

AERONAUTICS

Why Does An Airplane Fly?

These Experiments Will Show You How and Why

By JOSEPH H. KRAUS
Science Clubs of America Editor

THE ANSWER to this question may puzzle those who have not studied the subject. They know, for example, that the average block of wood floats in water, while a similar block of steel would sink. The wood floats because it is lighter than the quantity of water it displaces. However, if the block of steel were rolled thin and made into a can, or a boat, it would float also. Now it has become lighter than the weight of water it displaces. Similarly, a balloon rises in the air because the weight of the balloon and the gas it contains is lighter than the surrounding atmosphere. That is why it is called a lighter-than-air craft.

But an airplane is heavier than air. What then is the basis for its remaining aloft?

Scientists have established that two-thirds of the lift of an airplane's wings is produced by a partial vacuum created above the wings, the other third of the lift results from air pressure under the wings. Demonstrations to illustrate the action frequently are given in well-equipped laboratories.

Nevertheless, with only the simplest of materials, we can demonstrate some of the physical laws which apply to aerodynamics (that branch of science which treats of the laws of motion of gases and the mechanical effects they produce).

Whenever a stream of liquid, or gas, is caused to move rapidly it produces a low pressure area—a so-called "partial vacuum"—around it. This is known as the Bernoulli effect.

We can see this principle applied in a practical fashion by examining the ordinary fly-and paint-sprayers; or by making a sprayer of our own. For this we will need a corner of a cardboard box, a short length of Scotch or adhesive tape and an ordinary drinking straw.

With a sharp knife cut the straw in half, then cut off the corner from a two-inch square of cardboard. Attach the two straws to the edges of cardboard as shown in the diagram at 1. An air gap of about a sixteenth of an inch should separate the straws at the corner. The vertical straw should be so positioned that the top is at the midpoint of the horizontal straw.

Now dip the vertical straw into a glass of water and blow into the horizontal straw. When this is done the water is lifted up over the top of the vertical tube where the force of the air breaks it up into very fine particles which issue as a spray.

This experiment demonstrates the formation of an area of diminished pressure—a partial vacuum—produced by a gas, or air, in rapid motion. All fly- and paint-sprayers operate in the same fashion. Instead of blowing through a tube the stream of air is supplied by a pump.

Let us now carry our experiment one step further. About three-eighths of an inch from the edges bend up the two narrow ends of an ordinary visiting card. On the legs thus formed rest the card on a table. (See illustration 2.) Now try to blow it over. You will find that the harder you blow the more firmly will the card seem to cling to the table top. Here again



SCIENCE

Serving Science Clubs of America

we find that the Bernoulli effect applies. Again the air which has been put into rapid motion produces a partial vacuum. When this happens, the air in the room tends to rush in to fill the low pressure area. However, the card blocks its path, so to speak, with the result that the card is pressed more firmly to the table top. If we use a rather thin card for this demonstration we will find that the top curves downward under influence of the atmospheric pressure. (Air has weight. At sea level and under normal conditions, it presses upon every square inch of surface with a pressure of 14.7 pounds.)

Let us now tear off a strip of paper about eight inches long and about two inches wide. Fold over one end making a tab about a half inch long. Hold this strip against your chin, as is shown at 3, and blow hard. You will find that the paper, instead of being blown away, rises into the air stream. It moves up into the area of reduced pressure. The paper strip thus acts very much like the wing of an airplane and is lifted by the air stream.

It will be seen that in all of the examples given here, the partial vacuum was responsible for the effects obtained; it lifted the column of water in the sprayer, it held the card to the table top and it caused the paper in the last experiment to rise instead of being blown downward as one might suppose should happen.

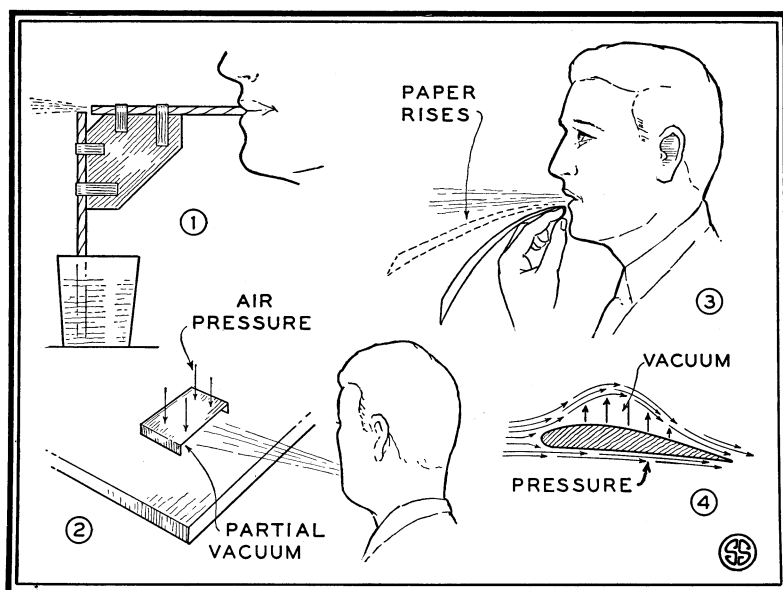
Let us apply the experimental knowledge so obtained to an airplane. In the experiments we have performed we have had a moving column of air. We must now change the order of things. Instead of moving a column of air it is the airplane which must be moved while the air remains more or less stationary. But the end result is the same; that is, the air moves with relation to the wing.

To produce this motion, an airplane uses an engine to drive an air propeller, which "bites" into a quantity of air at each revolution. This causes the airplane to move rapidly along the ground. When sufficient speed has been obtained in this fashion the airplane can take off.

Here again the vacuum created above the wing gives the plane much of its lift; in fact, instruments attached to various parts of the wing structure indicate that two-thirds of the lift is produced by this vacuum, the other third is given by air pressure under the wing.

In our experiments we have learned that a rapidly moving stream produces a partial vacuum and that this vacuum is most important to the lift of an airplane. In fact, without it, the airplane of today could not fly.

Science News Letter, October 11, 1941



OBSERVER



Sponsored by Science Service

These Pages Service Science Club Movement

This section, under the title of the monthly science clubs publication of the American Institute of the City of New York now absorbed in the SCIENCE NEWS LETTER, is the official organ of Science Clubs of America. Issues of the SCIENCE NEWS LETTER containing such center spreads as this will appear monthly October through May and will be sent to all sponsors and leaders of SCA affiliated science clubs. Other weekly issues of the SCIENCE NEWS LETTER will carry a brief Science Observer section for SCA news and announcements.

Age is now no barrier to participating in science club activities. Any individual or group, interested in science activities, may become affiliated with Science Clubs of America. The affiliation fee for a group is nominal, \$2 a year for 20 members or less, and brings a novel certificate of affiliation, membership cards, valuable service bulletins and other materials useful in club operation. Individuals may become associated with Science Clubs of America for a nominal fee of 25 cents, which includes a free copy of the 128-page Science Handbook for 1942 to be issued about Jan. 1.

Application blanks for club affiliation and further information about Science Clubs of America will be sent on request to Science Service, 1719 N St., N. W., Washington, D. C.

Science News Letter, October 11, 1941

SCIENCE CENTERS

Science Centers, those very essential permanent meeting places where science club members are accustomed to gather, give promise of even greater activity as the new season starts. In addition to Centers that already have from one to three years of experience behind them, and therefore are adept at the conduct of functions for clubs, a great many more Science Centers will be established this year.

This is necessitated by the spread of the science clubs movement in this country and others. It is a most important part of the whole program that every club have at least one opportunity a year to visit a function at a Science Center. There will be no difficulty in achieving this as the success of already existing Centers is becoming well known.

The state of Virginia, where the Junior and Senior Academies of Science are working together to bring science activity within the reach of every interested amateur, has expressed its whole-hearted backing of Science Clubs of America and is proceeding

with plans made at the end of last season. Similar renewal of activity is occurring in Missouri where more than 40 clubs "came alive" in September and began working out scheduled projects in their program.

In Middletown, New York, the very successful science fairs will be continued under a new director in the same Center. Farther north in the state, Rochester eased back into its Center activities with a gala "Hot Dog and Corn Roast" for all members in that area. The October 13 short wave broadcast from station WRUL (6.04-11.73 megacycles) at 9:30 p.m. (EST) will bring you greetings from this energetic Center.

An established Center at Baltimore, Maryland, has influenced the start of a neighboring one at Wilmington, Delaware. Big things are planned for the whole state of Ohio where a number of cities are ready to pop up almost simultaneously with new Centers. A Massachusetts manufacturer offers the use of the laboratories for skilled science club members in the community and another company is looking favorably upon a similar plan.

Science News Letter, October 11, 1941

NEWS OF CLUBS

The national science club program proved so valuable that geographic lines separating nations could not confine it. The result was that clubs in Puerto Rico, British West Indies and Canada soon found much of value in their affiliated memberships.

Now the science club movement reaches out across the sea and we welcome the first club from Europe, located at Lisbon, Portugal. This group, known as the *Centro Portuguez de Divulgacao Cientifica*, is under the sponsorship of Professor Antonio Crespo Viana.

The banding of migratory birds for the Government is of prime concern to the *St. Francis High School Science Club*, Clearfield, Pa.

*Sister Mary Esther, Science Teacher.

Individual projects and field trips occupy the attention of the *Monmouth (Ill.) High School Science Club*.

*Mr. Joseph D. Dixon, Teacher.

The *Laboratory Detectives* is the name of a club specializing in laboratory projects at the Sacred Heart Academy, Tampa, Fla.

*Sister M. Lucy Josephine, Science Instructor.

For six years the *Bi-Phy-Chem Club* of Sharon Hill High School, Sharon Hill, Pa., has been actively engaged in pursuit of science projects, the subject matter of which is cleverly featured in its name.

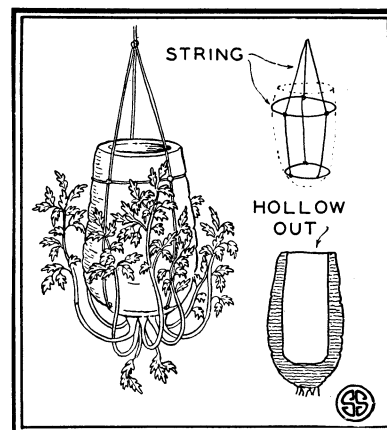
*George F. Stauffer, Head of Science Department.

Scientific experiments will occupy most of the attention of the *Bedford High Science Club*, Bedford, Va.

*Miss E. Deane Saunders, Teacher of Math, Bio and General Science.

Science News Letter, October 11, 1941

*Indicates sponsor.



BOTANY

Fine Decorative Effect Given by Humble Carrot

EVERYONE DELIGHTS in having a growing green plant in the home, particularly if that plant is somewhat unusual.

An interesting decoration for the home is a growing carrot. Its green lacy leaves sweeping upward around the root gives this ornament a touch of individuality.

The preparation is very simple. Cut a large and rather fresh carrot in half. With an apple corer, potato peeler or knife, scoop out the interior of the top half of the carrot to within about a half inch of the crown, leaving a wall thickness of about a quarter of an inch.

With thin string make a saddle in which to rest the half root and hang it in the window. Keep the carrot filled with water and in a few weeks the leaves will emerge. Remember that as the leaves grow the carrot body will have to be filled with water more often. The plant will continue to grow for several months, during which time it will require no other attention.

Science News Letter, October 11, 1941

Each Monday evening, 9:30 p.m. EST, on two frequencies (6.04 and 11.73 megacycles) Station WRUL of the World Wide Broadcasting Foundation, Boston, Mass. will present a SCA program. This is your program. Send in news of your club. Prepare transcriptions five minutes in length for broadcasting during this period. Hold a meeting around a short wave radio each Monday evening.



SCIENCE CLUBS OF AMERICA

SCA, under Science Service sponsorship, continues the pioneering activities of the American Institute of City of New York over the past 15 years and the Student Science Clubs of America which was merged with that movement. The American Institute continues to foster the regional activities of the junior clubs of the New York City area as a science center.

To effect close cooperation between the American Institute and Science Service, an advisory committee on SCA is being formed.

The principal SCA staff consists of Joseph H. Kraus, SCA editor, and Margaret E. Patterson, SCA membership secretary, based at New York in offices at 310 Fifth Avenue, also occupied by the American Institute, H. D. Lufkin in charge, and its Science Laboratory, Henry Platt directing.