ACIDS AND BASES

BY ELLY KENEDDY NALITSO

0708838163- 0779031329

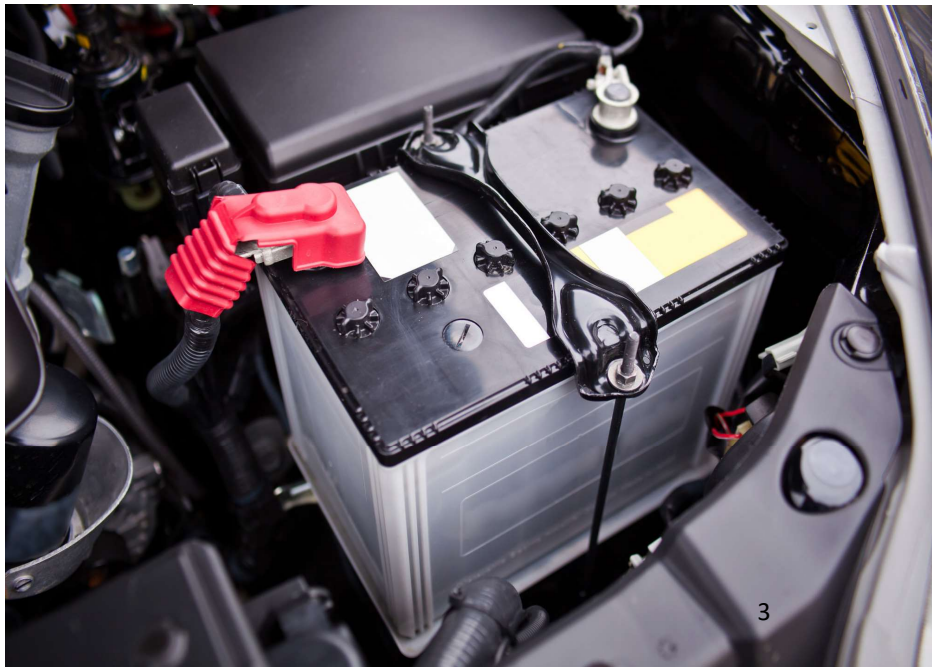
LEARNING OUTCOMES

The learner should be able to:

- ❑recognize that locally available materials and substances are either acidic or alkaline (k)
- ❑understand the concept of pH as a measure of the strength of acids and alkalis (u)
- ❑understand the reaction between acids and alkalis (u, s)

INTRODUCTION

- Have you ever tasted raw mangoes, oranges, okra, or neem leaves?
- To many people, the word acid is associated with the liquid used in car batteries.
- This is known to recharge the **battery** and cause skin burns .
- The word acid comes from the Latin word **acidus** which means **sour**



ACIDS

An acid is a substance which when dissolved in water produces hydrogen ions as the only positively charged ions

Some acids occur naturally in plants and animal and these include **methanoic** acid in bee and ant stings

- **Ethanoic** acid – found in vinegar and tomato juice
- **Citric** acid – found in citrus foods like lemons, oranges and grapefruit
- **Lactic** acid – found in sour milk and yoghurt, and in muscle respiration
- **Tartaric** acid – found in grapes
- **Tannic** acid – found in tea and ant's body
- **Formic** acid – found in bee stings

CONT……

- Proteins are also made up of **amino** acids while apples and other fruits contain vitamin C called **ascorbic** acid
- **Hydrochloric** acid – found in stomach juices

Properties of Acids

- Acids have a sour, sharp taste e.g. lemons are sour due to citric acid
- Acids change the colour of indicators
- Acids turn common indicator litmus – blue litmus to red
- Acids react with metals

USES OF ACIDS

- Sulphuric acid is used in car batteries
- Manufacture of ammonium sulphate for fertilizers
- Manufacture of detergents, paints, dyes, artificial fibers & plastics
- Hydrochloric acid can remove rust (iron(III) oxide) which dissolves in acids
- Acids are used in preservation of foods (e.g. ethanoic acid)

BASES AND ALKALIS

- Bases are oxides or hydroxides of metals and react with an acid to from a salt and water only
- Alkalis are bases which are soluble in water
- Most vegetables such as spinach, Amaranthus and hibiscus contain alkalis, tooth paste is an example of alkali.
- Name the **10** alkaline foods.

CONT……

Laboratory Alkalis -Sodium Hydroxide (NaOH) ,Aqueous Ammonia (NH_4OH)

Calcium Hydroxide, $Ca(OH)_2$

- All alkalis produce hydroxide ions (OH-) when dissolved in water. Hydroxide ions give the properties of alkalis. They don't behave as acids in absence of water.
- Alkalis are therefore substances that produce hydroxide ions, OH-(aq), in water.


Sodium Hydr
CORROSIVE
Ammonium Hydrox
CORROSIVE
Potassium Hydroxi
CORROSIVE

PROPERTIES OF ALKALIS

- Alkalis have a slippery feel
- Alkalis are hazardous
- Dilute alkalis are irritants
- Concentrated alkalis are corrosive and burn skin (caustic (i.e. burning) alkalis)
- Alkalis change the colour of indicators

USES OF ALKALIS

- Alkalis neutralize acids in teeth (toothpaste) and stomach (indigestion)
- Soap and detergents contain weak alkalis to dissolve grease
- Floor and oven cleaners contain sodium hydroxide (strong alkalis)
- Ammonia (mild alkalis) is used in liquids to remove dirt and grease from glass


ALKALINE FOODS
RawForBeauty
Beet Greens
Pumpkin
Chard Greens
Spirulina
Dandelions
Sea Veggies
Broccoli
Watercress
Alfalfa
Radishes
Celery
Mustard Greens
Cabbage
Edible Flowers
Collard Greens
Tomatoes
Cucumber
Chlorella
Kohlrabi
Sprouts
Wheat Grass
Wild Greens
Spinach
Dulce
Carrot
Lettuce
Cauliflower
Peppers
Garlic
Barley Grass
Kale

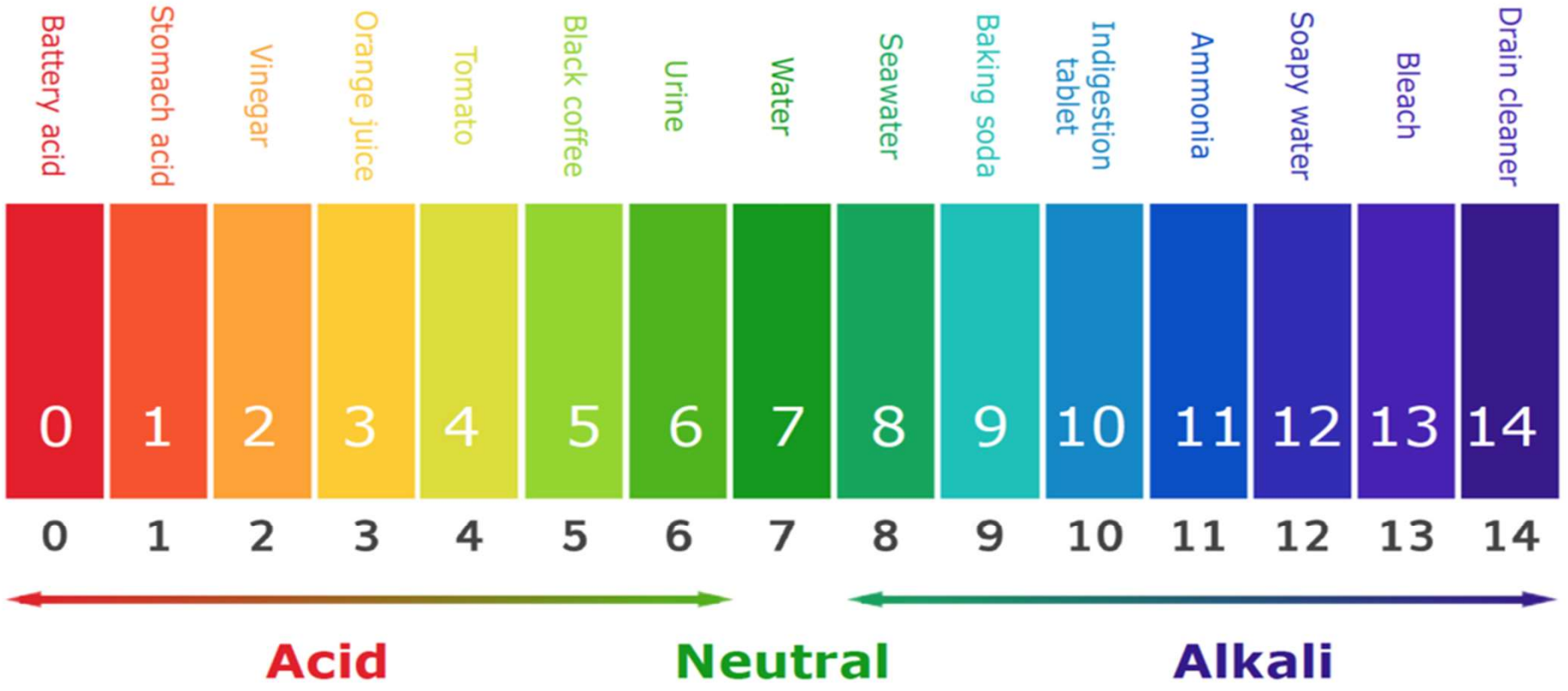
INDICATORS. (INTRO)

- What is an indicator?
- What is the use of the indicator ?

INTRODUCTION

- Acids and bases can be identified by identifying their taste however, some substances are **poisonous**.
- There fore it is not safe to identify whether substances are acidic , alkaline or neutral through tasting. Therefore **indicators are used** to identify whether substances are acidic or alkaline.
- An indicator is a substance that shows a **definite colour** in **acidic** medium and another definite colour in **alkaline** medium
- Indicators are used to determine the PH of compound and solutions
- pH is the acidity or alkalinity of a substance. The pH scale ranges from 0 to 14.

- Solution with pH 7 are neutral, those with a pH less than 7 are acidic and those greater than 7 are alkaline.



COMMON INDICATORS USED IN THE LAB

Litmus

- Methyl orange
- Phenolphthalein

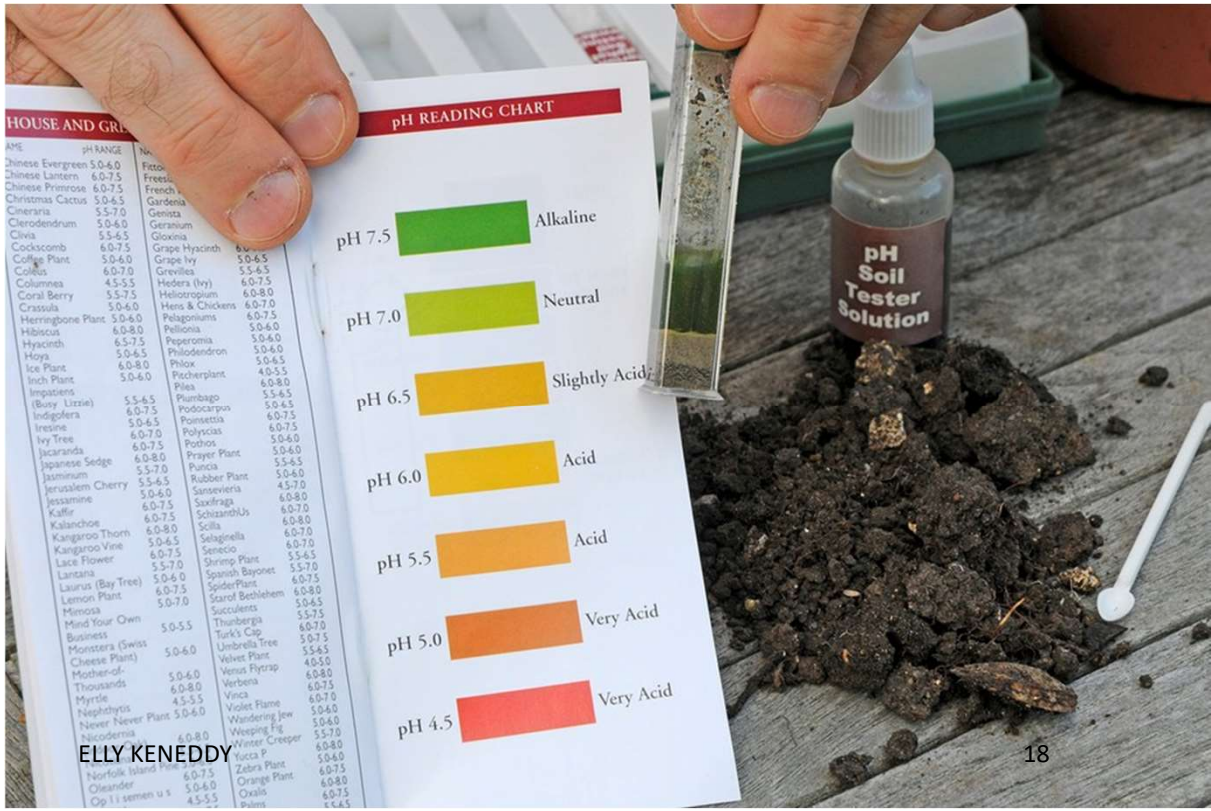
The table shows the change of colours made by some indicators

Indicator	Colour in acids	colour changes at pH	Colour in alkalis
Phenolphthalein	Colourless	9	Pink
Methyl orange	Red	4	Yellow
Litmus	Red	7	Blue
Screened methyl orange	Red	4	Green
Bromothymol blue	Yellow	7	Blue

MEASURING PH OF A SOLUTION

Universal indicators

- It can be in paper or solution form. Universal paper can be dipped into a solution then pH found is matched with the colour chart. It gives approximate pH value



MAKING A UNIVERSAL INDICATOR LOCALLY

Materials Needed

- ❖Red cabbage or petals of blue morning glory\hibiscus\red bougainvillea
- ❖Knife
- ❖Blender or food processor or mortar
- ❖Boiling water
- ❖Strainer or coffee filter
- ❖Containers for the indicator solution

PROCEDURE

- **Prepare the Cabbage:**

✓Chop the red cabbage into small pieces. The smaller the pieces, the more surface area there is for the extraction.

- **Blend the Cabbage:**

✓Place the chopped cabbage in a blender or food processor. Add a small amount of water to help with blending.

✓Blend until you get a mushy consistency.

- **Extract the Juice:**

- Transfer the blended cabbage into a heat-safe container.
- Pour boiling water over the cabbage mush, enough to cover it completely.
- Let it steep for about 10-15 minutes. This helps to extract the pigments from the cabbage.

- **Strain the Mixture:**

- After the mixture has cooled, strain it through a strainer or coffee filter into a clean container. The liquid you collect is your red cabbage indicator

Testing the Indicator:

- Pour a small amount of the red cabbage indicator into different test containers.
- Add a few drops of various household solutions (like vinegar, baking soda solution, lemon juice, soap, etc.) to each container.
- Observe and note the color change to determine the approximate pH of each solution

Using the Indicator:

- The red cabbage indicator will change colors depending on the pH of the substance it comes into contact with.
- **Acidic Solutions (pH < 7):** Red to pink
- **Neutral Solutions (pH = 7):** Purple
- **Basic Solutions (pH > 7):** Blue to green to yellow

COMMERCIAL ACID-BASE INDICATORS

- When indicators prepared from plant materials are stored in the laboratory for future use, they keep changing in composition and properties as time goes on. These changes give inconsistent results.
- Due to this, commercial indicators are used because they give consistent results
- The common commercial indicators used include: **methyl orange, phenolphthalein indicator, litmus paper and universal indicator**
- Universal indicator gives precisely more accurate results

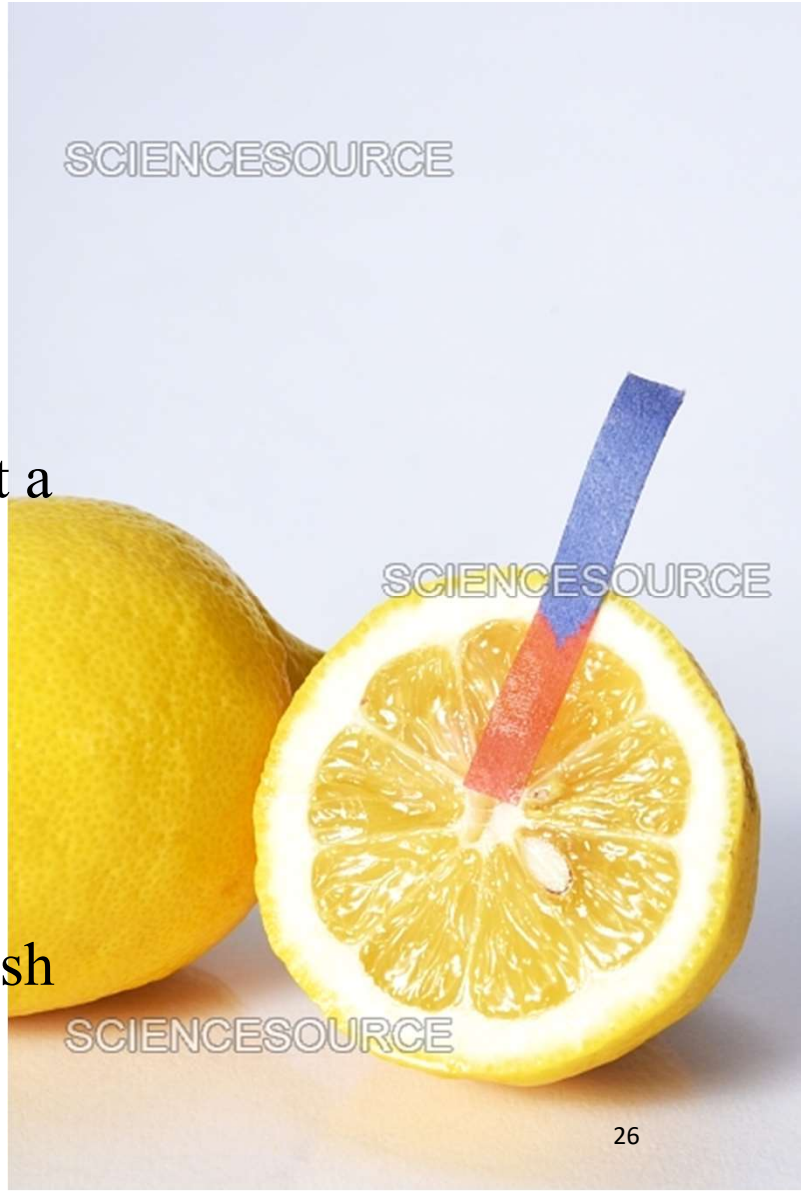
INVESTIGATING THE EFFECT OF DIFFERENT SUBSTANCES ON LITMUS PAPER

Materials

- Litmus paper(blue and red)
- Beaker
- Diluted liquid soap
- Tea leaves
- Water
- Wood ash solution
- Lemon juice
- Soda ash solution

METHOD

- Measure 2cc of lemon juice and pour it in a glass beaker
- Dip blue and red litmus paper in the solution one at a time
- Record your observation in the table
- Repeat the above procedures using Diluted liquid soap, Tea leaves, Water, Wood ash solution, Soda ash solution




Johnson
TEST PAPERS
Litmus Blue Indicator Paper
Litmus Blue Indicator Paper
Litmus Blue Indicator Paper
Litmus Blue Indicator Paper
Litmus Blue Indicator Paper


75
50
25
alamy

Blue litmus turns red

Red litmus turns blue

PH AROUND US

- Substances in body involved in good digestion have different pH values
- Blood to heart and lungs contains carbon dioxide making blood slightly acidic
- Acids are used in food preservations (ethanoic acid to preserve vegetables; benzoic acid used in fruit juices, jams and oyster sauce)
- pH affects plant growth – some plants grow in acidic soil; some need alkaline soil
- When hair is cleaned with shampoo which is alkali to dissolve grease, hair can be damaged unless it's rinsed or acid conditioner is used to neutralize excess alkali

STRONG AND WEAK ALKALIS

- **Strong base** - Base that completely ionizes in water to form hydroxide, $OH^-_{(aq)}$ ions. Examples. Sodium hydroxide, potassium hydroxide and calcium hydroxide.

Their reactions are irreversible. E.g. NaOH, KOH, $Ca(OH)_2$

$$Ca(OH)_{2(s)} \rightarrow Ca^{2+}_{(aq)} + 2OH^-$$

- **Weak base** - Base that partially ionizes in water. The remaining molecules remain unchanged as a base. Their reactions are reversible. E.g. NH_3

$$NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$$

STRONG AND WEAK ACIDS

- Acids are grouped into **weak** and **strong** acids.
- An acid is termed as strong or weak depending on its ease to release its hydrogen ions.
- **Strong** acids – They are those which are completely ionised in aqueous solution and they are strong electrolytes.
- All mineral acids are strong acids. Their reactions are irreversible. E.g. **Sulphuric** acid ,**Hydrochloric** acid **Nitric** acid

$$H_2SO_4\ (aq) \rightarrow 2H^+(aq) + SO_4^{2-}(aq)$$

- Weak Acids - acids that partially ionise in water. The remaining molecules remain unchanged as acids.
- They are weak electrolytes. Their reactions are reversible. E.g. Ethanoic acid (CH_3COOH), carbonic acid (H_2CO_3), phosphoric acid (H_3PO_4)

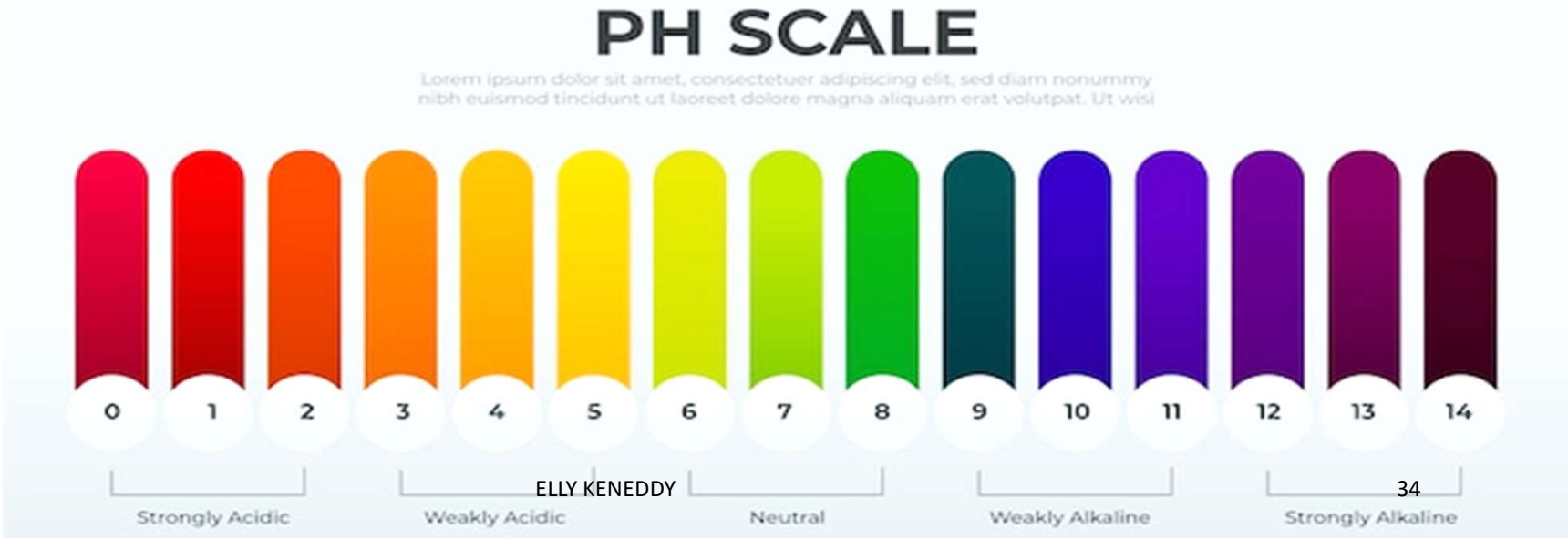
Equation

$$H_3PO_{4(aq)} \rightleftharpoons 3H^+_{(aq)} + PO_4^{3-}{}_{(aq)}$$

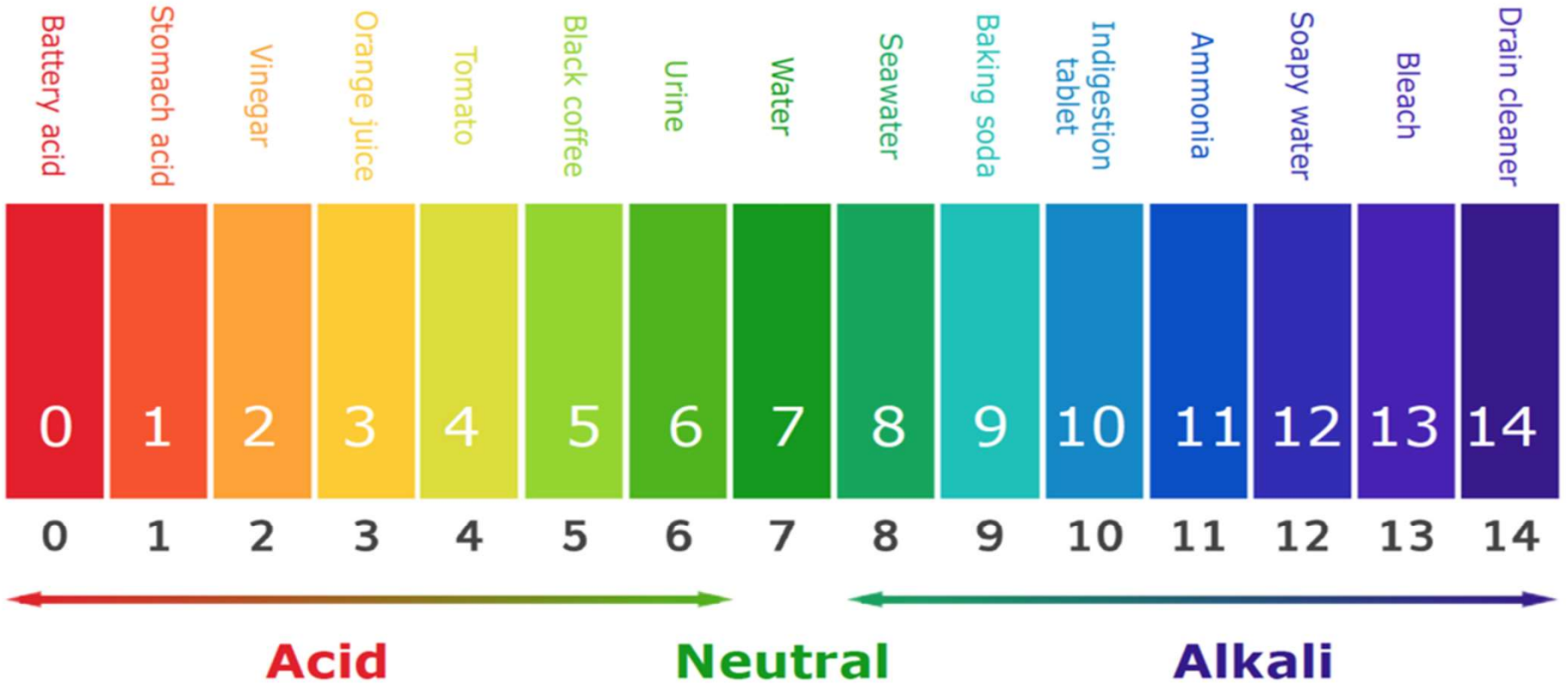
TESTING FOR STRENGTH OF ACID & ALKALIS

- Universal indicator solutions are the most useful indicator. It shows a series of colour changes as the acidity or alkalinity of a solution changes.
- Add 2 or 3 drops of universal indicator to test the various solutions.

- The pH scale is a scale of numbers from 0 to 14 used to express the degree of acidity or alkalinity of a substance.
- The pH number of water and other neutral substances is 7.
- Acidic solutions have a pH number less than 7, as the number decreases acidity increases.
- Alkaline solutions have a pH number of 8-14.The increase in number indicates increasing alkalinity.



- Solution with pH 7 are neutral, those with a pH less than 7 are acidic and those greater than 7 are alkaline.



NOTE

- The Ph scale reflects the amount of free hydrogen ions and hydroxide ions in a solution. The more the hydrogen ions, the more acidic the solution and the lower the Ph however the more the hydroxide ions , the more alkaline the solution and the higher the alkalinity of the solution.
- Strong commercial acids(mineral acids) have a Ph less than 4 e.g. nitric, hydrochloric and sulphuric acids.
- Strong bases like sodium hydroxide and potassium hydroxide have Ph values which are above 11

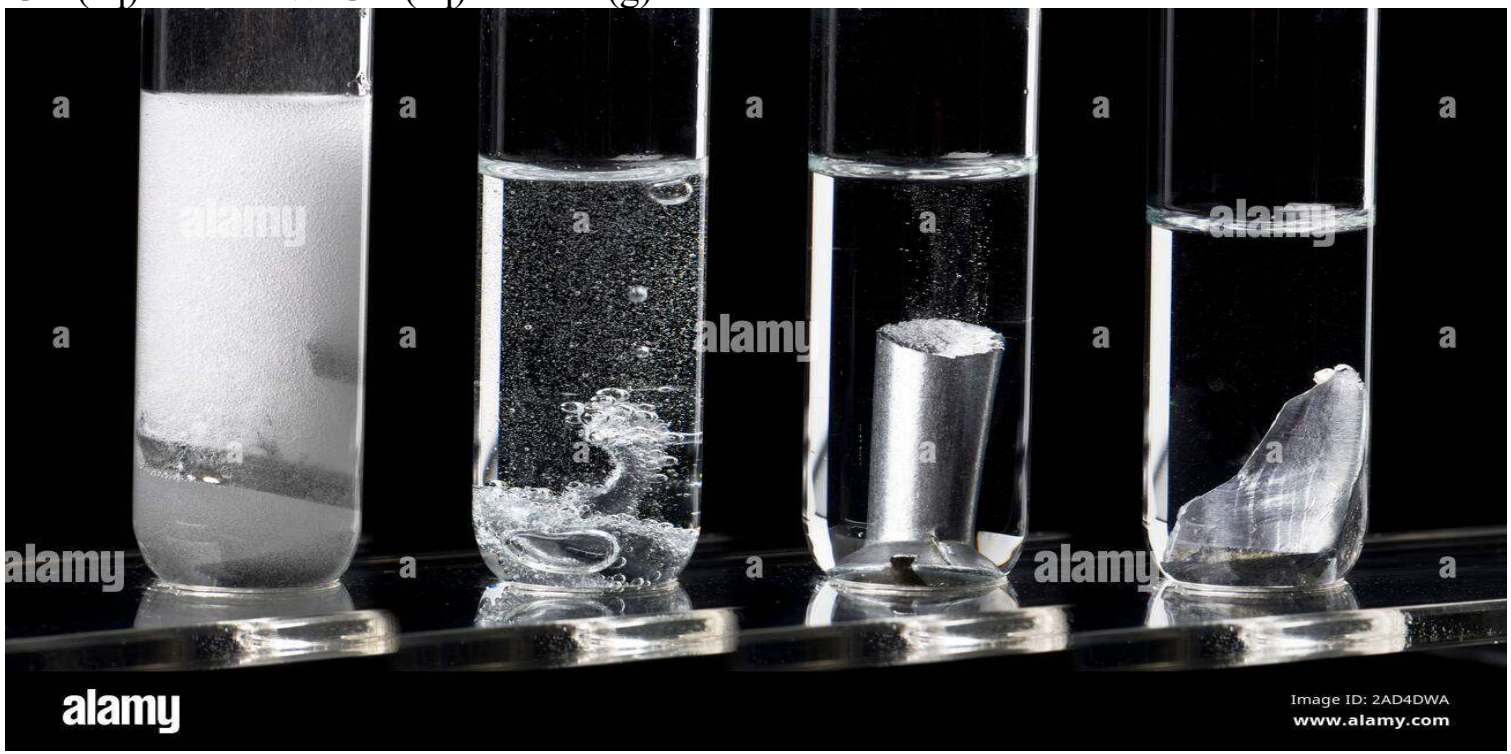
MEASURING PH USING A PH METER

- **Rinse the electrode** with distilled water and blot it dry.
- **Immerse the electrode** in the sample solution. Ensure that the electrode is fully submerged and there are no air bubbles around it.
- **Wait for the reading to stabilize**, which may take a few seconds to a minute.
- **Read the pH value** displayed on the meter

ACIDS REACT WITH METALS

Acids react with metals to produce hydrogen gas. The gas is tested with a burning splint which shows hydrogen burns with a '**pop' sound**.

$2Na(s) + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_{2(g)}$



ACIDS REACT WITH CARBONATES AND HYDROGEN CARBONATES (BICARBONATES)

- A salt, carbon dioxide gas and water are formed. To test for Carbon dioxide gas, the gas produced is bubbled into limewater which forms a white precipitate.

Carbonates

- $MgCO_{3(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\ (aq)} + CO_{2\ (g)} + H_2O$

Hydrogen carbonates/Bicarbonates

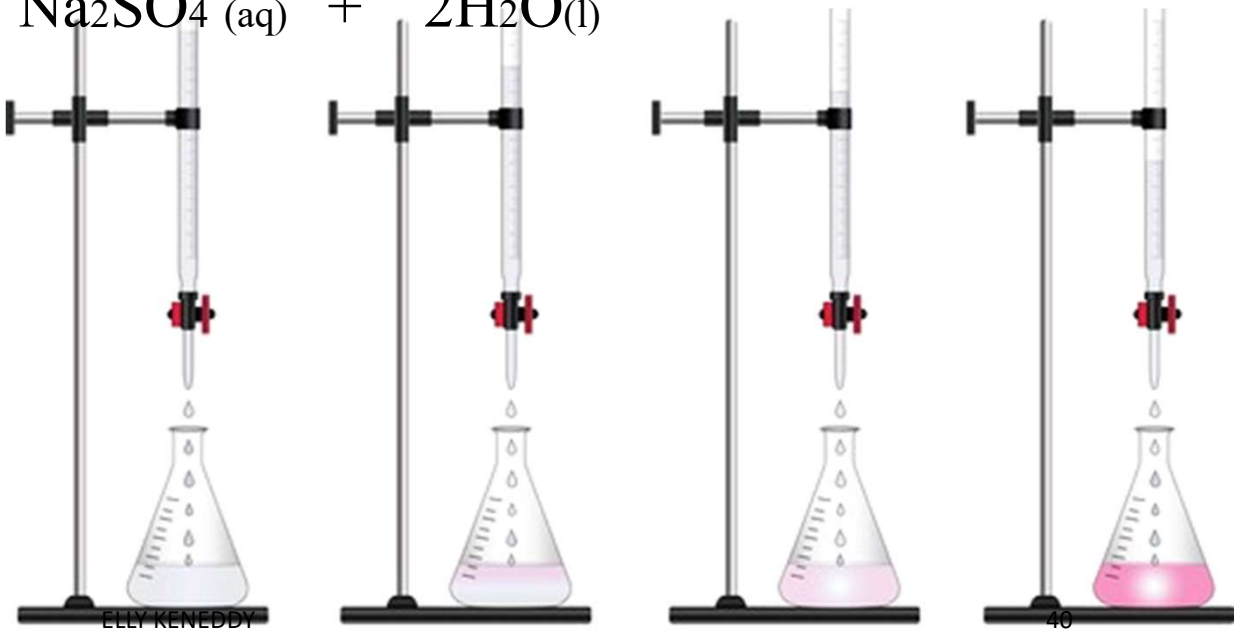
- $NaHCO_{3(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + CO_{2(g)} + H_2O_{\ (l)}$

NEUTRALIZATION REACTIONS

- A reaction in which an acid reacts with a base to form a salt and water only
- Energy is given out during the reaction. Common neutralization reactions include:

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

$2NaOH_{(aq)} + H_2SO_{4\ (aq)} \rightarrow Na_2SO_{4\ (aq)} + 2H_2O_{(l)}$



TOOTH DECAY

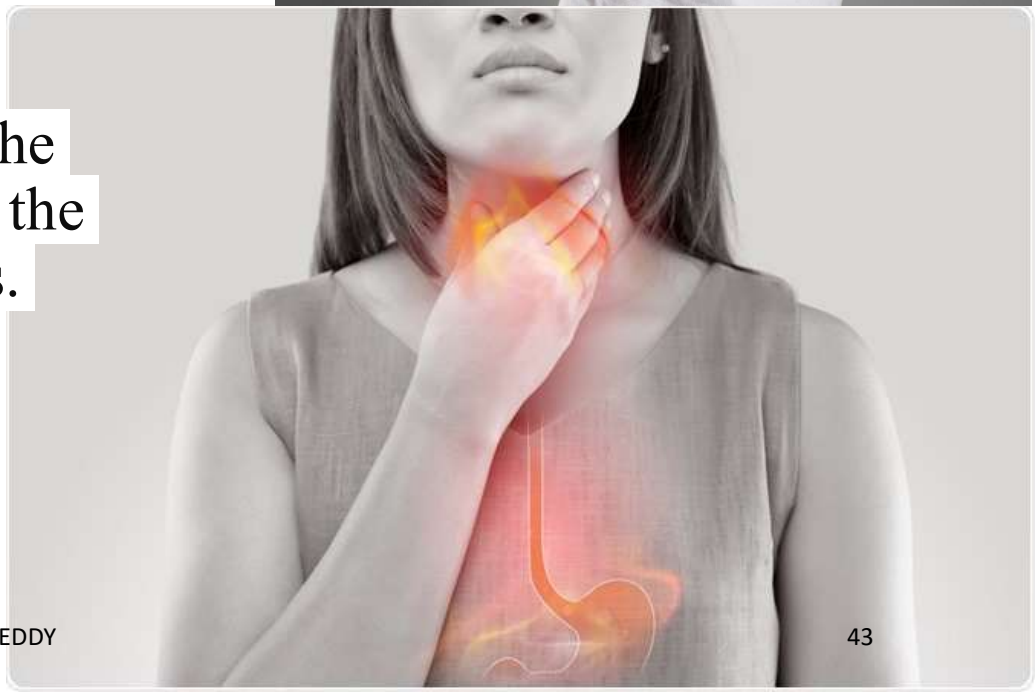
TOOTH DECAY

- Tooth decay, also known as dental caries or cavities, arises from the breakdown of tooth enamel caused by acids produced by bacteria in the mouth
- A sticky film called plaque forms on your teeth. Plaque consists of food particles, bacteria, and saliva. It's especially sticky on the chewing surfaces of the molars, between teeth, and near the gum line.
- When you consume sugary or starchy foods and drinks, the bacteria in plaque metabolize these carbohydrates and produce acids as a byproduct.
- The acids produced by the bacteria begin to erode the minerals in the tooth enamel, the hard, protective outer layer of the tooth. This process is known as **demineralization**.
- If the demineralization continues without. Interruption the enamel breaks down further, leading to the formation of tiny holes or cavities.

❖**Gastroesophageal Reflux Disease (GERD)**: Excess acid can backflow into the esophagus, causing **heartburn**, a burning sensation in the chest, and acid reflux.

This can lead to inflammation and damage to the esophageal lining.

❖**Peptic Ulcers**: High levels of stomach acid can erode the **stomach lining** and the lining of the duodenum (the first part of the small intestine), leading to **peptic** ulcers. **Symptoms** include abdominal pain, bloating, nausea, and vomiting.



PREVENTION OF HEART BURN.

1. **Avoid Trigger Foods**: Identify and avoid foods and drinks that trigger heartburn. Common culprits include spicy foods, citrus fruits, tomatoes, chocolate, caffeine, and alcohol.
2. **Eat Smaller Meals**: Large meals can put pressure on the lower esophageal sphincter (LES), leading to reflux. Eating smaller, more frequent meals can help.
3. **Avoid Lying Down After Eating**: Wait at least 2-3 hours after eating before lying down or going to bed to prevent stomach acid from flowing back into the esophagus.
4. **Maintain a Healthy Weight**: Excess weight can put pressure on the abdomen, pushing up the stomach and causing acid to reflux into the esophagus.

Home Remedies

1. **Baking Soda**: A teaspoon of baking soda mixed with water can neutralize stomach acid.
2. **Aloe Vera Juice**: Aloe vera can help soothe the esophagus and reduce inflammation.
3. **Ginger**: Ginger has natural anti-inflammatory properties and can help reduce heartburn symptoms. Try ginger tea or chewed ginger slices.

BEE STINGS

- Bee stings are acidic. The venom contains formic acid and other compounds that contribute to its acidity.
- To neutralize a bee sting, you can apply a weak base. **Common home remedies include**:
- **Baking soda (sodium bicarbonate)**: Make a paste with water and apply it to the sting area.
- **Toothpaste**: Many toothpastes contain mild bases and can help alleviate the pain.
- Additionally, washing the area with soap and water and applying ice can help reduce pain and swelling.


END OF TOPIC
THANKS FOR THE COOPERATION
ELLY KENY


ALWAYS AIM FOR EXCELLENCE
BY ELLY KENEDDY NALITSO
0708838163- 0779031329