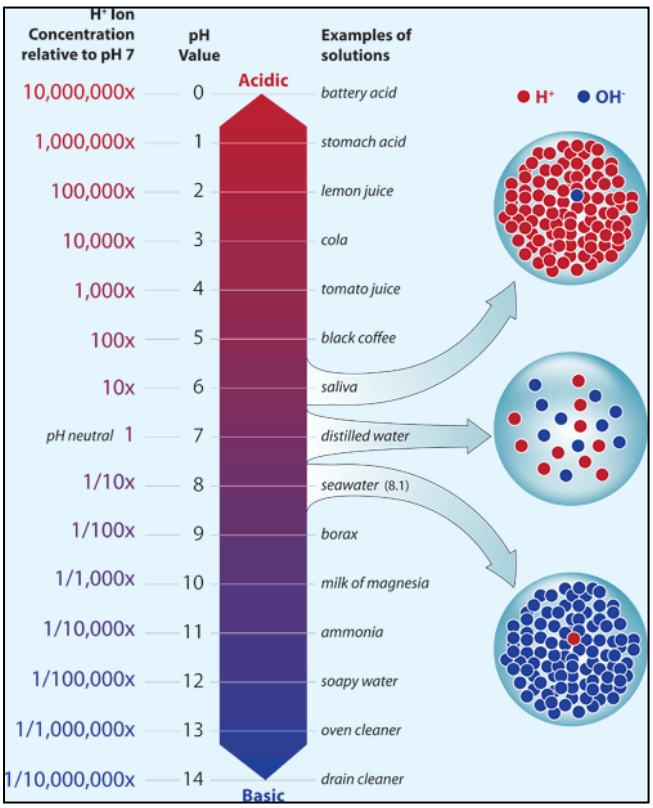
The pH scale measures level of acidity and alkalinity

The **pH scale** measures how acidic or alkaline a substance is. Substances with a pH of 7 are **neutral**, substances with a pH greater than 7 are **alkaline** (or 'basic') and substances with a pH lower than 7 are **acidic**. Remember alkalis are 'bases' that are soluble in water. (All alkalis are bases but not all bases are alkalis.)

The pH of a substance is determined by the concentration of hydrogen ions. The higher the concentration of hydrogen ions the lower the pH. A scale from 0-14 is used to indicate how acid or base a substance is.



The pH scale is **logarithmic** and as a result, each whole pH value below 7 is ten times more acidic than the next higher value. For example, pH 4 is ten times more acidic than pH 5 and 100 times more acidic than pH 6.



Substances with a pH of 7 are **neutral**, substances with a pH greater than 7 are **alkaline** (or 'basic') and substances with a pH lower than 7 are **acidic**. Remember alkalis are 'bases' that are soluble in water. (All alkalis are bases but not all bases are alkalis.) **The pH of a substance is determined by the concentration of hydrogen ions compared to hydroxide ions.** The higher the concentration of hydrogen ions the lower the pH.

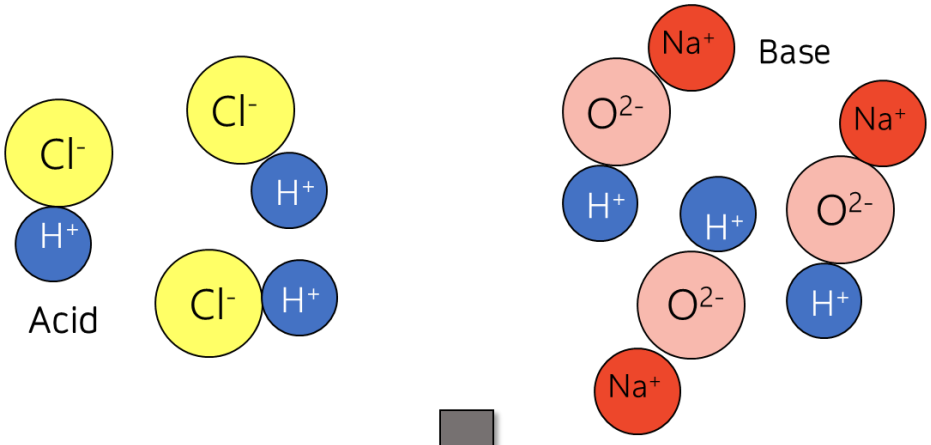
You can define acids and bases as being "strong" or "weak". **Strong acids** are compounds release a large amount of H^+ ions. A **weak acid** releases much less H^+ ions.

You can define bases as being "strong" or "weak". **Strong bases** are compounds where they release a large amount of OH^- ions. A **weak base** is a compound where there are much less OH^- ions released. Most weak base molecules remain unreacted.

1. Give the formula for these common acids and bases

Name	Chemical formula	Name	Chemical formula
hydrochloric acid		sodium hydroxide	
sulfuric acid		magnesium carbonate	
nitric acid 		ammonia 	

2a. Complete the particle diagrams to show a balanced neutralisation reaction when an acid and alkali (base) react together



2b. Which ion is being donated by the acid to the base?

2c. Which ion is created when the alkali reacts?

2d. What is the name and formula of the salt formed?

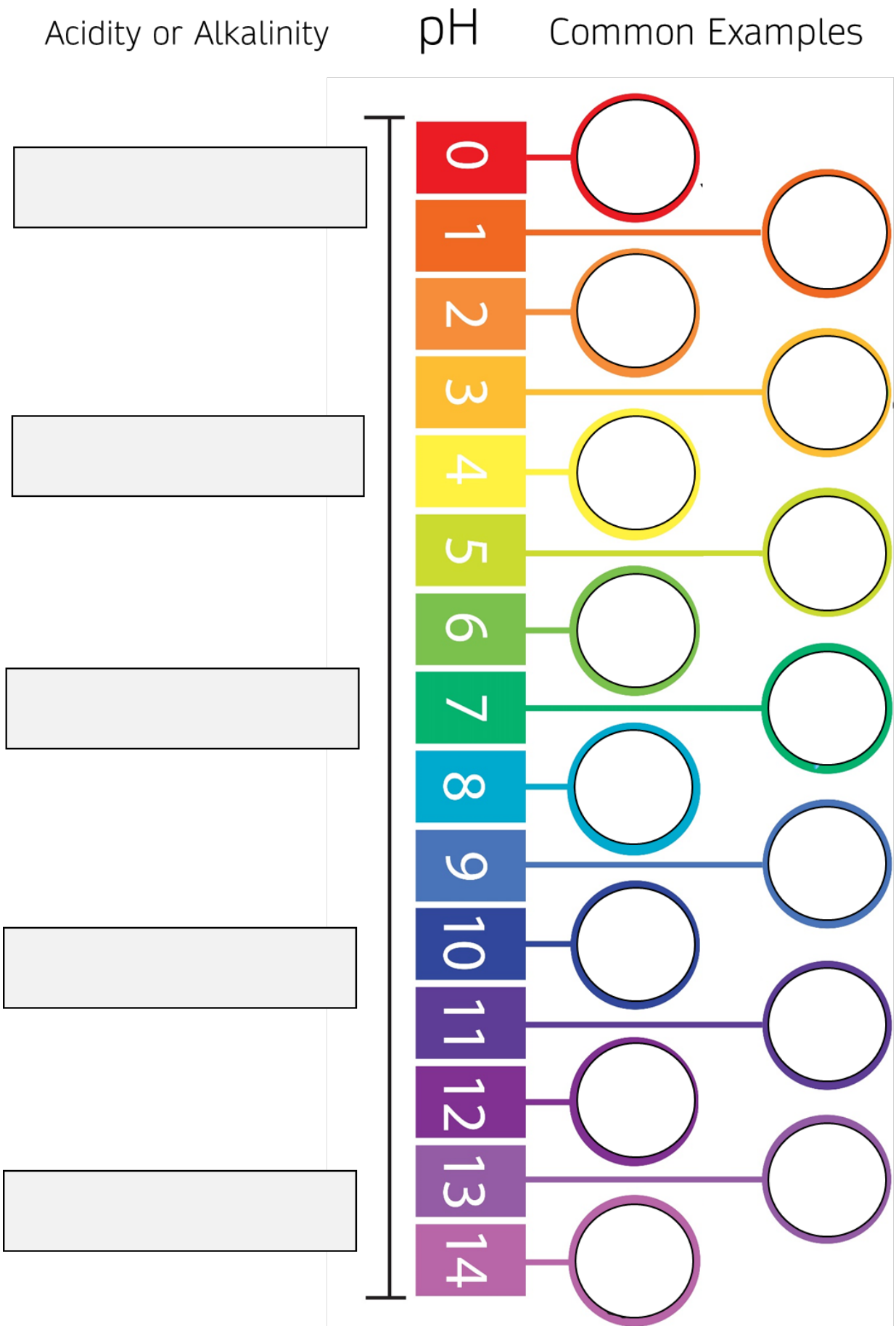
3. Complete the chart to describe the colour change of the litmus paper in each solution

Added to...	Blue Litmus	Red litmus
Acid solution		
Base solution		
Neutral solution		

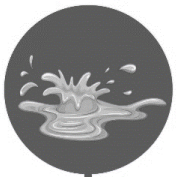
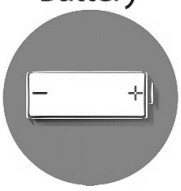
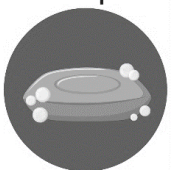
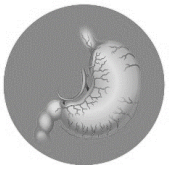
4. Fill-in in the chart below to match the correct indicator colour and complete the summary chart.

Summary of acids and bases Indicators, pH, description and ion concentration														
Blue litmus														
Red litmus														
Universal indicator														
pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Description								Weak base / alkali Accepts only a small proportion of H+ ions						
Examples of solutions found in the school Lab							Ethanoic acid (vinegar)	Sodium chloride				Sodium carbonate		
H^+ / OH^- ions								Concentration of H^+ ions is the **same** as that of OH^- ions						

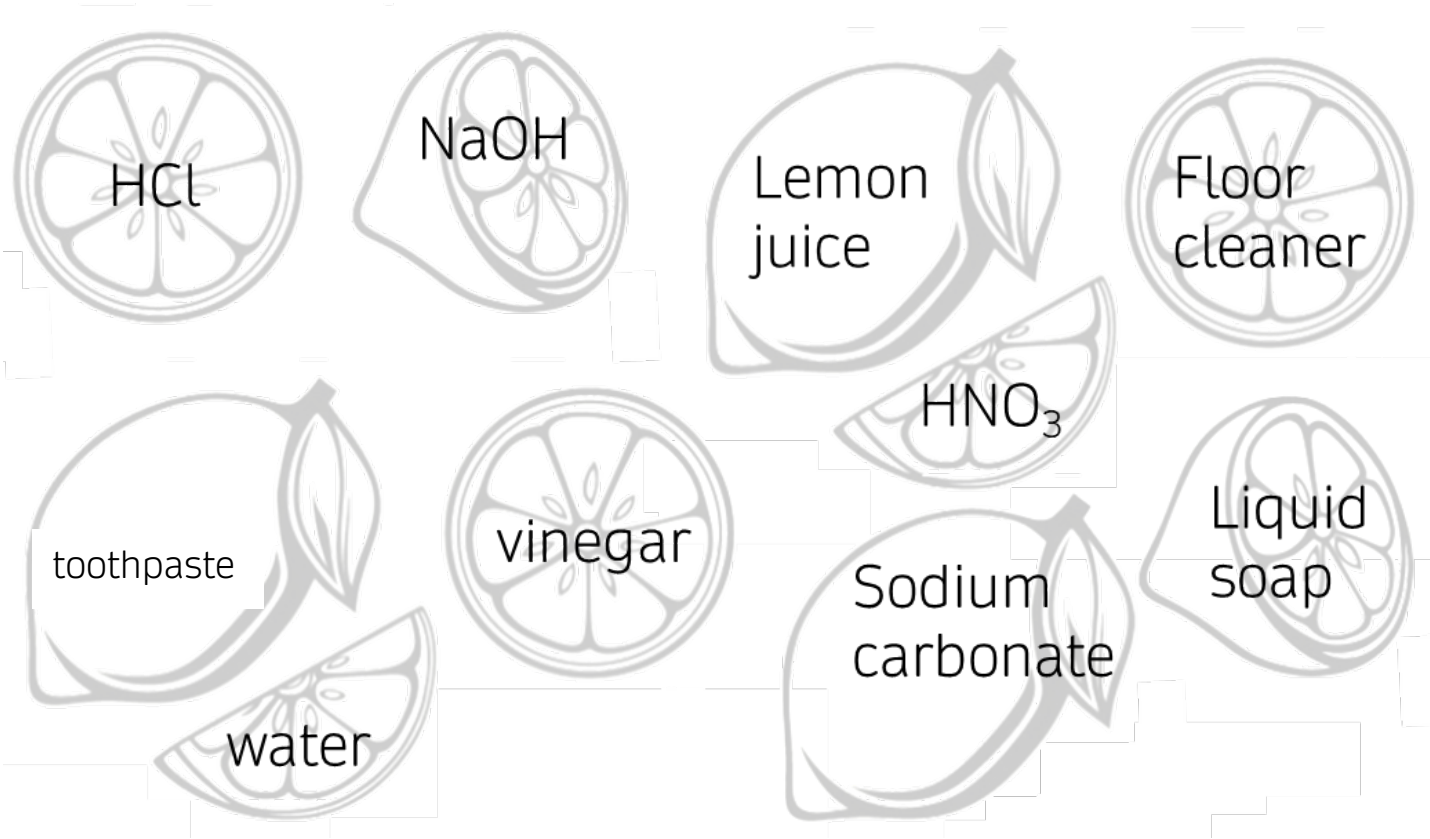
5. Cut and paste (or draw) the matching the common household substances to their correct pH/ Universal Indicator colour – and describe each pH area as strong/weak, acid/alkaline or neutral

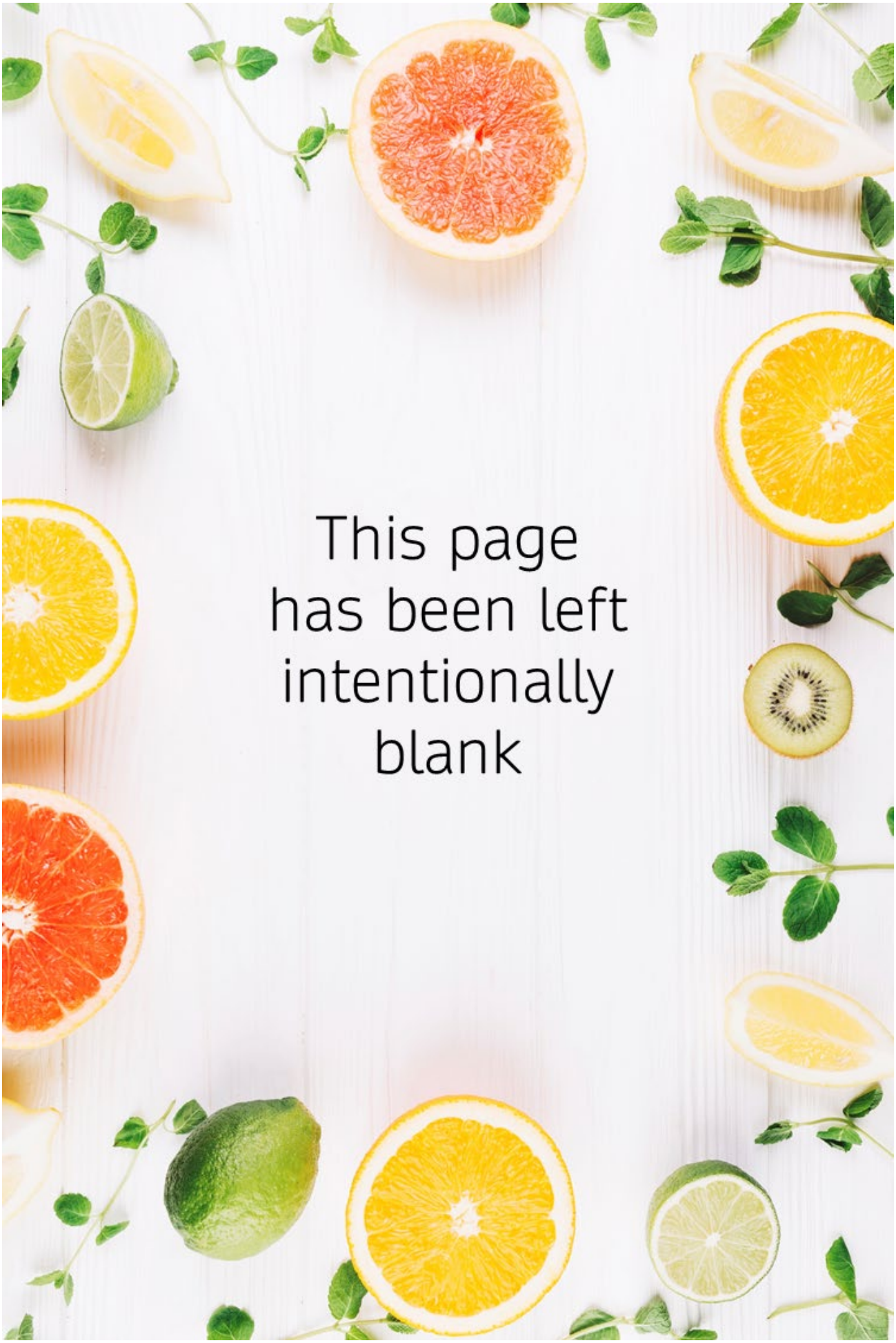


Cut for activity 6.

Water 	Coffee 	Baking Soda 	Bleach 	Battery 
Lemon 	Ammonia Solution 	Tomato 	Milk 	Stomach Tablets 
Drain Cleaner 	Vinegar 	Blood 	Soap 	Stomach Acid 

Cut shapes for activity 7




This page
has been left
intentionally
blank

7. Making Red Cabbage Indicator

Directions:

To make the indicator solution:

1. Cut a wedge of red cabbage into small pieces. Half fill a large beaker with the cabbage and cover with water.
2. Place the beaker on a heating element and bring the solution to a boil and then turn off the heat. Let it sit for about 30 minutes to cool down.
3. Decant the cabbage water into another beaker. The dark purple solution is the indicator.

pH Experiment:

1. Cut up the lemon shapes from previous page
2. Half fill 8 test tubes with indicator and into each one add a few drops of a solution written on the lemon shape. Mix until colour change (or no colour change) seen
3. Soak the appropriate paper shape in solution and leave on flat surface to dry.
4. Glue dried paper shapes onto space below