SCIENCE CLUBS OF AMERICA

Training for Youth and War W

Machines ★ WRITTEN TO CONFORM WITH PRE-INDUCTION TRAINING OUTLINES OF THE WAR DEPARTMENT ★ I

I---Terms Related to Study of Matter

By JOSEPH H. KRAUS
Science Clubs of America Editor

Every mechanic works with matter. Perhaps that statement sounds obvious. But think a bit. There are many important things which concern scientists and laymen, yet are not matter. Heat, for example, is not matter—neither are shadows or thoughts. Shadows are important to aviators; thoughts are important to all of us. But mechanics work with matter; some with wood, others with metal, plastics or glass.

Matter occupies space; has mass and weight, and can be perceived by the senses.

What do we mean by weight, mass, and the other terms applied to matter?

Weight

All matter has or can have weight, because every body is subject to the earth's gravitational attraction. From a lowly pollen grain to a mighty battleship—everything has weight. But weight is variable. On a spring balance you would weigh more, for example, near the north pole than you would at the equator. Also, you would weigh less the higher you ascend in an airplane.

But although your weight is less at high altitudes, you are still the same chunk of flesh and bones—the same quantity of matter. Scientists use the term "mass" to designate the quantity of matter in a body. Thus, the mass of a particular body remains unchanged, regardless of how the body may be shifted about; but its weight, dependent on the force of gravity, may change. Mass is constant, weight is variable—that is the main distinction.

Mass

Wherever the force of gravity remains constant, as it does at any one spot on the earth, mass is proportional to weight, and may be determined by weighing. Thus a pound of apples contains the same quantity of matter, or mass, as a pound of bananas, and the same as the pound weight against which each was balanced. Transport all to 4,000 miles above the earth's surface and both apples and bananas would weigh only a quarter of a pound. But they would still be balanced by the pound weight, because its weight too has been reduced to a quarter of a pound. The change in weight could be detected by a spring scale, but not by balancing one body against the other. This operation compares their masses.

Volume

Volume is simply the amount of space occupied by a body, as measured in cubic inches or cubic feet. For a rectangular body, it can be determined by multiplying together the length, width and thickness. For cylinders and spheres, the radius will also be used. But the volume of a piece of wire screening or some irregular piece of machinery cannot be determined in this way. Here scientific technique comes to the rescue.

If we put an odd-shaped object in a vessel brimful of water, the volume of water that overflows, which we can measure, is equal to the volume of the immersed body.

Impenetrability

Another of the general properties of matter is impenetrability; that is to say, two objects cannot occupy the same space at the same time. When you drive a nail into wood, the fibers of the wood are pushed aside to make room for the nail.

Density

A tennis ball and a baseball have approximately the same volume, but the baseball is much heavier than the tennis ball. More matter or mass is compacted into the same volume. We say that its density is greater.

We may define density as the mass per unit volume of a substance, or say: Density is equal to Mass divided by Volume. $(D = \frac{M}{V})$

Let's put it another way which is easier to remember. See the diagram at 3. Suppose one of these factors is not known. Put your finger over the representative letter. Now if you know the other two you can find the third. Suppose you want to determine the mass (M) of an object. Cover M with your finger, and you will see that density multiplied by volume is equal to mass. If you want to determine the density, you must divide the mass (M) by the volume (V). And if you want to determine volume, you must divide mass by density.

Experiments

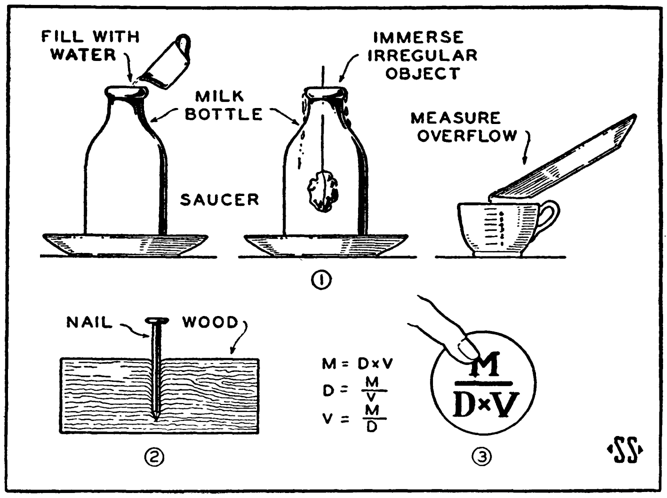
1—Place a milk bottle in a saucer and fill with water until some overflows into the saucer. Empty the saucer and wipe it dry but do not wipe the milk bottle. Lower some odd-shaped object into the milk bottle and catch the overflow in the saucer. Measure the overflow with a kitchen measuring cup or other means. It is equal to the volume of the object you put in the water.

2—Drive a nail into a block of wood and then saw through the center of the nail with a hacksaw. Observe how the fibers of the wood have been compressed.

3—Make up a small button as shown in Fig. 3, the use of which has already been explained.

Review Questions

1. What are some of the terms applied to matter?
2. What is the difference between weight and mass?
3. How can the volume of an irregular object be determined?
4. What is meant by impenetrability?
5. What is density?
6. What is the mass of an object whose density is 4 and volume is 3?
7. What is the density of an object whose mass is 4 and volume is 2?
8. What is the volume of an object whose mass is 4 and density is 8?



I---Magnetism Explained

By DR. MORTON MOTT-SMIT
Science Service Physics Write

Electricity and magnetism go hand in h
the instruments and machinery used in ou
and war operations involve both. We begin

Everyone has seen the little horseshoe r
be purchased at 5-10-cent stores, and kno
tract iron and steel.

This property is natural in certain iron ores. Lumps of such an ore were picked up by a Greek people who lived more than 2,000 years ago. They noted the power to attract iron. These people were known as the Magnesites, and so the curiously endowed stones they picked up came to be called magnets. Now they are called natural magnets, because most of our magnets today are man-made or artificial; and the property they all possess is now called magnetism.

In the early Middle Ages, mariners learned that an elongated natural magnet hung up by a thread would point to the north. They called it the lodestone or leading stone. Many a ship has been guided by this crude form of the mariner's compass. The Chinese knew all these things long before they were discovered in Western Europe.

Artificial Magnet

An artificial magnet can be made by stroking a piece of steel with a lodestone. Then this piece of steel can be used to magnetize another piece, and so on. Thus all you need to start experiments is to have at least one magnet. Or better, use the electrical method described in Experiment 1.

Soft iron can be very easily magnetized, but loses its magnetism almost at once. Hard steel is more difficult to magnetize but retains its magnetism. Thus we distinguish temporary and permanent magnets.

The end of a compass needle that points to the north is called the north pole, the other end, the south pole of the magnet. If we hang up a magnetized steel needle or bar, as in Fig. 3, it will point to the north like a compass, and knowing which direction is north, we can mark the ends or poles accordingly. If now we bring close another "bar magnet," whose poles have also been determined and marked, we shall find that like poles repel, unlike poles attract.

Poles

If we dip one of these bar magnets into iron filings, tacks or paper clips, we shall find that they cluster about the poles but will not stick in the middle of the mag-
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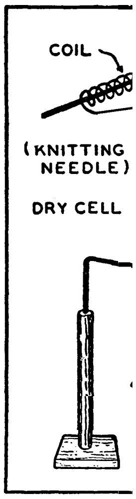


Workers

★ Electricity

ıed Many Uses

ıT-SMITH
.cs Writer

ınd in hand. Nearly all :d in our war production 'e begin with magnetism. seshoe magnets that can ınd knows that they at-

The magnetic force is thus ntrated at the poles, yet not ·ly so. If we use fine filings, ıall find that some will stick ıer parts of the magnet, but · and fewer toward the mid-

ɜry magnet has at least two . Suppose we break a long etized needle in the middle. hall find that each piece be- s a complete magnet with . and south poles at its ends, n be verified by the methods dy described. If we break wo pieces again in half, we have four complete magnets Fig. 4.

Magnetic Field

ıally let us take one of these s, lable 5 in the table, place a th card or a piece of glass it and sprinkle iron filings on :ard or glass. The magnet ıth will be clearly outlined by filings which will arrange selves in curved streams or passing from one end of the et to the other.

ıs experiment shows that is a field of force, a "mag- field," in the space about a .et, and the filings can teach uch about it. We shall find e go along that the field is mportant thing, the magnet : only one means of produc- t.

Experiments

·Wind a few turns of ordinary ıted bell wire around a steel knitting needle as shown in Fig. 1, and touch the ends of the wire for a moment to the terminals of a dry battery or a flashlight cell. This will convert the needle into a permanent bar magnet. The reason for this will be explained in a later lesson.

2—Lay an unmagnetized needle on the table near the edge, and stroke it with one end of a magnetized needle as shown in Fig. 2. Stroke always in one direction, lifting the magnetizing needle high on the return stroke as indicated by the dotted line.

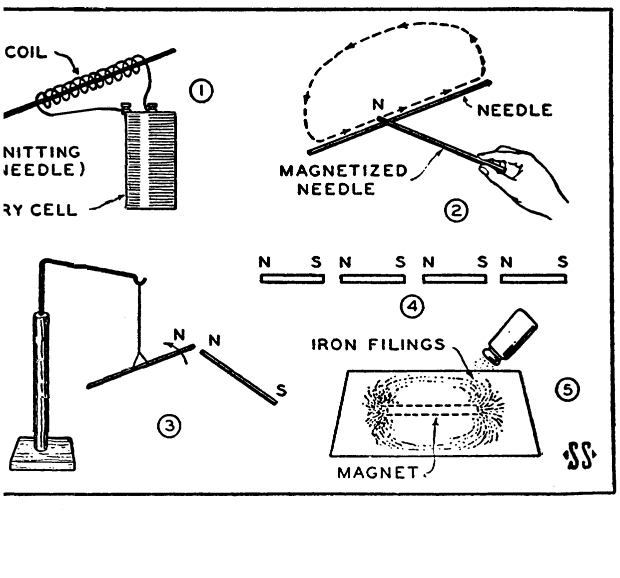
3—Suspend one of the magnetized needles from a stand made of wood or other non-magnetic material, using a thread stirrup to keep it horizontal as shown in Fig. 3. Perform the experiments already described.

4—With a pair of pliers or the aid of a vise, break a magnetized needle in two, and show that each piece is a complete magnet.

5—Place one of the broken pieces under a card, sprinkle with iron filings, and tap. Object of using one of the shorter pieces is to get a better field. If a good bar magnet or a thicker piece of steel can be obtained, the effects will be better.

Review Questions

1. What is the property of magnetism?
2. What is a natural magnet?
3. How can an artificial magnet be produced?
4. What is the difference between a temporary and a permanent magnet? What material is used for each?
5. What are the poles of a magnet, and where are they situated in a bar magnet?
6. What is the law of attraction and repulsion?
7. How many poles must a magnet have?
8. What is the effect of breaking a bar magnet in two?



War—It's Technical

All ages, men and women, are urged to study science fundamentals to aid in the war program. Courses being developed in response to Army request.

By WATSON DAVIS

➤ AMERICA'S fighting forces and the great industrial army for production need more technically trained men and women. *Science Service* is answering this call by making it possible for men, women, boys and girls to begin learning the fundamentals of electricity and machines.

The two simple articles on this page are the first of a series sent to newspapers that present the fundamentals of technical trainings recommended in the War Department's official pre-induction training program. (See *SNL,* Nov. 14).

They are shown here, reduced in size of type but otherwise exactly as they will appear weekly in newspapers all over the country.

Anyone who will read these articles carefully, do the experiments, and answer the review questions will have taken the first steps toward better preparation for actual service in the Army or in war work.

Lieut. Gen. Brehon B. Somervell, chief of the Army's Services of Supply, has said:

"Our Army today is an army of specialists. Out of every 100 men inducted into the service, 63 are assigned to duties requiring specialized training. We aren't getting those 63 specialists through the induction centers. Modern warfare dictates that we must have them.

"Yes, we must have these specialists—these men who know the fundamentals of electricity, who know automotive mechanics, who can operate radios or dismantle carbureters. Without them, your Army would be an incongruous mass, incapable for attaining any objective."

The Army through the U. S. Office of Education has asked the high schools of the nation, some 28,000 of them, to begin immediately courses in the fundamentals of electricity, machines, shopwork, radio and automotive mechanics, especially for the boys 16 to 18 years of age who are destined for induction into the Army. Within the next few months more than a million pupils are expected to be taking these special courses, following study outlines recommended by the War Department itself.

Secretary of War Henry L. Stimson praised this cooperation by stating: "No greater immediate contribution can be made by the schools of the nation toward winning the war than to give our youth the basic knowledge and technical skills needed for modern combat. By doing this job well the schools will free resources of the Army for specialized technical, military training."

It is of almost equal importance that older men and women of all ages learn the fundamentals of technology in order that they may make a maximum contribution to the war, in shop, factory and home. Men between the ages of 18 and 45 likely to be inducted in the Army at a later date are being urged by government officials to take these basic courses in evening schools. Both they and the high school boys will earn rapid promotion when they are in the Army if they can show that they have completed these basic courses with credit.

Science Service through newspapers is publishing practical and simple material that may be used for study in these classes or for home study and reading. Any reader will be able to profit from these clear, simple fundamental explanations that are as useful in everyday living as they are in war. The mother who stays at home while her menfolks go to war or work will need this information to meet the emergencies of wartime.

For the first time all high schools throughout the United States have the opportunity of studying the same basic courses. During the summer a corps of educational experts and teachers were assembled by the War Department to outline the material most essential to the Army's pre-induction training program. This outline was made standard for the whole nation.

In many high schools throughout the nation, science clubs are playing a leading role in introducing these war studies into the daily programs of the schools. Science Clubs of America, administered by *Science Service,* with over 2,000 affiliated clubs in high schools, has lent its energies to this war program, especially in connection with the more advanced courses that include radio code practice, touch typing, radio maintenance and repair and advanced auto mechanics.

A shortage of teaching equipment for these science courses has arisen in many schools. In such cases science clubs are cooperating in building needed apparatus or reconditioning it.