Illustrated Handbook of General Science Teaching Aids

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Parker Publishing Company, Inc.
West Nyack, New York

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West Nyack, N. Y.

Library of Congress Cataloging in Publication Data

Alusik, John, (date)
Illustrated handbook of general science teaching aids.

1. Science--Laboratory manuals. 2. Science--Study and teaching (Secondary) I. Title.
Q161.2.A48 507'.8 72-10837
ISBN 0-13-451047-X

Printed in the United States of America

How This Book Will Help You Teach Science More Effectively

This illustrated handbook describes simple, effective science teaching aids you can make. Construction of the various devices lies well within the skills of the junior high school teacher. The materials used in every project are easily obtainable and in most cases relatively inexpensive.

To increase its utility value, the book is organized into various units of science instruction—and will group together the materials related to a specific unit. Construction diagrams give maximum clarity with the necessary measurements. Suggested materials are described in detail along with, in many cases, the source of supply. Photographs are used to supplement and further clarify the construction diagrams and will help insure a complete, detailed description of each project.

Everything in this book has been used repeatedly in classroom instruction over a ten-year period. Many of the projects were demonstrated by students during science shows as well as in the classrooms. Each project illustrates basic science concepts and can remain as a permanent part of science instruction program.

Learning in any subject area demands involvement. As is so often the case, the apparent science-shy student may possess manual skills which a teacher can utilize not only to motivate the student, but to provide him with an opportunity to make a significant contribution to the class. During the course of constructing many of the aids listed in this book, I often asked students in wood shop and metal shop classes to assist in various aspects of construction. On many occasions, students have made suggestions for changes as well as suggestions for substitution of materials. Problem solving was a continuous process during the construction phase, and in the process touched many areas outside of school and even involved parents, who frequently made significant contributions.

A shortage of funds sometimes limits the teacher's ability to purchase ready-made equipment that illustrates important scientific principles. This book not only helps the teacher overcome that problem, but will also bring greater student participation in making and using the various projects. There is a great range of possibilities insofar as variation or substitution of materials is concerned, and developing variations in some projects and materials can help the teacher easily bring about a tailor-made device to suit a particular classroom situation.

In summary, this book provides detailed, specific information about scientific teaching devices you can make and use in your classroom. It provides a sharp focus on each project, tells how to construct it—and even shows what it should look like when it is finished. Everything in this book is real, does work, and has been used many times in a large variety of classroom situations. You will find it a valuable working tool in developing more meaningful science teaching techniques, and in stimulating your students to a greater interest and participation in science.

John Alusik

Acknowledgments

The author wishes to express his appreciation to the following for their contributions of ideas and materials in the preparation of this manuscript:

Air Pollution Detector (Liquid Type)—Design taken from Popular Science Monthly, October 7, 1970, Popular Science Publishing Co., Inc.

Air Pollution Detector (Slide Type)—Air Pollution Experiments for Junior and Senior High School Science Classes, Air Pollution Control Association, Pittsburgh, Pennsylvania, 1969.

DNA Molecule—R. McKeeby, Union College, Cranford, New Jersey.

Geyser—Sourcebook for Geology and Earth Sciences, Robert L. Heller, Editor. Holt, Rinehart and Winston, Inc., N. Y.

Wind Tunnel—A Student Guide to Aeronautics, Merril E. Tower, Aero Publishers, Fallbrook, California.

Photographs by Ken Davis

This book is dedicated to all my past and present students. Some gave me ideas for materials in the book, others brought in raw materials used in making the teaching aids, many actually helped with the construction—and all helped motivate me to put this collection into book form.

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chapter 1

Developing Projects That Teach about Air

Just as some animals live at the bottom of the sea, we live at the bottom of an ocean of air called the atmosphere. Like the animals of the sea who adapted to the crushing weight of water, man has adapted to the pressure of the air that extends from the earth's surface to the top of the atmosphere. If we could imagine a column of air with a surface area of 1 square inch extending over 20,000 miles high, we would record a pressure of 14.7 pounds on every square inch of surface at sea level.

Although air is a mixture of gases, man has learned how to use air to serve his purposes. We know that air can be compressed, as in an automobile tire, and we can create a difference of pressure to make a siphon work or a balloon rise. By understanding the nature and behavior of air, man has invented many mechanical devices that help him to improve his way of life and adjust to his environment.

On the following pages are a few ideas and devices you can construct that might help you understand the nature and behavior not only of air, but of objects that move through it.

It is left to your imagination how you can construct, vary, or adapt the following ideas to your satisfaction.

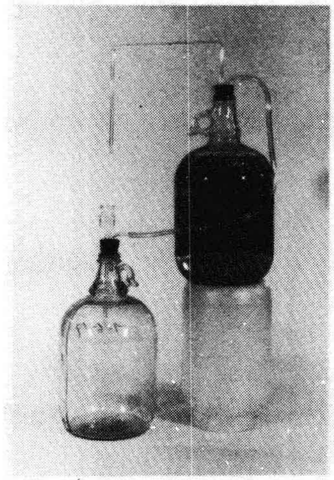
AIR PRESSURE

The apparatus shown in the illustration with the two gallon jugs is intended to provide the solution to the demonstration relating to the effect of air pressure on the surface of a liquid after it is displaced by water. It is suggested that the same apparatus (tubing, stoppers and funnel) be inserted in empty duplicator fluid cans and the demonstration begun just before the students enter the class. The objective here is an attempt to form a hypothesis leading to a solution. It is interesting to note the line of questioning taken by the students as to why water flows up the glass tubing. It is suggested that the teacher not participate in the discussion.

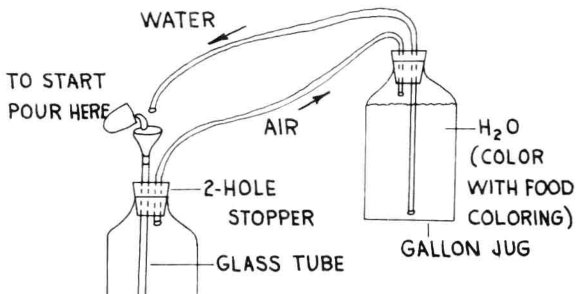
After a number of hypotheses are formed by the students, the teacher should place the apparatus using the jugs on the demonstration table to provide the solution. The students should conclude that the water poured into the lower can displaces air in the lower can. The air is forced up the tubing into the upper can where the air pressure on that liquid forces the liquid out of the upper can. The flow will stop when the top can is empty. To start the demonstration again, switch positions of the cans and pour water into the funnel again.

It is suggested that the experimenter use food coloring dye in the liquid in the one gallon jugs at the beginning of the demonstration.

Photo 1



AIR PRESSURE DIAGRAM 1



POUR H_2O INTO FUNNEL TO BEGIN DEMONSTRATION.
WATER POURED INTO FUNNEL DISPLACES AIR IN THE LOWER JUG.
AIR IS FORCED INTO UPPER JUG AND AIR PRESSURE FORCES WATER OUT OF UPPER JUG.
PLACE UPPER JUG ABOUT 12" ABOVE LOWER JUG.
(THIS DEMONSTRATION CAN BE DONE BY USING DUPLICATOR FLUID CANS—AND HAVE STUDENTS DEVELOP A HYPOTHESIS.)

BERNOULLI'S PRINCIPLE

Very often students memorize Bernoulli's principle of air flow, but the vacuum cleaner motor provides an opportunity for the class to develop relationships that exist between Bernoulli's principle, air flow around the surface of an airplane wing, and air flow around a sphere.

Upon occasion I have used a very long extension cord and walked into the classroom with a 4-inch styrofoam sphere suspended in the air flow. The motor can be placed on the demonstration table and tilted slightly from the vertical and the sphere will remain suspended in the air flow.

It is suggested that an airplane wing cross-section be drawn on the chalkboard to illustrate the air flow pattern around the wing, with the higher pressure on the bottom of the wing and the lower pressure on the top surface of the wing resulting from increased velocity. Again it is suggested that an attempt be made to motivate the students in formulating a hypothesis. Spheres of various sizes and weights can be used as supplementary experiments after the concept is understood. Various tank-type vacuum cleaner motors are easily adapted to the demonstration. The motor must be completely enclosed in its housing. Be sure that the air intake at the base of the motor housing is free from obstruction at all times. A tapered portion of the handle can be inserted in the exit opening or a plastic pipe may be fitted in place.

Bernoulli's Principle—when a fluid (liquid or gas) is in steady flow, its pressure will be high wherever its velocity is low; and conversely, its pressure will be low wherever its velocity is high.