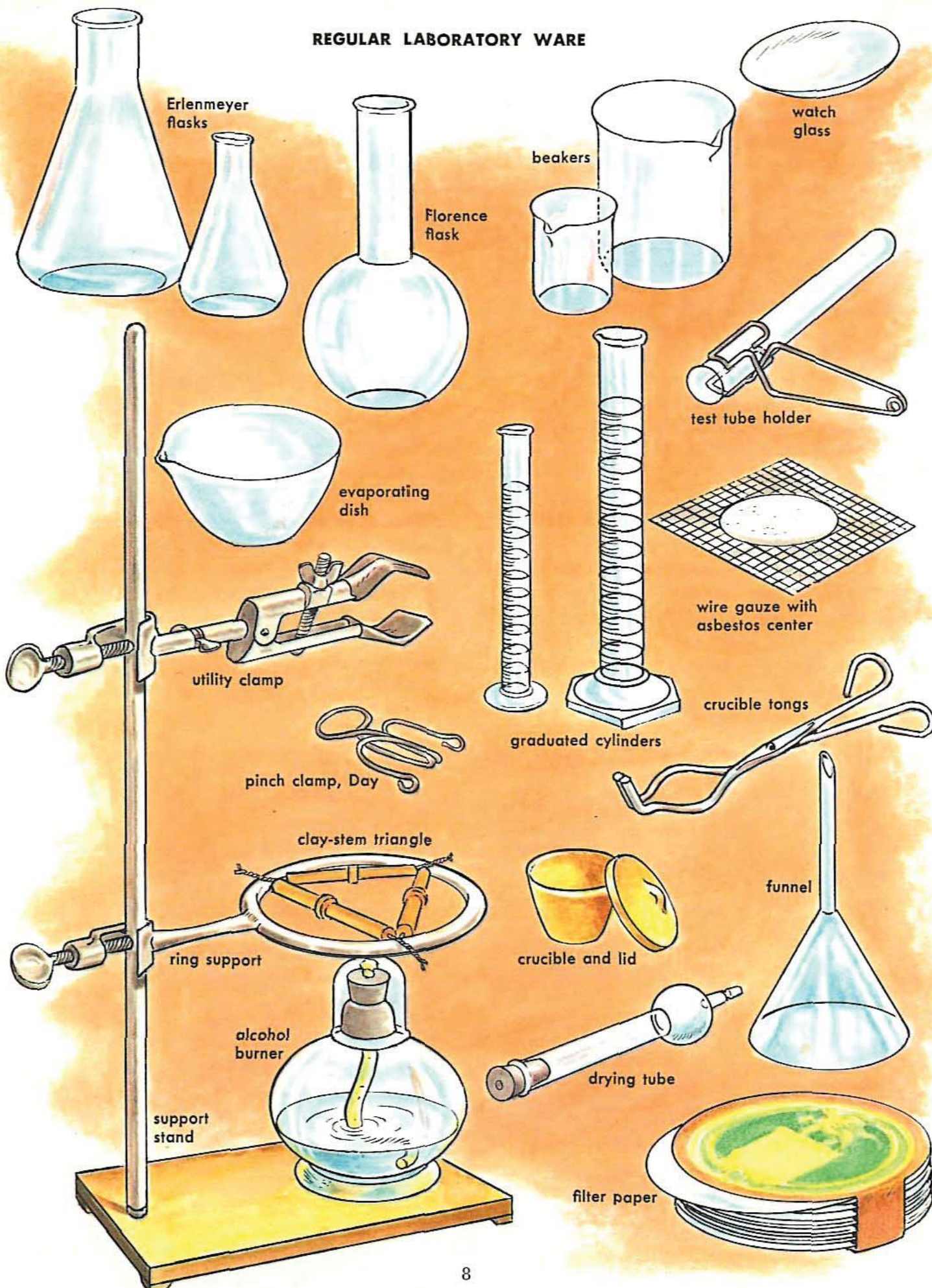


REGULAR LABORATORY WARE



Erlenmeyer flasks

Florence flask

beakers

watch glass

evaporating dish

test tube holder

utility clamp

wire gauze with asbestos center

pinch clamp, Day

graduated cylinders

crucible tongs

clay-stem triangle

funnel

ring support

crucible and lid

alcohol burner

drying tube

support stand

filter paper

Equipment for Chemistry

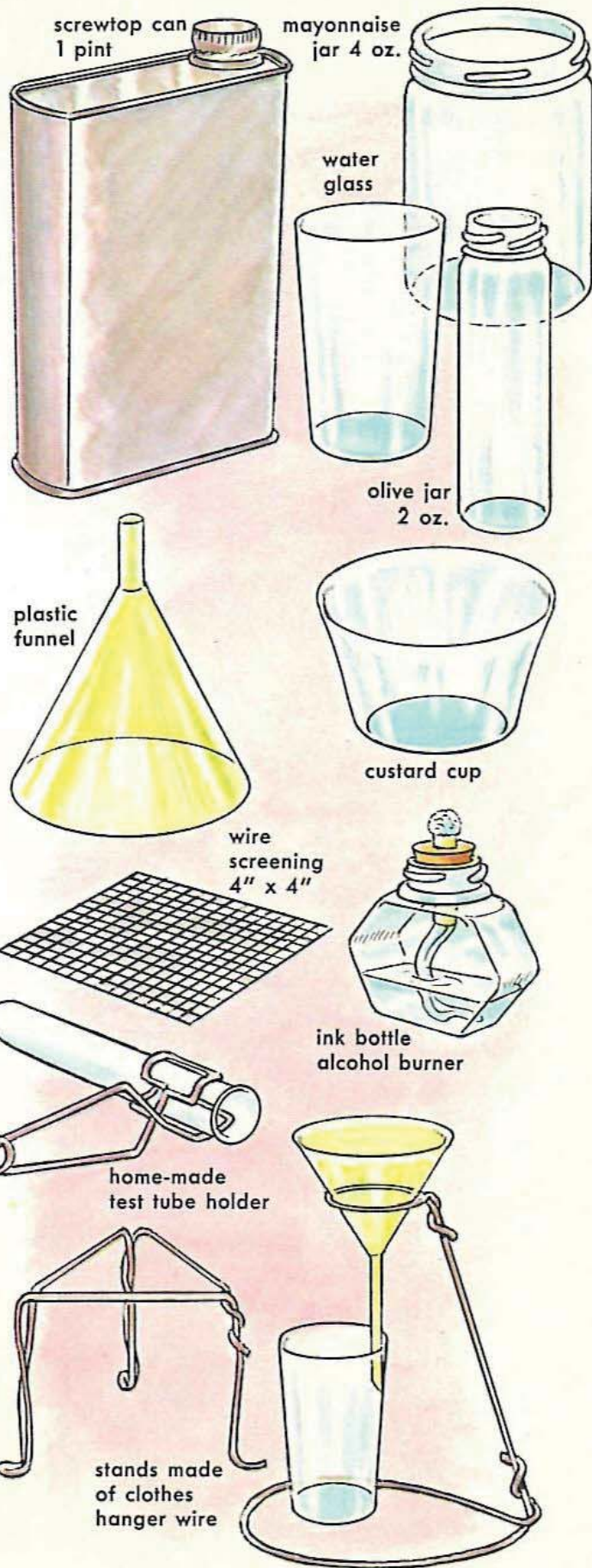
SOME of the greatest discoveries in chemistry were made by scientists who had no special equipment but simply used whatever was at hand.

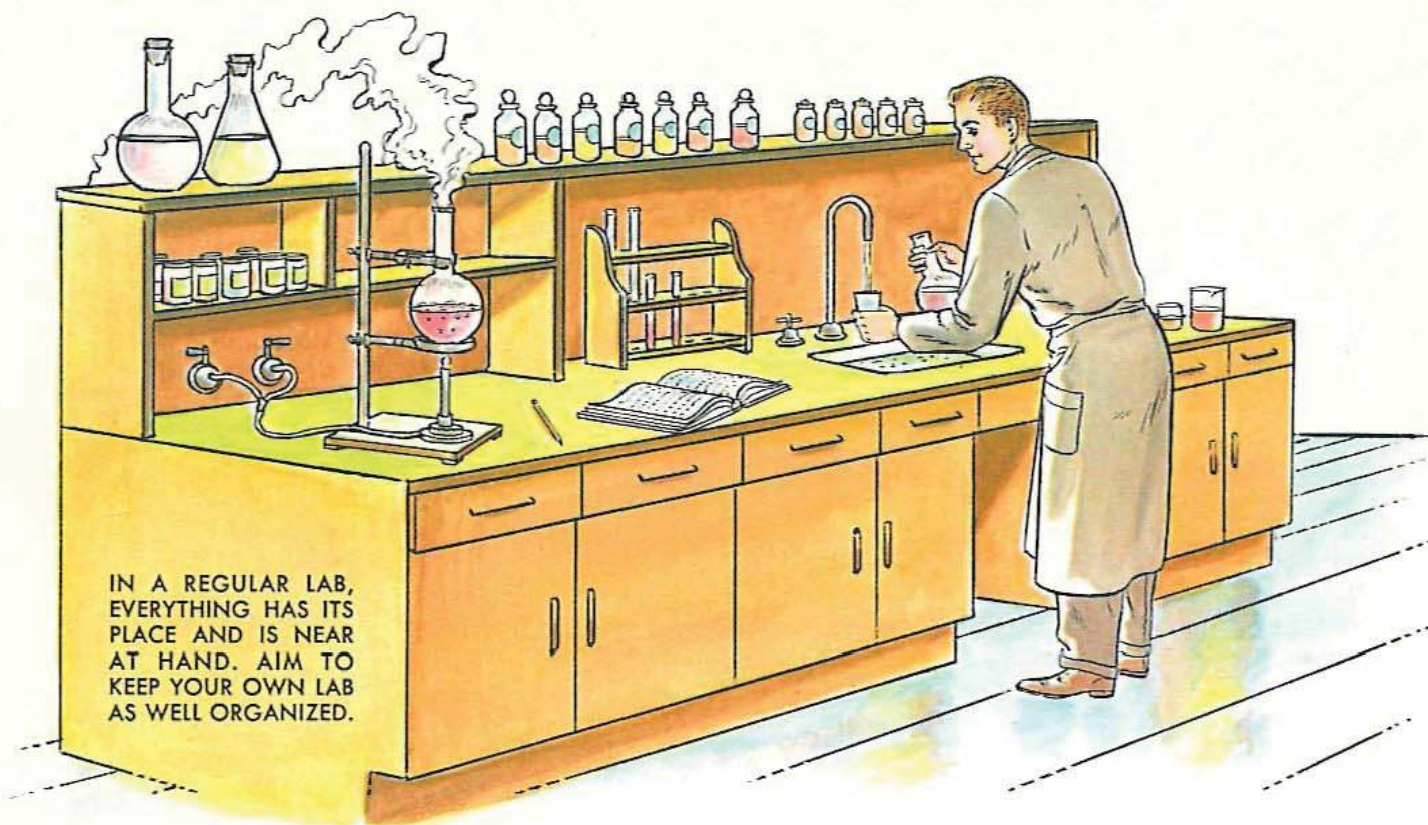
In your home lab experiments it will pay you to follow the example of these early chemists. Put your imagination to work. Use whatever suitable equipment you can find around the house (as suggested in column to the right) and buy only what is absolutely necessary (as shown below). Some items may be purchased in a local drugstore or scientific supply shop. If not, you can buy them from one of the suppliers listed on page 110.

Later on — if you really get excited about chemistry — you may want to use your pocket money for some of the lab equipment shown on page 8.

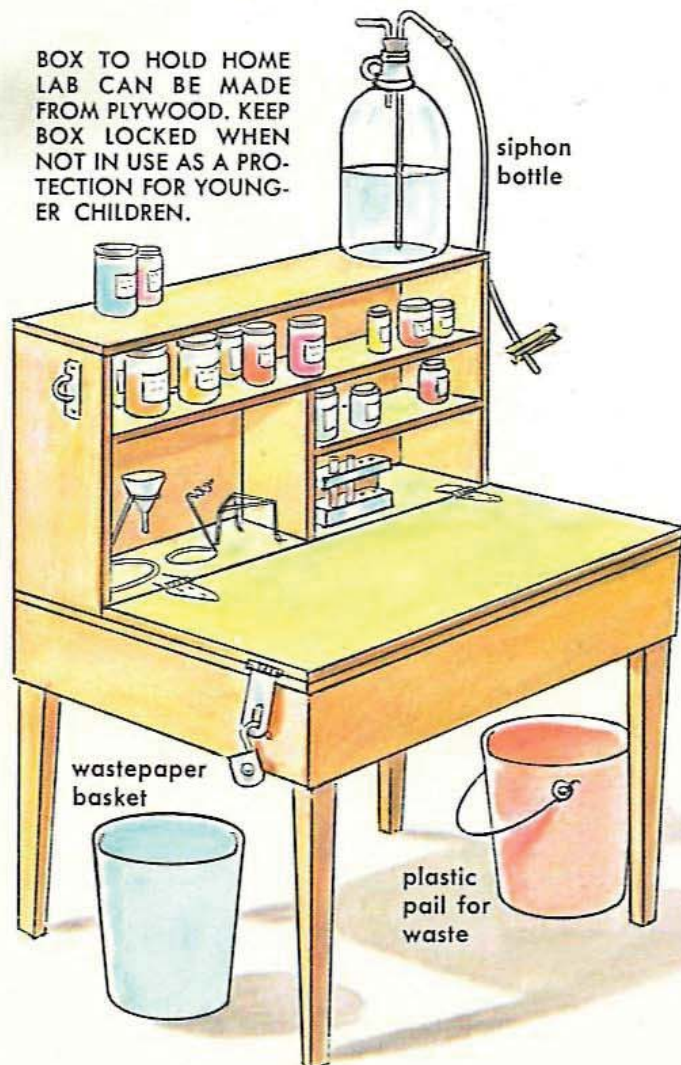
IMPROVISED EQUIPMENT FOR HOME LAB

LABORATORY WARE FOR HOME LAB





Setting Up Your Home Laboratory



It is possible that you may be permitted to work at the kitchen table when this is not in use. But it is far better if you have a place where you will not be disturbed and where you can store your equipment — a corner in your room, or in the basement or the garage.

These are the things you'll need in your lab:

Work Table. An old, sturdy table will do. Cover it with a plastic top to protect the wood.

Water Supply. If you have a faucet nearby, fine. Otherwise, make a siphon bottle (page 11).

Waste Disposal. If you can dump your waste directly into the kitchen *drain* (NOT into the sink), you are all right. If not, collect it in a plastic pail to be thrown out when you're finished.

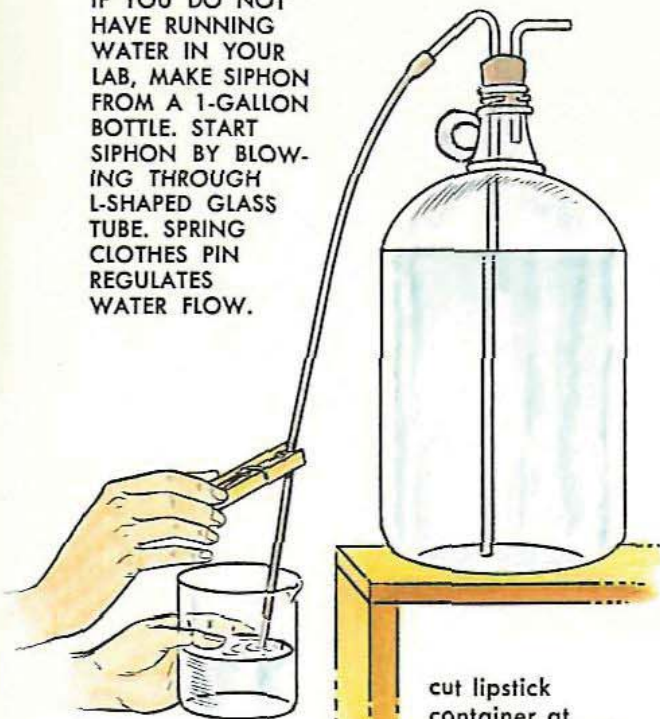
Source of Heat. In the regular laboratory, special gas burners are used. In the home lab, you can use a burner for denatured alcohol. Have a shallow metal pan under the burner for fire safety.

Storage. If there's no one around to disturb your chemicals and equipment, an open shelf is OK. Otherwise, use a box that can be locked up.

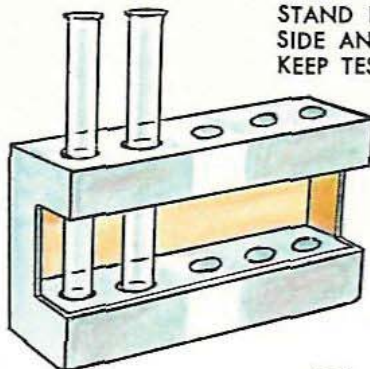
Containers. Keep chemicals in glass jars and bottles. LABEL THEM ALL CLEARLY.

Stands. Make your own test tube stand as well as stands for holding glassware for heating.

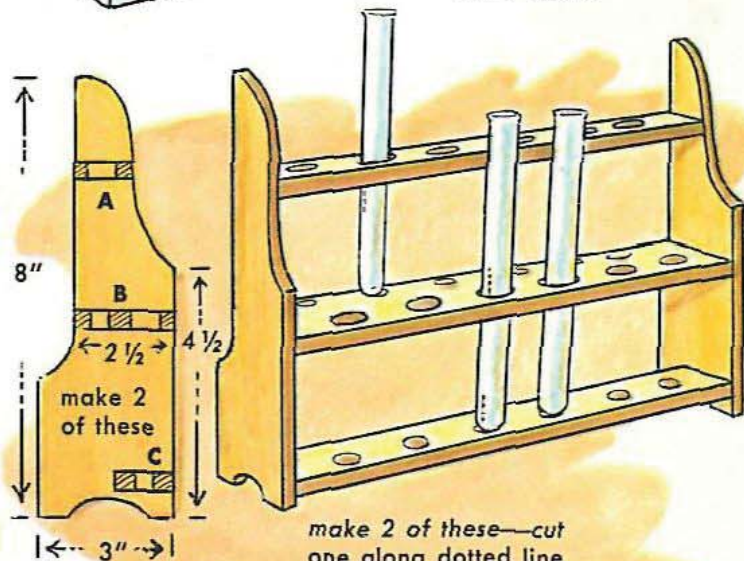
IF YOU DO NOT HAVE RUNNING WATER IN YOUR LAB, MAKE SIPHON FROM A 1-GALLON BOTTLE. START SIPHON BY BLOWING THROUGH L-SHAPED GLASS TUBE. SPRING CLOTHES PIN REGULATES WATER FLOW.



YOU CAN MAKE A SIMPLE TEST TUBE STAND FROM A SALT BOX. CUT OUT SIDE AND USE CUT-OUT SECTION TO KEEP TEST TUBES LINED UP STRAIGHT.



REGULAR LAB STAND FOR TEST TUBES CAN BE PRODUCED FROM STRIPS OF 1/4-INCH WOOD. FOLLOW PATTERNS BELOW TO MAKE TWO SIDES AND THREE HORIZONTAL PIECES. DRILL HOLES. ASSEMBLE WITH THIN TACKS.



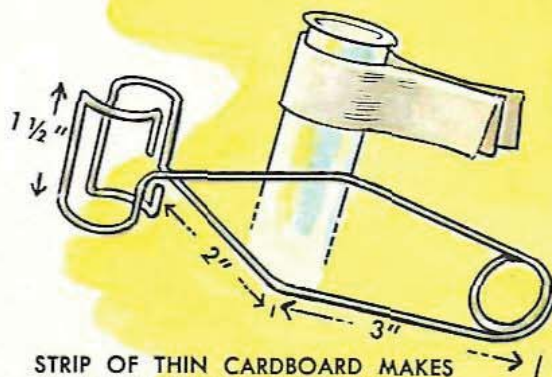
use half of Thermos bottle cork



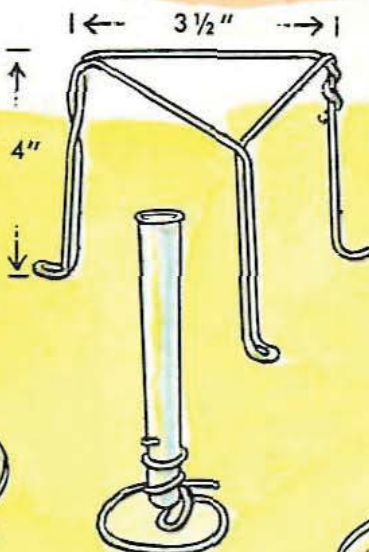
"screw" lipstick tube through cork



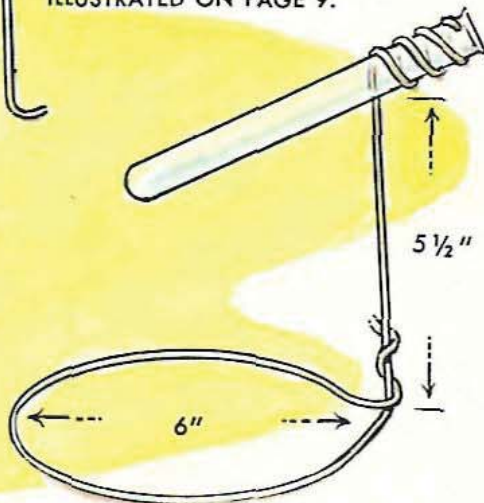
MAKE AN ALCOHOL BURNER FROM INK BOTTLE, THERMOS BOTTLE CORK, AND LIPSTICK CONTAINER. BUY WICK AT A HARDWARE STORE.

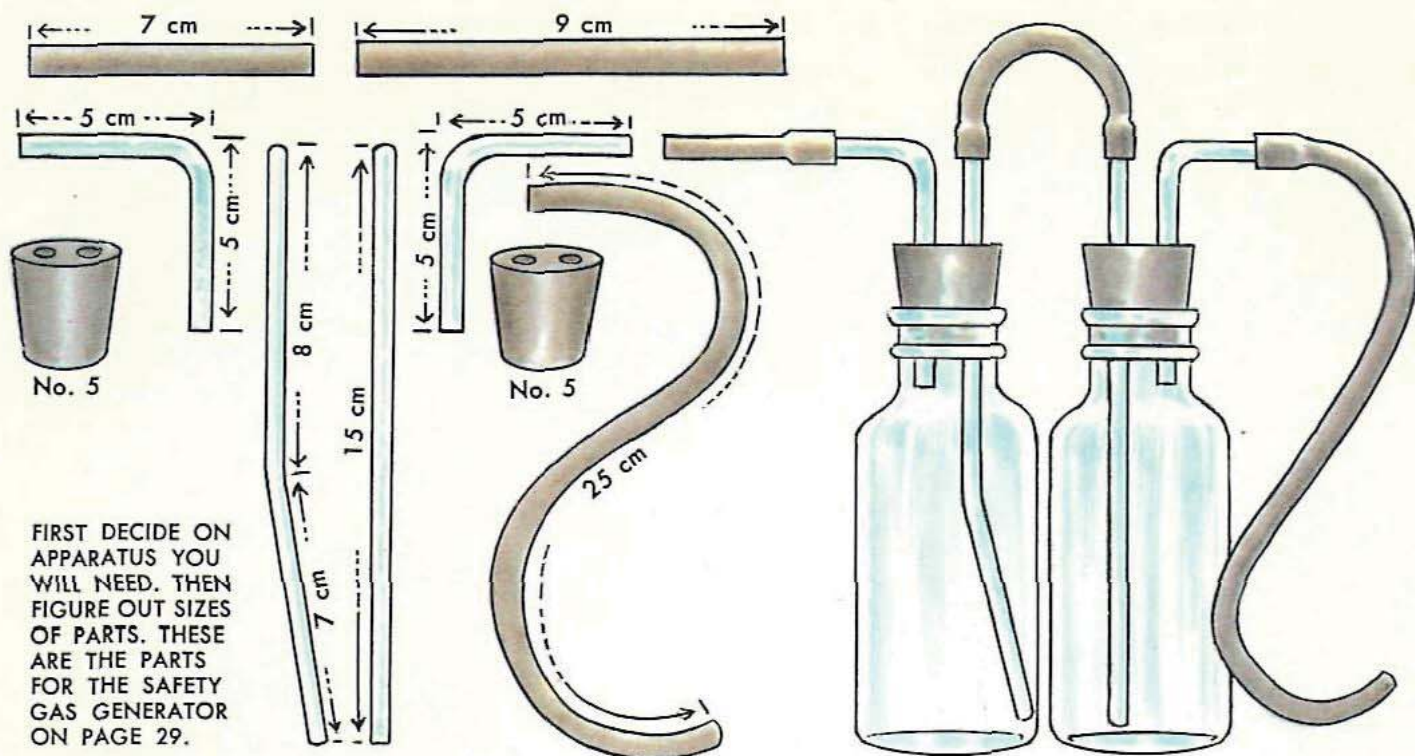


STRIP OF THIN CARDBOARD MAKES AN ADEQUATE TEST TUBE HOLDER. IF YOU LIKE, YOU CAN MAKE A HOLDER FROM CLOTHES HANGER WIRE AS SHOWN HERE.



USE A PAIR OF PLIERS FOR MAKING THESE STANDS FROM CLOTHES HANGER WIRE. ALSO MAKE THE FUNNEL STAND ILLUSTRATED ON PAGE 9.





Making Apparatus for Experiments

Most of your chemical experiments you will perform in test tubes and jars. But occasionally you will need an apparatus — a device consisting of bottles and stoppers, glass and rubber tubing.

A good chemist takes pride in his apparatus. He makes it with great care — not just for looks but, more important, for safety. An apparatus that leaks flammable gas can be very dangerous.

Before you start to put an apparatus together, make a simple drawing of it so that you will know what it will consist of. Then get out the various parts you will need to put it together.

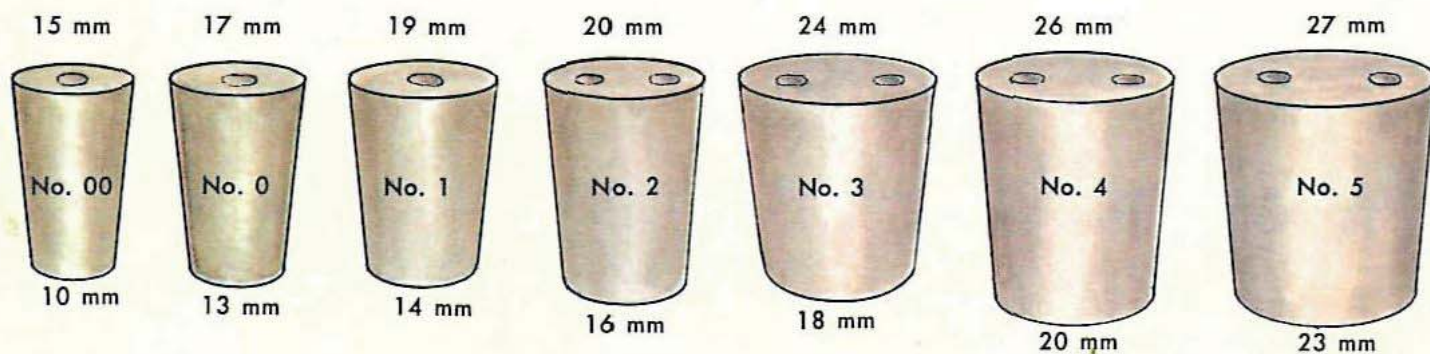
To make an apparatus, you need to know how to

cut a glass tube, how to bend it, and how to draw it to a jet point. See page 13.

It is wise to use glass tubes of one diameter only, with rubber tubing to fit. Glass tubes of an *outside* diameter of 6 millimeters fit snugly into the holes in the usual rubber stoppers. Rubber tubing of an *inside* diameter of $\frac{3}{16}$ " fits over the 6mm glass tubes.

To determine the right size stoppers to use in the bottles of your apparatus, measure the mouths of the bottles against the stoppers shown below in actual size. Order stoppers by number. Keep a selection of different sizes on hand.

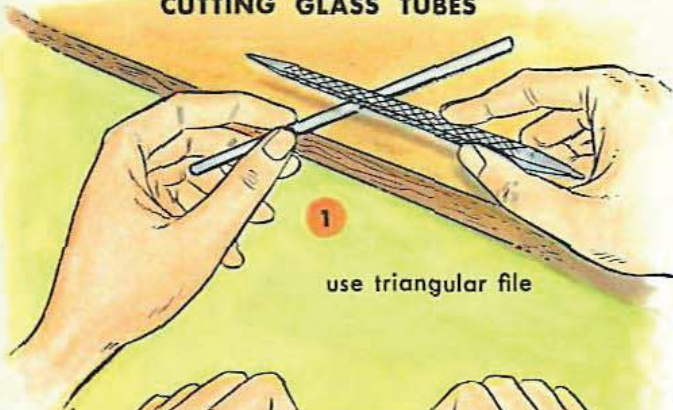
Follow the safety precautions on page 16.



THESE ARE THE ACTUAL SIZES OF RUBBER STOPPERS. BY MEASURING THEM AGAINST YOUR LAB WARE YOU WILL

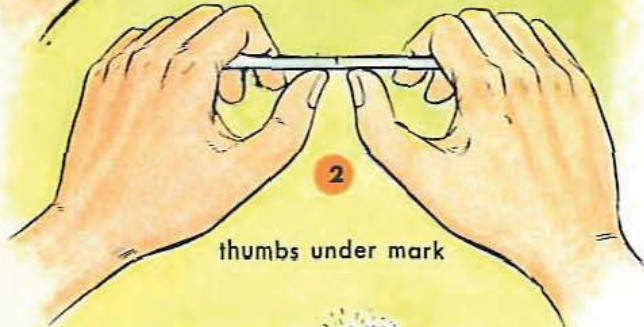
KNOW WHICH TO ORDER. No. 0 FITS THE 16 mm TEST TUBE. No. 5 FITS 4-OZ. WIDE-MOUTH BOTTLE.

CUTTING GLASS TUBES



1

use triangular file



2

thumbs under mark

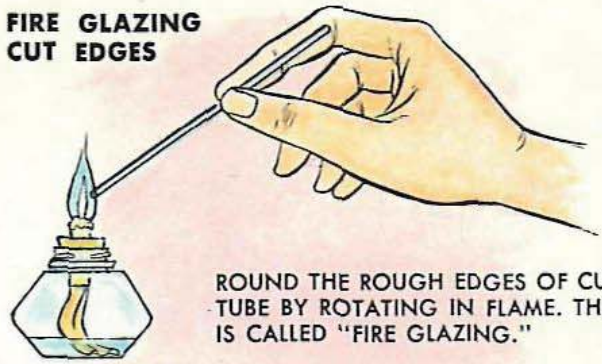


3

push thumbs away from you

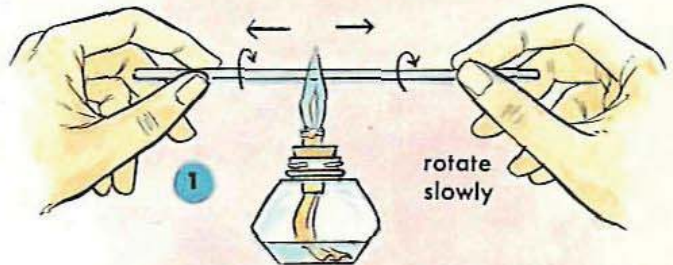
- 1 MAKE SINGLE SCRATCH WITH FILE—DO NOT "SAW."
- 2 HOLD TUBE WITH BOTH HANDS, THUMBS BELOW MARK.
- 3 SNAP TUBE INTO TWO PIECES WITH A QUICK JERK.

FIRE GLAZING CUT EDGES



ROUND THE ROUGH EDGES OF CUT TUBE BY ROTATING IN FLAME. THIS IS CALLED "FIRE GLAZING."

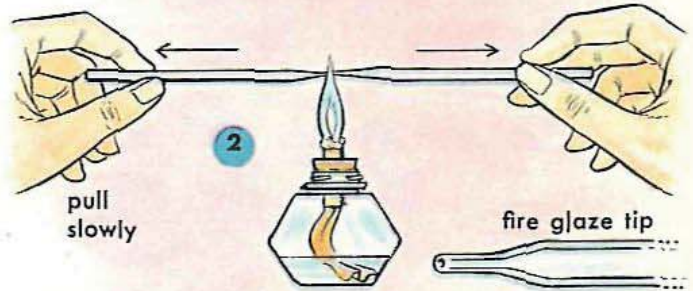
MAKING JET POINT



1

rotate slowly

heat for about 1 1/2 inches



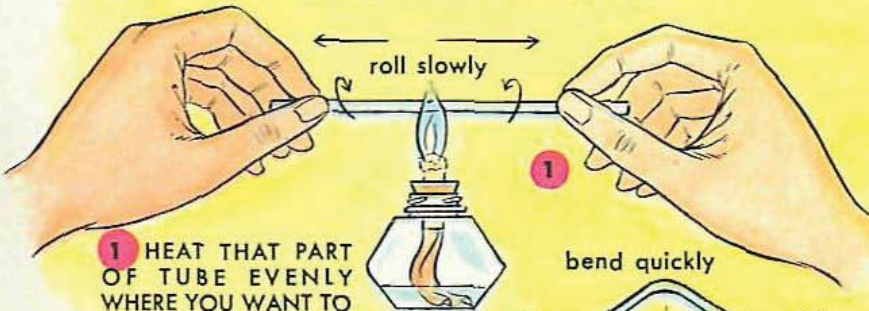
2

pull slowly

fire glaze tip

- 1 HEAT SECTION OF TUBE EVENLY WHERE YOU WANT TO FORM JET POINT, BY ROLLING IT IN THE FLAME.
- 2 WHEN SOFT, PULL SLOWLY. CUT APART WHEN HARD.

BENDING GLASS TUBES



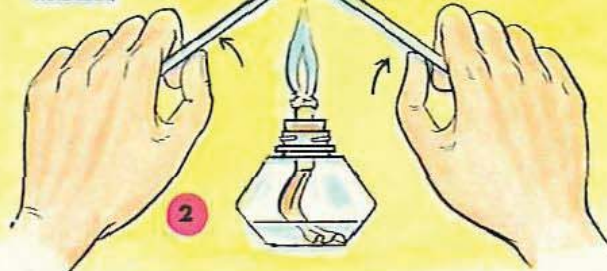
1

roll slowly

bend quickly

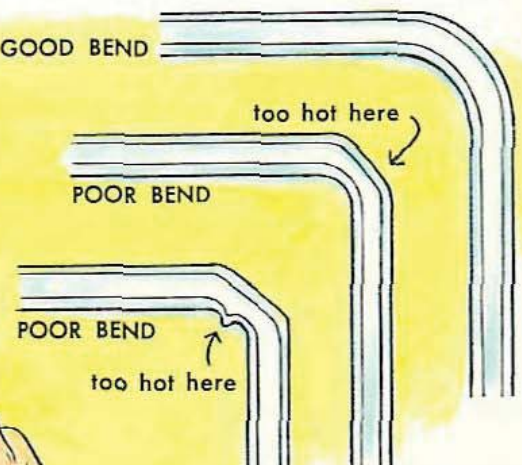
1 HEAT THAT PART OF TUBE EVENLY WHERE YOU WANT TO BEND IT, FOR ABOUT TWO INCHES, BY ROLLING AND MOVING THE TUBE BACK AND FORTH.

2 WHEN GLASS IS SOFT, REMOVE FROM FLAME. BEND QUICKLY. HOLD UNTIL THE GLASS HARDENS.



2

GOOD BEND



IF HEATED TOO MUCH, THE TUBE WILL FLATTEN OR "BUCKLE."



Scientific Measurements

IN SCIENCE, the metric system is preferred over our usual system. It is much easier to work with when once you have learned it — for instead of dividing or multiplying by 12 or 32 or 16 to go from one unit to the next, you simply move the decimal point. Just remember these two things:

1. That the names of the basic units are meter for lengths, liter for volumes, grams for weights — abbreviated to m, l, and g (without a period after them).
2. That 1000 of a kind are called kilo; 100, hekto; 10, deca; 1/10 is called deci; 1/100, centi; 1/1000, milli.

METRIC UNITS OF LENGTH

1000 meters (m) = 1 kilometer (km)
 1 meter (m) = 1000 millimeters (mm)
 1 meter (m) = 39.37 inches
 2.540 centimeters (cm) = 1 inch

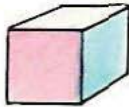
METRIC UNITS OF VOLUME

1 liter (l) = 1000 cubic centimeters (cm³ or cc)
 1 liter (l) = 1000 milliliters (ml)
 1 liter (l) = 1.06 quarts (liquid)
 0.946 liter (l) = 1 quart (liquid)

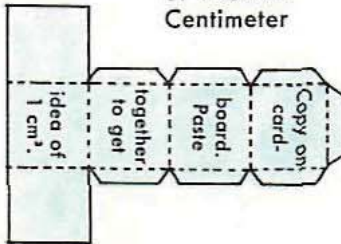
METRIC UNITS OF WEIGHT

1000 grams (g) = 1 kilogram (kg)
 1 gram (g) = 1000 milligrams (mg)
 1 gram (g) = 0.035 ounces avoirdupois
 28.350 grams (g) = 1 ounce avoirdupois

1 cubic centimeter =
 1 cm³ = 1 cc =
 1 milliliter =
 1 ml



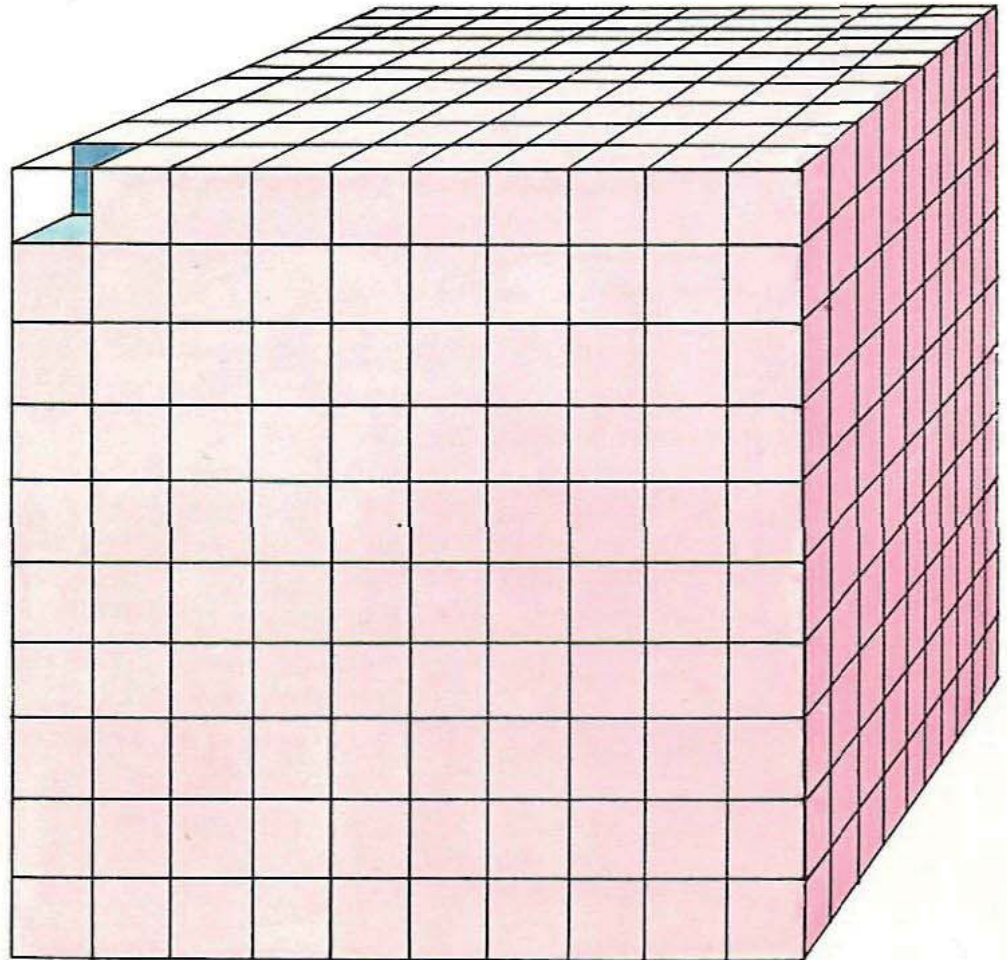
Making a Model of a Cubic Centimeter



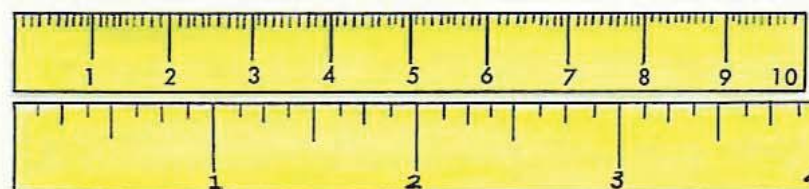
BOTTOM LINE OF FIGURE TO THE RIGHT IS 1 DECIMETER (1 dm) OR 10 CENTIMETERS (10 cm) OR 100 MILLIMETERS (100 mm).

FRONT SURFACE OF FIGURE IS 1 SQUARE DECIMETER (1 dm²) OR 100 SQUARE CENTIMETERS (100 cm²).

VOLUME OF WHOLE FIGURE IS 1 CUBIC DECIMETER (1 dm³) OR 1000 CUBIC CENTIMETERS (1000 cm³ OR 1000 cc) OR 1000 MILLILITERS (1000 ml) OR 1 LITER (1 l). 1 l WATER WEIGHS 1 KILOGRAM (1 kg).



1 cubic decimeter = 1 liter = 1000 cubic centimeters = 1000 milliliters



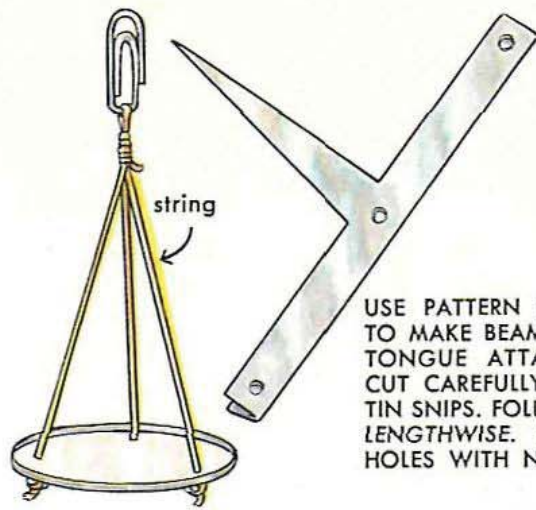
centimeter ruler

inch ruler

MAKING A HAND BALANCE

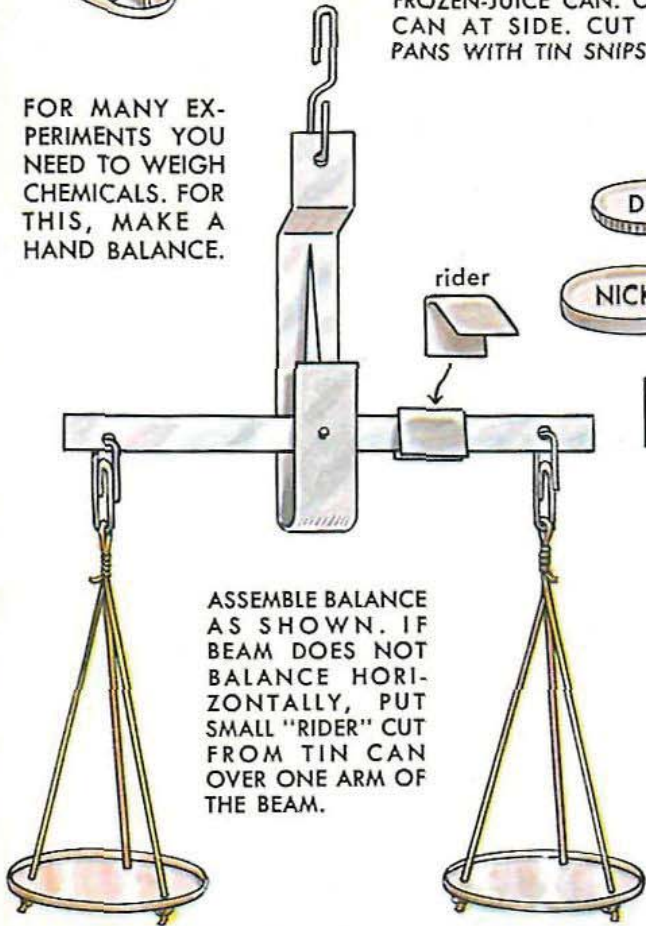


MAKE THE TWO PANS FOR THE HAND BALANCE FROM TOP AND BOTTOM OF A FROZEN-JUICE CAN. OPEN CAN AT SIDE. CUT THE PANS WITH TIN SNIPS.



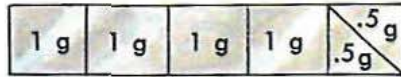
USE PATTERN BELOW TO MAKE BEAM WITH TONGUE ATTACHED. CUT CAREFULLY WITH TIN SNIPS. FOLD BEAM LENGTHWISE. PUNCH HOLES WITH NAIL.

FOR MANY EXPERIMENTS YOU NEED TO WEIGH CHEMICALS. FOR THIS, MAKE A HAND BALANCE.



ASSEMBLE BALANCE AS SHOWN. IF BEAM DOES NOT BALANCE HORIZONTALLY, PUT SMALL "RIDER" CUT FROM TIN CAN OVER ONE ARM OF THE BEAM.

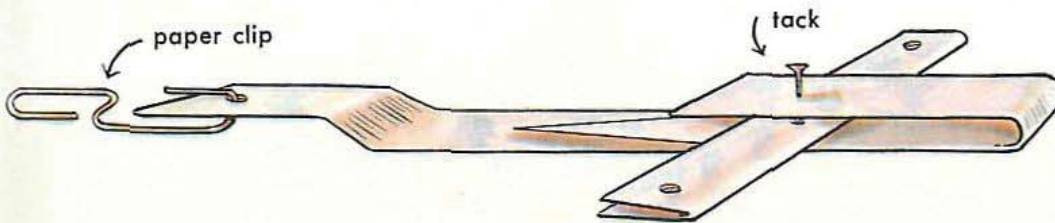
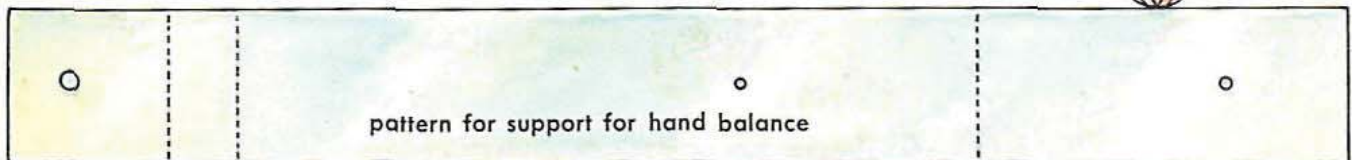
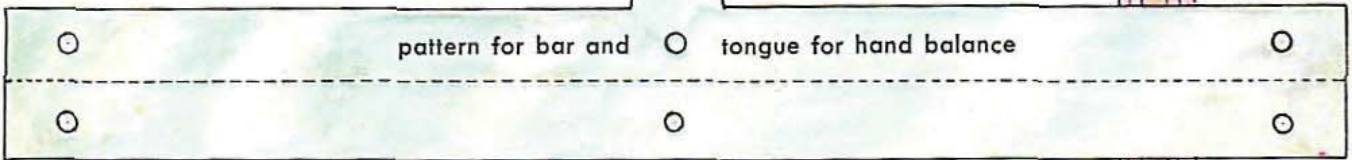
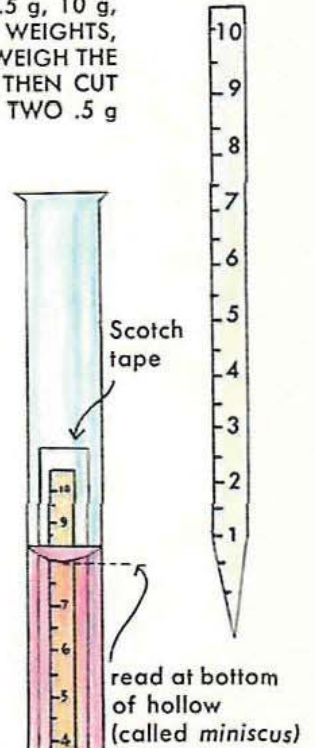
DIME = 2.5 g
NICKEL = 5 g



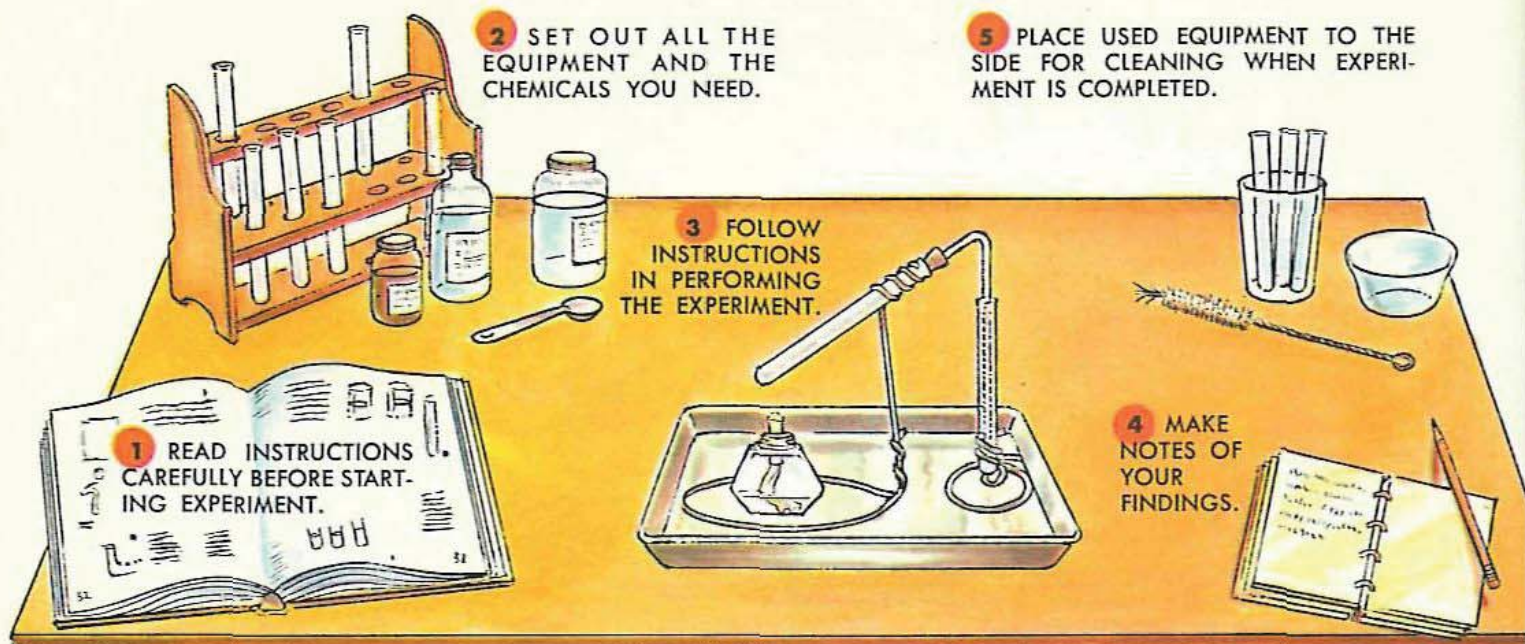
YOU CAN USE COINS TO WEIGH 2.5 g, 5 g, 7.5 g, 10 g, ETC. FOR SMALLER WEIGHTS, CUT A TIN STRIP TO WEIGH THE SAME AS A NICKEL. THEN CUT IT IN FOUR 1 g AND TWO .5 g WEIGHTS.

MAKING A GRADUATE
A GRADUATE IS USED FOR MEASURING LIQUIDS.

YOUR 6" TEST TUBE HOLDS 22 ml. YOU CAN USE IT FOR ROUGH MEASUREMENTS: TUBE NOT QUITE FULL IS 20 ml, NOT QUITE HALF FULL 10 ml. FOR SMALLER AMOUNTS, COPY THE RULER TO THE RIGHT AND ATTACH IT TO THE SIDE OF A TEST TUBE WITH SCOTCH TAPE FOR MEASURING ml's.



COPY THE PATTERNS ABOVE ONTO A PIECE OF PAPER. TRANSFER DESIGNS TO PIECE OF TIN CAN. CUT OUT AND BEND AS SHOWN TO THE LEFT.



Correct Laboratory Techniques

IN YOUR home laboratory, three considerations are of the greatest importance: SAFETY, NEATNESS, and EXACTNESS.

SAFETY — All the experiments in this book are safe when done in the correct laboratory way as shown on these pages.

Treat chemicals with respect. Never taste anything unless specifically told to do so. If there are younger children in the family, lock up your chemicals when you are not working with them.

Protect your clothes with a plastic apron.

Be careful with fire. When you use your alcohol burner, have a metal pan under it for safety.

NEATNESS — Get the habit of lining up equipment and chemicals you need on one side and placing used items on the opposite side — keeping the space between them clear for your experiments.

Put chemicals away and clean glassware as soon as you have finished an experiment.

EXACTNESS — Label all bottles and jars containing chemicals clearly and correctly.

Where amounts of chemicals are not given, use the smallest amount that will tell you what you want to know.

Observe the chemical reactions carefully and make complete notes of them as you go along.



PLAY SAFE WHEN YOU PUT A GLASS TUBE IN A STOPPER. PROTECT YOUR HANDS BY WRAPPING TOWEL AROUND THEM. MOISTEN GLASS TUBE AND STOPPER WITH WATER, THEN PUSH THE TUBE INTO THE STOPPER WITH A SCREWDRIVER MOTION.



WHEN YOU MAKE AN APPARATUS FOR A CHEMICAL EXPERIMENT, MAKE SURE THAT ALL CONNECTIONS ARE AIR-TIGHT. USE THE RIGHT SIZE STOPPER FOR MOUTH OF CONTAINER, GLASS TUBES THAT FIT SNUGLY INTO THE STOPPER HOLES, AND TIGHT-FITTING RUBBER TUBING.



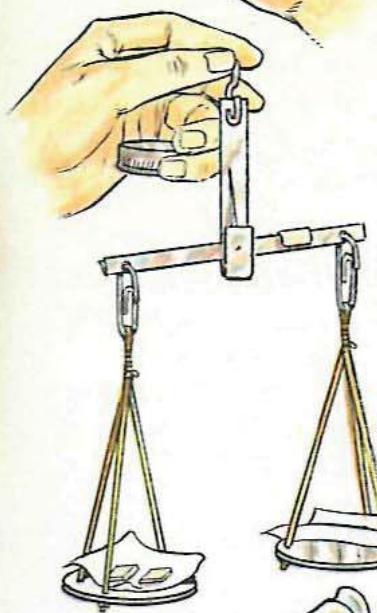
MAKE IT A HABIT TO READ A LABEL TWICE TO BE SURE YOU HAVE THE RIGHT CHEMICAL.



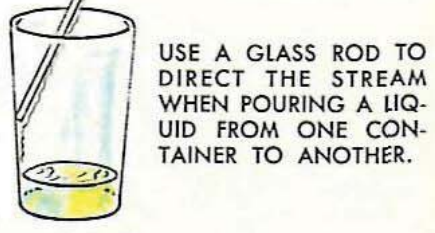
TRAINED CHEMISTS NEVER PUT STOPPER OF BOTTLE ON DESK—THEY KEEP IT IN ONE HAND.

1 TAKE STOPPER OFF BOTTLE WITH YOUR LEFT HAND.

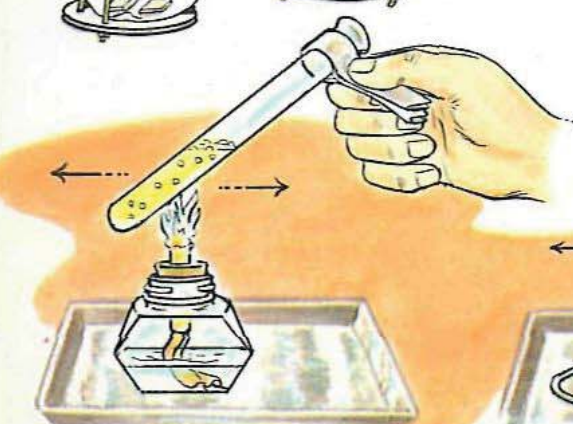
2 KEEP STOPPER IN THE LEFT HAND WHILE YOU POUR FROM THE BOTTLE IN YOUR RIGHT, WITH THE LABEL FACING UP, THEN REPLACE THE STOPPER.



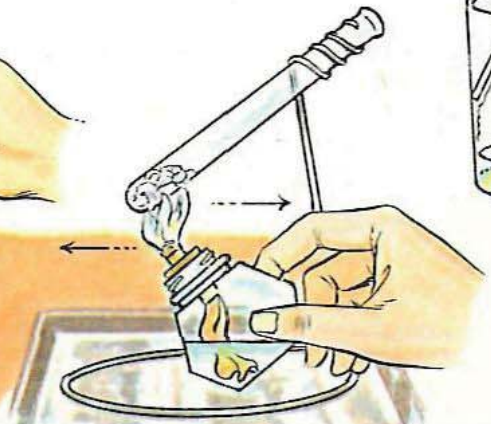
IN WEIGHING OUT A DRY CHEMICAL, PLACE EQUAL-SIZED TISSUE PAPERS ON EACH PAN OF THE SCALE. ROLL JAR BETWEEN FINGERS OR TAP IT GENTLY WITH YOUR INDEX FINGER.



USE A GLASS ROD TO DIRECT THE STREAM WHEN POURING A LIQUID FROM ONE CONTAINER TO ANOTHER.



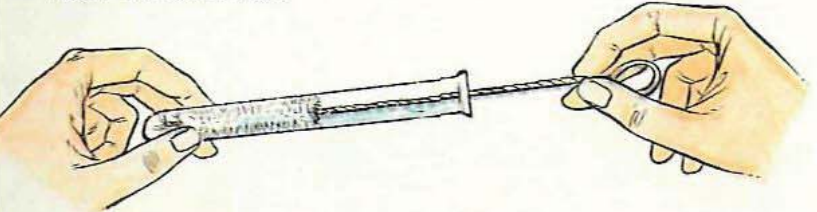
WHEN HEATING A LIQUID IN A TEST TUBE, HOLD TUBE WITH A HOLDER. KEEP THE TUBE MOVING. DO NOT HEAT BOTTOM OF TUBE—CONTENTS MAY "BUMP" AND SQUIRT OUT. NEVER POINT MOUTH OF TEST TUBE TOWARD YOURSELF OR TOWARD ANYONE ELSE.



WHEN HEATING A SOLID IN A TEST TUBE, PLACE THE TUBE IN A STAND AND MOVE THE FLAME OF YOUR BURNER BACK AND FORTH TO HEAT THE CONTENTS EVENLY.



DO NOT BRING TEST TUBE UP TO YOUR NOSE FOR SMELLING. INSTEAD, WAFT THE ODORS TOWARD YOU WITH YOUR HAND.



USE A TEST TUBE BRUSH FOR CLEANING TEST TUBES. RINSE IN COLD WATER.