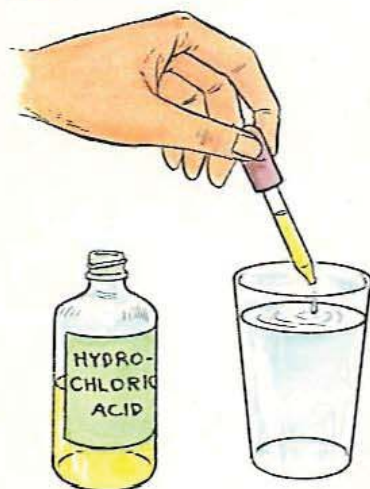


HOW DO YOU KNOW AN ACID?

1. ACIDS TASTE SOUR.



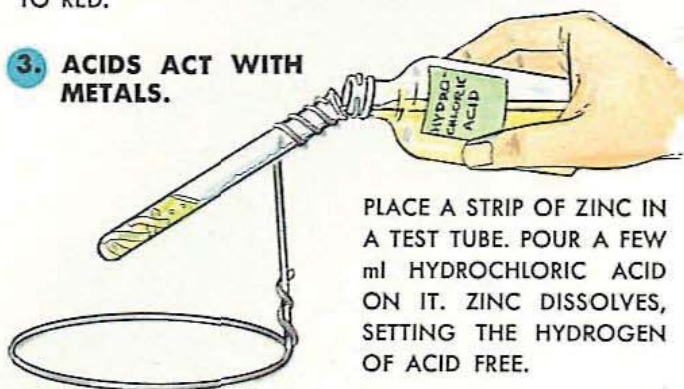
ADD 5 ml HYDROCHLORIC ACID TO 15 ml WATER. DROP 5 DROPS OF MIXTURE IN GLASS OF WATER. DIP FINGER IN THIS HIGHLY DILUTED ACID. TASTE DROP ON FINGER TIP.

2. ACIDS ACT WITH INDICATORS.



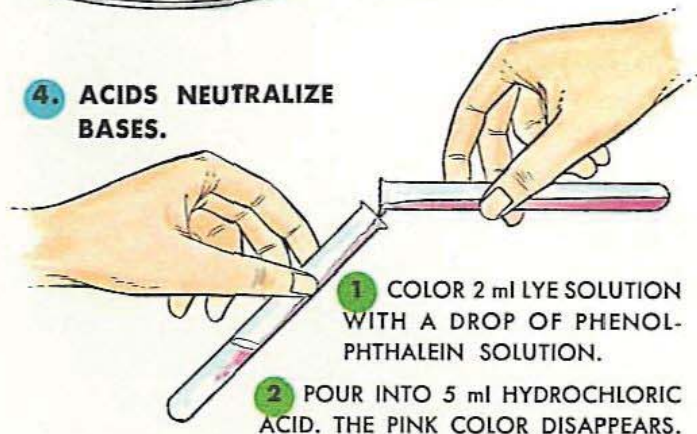
PLACE DROP OF DILUTED HYDROCHLORIC ACID ON STRIP OF BLUE LITMUS PAPER. THE COLOR CHANGES TO RED.

3. ACIDS ACT WITH METALS.



PLACE A STRIP OF ZINC IN A TEST TUBE. POUR A FEW ml HYDROCHLORIC ACID ON IT. ZINC DISSOLVES, SETTING THE HYDROGEN OF ACID FREE.

4. ACIDS NEUTRALIZE BASES.



1 COLOR 2 ml LYE SOLUTION WITH A DROP OF PHENOL-PHTHALEIN SOLUTION.

2 POUR INTO 5 ml HYDROCHLORIC ACID. THE PINK COLOR DISAPPEARS.

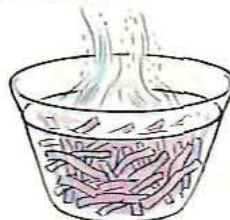
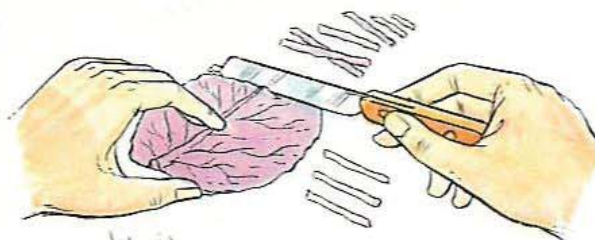
Working With Acids

ACIDS have many traits in common. They taste sour. They change the color of certain plant substances—which are called “indicators.” They contain hydrogen (H) that can be replaced by a metal. They neutralize bases.

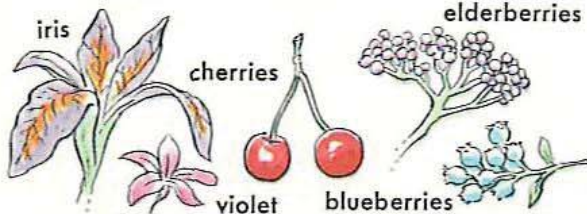
But what is an acid? Earlier, the “acidic” traits were used to define an acid. But with the modern understanding of the atom, a different definition is used. You will remember that the nucleus of an atom contains positively charged protons. Acids in solution liberate protons as ions (H^+). And so we say that an acid is a substance that will give up—or “donate”—protons to another substance. Acids are “proton donors.” The foremost acids used in industry are sulfuric acid (H_2SO_4), nitric acid (HNO_3), and hydrochloric acid (HCl).

The first two — sulfuric acid and nitric acid — should NEVER be used in the home lab. They are much too DANGEROUS. They destroy the skin and might blind you if you got them in the eyes. (Whenever a chemical experiment would ordinarily call for sulfuric acid, this book uses sodium acid sulfate — $NaHSO_4$, sodium bisulfate, “Sani-Flush”; wherever (CONTINUED ON PAGE 44)

HOME-MADE INDICATORS



CUT UP OR GRATE A RED CABBAGE LEAF. DROP IN HOT WATER. STEEP FOR 1/2 HOUR. POUR OFF LIQUID. USE AS INDICATOR.



MANY FLOWERS AND FRUITS CONTAIN COLORING MATTER WHICH YOU CAN EXTRACT WITH HOT WATER AND USE AS AN INDICATOR FOR ACIDS AND BASES.

Working With Bases

BASES taste brackish. They change the color of "indicators." They contain a combination of oxygen and hydrogen atoms called "hydroxyl" (OH). They neutralize acids.

But what is a base? When a base is dissolved in water it liberates negatively charged hydroxyl ions (OH⁻). When a base is neutralized, these ions take on — or "accept" — positively charged protons from another substance. A base is a substance that will accept and combine with protons from another substance. Bases are "proton acceptors." The most important bases are sodium hydroxide ("lye," NaOH), ammonium hydroxide ("ammonia," NH₄OH), and calcium hydroxide ("slaked lime," Ca(OH)₂).

The first of these — sodium hydroxide — is used in many households to clean sluggish drains and to keep sinks from stopping up ("Drano"). **USE IT WITH GREAT CARE** in your experiments. Do not touch lye flakes with your fingers and do not get the solution on your skin — it dissolves the natural oil. It is particularly dangerous to get lye in your eyes. If you get lye on you, dilute it quickly with **LOTS OF WATER**.

(CONTINUED ON PAGE 45)

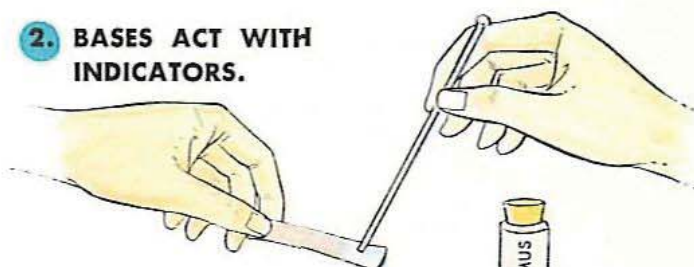
HOW DO YOU KNOW A BASE?

1. BASES TASTE BRACKISH.



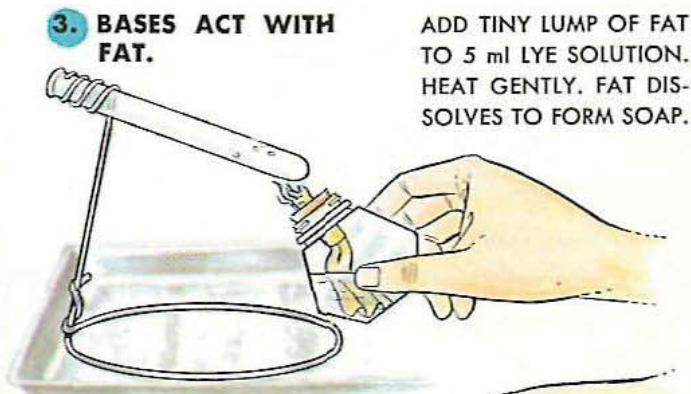
DISSOLVE 5 g (1 TEASPOON) LYE IN 50 ml WATER. DROP 5 DROPS OF SOLUTION IN GLASS OF WATER. DIP FINGER IN THIS HIGHLY DILUTED BASE. TASTE DROP ON FINGER TIP.

2. BASES ACT WITH INDICATORS.



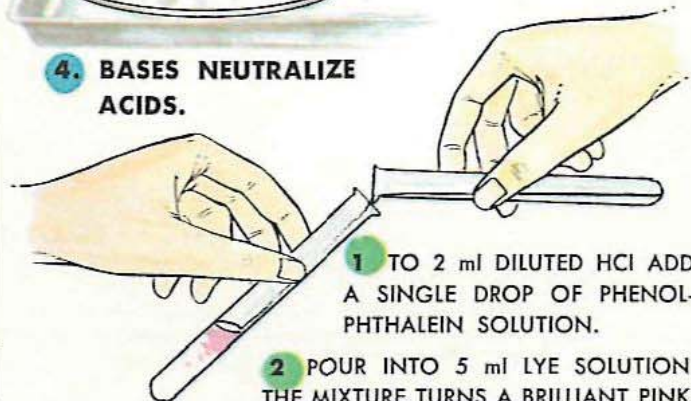
PLACE DROP OF LYE SOLUTION ON RED LITMUS PAPER. THE COLOR INSTANTLY CHANGES TO BLUE.

3. BASES ACT WITH FAT.



ADD TINY LUMP OF FAT TO 5 ml LYE SOLUTION. HEAT GENTLY. FAT DISSOLVES TO FORM SOAP.

4. BASES NEUTRALIZE ACIDS.



1 TO 2 ml DILUTED HCl ADD A SINGLE DROP OF PHENOL-PHTHALEIN SOLUTION.

2 POUR INTO 5 ml LYE SOLUTION. THE MIXTURE TURNS A BRILLIANT PINK.

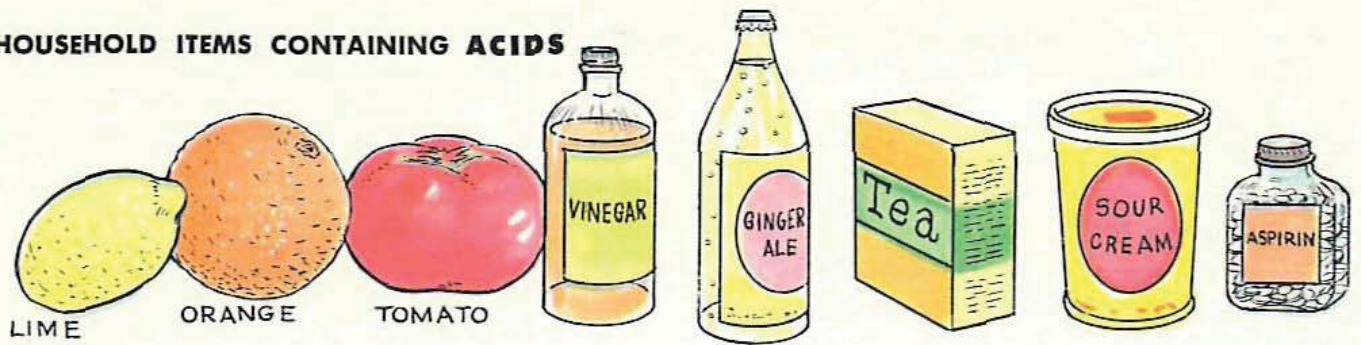
LABORATORY INDICATORS

LITMUS PAPER IS MOST COMMONLY USED INDICATOR. AN ACID TURNS BLUE LITMUS RED. BASES TURN RED LITMUS BLUE.

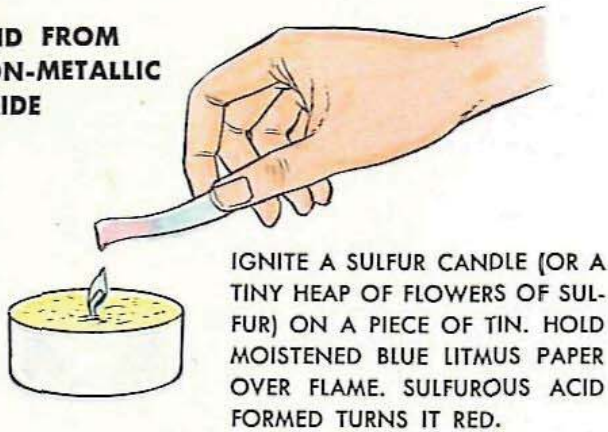
pHYDRION PAPER IS MORE EXACT INDICATOR FOR ACIDS AND BASES.

WHITE PHENOLPHTHALEIN TURNS PINK WITH BASES. GET SMALL AMOUNT FROM DRUG STORE. DISSOLVE A PINCH (0.05 g) IN 50 ml DENATURED ALCOHOL.

HOUSEHOLD ITEMS CONTAINING ACIDS



ACID FROM NON-METALLIC OXIDE

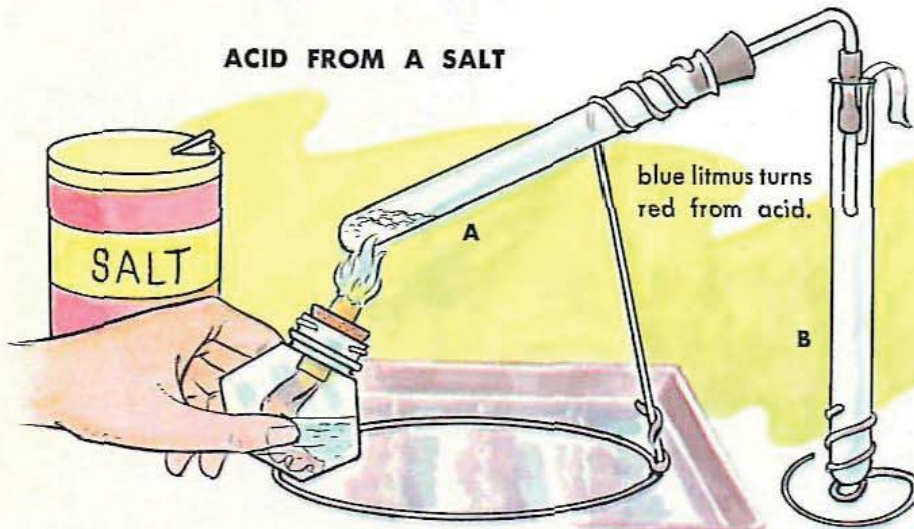


Acids—Continued

nitric acid would be called for, this book produces it in a mixture of a nitrate, KNO_3 , and sodium bisulfate.)

Hydrochloric acid is used in many households under the name of "muriatic acid." **Whenever you use hydrochloric acid in an experiment, USE IT WITH GREAT CARE.** If any of it gets on you, dilute it quickly with **LOTS OF WATER.** Or neutralize it with bicarbonate of soda (but not if in the eyes).

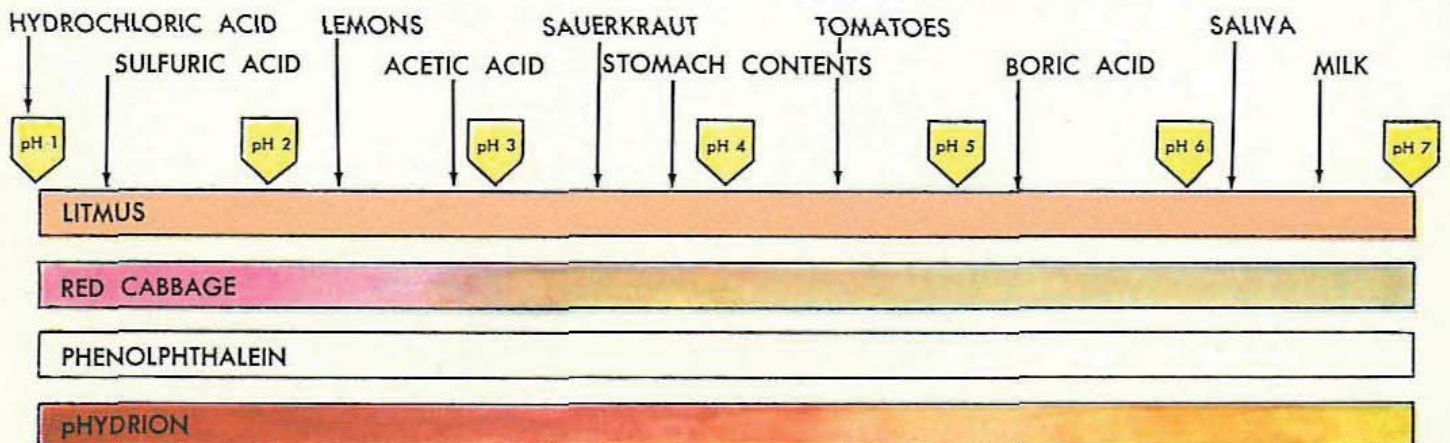
ACID FROM A SALT



SET UP APPARATUS AS SHOWN. INTO TEST TUBE A DROP MIXTURE OF $\frac{1}{4}$ TEASPOON TABLE SALT AND $\frac{1}{2}$ TEASPOON SODIUM BISULFATE. HEAT. HYDROGEN CHLORIDE PRODUCED TURNS MOISTENED BLUE LITMUS RED. ADD 2 ml WATER TO TEST TUBE B. SHAKE. RESULT IS WEAK HYDROCHLORIC ACID.

pH SYSTEM IS A WAY OF DESCRIBING THE RELATIVE ACIDITY OR ALKALINITY OF A SOLUTION. PURE WATER

IS NEUTRAL WITH pH7. THE LOWER THE NUMBER BELOW 7, THE MORE ACID THE SOLUTION. THE HIGHER



HOUSEHOLD ITEMS CONTAINING BASES



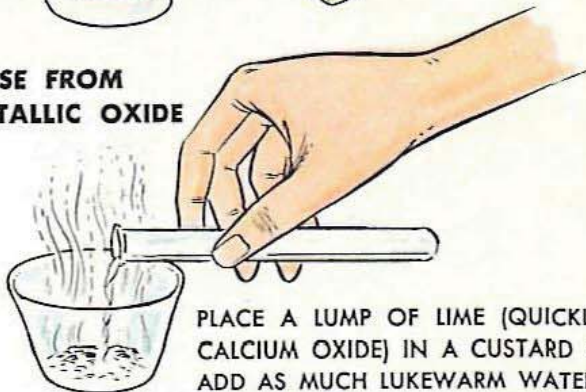
Bases—Continued

You can also neutralize it with vinegar (but not if in the eyes).

Ammonia is a common household cleaning liquid. Ammonia should also be handled with care and should be washed off quickly if you get it on you. Also watch your nose when you work with ammonia. It has a very strong smell.

Calcium hydroxide is a white powder. You will use it in a great number of experiments.

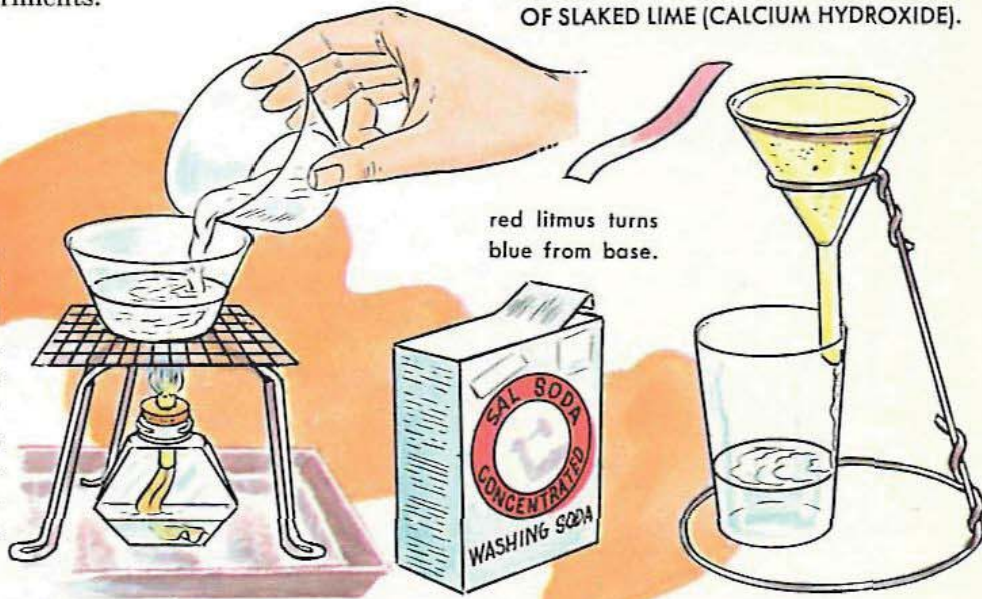
BASE FROM METALLIC OXIDE



PLACE A LUMP OF LIME (QUICKLIME, CALCIUM OXIDE) IN A CUSTARD CUP. ADD AS MUCH LUKEWARM WATER AS IT WILL ABSORB. LIME HEATS UP, GIVES OFF STEAM, CRUMBLES INTO POWDER OF SLAKED LIME (CALCIUM HYDROXIDE).

BASE FROM A SALT

IN A CUSTARD CUP, DISSOLVE 1 TEASPOON SAL SODA (WASHING SODA, SODIUM CARBONATE) IN 50 ml WATER. HEAT SLIGHTLY. ADD SLAKED LIME MIXED WITH WATER. STIR. CHEMICAL REACTION PRODUCES SODIUM HYDROXIDE AND CALCIUM CARBONATE. FILTER. CLEAR LIQUID CONTAINS THE SODIUM HYDROXIDE (LYE). THE CALCIUM CARBONATE IS HELD BACK BY THE FILTER.



red litmus turns blue from base.

THE NUMBER ABOVE 7, THE MORE ALKALINE THE SOLUTION. WHEN YOU KNOW AT WHAT pH AN INDICATOR

CHANGES COLOR, YOU CAN DETERMINE THE ACIDITY OR ALKALINITY OF THE SOLUTION YOU ARE TESTING.

