

2.ACIDS AND BASES

In our daily life we use a lot of materials. Even our food has a lot of variety. Different items also have different taste. In preparing and storing food we take a lot of care. In this chapter we would try to understand the reasons for some of them. Let us first think over the following questions related to what we eat.

- What sort of food do we eat?
- Are all the items alike? For example do they have the same colour, taste etc.
- In what ways are they different?
- What kind of tastes do food substances we eat have?



Fruits, vegetables and other food substances have different tastes.

Write the names of food substances that you know in the appropriate column, based on their taste:

S.No.	SWEET	SOUR	BITTER	SALTY	SPICY
1.	Sugar	Lemon Juice	Bitter Gourd	Common Salt	Red Mirchi
2.					
3.					
4.					
5.					
6.					

- Do you experience any other tastes in your daily life? Write them below.

- Do you find any difference in the taste of a raw and a ripe fruit?
- Do some substances change their taste when cooked?
- Do substances change their taste when added to some other substances?
- Add salt to lemon juice. How do the two together taste now?
- Add sugar to lemon juice what change do you notice in the taste?
- Is there any difference in the taste without sugar?
- Do some substances change colour when added to other substances?
- Have you observed any change when lime water is added to turmeric?

Let us do - 1

Take some turmeric powder. Add a bit of water to it and prepare turmeric paste. Rub the turmeric paste on a white paper. Draw a flower on that paper with a pencil. Colour the flower with soap water using a brush.



- Does the colour of the flower remain the same when soap water is used?

Similarly take some lime water. Add a few drops of it on a piece of turmeric paper. Does the paper change its colour? Is the changed colour of turmeric paper the same in both the cases?

Rani and Sai dropped food they were eating on a white sheet. They washed the sheet with soap and found to their surprise a red spot appearing on the sheet.

- What is the reason for the red spot?

Colour Change:- We notice here that turmeric changes colour when soap water or lime water is added to it. Is it possible that some other substances also change their colour. Let us see.

Let us do - 2

Take a piece turmeric paper. Find as many of the substances given in the table-3 as possible and put them on the turmeric paper one by one. You could try using other substances around you as well.

- What do you observe? Do you find any change in colour?
- We notice that the colour of turmeric paper changes with some substances when added to it.

The substances which indicate a change in colour when some substances are added to them are known as indicators.

Turmeric is a natural indicator. We can also prepare other natural indicators mentioned in the table - 2 and carry out the tests.

Let us test some substances using these natural indicators. To the substances mentioned in the table - 3, add natural indicators and observe the change in colour. Write the changed colours in the table-2

Indicator	Colour of the Indicator Paper	COLOUR CHANGE OBSERVED							
		Vinegar	Apple Juice	Banana	Lemon Juice	Soap	Lime Water	Glass Cleaner	Milk of Magnesia
Turmeric									
Petals of Hibiscus									
Mango Leaf									
Beetroot									
Oleander									

Try with some other substances and observe the changes.

Let us do - 3

Take solutions of some juices of fruits, vegetables, cold drinks and various solutions and test them with blue and red litmus papers. List out results in the table (3), by marking (✓) in the relevant column.

Substance	Red litmus turns blue	Blue litmus turns red	No Change in litmus
1. Orange			
2. Tomatoes			
3. Baking Soda			
4. Mineral Water			
5. Vinegar			
6. Salt Water			
7. Shampoo			
8. Washing Soda			
9. Spirit			
10. Saliva			
11. Cucumber			
12. Ridge gourd			
13. Kheera			
14. Butter Milk			
15. Milk			
16. Cold Drink			
17. Lemon Juice			
18. Grape Juice			
19. Bathing Soap			
20. Detergent Soap			
21. Lime Water			
22. Sugar			

TABLE 3

- Which of the above substances changed red litmus to blue?
- Which of the above substances changed the blue litmus to red?

Preparation of Lime water

Take half a beaker full of water. Add about 5 gm of lime that we apply to betel leaves. Stir the beaker well and let it stand overnight. Filter this solution the following day. Use this filtrate in all experiments you perform. This solution should be transparent.

The substances that turn blue litmus to red are acidic in nature. The substances that are soapy to touch and turn red litmus to blue are basic in nature.

Some of the substances given in the list did not change the colour of either blue or red litmus. These are said to be neutral in nature.

Precautions

Don't taste any substance unless your teacher instructs you. Wash the testtube, stick or dropper you used for putting drops of substances on different paper strips for next use.

Let us do - 4:

Classify the above substances into the following categories from the above observations.

Acidic Substance	Basic Substance	Neutral Substance

TABLE 4

- Now take things which are sour in taste and used as food e.g. curd, lemon juice etc. Check with blue and red litmus, what happens?

Indicators:

The strips of litmus paper change the colour, based on the nature of the material put on them. These are all indicators. They tell us whether a substance is acidic or basic. They are used extensively in studying substances and their properties.

Acidic Nature:-

You may have experienced a burning sensation when bitten by an ant. The sensation is due to the presence of formic acid that the ant releases. The acids which found in animals and plants are called as natural acids.

The substances that contain different acids. are given in the table 5.

ACID	SUBSTANCE
Acetic Acid	Vinegar
Citric Acid	Lemon, Orange
Butyric Acid	Stale cheese
Lactic Acid	Battered Milk, Curd
Oxalic Acid	Spinach, Tomato
Malic Acid	Apples
Tannic Acid	Tea
Oleic Acid	Olive Oil
Stearic Acid	Fats
Tartaric Acid	Grapes, Tamarind
Palmitic Acid	Palm Oil
Ascorbic Acid	Amla (emblica fruit)
Uric Acid	Urine

Apart from natural acids, there are certain acids like Hydrochloric acid, Sulphuric acid and Nitric acid etc. that are prepared from minerals.

Basic Nature:-

How do you feel when you touch a cake of soap? Take it between your fingers and gently rub your fingers on it? Do the same with the other material. What difference do you notice?

- You might have touched soap water or lime water. How do you feel?
- Can you list out some more substances that are soapy to touch?

The substances which are soapy to touch are basic in nature.

Some substances that we use in our daily life, contain different bases. For example soap, glass cleaners etc. Various substances containing bases are listed in the below table.



TABLE - 6

SUBSTANCE	BASE
Lime Water	Calcium Hydroxide
Glass Cleaners	Ammonium Hydroxide
Soaps	Sodium Hydroxide / Potassium Hydroxide
Milk of Magnesium	Magnesium Hydroxide

Let us do - 5

Burn a small piece of Magnesium ribbon by holding it with tongs. Collect the white ash and dissolve it in a little water. Touch the solutions formed and test this solution with blue litmus and red litmus.



- What do you observe?

Oxides of Magnesium when dissolved in water form Magnesium Hydroxide. Similarly oxides of Potassium and Sodium form Potassium Hydroxide and Sodium Hydroxide when dissolved in water. All these are basic in nature. They would be soapy when touched.

Let us do - 6

Take the substances that are given in table (3) and test them with Phenolphthalein and Methyl orange solution. Take a small amount of the substance in two test tubes. Add a few drops of phenolphthalein and methyl orange to each test tube separately. Note the effect. Repeat the process for all the substances one by one. Draw a table just like table (7) in your notebook. Record your observations in that table.

SUBSTANCES	CHANGE OBSERVED	
	Colourless Phenolphthalein	Methyl Orange

Do you believe that blood comes out of a lemon? How is it possible?



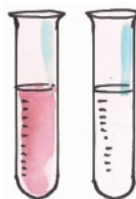
When a magician or a juggler cuts a lemon, blood flows out of it! Actually, he uses a knife dipped in methyl Orange or hibiscus solution to cut the lemon. When Methyl orange is mixed with citric acid (lemon juice) it turns red. But it is not blood. In many of our places we find people doing this and presenting it as magic. Now you can also do this!

- What can you conclude from the above data? Keep in mind that some substances are acidic, some are basic and some are neutral.
- Compare the above observations with those in case of litmus test.
- Can you distinguish acids and bases using the indicators?
- What would be the criteria for deciding this?

Methyl orange gives red colour with acids and yellow colour with bases. Phenolphthalein remains colourless in acidic solution while it turns pink in basic solution.

Let us do some more experiments

Take a natural acid say lemon juice in six test tubes and add Copper, Zinc, Magnesium, Iron, Brass, Aluminium pieces to each one of the test tubes separately.



Note your observations.

Light a matchstick and introduce it into the test tubes. What do you observe?



Henry Cavendish

Henry Cavendish, an Italian Scientist discovered a colourless gas called Hydrogen.

It catches fire with a sound. Is it Hydrogen?



Do you know?

Why are the inner sides of vessels made up of brass and copper coated?

When some substances are kept in a copper container for a long time then a blue - green layer is formed in the inner walls of the container. Copper reacts with the acids present in the substances and forms a blue - green compound. To avoid this reaction the inner walls of these vessels are coated with Tin.

- Why are pickles, jams, jellies preserved in glass, porcelain and plastic containers?

Have you heard about Acid rains?

Do you know what acid rains are? Acid rains are the combination of Carbonic acid, Sulphuric acid and Nitric acid with rain water. Acid rains causes damage to buildings, manuments like Tajmahal and to our skin. Industrial waste gases contain Sulphur dioxide, Nitrogen Oxide, Carbon dioxide. When they get mixed with



moisture they change to acids.

Acid rains are also witnessed in our State in Visakhapatnam district. Can you guess the reason for acid rain in Visakhapatnam?

Let us do - 7

Take lemon juice in two test tubes and add some pieces of marble to one test tube and egg shells to another.



What do you observe?

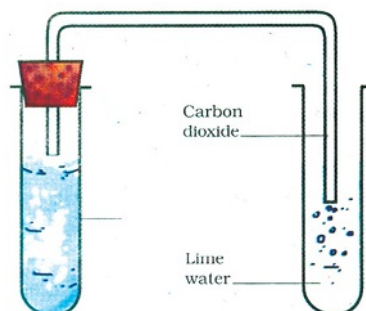
Bring a burning match stick near the test tube.

What happens?

These are due to release of some gas.

Pass the gas into lime water. What happens?

Can you see the formation of precipitation?



Now try to write the properties of acids and bases from your observations in the above experiments.

We have seen that neutral solutions have no effect on indicators. We have also seen that acids and bases have different effects on indicators. When is the solution made by mixing of an acid and a base, be a neutral?

Let us do -8

Take a clean test tube using a clean dropper put 10 drops of Hydrochloric acid carefully in it and also add 2 drops of phenolphthalein indicator solution.

What is the colour of the resulting solution?

Now add Caustic soda solution (Whose concentration is equal to Hydrochloric acid) drop by drop to the test tube.

After each drop shake the test tube well and see if there is any change in the colour of the solution.



Keep adding the Caustic soda drop by drop until the colour turns pink. Now what kind of solution does the test tube have?

Add one drop of Hydrochloric acid and see if it changes back to its original (colourless) state. If not, then add one more drop of Hydrochloric acid. Keep doing this until the solution in the test tube becomes colourless again.

Now can you say what kind of solution this is? Check your claim with litmus paper.

On the basis of this experiment can you explain how would you convert an acidic solution into basic solution?

If you are given a basic solution how can you turn it into an acidic solution?

In the above experiment you might have noticed that if we add excess base (caustic soda) to acidic solution (Hydrochloric acid) it gets converted into a base; similarly we can change a base into an acid by adding the acid in excess.

If you are given a solution of Hydrochloric acid how can you make it into a solution which is neither acidic nor basic?

If you are given a caustic soda solution, how can you make it into a solution which is neither acidic nor basic?

When acids and bases are mixed in equal concentrations they give a neutral solution. We learn more about neutralization in higher classes.

Fertile land - Organic manures:-

In recent years the use of chemical fertilizers has increased. Though the use of chemical fertilizers increases the production of crops, it changes the nature of the soil. Some fertilizers increase the acidity of the soil and some changes its basicity. Thus use of natural organic manure is becoming more preferred these days.



Salts:-

We have seen in the process of neutralization, both the acidic and the basic qualities are changed. Actually when an acid and a base are mixed, a chemical reaction takes place and a salt is produced.

For example by neutralizing Hydrochloric acid solution with Caustic soda (Sodium Hydroxide) solution, a salt Sodium Chloride is formed. Formation of a salt depends on the type of an acid and a base.

Remember:- All neutral solutions are not salt solutions. Sugar and Starches are neutral but they are not salts.

Let us do - 9

Test the following salt substances with red litmus and blue litmus papers. Record your observations in the table.

Salts which change blue litmus to red are acidic salts and salts which change red litmus to blue are basic salts. Some salts affect neither blue nor red litmus papers. These are called neutral salts.

Salt Substance	Effect on Blue Litmus Paper	Effect on Red Litmus Paper
Copper Sulphate		
Common Salt		
Sodium Carbonate		

Let us do - 10: Classifying salts

Collect some salt substances with the help of your teacher, make their salt solutions. Test the salt solutions with blue litmus and red litmus papers. Classify these salts as per your observations in the given table.

Why is our sweat salty ?

Acidic Salts	Basic Salts	Neutral Salts

Our body needs many types of salts. We lose some salts through excretion. So sweat is salty.

Do you know?

Uses of some acids, bases and salts

ACIDS	BASES	SALTS
Preparation of Pickles - Acetic Acid	Removing of grease Stain - Ammonium Hydroxide	Food preservation - Common Salt
Preparation of Puli-hora - Citric Acid	Soap contains Potassium Hydroxide & Sodium Hydroxide	Wash Clothes Washing Soda
Cold Drinks - Carbonic Acid	Bleaching Powder contains - Calcium Hydroxide	Cold Drinks
Removal of Ink stains - Oxalic Acid	Fire extinguisher contains - Aluminum Hydroxide	Cake - Baking Soda
Manures, Batteries - Sulphuric Acid		
Medicine, Dyes - Hydro chloric Acid		
Explosives - Nitric Acid		

Keywords:-

Indicator, Acid, Base, Red litmus, Blue litmus, Acidic substance, Basic Substance, Neutral Substance, Salts, Neutralization, Acid rain.

What we have learnt

- Indicator helps us to find whether the solution is acidic or basic or neutral.
- Red litmus paper, blue litmus paper, phenolphthalein, methyl orange Hibiscus, turmeric and rose petals are natural indicators.
- The substances that turn blue litmus to red are acidic in nature.
- The substances that are soapy to touch and turn red litmus to blue are basic in nature.
- Acid rains are the combination of Carbonic acid, sulphuric acid and Nitric acid with rain water.
- All substances whose solutions are neutral are not salts. For eg. sugar and starch solutions are neutral, but they are not salts.
- In the process of Neutralization, both the acidic and basic qualities are neutralised.
- Salts need not always be neutral, they can be acidic or basic.

Improve your learning

1. The sting of a wasp is basic. How can we treat the sting of a wasp?
2. Why are acids not stored in a metal container?
3. Acidic, basic and neutral solutions are given in three test tubes and you are given a strip of red litmus? How will you identify the three solutions?
4. When drops of lemon juice are put on blue litmus it turns red what will happen if you put some drops of soap solution on the same position on litmus paper?
5. What happens when Nitric acid is added to egg shell?
6. Turmeric stains on white clothes, when washed with soap, turn red. Why?
7. Ammonia is present in window cleaners. It turns red litmus blue. What is its nature?
8. What is the nature of urea? Is it acidic, basic / neutral? How can we verify it?
9. Red litmus paper is dipped in a solution. It remains red. What is nature of the solution? Explain your answer?
10. What is the effect of basic substances on turmeric paper?
11. Can flowers and turmeric papers also be called indicators? Why?
12. Correct the statement if it is wrong
a) Indicators show different colours in acidic and basic solutions.
b) Sodium Hydroxide turns blue litmus red.
c) Tooth decay is caused by the presence of base.
13. Take vinegar, lemon juice, soapy water, baking soda in different vessels. Put beetroot pieces in the vessels. Predict what happens? Verify your prediction by observing the changes. After 10 minutes, 30 minutes, 60 minutes record your observations. What do you conclude?
14. Visit a doctor. Find out the medicines she prescribes to treat acidity. Ask her how acidity can be naturally prevented. Prepare a report.
15. Prepare red cabbage juice by boiling a piece of red cabbage in water. Use it as an indicator and test acidic and basic solutions with it. Present your observations in the form of a table.
16. Collect different flowers and prepare their natural indicators with the help of filter papers.
17. Test the nature of lemon juice and milk sample with help of natural indicators prepared from different flowers. Explain their nature.
18. How do you feel about nature? It is a big natural laboratory that contains innumerable indicators!
19. Choose the correct answer:
a. To protect tooth decay we are advised to brush our teeth regularly. The nature of the tooth paste commonly used is
(i) Acidic (ii) Neutral (iii) Basic (iv) Baking soda
b. Which of the following is acidic in nature?
(i) Lemon juice (ii) Baking Soda (iii) Lime Water (iv) Antacid
20. Match the following
a) Lactic Acid () (1) Tomato
b) Acetic Acid () (2) Lemon
c) Citric Acid () (3) Vinegar
d) Oxalic Acid () (4) Curd
21. Why industrial wastes are neutralised before releasing into water?