pH Meter

BASICS OF CHEMISTRY

RECAP

UNITS

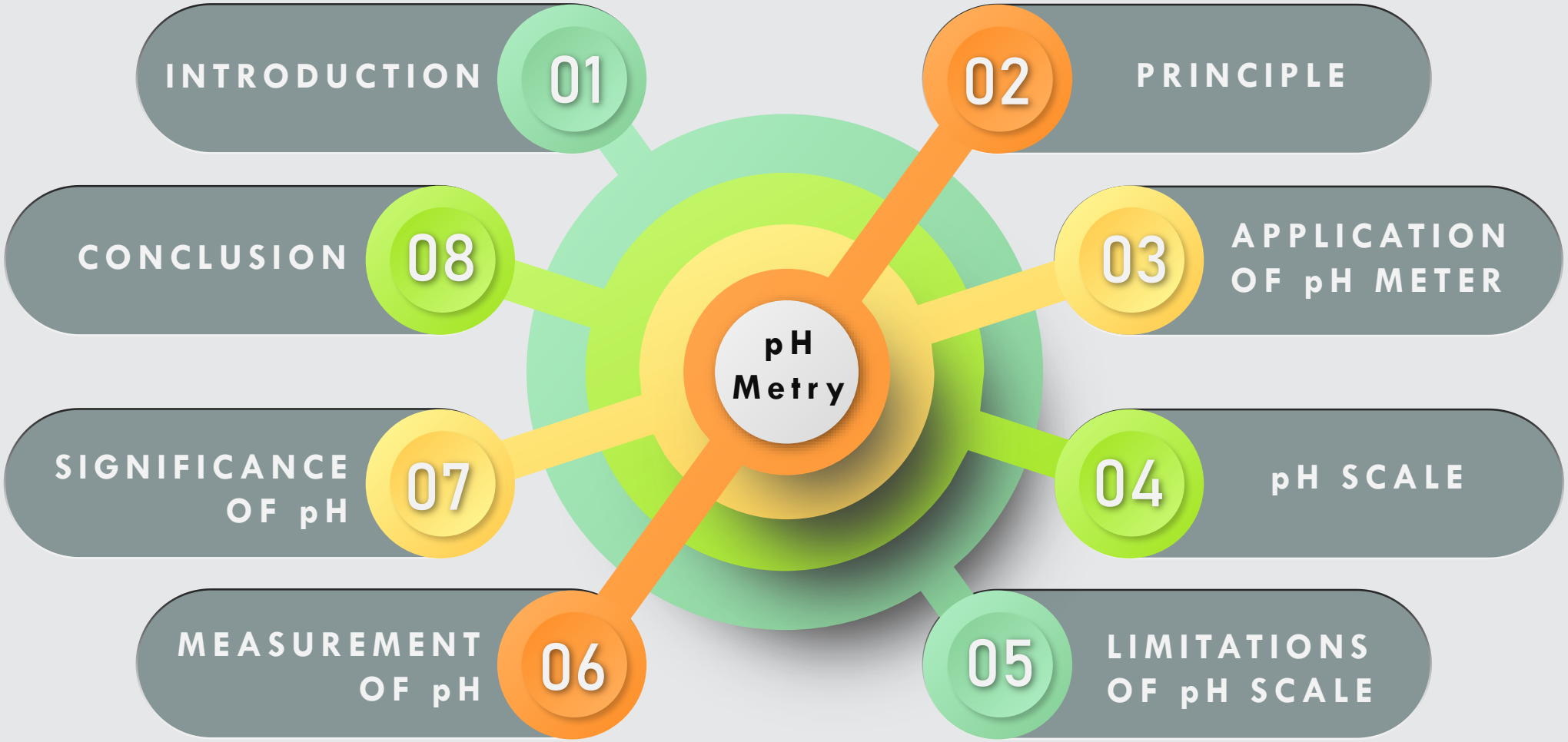
NORMALITY

STANDARDIZATION

PURITY

EXPERIMENT
Std. OF HCL &
KOH PURITY

CONTENTS


pH Metry
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02 PRINCIPLE
03 APPLICATION OF pH METER
04 pH SCALE
05 LIMITATIONS OF pH SCALE
06 MEASUREMENT OF pH
07 SIGNIFICANCE OF pH
08 CONCLUSION

INTRODUCTION

pH Meter - DEFINITION

1. A pH Meter Is An Electronic Instrument Used For Measuring The pH (Acidity Or Alkalinity) Of A Liquid (Though Special Probes Are Sometimes Used To Measure The pH Of Semi-solid Substances).

2. A Typical pH Meter Consists Of Special Measuring Probes (A Glass Electrode And A Reference Electrode) Connected To An Electronic Meter That Measures And Displays The pH Reading.

INTRODUCTION

pH - DEFINITION

3. pH is defined as $-\log[H^+]$, where $[H^+]$ is molar hydrogen ion concentration.

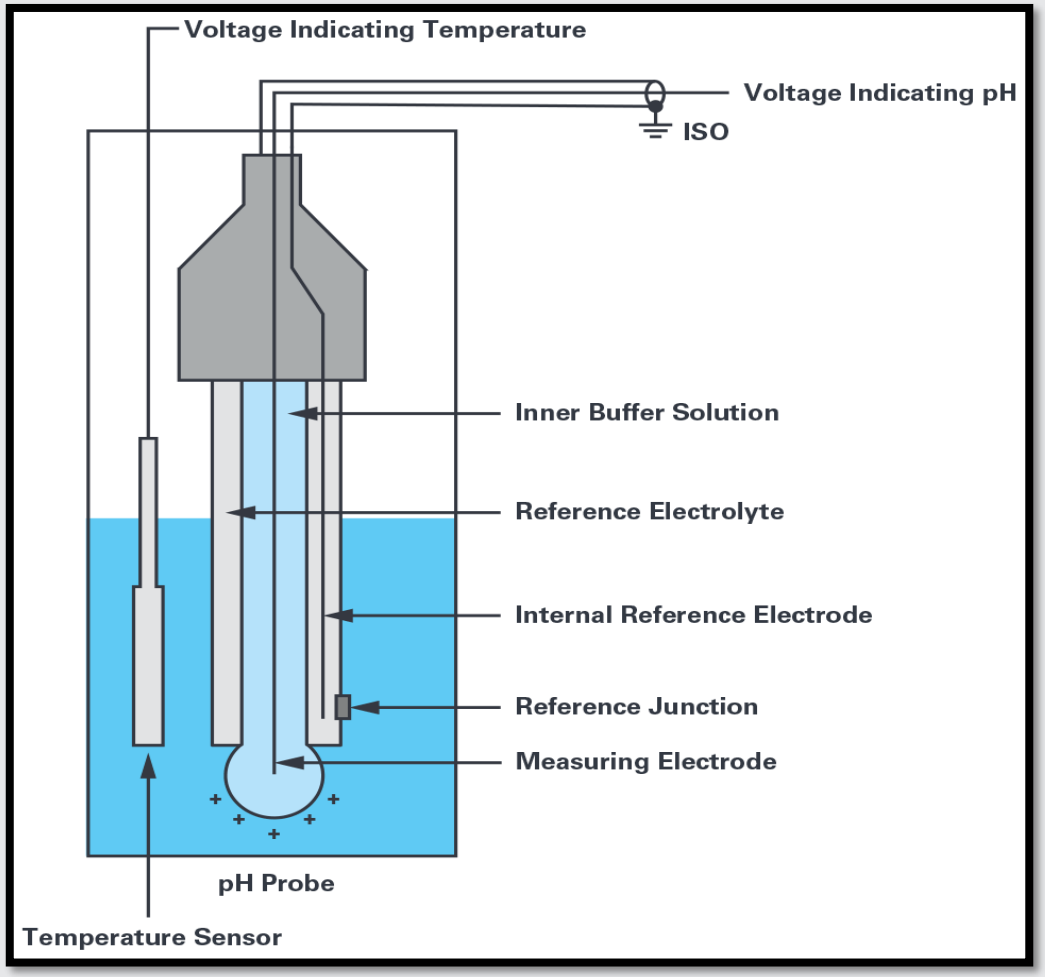
4. Actually pH must be defined in terms of the thermodynamic activity of the H^+ ion and not as molar concentration.

PRINCIPLE OF WORKING

1. **The Glass pH Probe Contains Two Electrodes.**

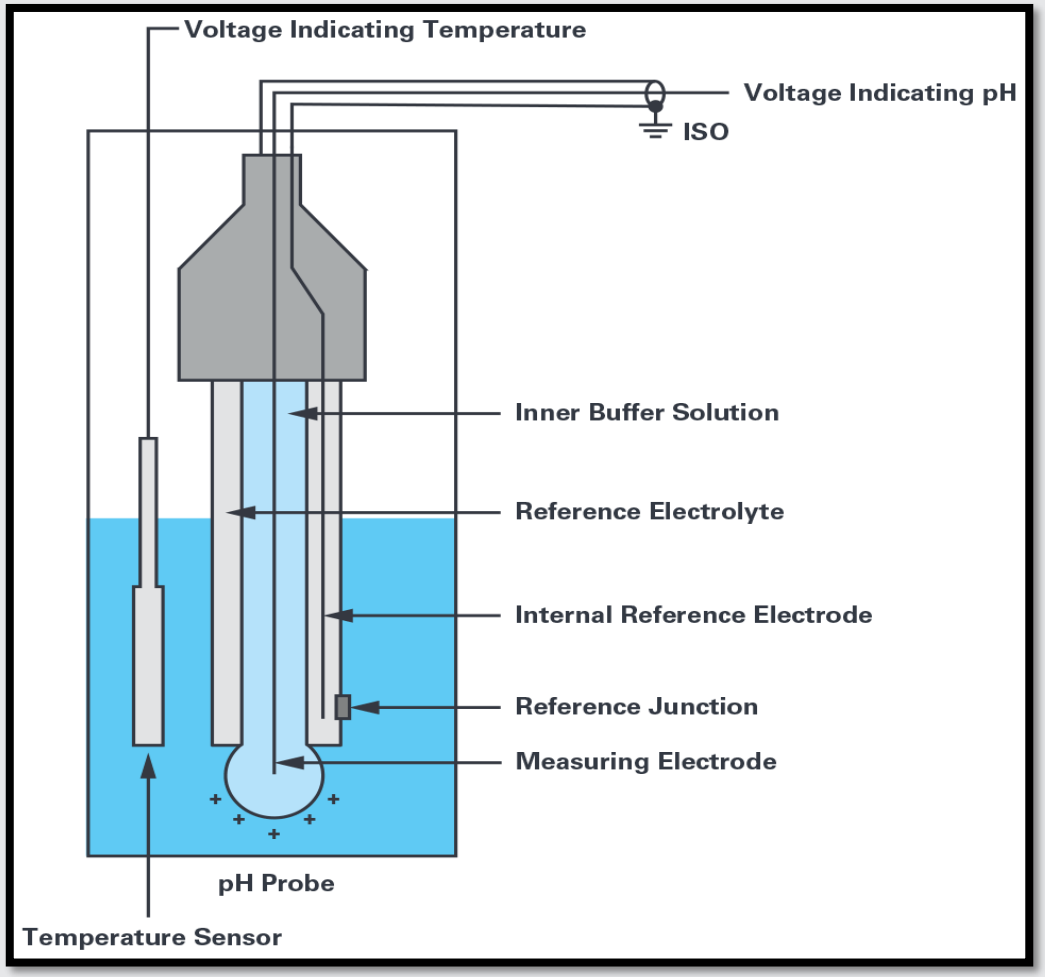
Glass pH Probe Consists of 2 Electrodes

- **Glass Tube Filled With pH 7 Buffer Solution**
- **Glass Tube Containing Saturated KCl Solution**



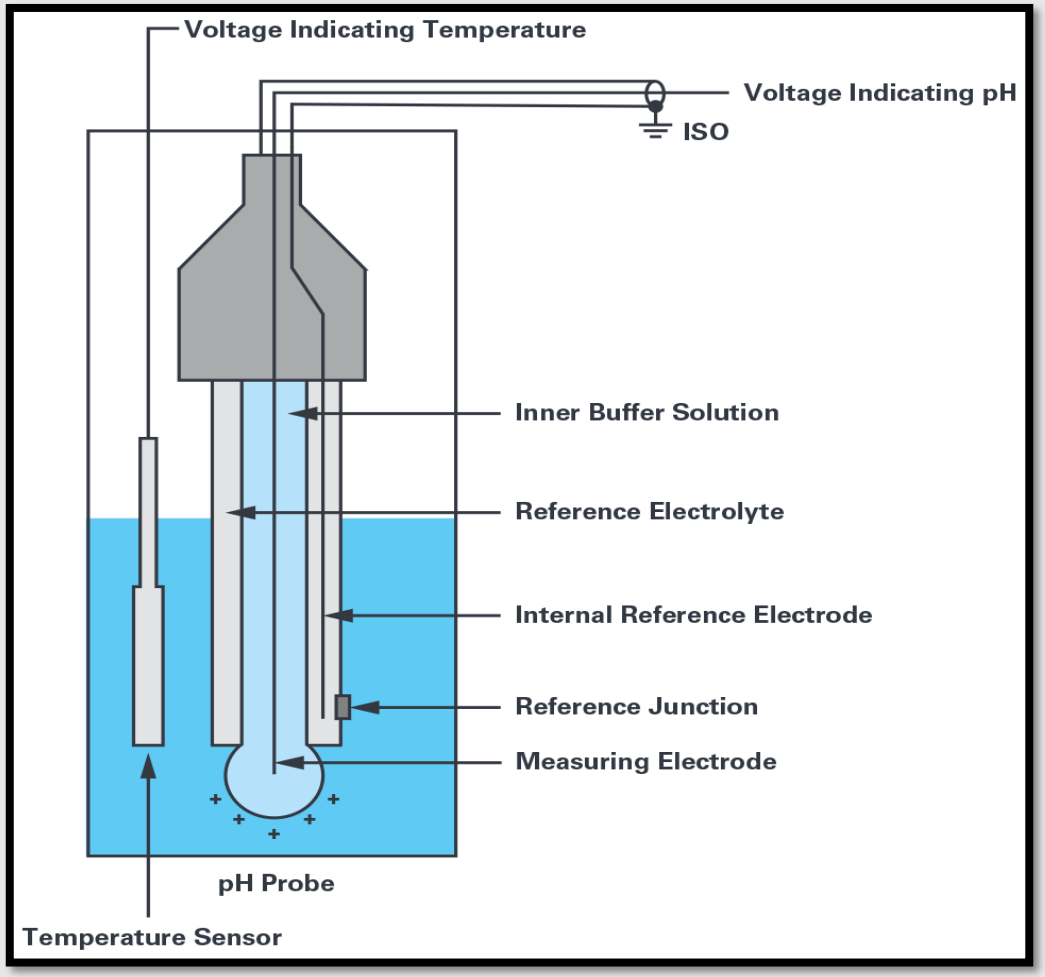
PRINCIPLE OF WORKING

1. The Sensor Electrode Bulb Is Made Up Of Porous Glass Membrane Coated With Silica And Metal Salts.
2. A Silver Wire Coated With Silver Chloride Immersed In pH 7 Buffer In The Bulb. Another Silver Wire Coated With Silver Chloride Is Immersed In The Saturated Potassium Chloride In Reference Electrode As Shown In The Figure
3. When The Probe Is Placed In A Solution To Measure The pH, Hydrogen Ions Accumulate Around The Bulb And Replace The Metal Ions From The Bulb. This Exchange Of Ions Generates Some Electric Flow That Is Captured By The Silver Wire.



PRINCIPLE OF WORKING

4. The Voltage Of This Electric Flow Is Measured By The pH Meter By Converting It Into pH Value By Comparing The Generated Voltage With The Reference Electrode
5. Increase In Acidity Of The Solution Has A Greater Concentration Of Hydrogen Ions That Increases The Voltage. This Increased Voltage Decreases The pH Reading In pH Meter.
6. In The Same Manner, An Increase In Alkalinity Decreases The Hydrogen Ions Or Increases In Hydroxyl Ions Concentration Also Decreases The Voltage And Increase The pH Value In pH Meter.



APPLICATIONS OF pH METER

Agriculture

Pharma

QA & QC Across Majority Of Industries

EFFLUENT TREATMENT

FOOD INDUSTRY

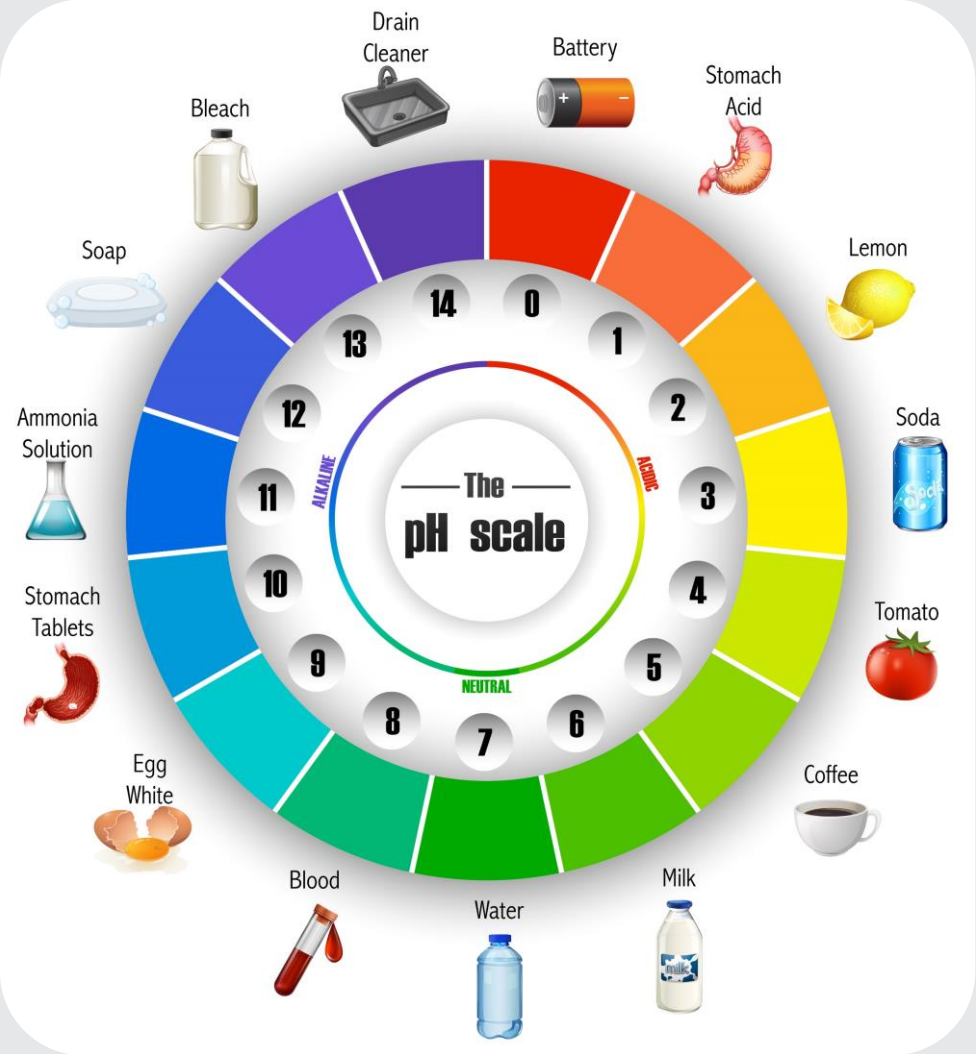
Chemical & Petrochemical

BIOTECH

PERSONNEL HYGIENE & GROOMING PRODUCTS

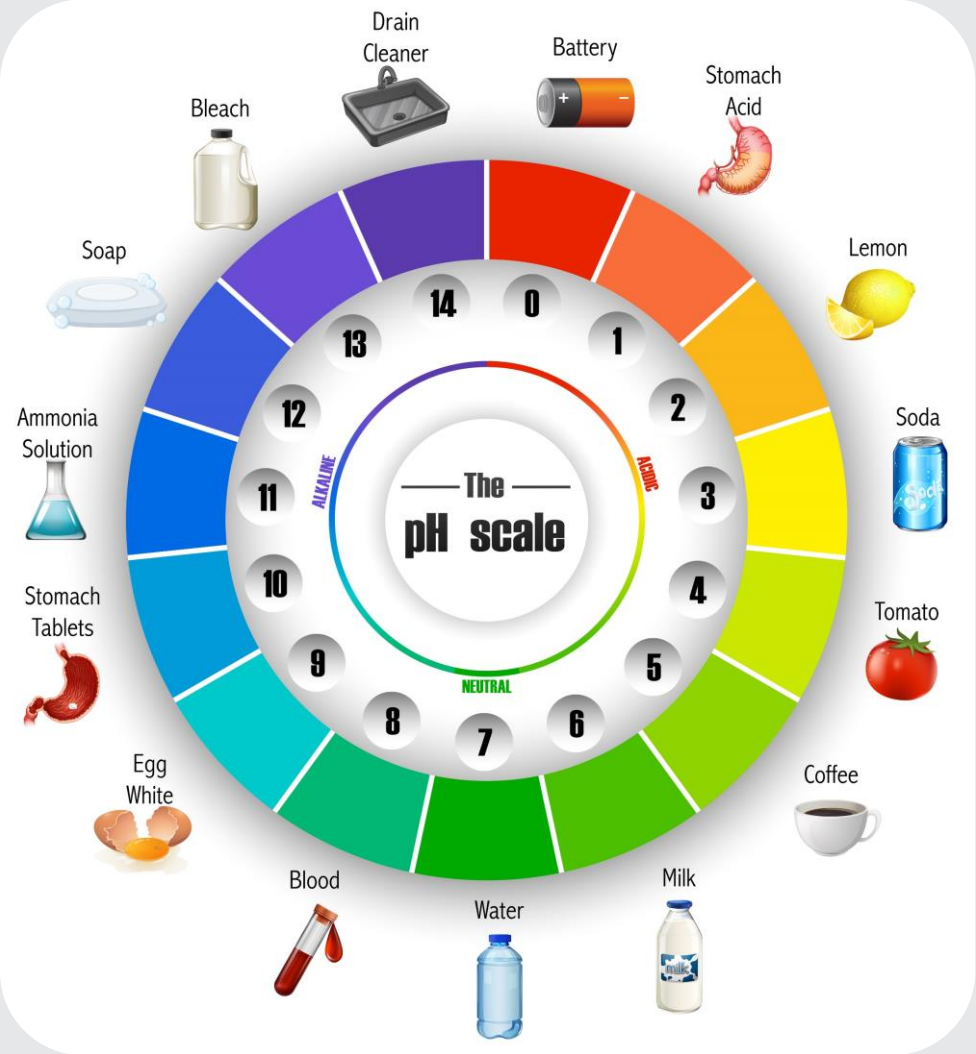
pH SCALE

1. A pH Scale Is Used For Measuring The Acidity Or Basicity Of An Acid Or A Base Or A Solution In A Laboratory.
2. It Has Readings From 1-14 Where 1 Shows The Most Acidic Substance And 14 Shows The Most Basic Substance.
3. 7 pH Is For Neutral Substances.

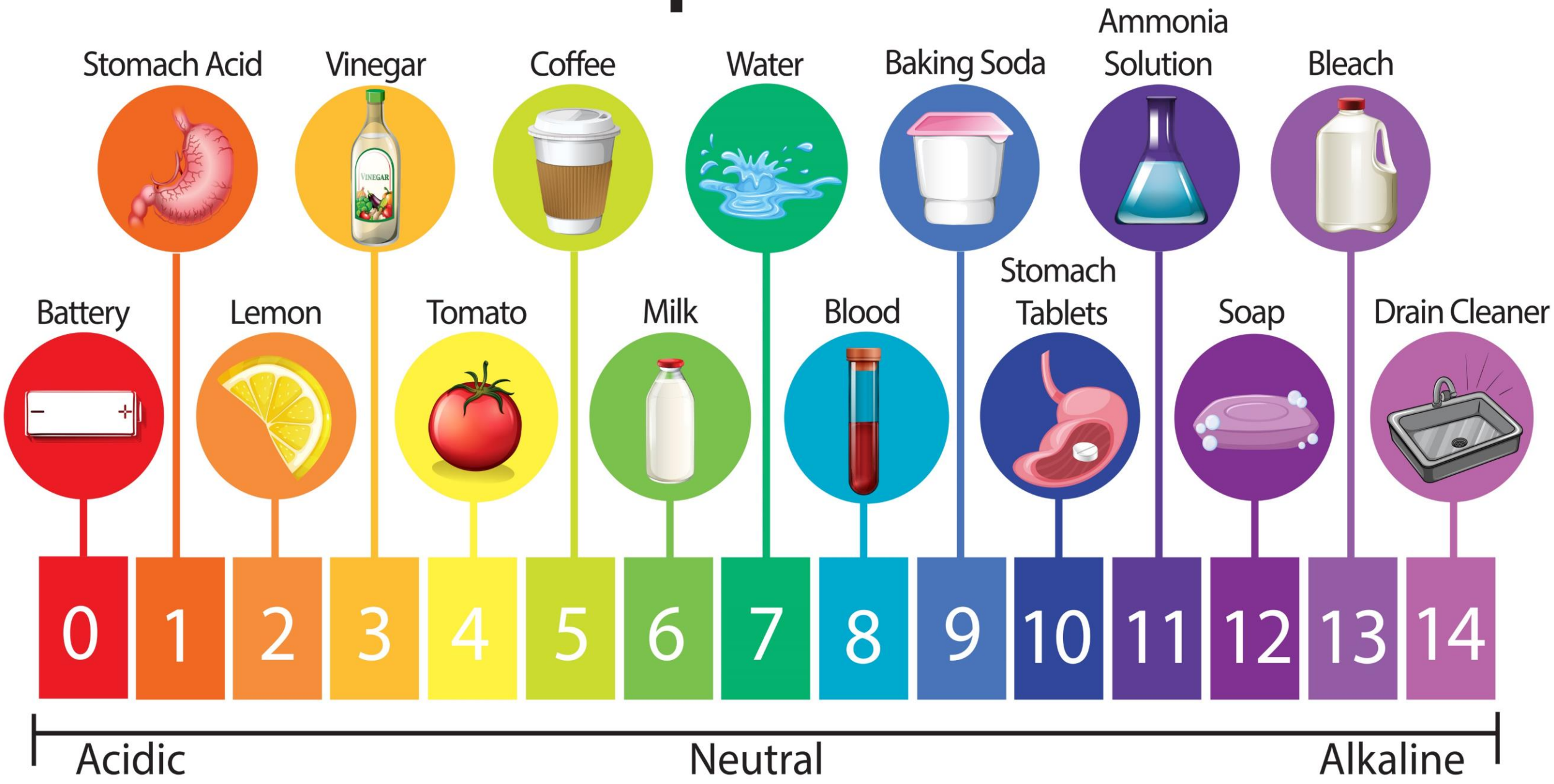


pH SCALE

pH Value	H^+ Concentration Relative to Pure Water	Example
0	10 000 000	battery acid
1	1 000 000	gastric acid
2	100 000	lemon juice, vinegar
3	10 000	orange juice, soda
4	1 000	tomato juice, acid rain
5	100	black coffee, bananas
6	10	urine, milk
7	1	pure water
8	0.1	sea water, eggs
9	0.01	baking soda
10	0.001	Great Salt Lake, milk of magnesia
11	0.000 1	ammonia solution
12	0.000 01	soapy water
13	0.000 001	bleach, oven cleaner
14	0.000 000 1	liquid drain cleaner

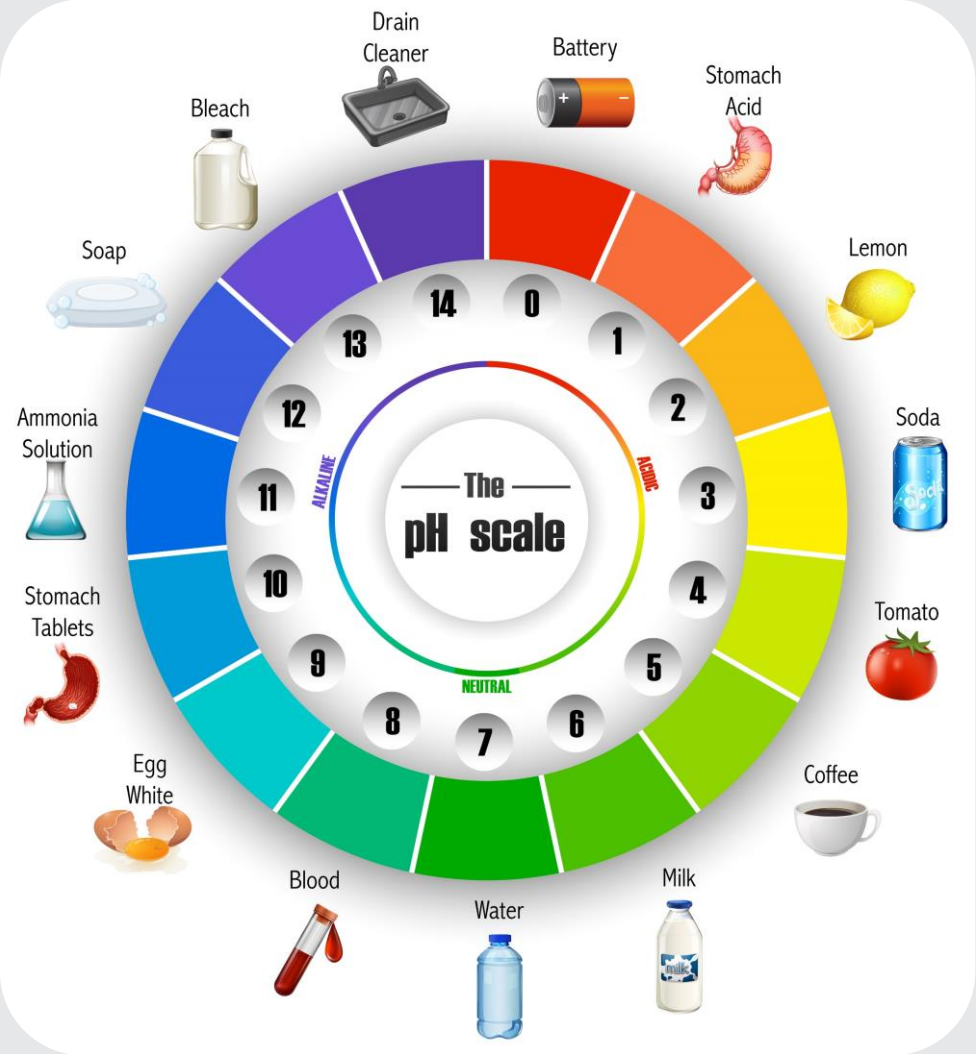


The pH Scale


Battery
Stomach Acid
Lemon
Vinegar
Tomato
Coffee
Milk
Water
Blood
Baking Soda
Stomach Tablets
Ammonia Solution
Soap
Bleach
Drain Cleaner
VINEGAR
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Acidic
Neutral
Alkaline

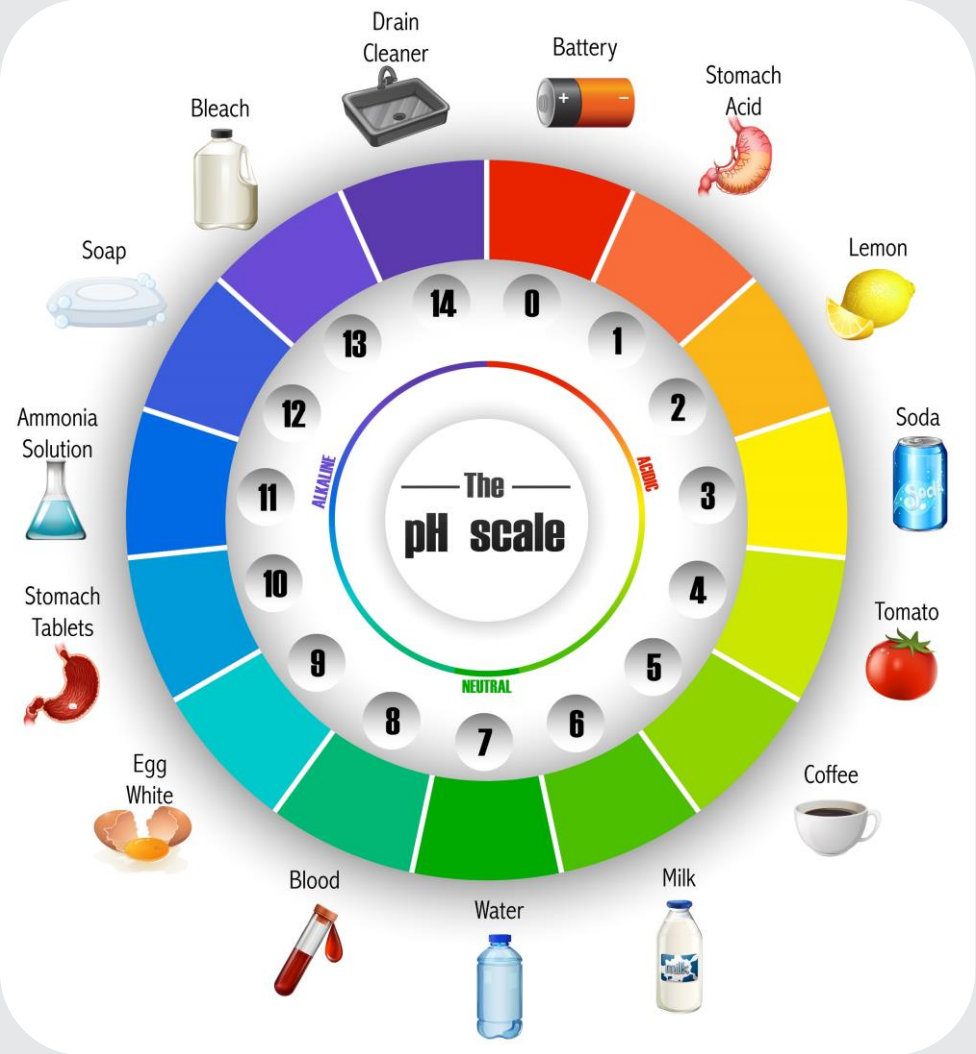
LIMITATIONS OF pH SCALE

1. pH Values Of The Solutions Do Not Give Us Immediate Idea Of The Relative Strengths Of The Solutions. A Solution Of pH =1 Has A Hydrogen Ion Concentration 100 Times That Of A Solution pH = 3 (Not Three Times).
2. pH Value Zero Is Obtained In 1 N Solution Of Strong Acid. If The Concentration Is 2 N, 3 N, 10 N, etc. The Respective pH Values Will Be Negative.



LIMITATIONS OF pH SCALE

3. A Solution Of An Acid Having Very Low Concentration, Say 10^{-1} N, Can Not Have pH 8, As Shown By Ph Formula But The Actual pH Value Will Be Less Than 7.
4. pH Scale Lacks Internal Consistency.



MEASUREMENT OF pH

A
TYPES OF pH METER

B
TYPES OF ELECTRODE

C
UNIVERSAL INDICATOR

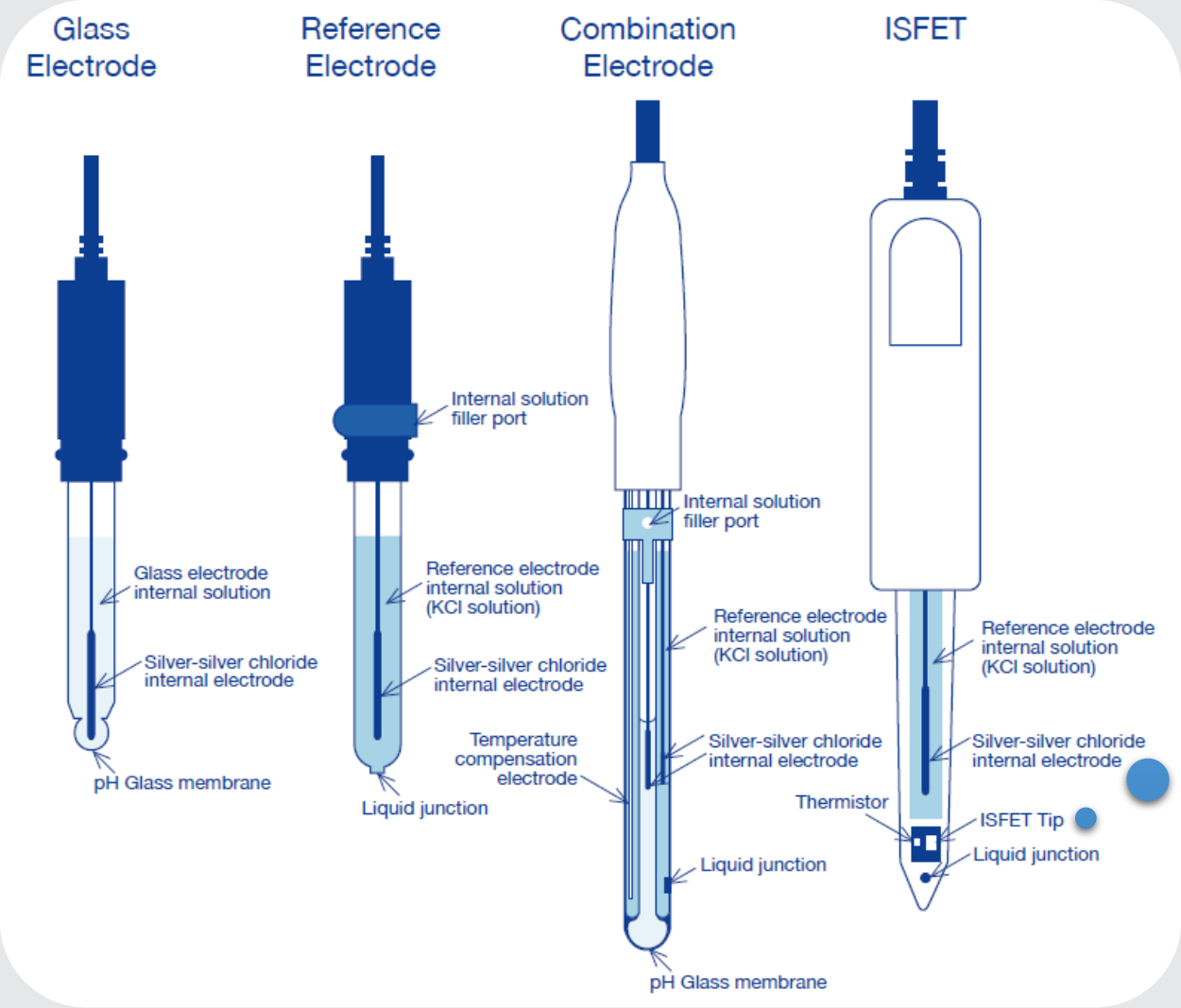
D
CALIBRATION & USE

TYPES OF pH METER

MANUAL pH METER

DIGITAL pH METER

TYPES OF pH METER ELECTRODE



ISFET
Ion Sensitive Field-Effect Transistor

TYPES OF pH METER ELECTRODE

	Shape	Property / Application
	sphere (bulb)	constant quality, low resistance because of large surface area, for most applications
	cone	robust, smooth, easy to clean, universally applicable
	cylinder	shock-proof, for general applications, especially useful for fermenter electrodes
	spear	high resistance, suitable for penetrating semi-solid media
	flat	high resistance, shock-proof, easy to clean, suitable for surface measurements

UNIVERSAL pH INDICATOR

A **Universal Indicator** Is A **pH Indicator** Made Of A Solution Of Several Compounds That Exhibits Several Smooth Colour Changes Over A Wide Range **pH** Values To Indicate The Acidity Or Alkalinity Of Sol

1 SOLUTION INDICATOR

2 PAPER INDICATOR

SOLUTION

The Main Components Of A **Universal Indicator,** In The Form Of A **Solution,** Are Thymol Blue, Methyl Red, Bromothymol Blue, And Phenolphthalein. This Mixture Is Important Because Each Component Loses Or Gains Protons Depending Upon The Acidity Or Alkalinity Of The **Solution** Being Tested.

UNIVERSAL pH INDICATOR

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Turn On Your pH Meter.

Before You Begin To Calibrate And Use Your pH Meter You Will First Need To Turn It On And Allow Adequate Time For The Meter To Warm Up. This Should Generally Take Around 30 Minutes, But Check Your pH Meter's Operating Manual For Exact Time.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Clean Your Electrode.

Take The Electrode Out Of Its Storage Solution And Rinse It With Distilled Water Under An Empty Waste Beaker. Once Rinsed, Blot Dry (Do Not Wipe) With Lint Free Tissue, Which Are Available At Most Office Supply Stores.

Be Sure To Rinse Your Electrode In A Waste Beaker That Is Different From The Beaker You Will Be Calibrating In.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Clean Your Electrode.

Avoid Rubbing The Electrode As It Has A Sensitive Membrane Around It.

If You Find The Electrode To Be Particularly Dirty, Consult Your Operating Manual For Recommended Cleaning Solutions.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Prepare Your Buffers.

You Will Generally Need More Than One Buffer For Calibrating A pH Meter.

The First Will Be A "Neutral" Buffer With A pH Of 7, And The Second Should Be Near The Expected Sample pH, Either A pH Of 4 Or 9.21.

Buffers With A Higher pH (9.21) Are Best For Measuring Bases, Whereas Buffers With A Low pH (4) Are Best For Measuring Acidic Samples.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Prepare Your Buffers.

Once You Have Chosen Your Buffers Allow Them To Reach The Same Temperature As The pH Meter Because pH Readings Are Temperature Dependent.

Pour Your Buffers Into Individual Beakers For Calibration.

Check With Your pH Meter Manufacturer, Or Current Educational Or Professional Institution, About Acquiring pH Buffer Solutions.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Prepare Your Buffers.

Buffers Should Be Kept In A Beaker For No Longer Than Two Hours.

Discard The Buffer When You Are Finished.

Do Not Return It To Its Original Container.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Place Your Electrode In The Buffer With A pH Value Of 7 And Begin Reading.

Press The “Measure” Or Calibrate Button To Begin Reading The pH Once Your Electrode Is Placed In The Buffer.

Allow The pH Reading To Stabilize Before Letting It Sit For Approximately 1-2 Minutes.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Set The pH.

Once You Have A Stable Reading, Set The pH Meter To The Value Of The Buffer's pH By Pressing The Measure Button A Second Time.

Setting The pH Meter Once The Reading Has Stabilized Will Allow For More Accurate And Tuned Readings.

Although Not Necessary, If You Stir Your Buffer Before Measuring Be Sure To Stir All Other Buffers And Samples In The Same Way.

pH METER CALIBRATION & USE

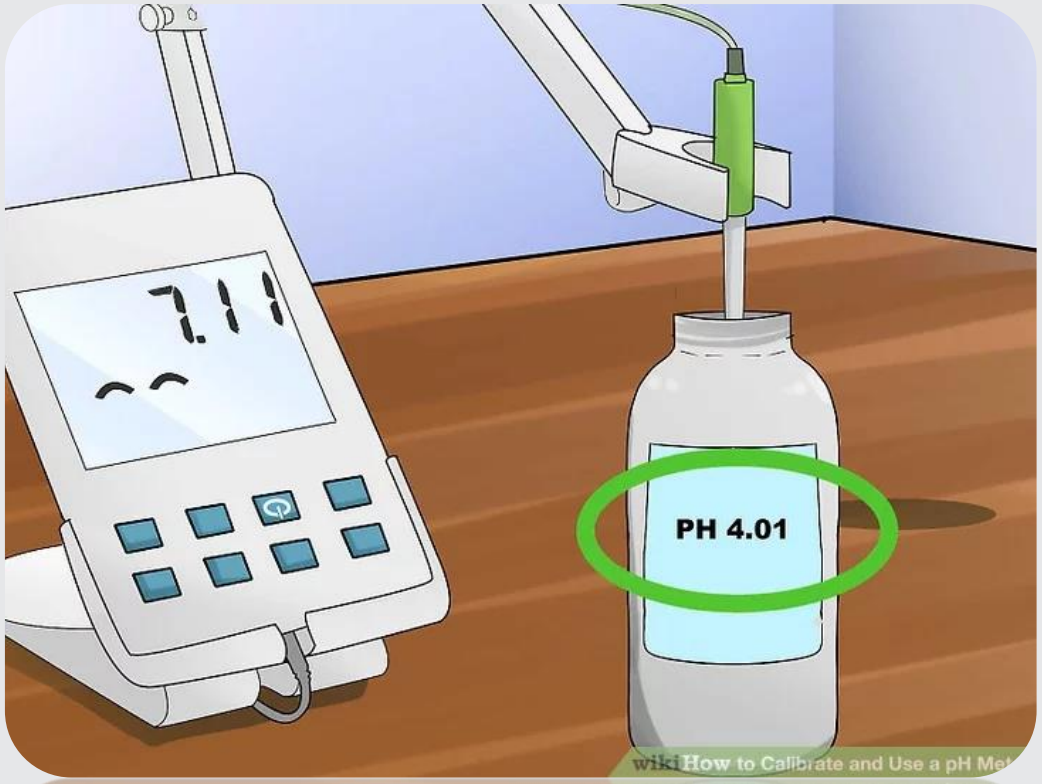
PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Rinse Your Electrode With Distilled Water.

Rinse And Pat/Blot Dry With A Lint-free Tissue, In Between Buffers.

pH METER CALIBRATION & USE

PREPARATION ① ② ③ | CALIBRATION ① ② ③ ④ ⑤ ⑥ | MEASUREMENT ① ② ③

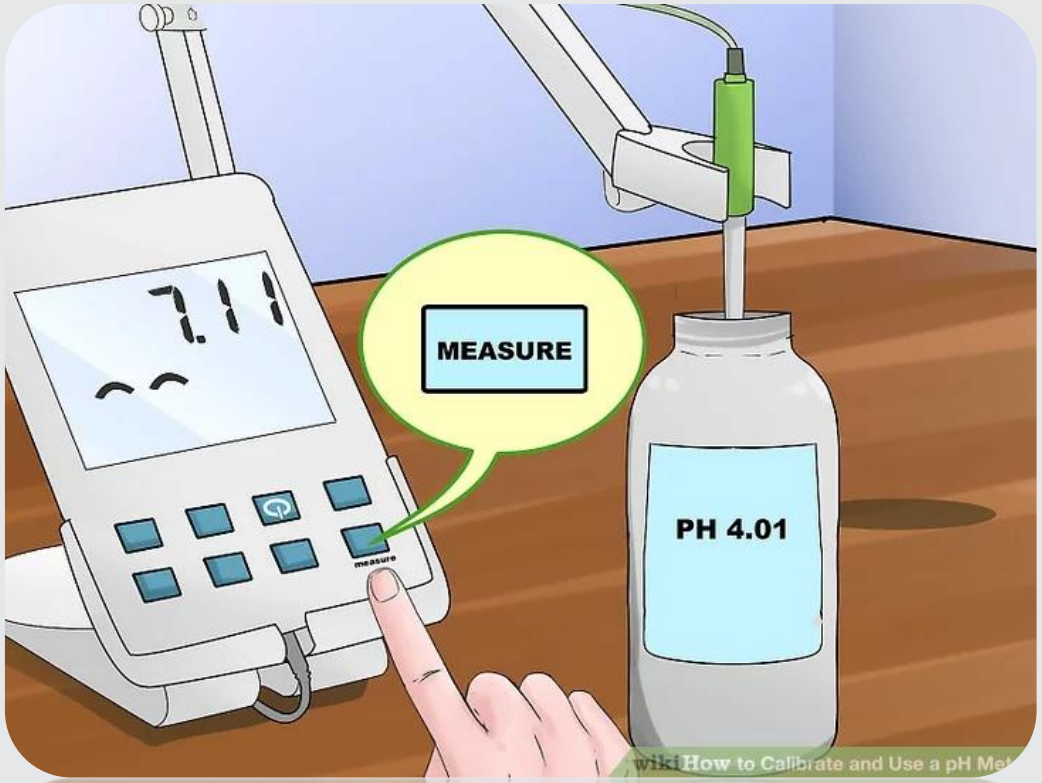


Place Your Electrode In The Appropriate Buffer For Your Sample And Begin Reading.

Press The Measure Button To Begin Reading The pH Once Your Electrode Is Placed In The Buffer.

pH METER CALIBRATION & USE

PREPARATION ① ② ③ | CALIBRATION ① ② ③ ④ **5** ⑥ | MEASUREMENT ① ② ③

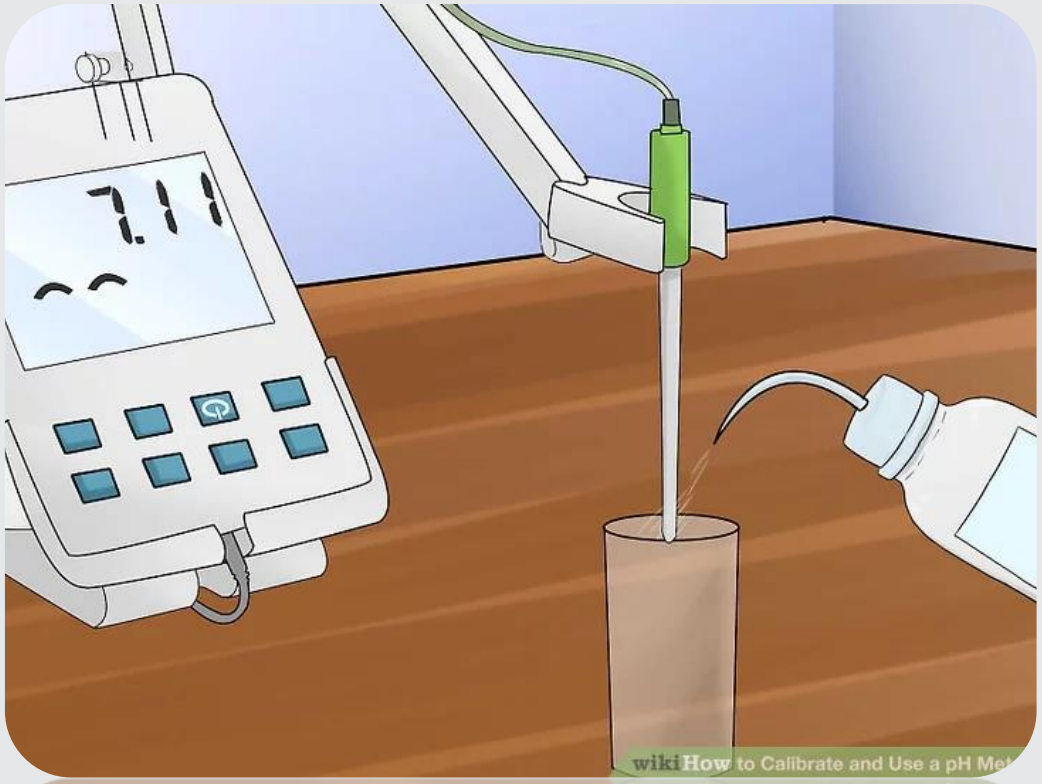


Set The pH A Second Time.

Once Your Reading Has Stabilized, Set The pH Meter To The Value Of The Buffer's pH By Pressing The Measure Button.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3



Set The pH A Second Time.

Once Your Reading Has Stabilized, Set The pH Meter To The Value Of The Buffer's pH By Pressing The Measure Button.

pH METER CALIBRATION & USE

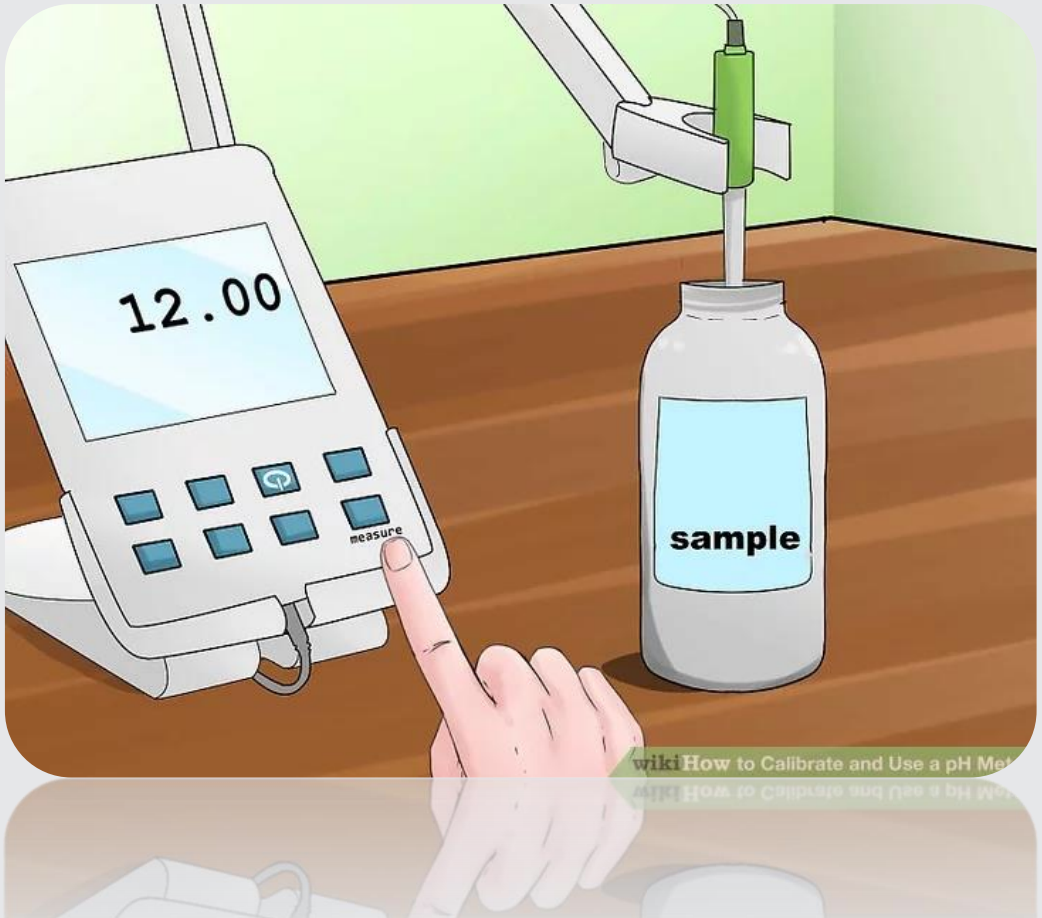
PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Place Your Electrode In Your Sample And Begin Reading.

Once Your Electrode Is Placed In Your Sample, Press The Measure Button And Leave The Electrode In Your Sample For Approximately 1-2 Minutes.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3



Set Your pH Level.

Once The Reading Has Stabilized, Press The Measure Button. This Is The pH Level Of Your Sample.

pH METER CALIBRATION & USE

PREPARATION 1 2 3 | CALIBRATION 1 2 3 4 5 6 | MEASUREMENT 1 2 3

Clean Your Electrode After Use.

Rinse Your Electrode With Distilled Water And Blot Or Dab Dry With A Lint-free Tissue. You May Store Your pH Meter Once Clean And Dry.

Consult Your Operation Manual For Optimal Storage Practices For Your Specific pH Meter.

CONCLUSION

pH Meter Is More Useful Than The Other pH Indicators Because It Gives Accurate Reading (E.G., For Detection Of Blood pH) And Can Measure The pH Of A Liquid As Well As A Semi-Solid Substances.

SIGNIFICANCE OF pH METRY

Agriculture

Pharma

Chemical & Petrochemical

BIOTECH

QA & QC Across Majority Of Industries

EFFLUENT TREATMENT

FOOD INDUSTRY

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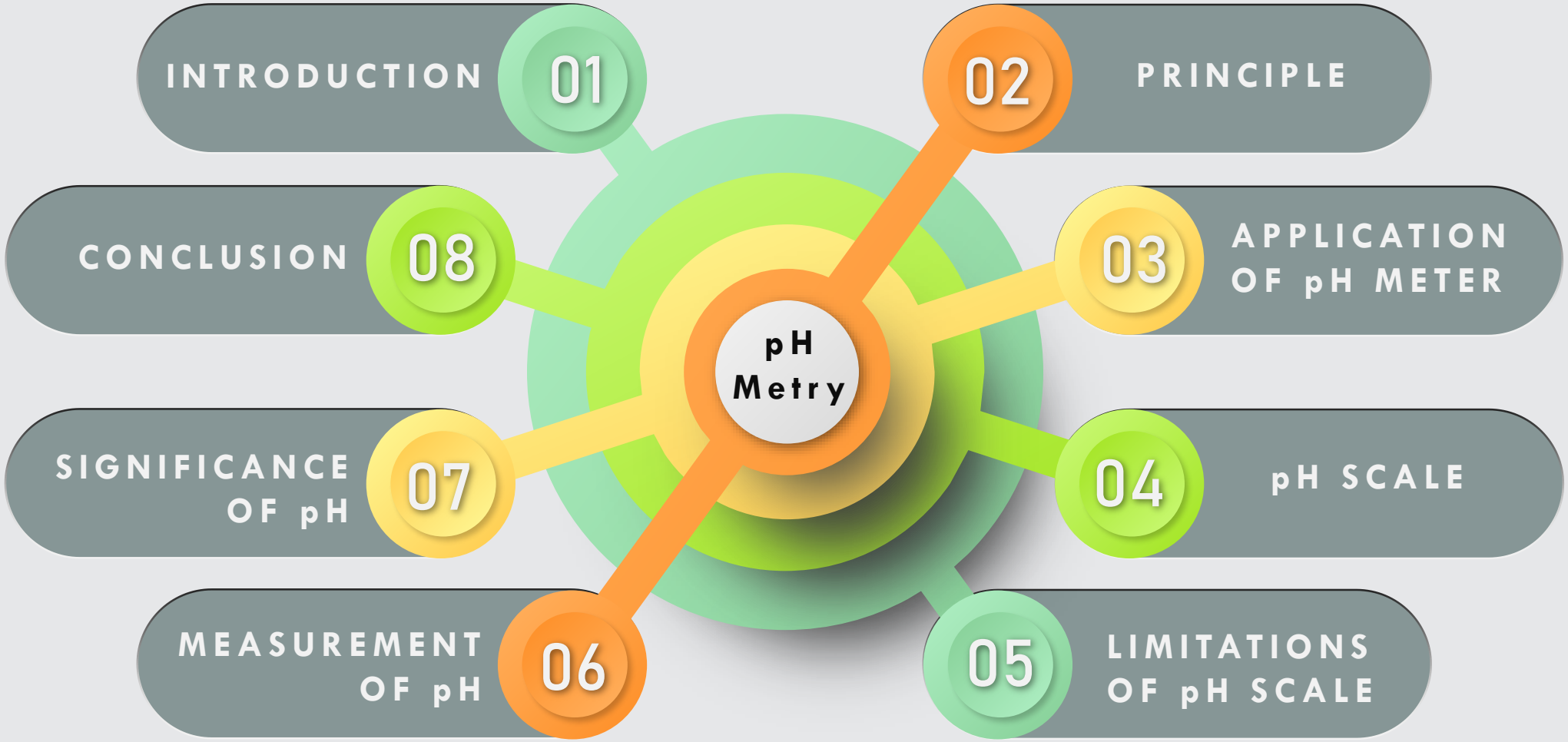
SUMMARY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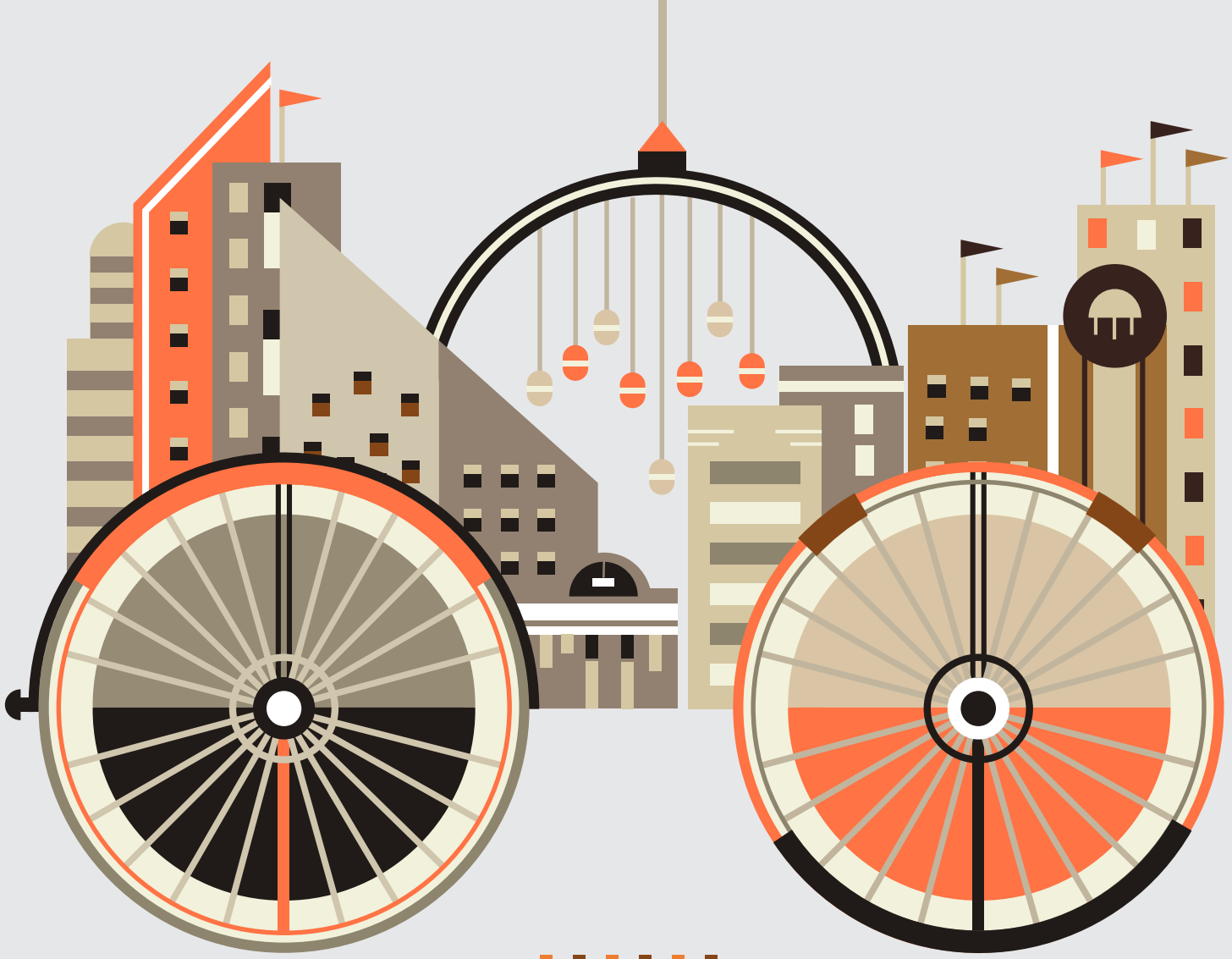

THANK YOU VERY MUCH