DOCUMENT RESUME

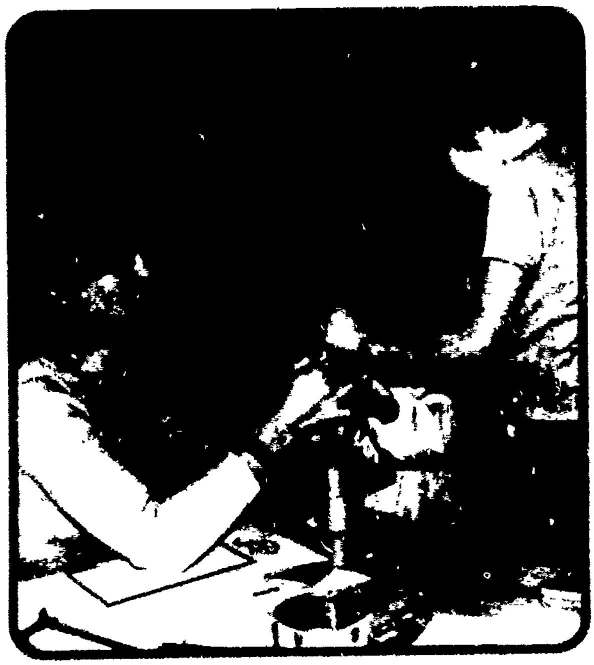
ED 220 298 SE 039 060

AUTHOR	Manfre, Edward; Donahoe, Charles
TITLE	USMES Design Lab Manual. Fifth Edition. Trial Edition.
INSTITUTION	Education Development Center, Inc., Newton, Mass.; Unified Science and Mathematics for Elementary Schools, Newton, Mass.
SPONS AGENCY	National Science Foundation, Washington, D.C.
REPORT NO	ISBN-0-89292-027-0
PUB DATE	77
GRANT	SED-69-01071
NOTE	108p.; For related documents see SE 039 061-098 and ED 142 362.
AVAILABLE FROM	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212 ($4.00).
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Educational Facilities; Elementary Education; *Elementary School Mathematics; *Elementary School Science; Interdisciplinary Approach; Language Arts; Learning Activities; Mathematics Education; *Problem Solving; Process Education; *Resource Centers; Resource Materials; Science Course Improvement Projects; Science Education; Social Studies; Staff Role; Teaching Guides; Teaching Methods; *Unified Studies Curriculum
IDENTIFIERS	National Science Foundation; *Unified Science Mathematics for Elementary Schools

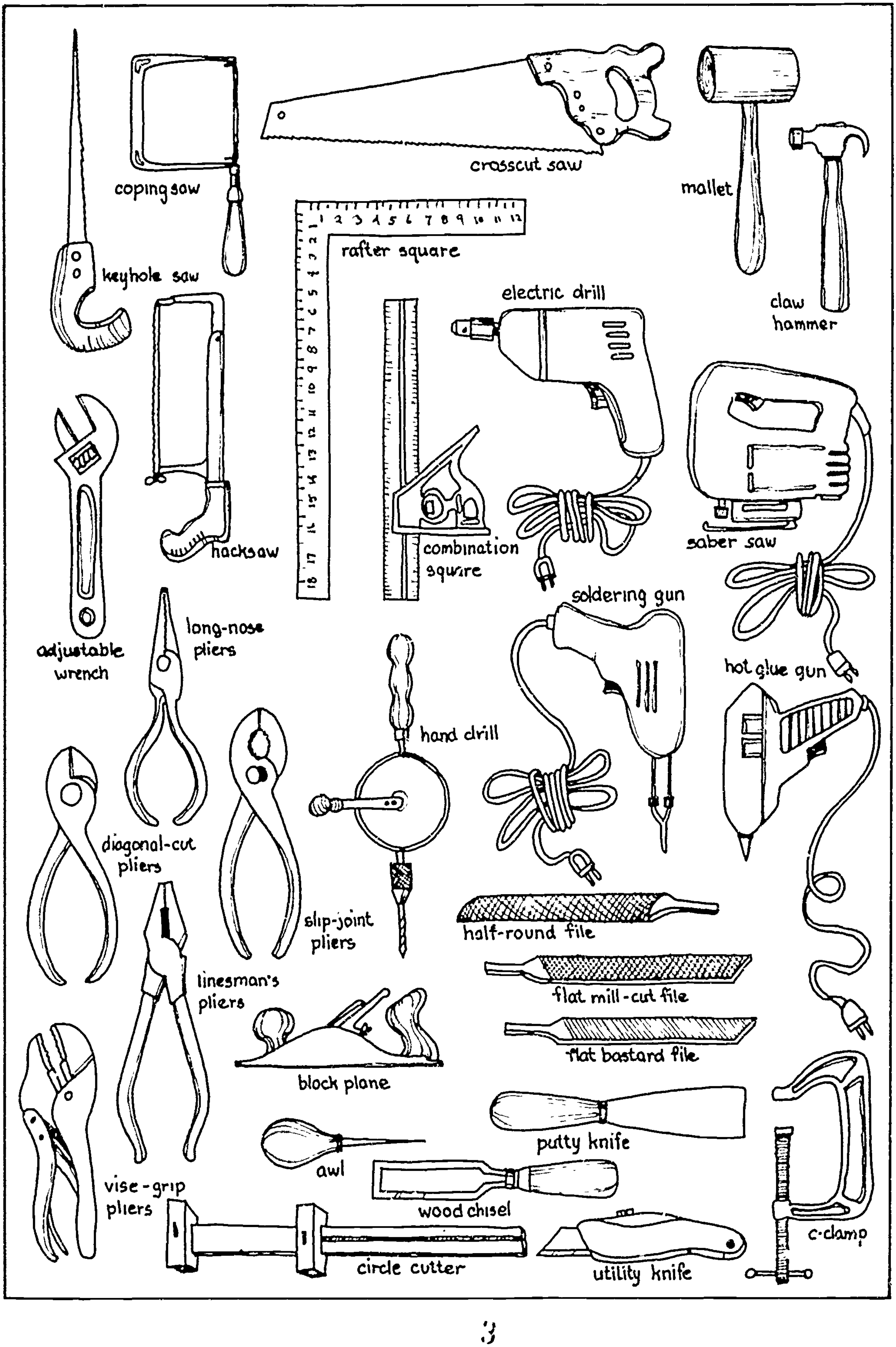
ABSTRACT

This manual serves as a resource for Design Labs in the Unified Sciences and Mathematics for Elementary Schools (USMES) program. A Design Lab is not a customary "shop" where students receive training in woodworking, metalworking, and other crafts. Instead, when a construction need arises during USMES units, a Design Lab becomes the central location for tools, materials, and working space for students to plan and build according to their theories, make and benefit from mistakes, and develop improved designs. Section I provides general information, focusing on the USMES Design Lab concept, tone of student activities, safety considerations, and what students have made in Design Labs. Section II, focusing on setting up Design Labs, discusses planning a Lab, forms of Design Labs (in-class Labs, portable Labs, separate-room Labs), and Design Lab tools and materials. Section III addresses staffing and training, including an overview of staffing/training considerations, Design Lab orientation methods, staffing, and teacher training. Appendices include a bibliography, list of Design Lab "How To" cards, nature of USMES and its resources, tri-wall (three-layered cardboard) ordering information, and Design Lab inventory lists. (Author/JN)

Design Lab Manual



USMES


coping saw
crosscut saw
mallet
rafter square
keyhole saw
electric drill
claw hammer
adjustable wrench
hacksaw
combination square
saber saw
soldering gun
long-nose pliers
hot glue gun
hand drill
diagonal-cut pliers
slip-joint pliers
half-round file
linesman's pliers
flat mill-cut file
flat bastard file
block plane
putty knife
awl
vise-grip pliers
wood chisel
c-clamp
circle cutter
utility knife

Contributors.

This Edition of the Design Lab Manual:

written by:	Edward Manfre and Charles Donahoe
designed and illustrated by:	Barbara Low
production manager:	Edward Manfre
art director:	John Saalfield
cover photographer:	Jean Keskulla
producti n assistants:	Nancy Gardner Weiner Peter Zevitas

Design Lab Staff

These people have staffed Design Labs at USMES-run workshops and helped develop the Design Lab concept.

Frank O'Brien	Design Lab Workshop Director, MIT, Cambridge, MA
Charles Donahoe	Design Lab Coordinator (USMES)
John Saalfield	Assistant Design Lab Coordinator (USMES)
Nort Salz (6)*	Saxtons River School, Saxtons River, VT
Charles Douglas (6)	University High School, Urbana, IL
Sandy Szedlak (5)	Mt. Hope School, Lansing, MI
Michael McCabe (3)	Locke School, Arlington, MA
Erwin Drechsler (2)	O'Keeffe School, Chicago, IL
Malachi Johnson (2)	Boston, MA
Claydred Lite (1)	Pleasantview School, Lansing, MI
Arthur Shaw (1)	Crosby School, Arlington, MA
Yolanda Benjamin (1)	Charleston, SC
Leonard Orten (1)	Monte Vista School, Monterey, CA
Louise Buchner (1)	Washington, DC
Bob Grotlushen (1)	Heatherwood School, Boulder, CO

*Number of years on Design Lab Staff

Special Thanks

to Carolyn Clinton Arbetter who gave many helpful suggestions; to the hundreds of USMES teachers and lab personnel who turned the Design Lab concept into a reality; and most of all to the thousands of children who hammered and sawed in labs throughout the country and who let us know what a Design Lab should be.

The Design Lab Manual is a resource developed by the USMES Project: Earle L. Lomon, Project Director, Betty M. Beck, Associate Director for Development, Thomas L. Brown, Associate Director for Utilization Studies, Quinton E. Baker, Assoicate Director for Administration.

Design Lab Manual

Unified
Sciences and
Mathematics for
Elementary
Schools

5th Edition

This material is based upon research supported by the National Science Foundation under Grant No SED69-01071. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Trial Edition

Complete USMES Library ISBN: 0-89292-033-5
Design Lab Manual ISBN: 0-89292-027-0

Printed in the United States of America

Table of Contents

THE LAB AND HOW TO USE IT

1. What's it all about?:
   THE USMES DESIGN LAB CONCEPT
2. Children at the wheel
   THE TONE OF LAB ACTIVITIES
3. Grams of prevention
   SAFETY IN THE DESIGN LAB
4. Many a splendid thing
   WHAT CHILDREN HAVE MADE IN THE LAB

I

SETTING UP A LAB

5. First things first.
   PLANNING A LAB
6. A lab to fit your needs
   FORMS OF DESIGN LAB
7. Beg, borrow, and buy.
   DESIGN LAB TOOLS AND MATERIALS

II

STAFFING AND TRAINING

8. Personnel matters
   [illegible]
9. [illegible] up teachers
   [illegible]
10. Who's minding the lab?
   [illegible]
11. The making of a manager
   [illegible]

III

APPENDIX

A. Bibliography
B. Design Lab "How To" Cards
C. What's USMES?
D. Tri-Wall ordering information
E. Design Lab inventory list

About this Manual

This book is in sections because different people use it for different reasons.

- Section I is for everybody. If you just want to know about the Design Lab and how it fits into the USMES program, the first four chapters cover the essentials. Or if you've had extensive workshop training, you can use this section for a concise yet comprehensive review.

- Section II is for anyone involved in setting up one or more Design Labs. If you have to set up a lab from scratch and don't know where to begin, this section explains what you need to know to get the job done. Even if you're simply planning to scrounge a few tools for an existing lab or for your classroom, you'll find some of the material in these three chapters useful.

- Section III is for anyone who has administrative responsibility for one or more labs. If you're coordinating a lab program for a school district, you'll want to read the entire section. If you're an USMES teacher who wants to share your in-class collection of tools, you might read only Chapter 9 to get suggestions for showing your colleagues the potentials of a Design Lab.

The suggestions, tips, and examples that fill this book have been culled from six years of Design Lab experience involving hundreds of educators, hundreds of schools, and thousands of students. More than anything else, this manual is a compilation of what has been learned from that experience.

THE LAB
AND HOW TO USE IT

1. What's it all about?:
   THE USMES DESIGN LAB CONCEPT

2. Children at the wheel:
   THE TONE OF LAB ACTIVITIES

3. Grams of prevention:
   SAFETY IN THE DESIGN LAB

4. Many a splendid thing:
   WHAT KIDS HAVE MADE IN THE LAB

Section One

1 What's it all about?:

THE USMES DESIGN LAB CONCEPT

design *vb* to create, fashion, execute, or construct according to plan **+** **lab** *n* laboratory; broadly: a place in which one expands, observes, and/or practices **=** **DESIGN LAB**

Why a lab?

Sitting and thinking is usually not enough to solve real problems. "Doing" plays a large part, too, and "doing" often means designing and building. Children working on a Growing Plants challenge may need to construct planters or shelves. Children trying to improve a pedestrian crossing may want to build a trundle wheel to help them measure the width of a street. When a construction need arises, a Design Lab--a central location for tools, materials, and working space--can be the best resource a child ever had.

What is it?

Although the term Design Lab may conjure up images of a fully equipped workshop, this is only one of many forms a lab may take. A Design Lab may also be a corner of a classroom containing a few tools; it may be a roll-away cart stocked with tools and capable of traveling from room to room; or it may be part of an existing science or math lab. The tools and materials that make up a Design Lab can range from a few basics like a hammer, saw, screwdriver, nails, and lumber scraps to a complete inventory (see Appendix C). Sure, a well-stocked Design Lab room has advantages over a threadbare in-class lab; but when students' wheels are turning, a Design Lab in any form will help children get the most mileage from their ideas.

What isn't it?

A Design Lab is not a customary "shop" where students receive training in woodworking, metalworking, and other crafts. Instead, students are free to plan and build according to their own theories, free to make mistakes, benefit from those mistakes, and develop improved designs. Children learn to be inventive and scientifically curious. And they learn to work with others.

Where do adults fit in?

Providing this open atmosphere is the Design Lab manager or the classroom teacher (or both). Thanks to preparation in the use of USMES, the manager or teacher can show children how to use tools and materials safely and effectively. Such instruction, given as the need arises, helps students carry out their own ideas. Design Lab "How To" Cards (see Appendix B) and advice from classmates also help students pick up needed skills.

When is it used?

Students use the Design Lab as the need arises. For example, children trying to solve the problem of poor lighting or lack of storage space might use the lab to design and construct shelves or lamps. Or they might first create measuring devices to assess light levels. In either case, they use the lab for a problem-solving purpose. When the lab is used this way, students learn more than just how to hold a hammer or handle a saw. They also develop abilities to measure, calculate, observe, and analyze; in fact, they practice all the skills required by the problem-solving process.

CAUTION

Working in the Design Lab can too easily become an end rather than a means. Because most kids get quite a kick out of using tools, it may be tempting for teachers to send kids to the lab with the instruction, "Do USMES." In USMES, the Design Lab should serve only as a resource--a means for solving real problems. A Design Lab may make an USMES program what it is, but a lab does not in itself make an USMES program.

3 Children at the wheel:

THE TONE OF DESIGN LAB ACTIVITIES

This is what you'll hear in a Design Lab

"How does it work?"

"Why?"

"Try it!"

"Show me."

"Prove it to me."

You ~~won't~~ hear this

"Do it this way."

"That's not how to do it."

"You can't do that."

"Do it the way I told you."

Teachers and Design Lab managers make the lab a place where ideas are brewed, exchanged, and encouraged.

When you first enter a lab, activity and noise may seem overwhelming: children hammering and sawing; a small cluster here assembling a home-made burglar alarm; another group, over there, sawing lumber for shelves. It's noisy! Children move around; they get materials, discuss designs, find out how to use a drill or how to make a corner with Tri-Wall. But as you approach a particular group and listen to the conversations, you discover a structure within the apparent chaos. The children have plans and reasons for building the devices they're working on. Their questions have meaning: "How can I measure this board?" "How can I make a large circle?" "How can I make this model to scale?"

Real problem solving, of course, is the framework for such a scenario. Motivation and concentration are high because children are working on things they need. But the teacher or Design Lab manager plays a key role too, helping to establish an open and productive tone.

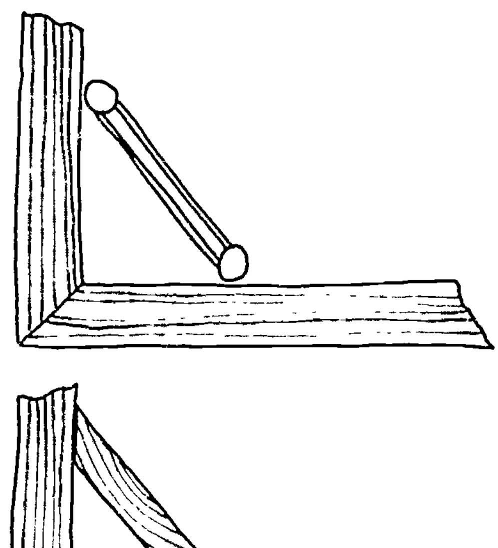
Adults in the lab assist without directing. The teacher or manager usually moves from group to group, encouraging students to plan and to think things through, and often asking children to explain the workings of what they're designing or building. Because children are mostly on their own, they consider the teacher or manager a resource rather than someone who knows all the right answers and who will tell them what to do.

LAB EXPERIENCES

No hard and fast rules exist for creating the proper atmosphere in the Design Lab. No formula can specify how to assist children without directing them. No recipe can tell you when and how to offer questions and suggestions. Styles of teaching vary too much for that. Even so, examples are useful. The following reports of adults helping children in the lab illustrate how teachers and managers can find the happy medium between doing nothing and taking over.

Cutting corners

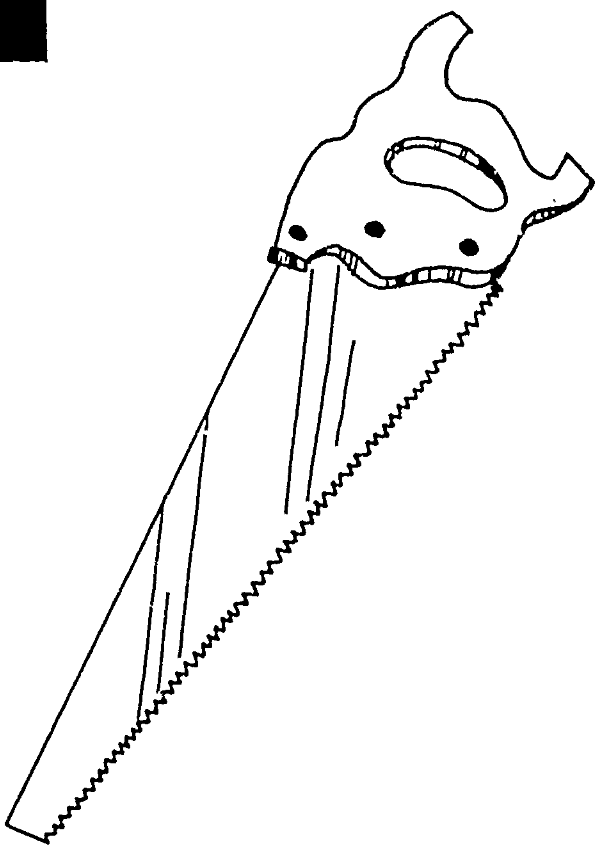
As part of their work on Play Area Design, some children built a hockey game but were confused about how to make the puck rebound properly from the corners. When asked for a solution, their teacher helped the children solve the problem for themselves. He asked them what they wanted to happen when the puck was hit into the corner and how they could bring this about. The children suggested placing a triangular piece of wood in the corner or stretching an elastic across two nails. Following the teacher's advice, they tried both methods. The wood worked better, they decided, and they went on to finish the construction of their game.



LAB EXPERIENCES

Tool phobia

In a class that was working on the Classroom Design unit, four girls had designed a table but were reluctant to build it. They were apprehensive about using tools and decided to let some boys construct the piece. Their teacher persuaded them to change their minds. Along with instructions on how to use several tools, he gave them encouragement and supervision. The previously hesitant builders became extremely enthusiastic as they turned their design into reality.



A sharper saw

In another class working on the Classroom Design unit, some children had difficulty sawing legs for the chair they planned to build. Their teacher examined the saw they were using and revealed part of their problem--the tool was not sharp; its teeth were all in a line. He showed the students a sharp handsaw and emphasized that adjacent teeth on the blades pointed in different directions. The children used the sharp saw to finish cutting legs for their chair.

A two-dimensional chair

One boy in the same class thought he could make a chair by tracing its shape on a large piece of Tri-Wall and cutting it out (a two-dimensional chair). The teacher asked the boy to draw the chair on a piece of paper and cut it out:

T: What's the matter with it? Could you sit on it?
S: No.
T: Why?...Is there anything on the other side?
S: No.
T: What did you say you're going to make first?
S: The seat.
T: Now you realize that you can't draw this outline on a piece of cardboard and just cut it out and have a chair. Make a small model of it. Cut all the pieces out of that paper and then put it together and we'll see what it looks like.

When the boy had completed the drawing, he showed it to the teacher who then encouraged the child to cut out the pieces and assemble the model.

Tips for Teachers and Managers

To each his or her own

Each student works in the Design Lab at his or her own level. Reports from teachers have indicated that work in the lab inspires "slower" students to accomplish great things when given half a chance. If possible, adults should acknowledge some element of success in each task done by each student. Immediate success, however, often means that students are not stretching their abilities and not learning from their mistakes.

Seeing is believing

Even before they need to use it, children should see the Design Lab: the tools, equipment, and materials. A brief introduction helps them better define what they will and won't be able to do as part of their work on an USMES challenge.

Tips for Teachers and Managers

"I don't know" is O.K.

When a child needs to learn a particular "how-to" skill, the teacher or manager can tell or show the student how to do it or refer the child to an appropriate "How To" Card. A demonstration is usually best. When a teacher does not know the answer to a Design Lab problem; this should be freely admitted. Frankness helps children realize that you don't need to be an expert to build something. Teachers and managers should also encourage students to look up information from suitable sources.

Building confidence

Adults should not program Design Lab activities. When students themselves decide what they need to work on, they build not only useful items, but self-confidence and self-reliance as well.

Use as needed

Because lab activities are not programmed, schedules should be flexible. Fixed ones are impractical. If it's prearranged that a class will go to the Design Lab every Wednesday at 2 p.m., many of those visits will be unproductive.

Helping kids stay on target

Teachers may want students to keep work records. Even a simple log can do wonders for a child's memory after a two-week recess. Also, a five- or ten-minute class discussion before each lab visit helps children clarify what they plan to accomplish during the session.

Class and lab: The same coin

Children should see that activities in the lab and classroom work on the challenge are two sides of the same coin. Class discussions and the teacher's presence in the lab can make this interrelation clear. Many USMES teachers accompany their students to the Design Lab and work hand-in-hand with them. Although scheduling and other problems may interfere with good intentions, experience has shown that whenever teachers have not participated with their students in the Design Lab, the children's progress in lab activities has fallen off drastically. Successful Design Lab managers bring teachers into the lab on a scheduled basis whenever possible.

NOTES

3 Grams of prevention:

SAFETY IN THE DESIGN LAB

**SUPERVISION AND INSTRUCTION
MAKE THE DESIGN LAB A SAFE PLACE
FOR CHILDREN TO PLAN AND BUILD.**

Design Labs are safe. In six years of lab activity involving thousands of children in hundreds of schools, no serious accidents have occurred. Students in kindergarten through eighth grade have shown consistently that they can and do work safely with a wide range of tools: pliers, hammers, saws, soldering guns, electric drills, hot glue guns, to name a few.

Safety is no accident

Safety does not come without effort. Adults must take preventive measures: teaching children how to use tools and supervising without taking over. By adopting the precautions outlined below, Design Lab personnel make it possible for children to plan and build creatively, purposefully, and safely.

GUIDELINES FOR MAINTAINING A SAFE LAB

*Five rules derived from common sense
and validated by experience*

- Make sure an adult is present whenever children use the Design Lab.
- Have an adult closely supervising or nearby when a child uses a power tool or a utility knife.
- Keep the lab uncrowded.
- Prohibit fooling around and post a rule to that effect.
- Make sure that children know how to use tools properly by seeing that students get the instruction they need when they need it.

Supervision

Children are at the wheel in the Design Lab, but adults have access to the brakes. Teachers and lab managers should always be in positions to stop immediately any action that threatens injury. If you sense that some behavior or some experiment is getting out of hand, step in. Until you're comfortable drawing the line, it's better to be overcautious, even at the risk of interfering a bit too much in children's work.

Instruction

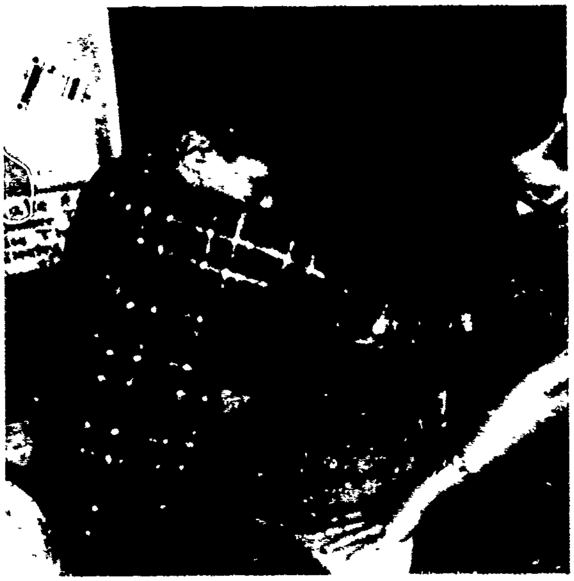
Supervision is only half the prevention story. Instruction is the other half. Consider a child about to use a saber saw. That student must know about the tool: what precautions to take, how to hold the saw, how to maneuver it. Such knowledge comes from the teacher or Design Lab manager. It comes in skill sessions of various forms--from individual to large-group instruction.

On the route to safety, the first step is making sure there is an adult available who is proficient in teaching the skills of tool use. If you're not totally confident about your abilities with tools, you may want to enlist some help. An industrial arts teacher, a Design Lab coordinator, or a skilled parent may be willing to take on all or part of the instruction chores until you're ready to go it alone. Design Lab "How To" Cards will also help.

What to teach

Whatever tool you're demonstrating or explaining, three basics should be covered:

- Purpose of the tool: When is it used? What jobs can it do?
- Precautions: What potential dangers does the tool have? Are there sharp edges?...hot surfaces? How can accidents be prevented?
- Effective use: How should the tool be held? How should it be applied to the workpiece? How should the workpiece be set up?



When to teach

Teach skills when children need them. A technique involving a hand tool should be taught to an individual student or small group that's ready to put the skill to work. A student about to cut sections of wood for a classroom bookshelf makes an ideal audience for a short demonstration of how to choose and use the right handsaw. The same student, however, will lose interest quickly if forced to sit through a demonstration of correct screwdriver use.

Power tools are exceptions because they require more precautions. You may want to bring together a whole class for demonstrations of the saber saw, electric drill, glue gun, and soldering gun, even if most of the children do not plan to use these tools right away.

How to teach

A demonstration--short and to the point--is best. After showing and telling the essentials, let the child (or children) practice. While the tool is in the student's hands, you can add more pointers. When you're satisfied that the youngster can get the job done safely and effectively, it's time to move on.

A SAMPLE SKILL SESSION

A student who has never used a saw plans to cut a two-by-four to make legs for a table. The lab manager--

1. explains that a crosscut saw is better suited than a saber saw for cutting wood thicker than one inch.
2. shows how to distinguish a crosscut saw from other handsaws.
3. demonstrates how to position and secure the workpiece, then lets child do it.
4. demonstrates how to hold the saw, then lets child do it.
5. demonstrates how to make the initial notch, then lets child do it.
6. demonstrates how to move the saw in a smooth, back-and-forth motion, then lets child do it.
7. explains how to finish the cut, then lets child do it.

The entire process may take 5-10 minutes.

Other ways to teach

Demonstrations are not always possible. Teachers and lab managers cannot be in two places at once. Of course, children needing help can be asked to wait. Indeed, when they want help with power tools, there is no other choice but waiting for an adult.

For hand tools, however, there are alternatives to adult assistance. Design Lab "How To" Cards provide illustrated explanations of construction techniques that students are likely to find useful. For example, by reading one set of cards children can learn how to drill clearance and pilot holes. While students practice a new skill, they can keep the appropriate cards in view for handy reference. Remember that cards dealing with power tools should be used only as refreshers or references and snould not substitute for adult demonstrations or supervision. (See Appendix B for list of Design Lab "How To" Cards.)

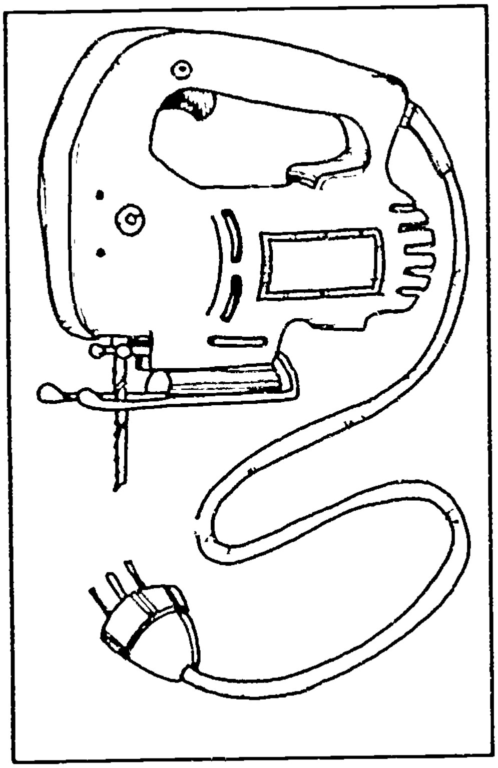
Kids teach kids

Another popular alternative to adult assistance is help from peers. In most groups there are a few children who have worked with tools at home and who exhibit both confidence and competence when hammering, sawing, and putting things together. Such students or those who simply learn lab skills quickly often help classmates who might be having some difficulty extracting a nail or leveling a surface.

Peer teaching is valuable, particularly during the first few months of a lab when a manager or teacher just can't seem to keep up with children's demands for assistance. Relieving as it is, the process should be supervised. You don't have to look over the shoulder of every kid who helps out a friend, but you should glance across the lab at times to see and hear that what's being taught is correct. Also, become familar with the abilities of those students who give others a hand. Although demonstrating and supervising the use of power tools is for adults only, when it comes to hand tools, kids make great teachers.

In the Design Lab, knowledge is safety. Whether you'll be teaching about tools or just supervising their use, here are some things that you should know and that you should make sure children know about handling power tools and sharp instruments.

SABER SAW

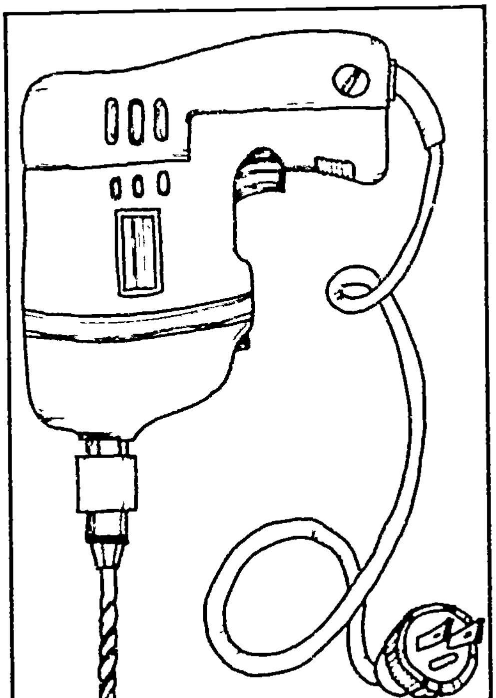


Saber saws with spring-loaded switches are safest. These saws run only while the trigger is held in, and thus a child cannot plug it in while it's on. Nor can anyone accidentally leave the tool running while it's not in use.

Instruct children to-

- Start the saw before bringing it into contact with the workpiece. A saber saw can "jump" if it's turned on while the blade is touching the material to be cut.
- Keep the saw as flat against the workpiece as possible to reduce vibration while cutting.
- Apply the same force throughout the cut--even as the last part of the cut is made--for better control of the saw and for a cleaner cut. If the saw is given an added push as the cut is finished, the wood may splinter.
- Use a saber saw only with an adult present who knows you're using it.

ELECTRIC DRILL

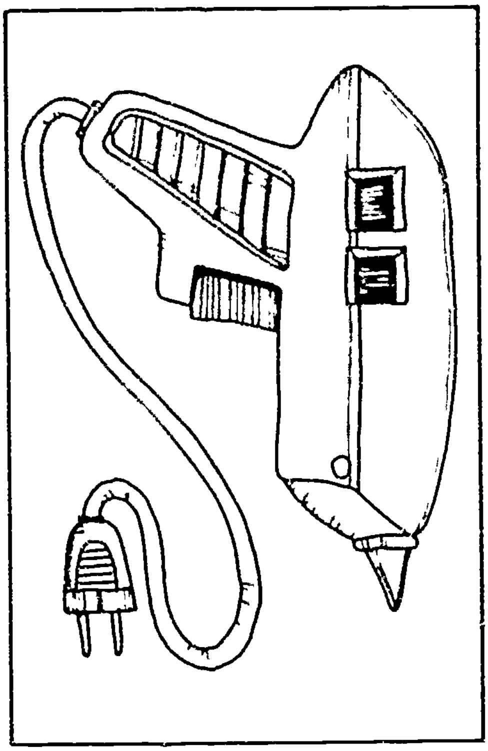


Drills with spring-loaded switches are safest. These drills run only while the trigger is held in.

Instruct children to-

- Start the drill only when the bit is touching the workpiece. If the bit is spinning when contact is made, it will likely deflect off the surface and may cause injury to an unsuspecting finger.
- Keep the drill running while withdrawing the bit from the hole. Avoid forcing the bit when the drill is not running.
- Have an adult check to see that the bit is properly inserted and sufficiently tightened before drilling.
- Use the electric drill only with an adult present who knows you're using it.

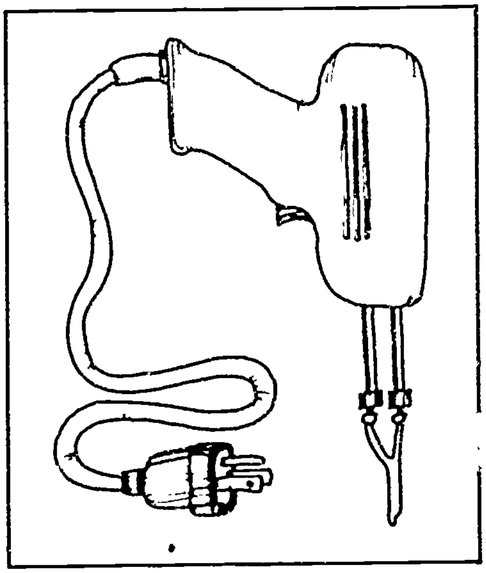
HOT GLUE GUN



Instruct children to-

- Keep fingers away from the two dangerously hot parts of the glue gun: the tip (where the glue comes out) and the heating element (the chamber into which glue sticks are inserted).
- Apply hot glue carefully.
- Keep hands and rest of body away from hot glue--it sticks and burns.
- Unplug the tool after use.
- Wear safety gloves while using the glue gun.
- Use the glue gun only when an adult is present who knows you're using it.
- Bring the glue gun to the "cooling off" station when you're done.

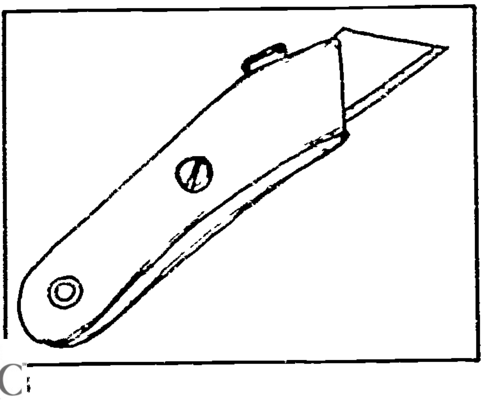
SOLDERING GUN



Instruct children to-

- Use the soldering gun in an uncrowded, uncluttered portion of the lab (preferably in an area designated for soldering only).
- Keep away from someone who is soldering.
- Use the gun only with adult supervision or, if you're experienced, with an adult nearby who knows you're using the tool.
- Unplug the tool after use.
- Bring the soldering gun to the "cooling off" station when you're done.

UTILITY KNIFE



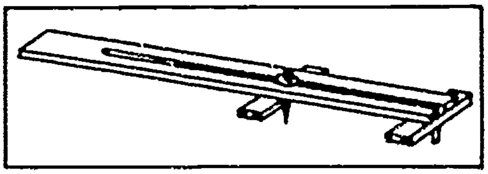
Utility knives should not be used in the Design Lab unless they have retractable blades.

Instruct children to-

- Make a cut by moving the knife away. Never cut by pulling the knife toward you.
- Keep blade away from hands, arms, legs, body. It's deceptively sharp.
- Retract blade and put away knife after use.

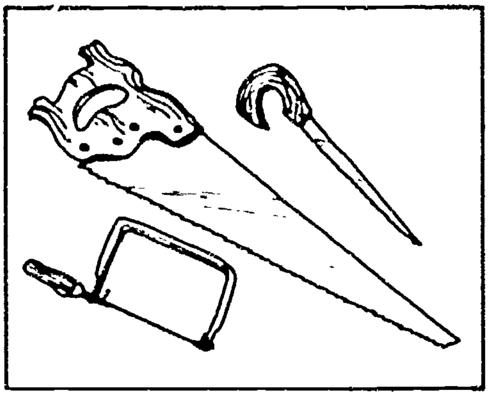
CIRCLE CUTTER

Make sure there is a cover for the razor-sharp blade; a scrap of Tri-Wall works well.



HANDSAWS

Make sure that children who are sawing have supported their workpieces on sawhorses or suitable substitutes, for example, a low, sturdy workbench.



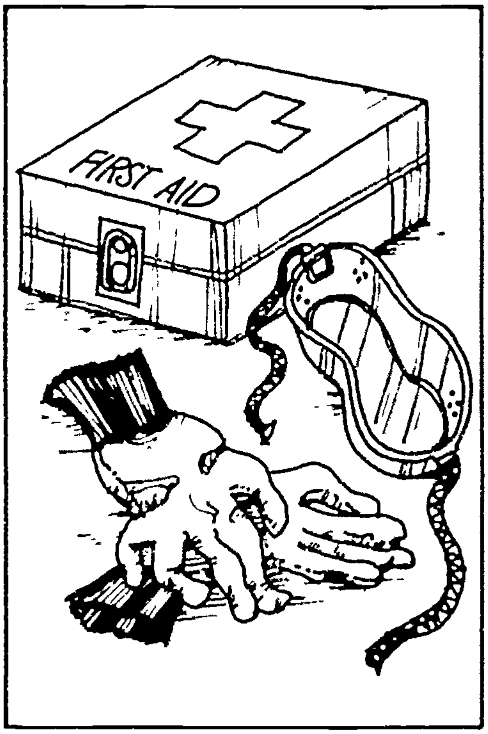
Instruct children to-

- Watch fingers when sawing. Keep them far enough from blade so a "jumping" saw will not cause injury.

- Use the appropriate saw for each job.

NECESSARY ACCESSORIES

SAFETY GLOVES help protect hands when working with glue gun, soldering gun, or materials with sharp edges. The right fit is crucial; so have several sizes available. Gloves that are too big or too small for a child are more of an impediment than a protection.



SAFETY GOGGLES can help protect eyes when sawing, drilling, or doing anything that sends particles flying. When they become badly scratched, discard the goggles and replace with a new pair. Scratches impair visibility and render the goggles more dangerous than protective.

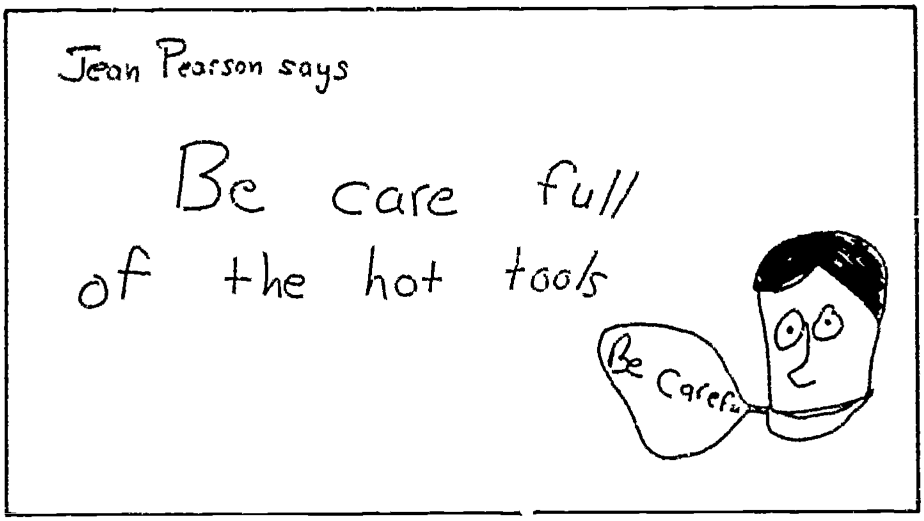
Check regulations in your state or school district. Rules about eye protection vary.

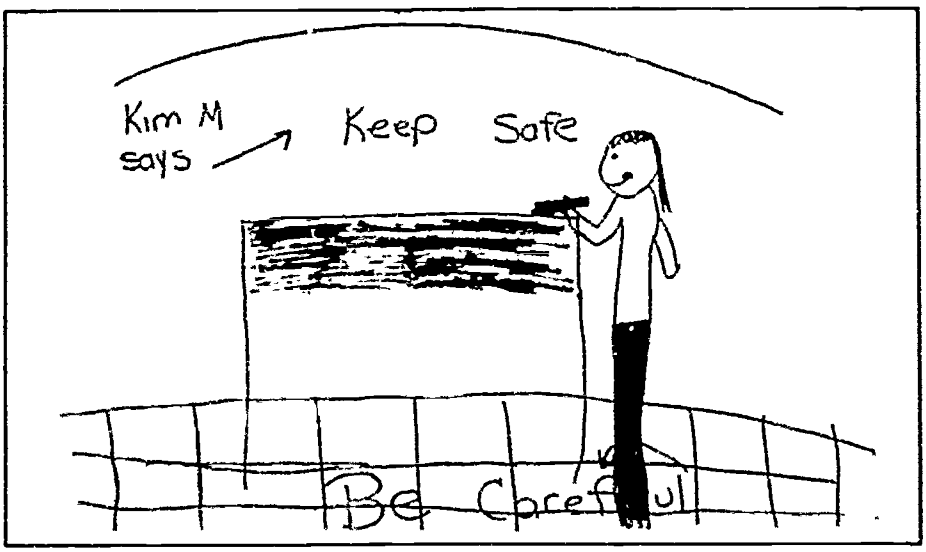
FIRST AID KITS are standard Design Lab items; every lab should have at least one. You can buy kits at drug or department stores. A friendly storekeeper might even donate one.

Spreading the word

Kids are often the most energetic campaigners for safety. Whether it's an entire class making a coordinated effort, perhaps as part of the Design Lab Design unit, or just a few students who seem excited about the task, spreading the safety gospel is bound to help your cause. The promoters themselves will become extremely safety conscious, and they'll probably make it difficult for other lab users to be negligent. Establishing rules for the lab, creating posters, and speaking to classes are some of the methods the young publicists may adopt. Lab improvers in Arlington, Massachusetts, wrote poetry to get their message across:

> Be careful what you touch,
> Because we care about you very much





Decorative posters made by second graders working on the Design Lab Design unit keep words of caution in view of all those who use the Thompson School Design Lab in Arlington, Massachusetts.

NOTES

4 Many a splendid thing:

WHAT KIDS HAVE MADE IN THE LAB

Observing a few labs in action would be the best way to grasp the flavor of what goes on in Design Labs and to see the diversity and quality of what comes out of them. If visits are impractical, then look through these photos, illustrations, and descriptions of a representative sample of lab projects. It may be the next best thing to being there.

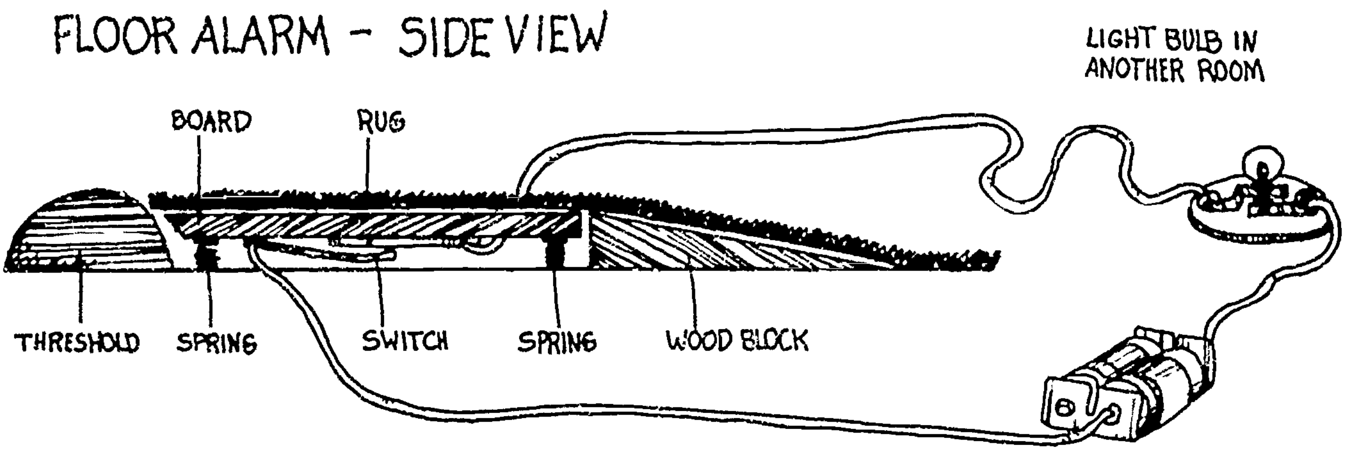
Stop Sign

As part of creating a test course to see how safely students rode their bicycles, a class of second and third graders in Iowa City built a half-size model of a stop sign. Getting the scale right was the most complicated aspect of this venture. The children measured the dimensions of an actual stop sign, including the length of the pole and height of the letters. But when they tried dividing each measurement by 2, the students couldn't get consistent results. So they scrapped the standard pencil-and-paper methods of division and turned to a more tangible device. To divide 8½", for example, by 2, the children rounded off to 8" and then made a pile of 8 sticks. Their next procedure, which resembled the "one for you, one for me" routine, resulted in 2 piles of 4 sticks each. That told them that 8" divided by 2 is 4". When all the scale dimensions had been calculated in this way, the final model was cut, assembled, lettered, and painted. (Ernest Horn School)

Trundle Wheels

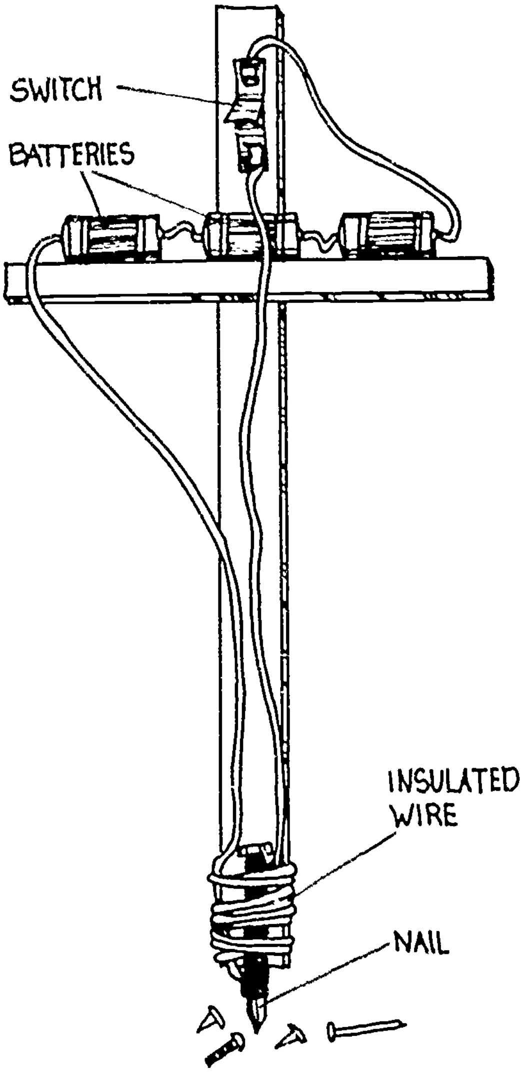
A round ruler comes in handy for measuring long distances, so it's no wonder that USMES students who need to find the dimensions of a lunchroom or a playground often make trundle wheels. This sixth-grade girl used her hand-made device to help create a scale layout of a busy intersection near her school in Lexington, Massachusetts. For that end, she and some classmates made several wooden trundle wheels, sanding the sawed circle for a smooth roll and measuring the circumference with string. Tests in the lab by the designers showed that the instruments gave the same results as straight rulers over a trial span of fifteen feet. (Adams School)

Not all trundle wheels are round. One boy from another class working on the Pedestrian Crossings unit incorporated a square wheel into his design. When he used his "improved" version to measure the width of a street, he was able to begin with the wheel flush against the curb. (Hardy School)



Floor Alarm

Theft of Design Lab supplies was a problem that a group of fifth graders in Boston sought to solve with an electric alarm system. A would-be burglar who entered the lab would step upon a hidden switch that lighted a small bulb in a classroom across the hall. The final version (illustrated) was the culmination of many weeks of trial and error. Changing the original enamel-coated wire to plastic-insulated wire got rid of troublesome short circuits; durability improved when the contacts were moved from the floor to the base of the switch; and the idea of using springs to keep the switch open only came after several springless models failed to do the job. (Dearborn School)

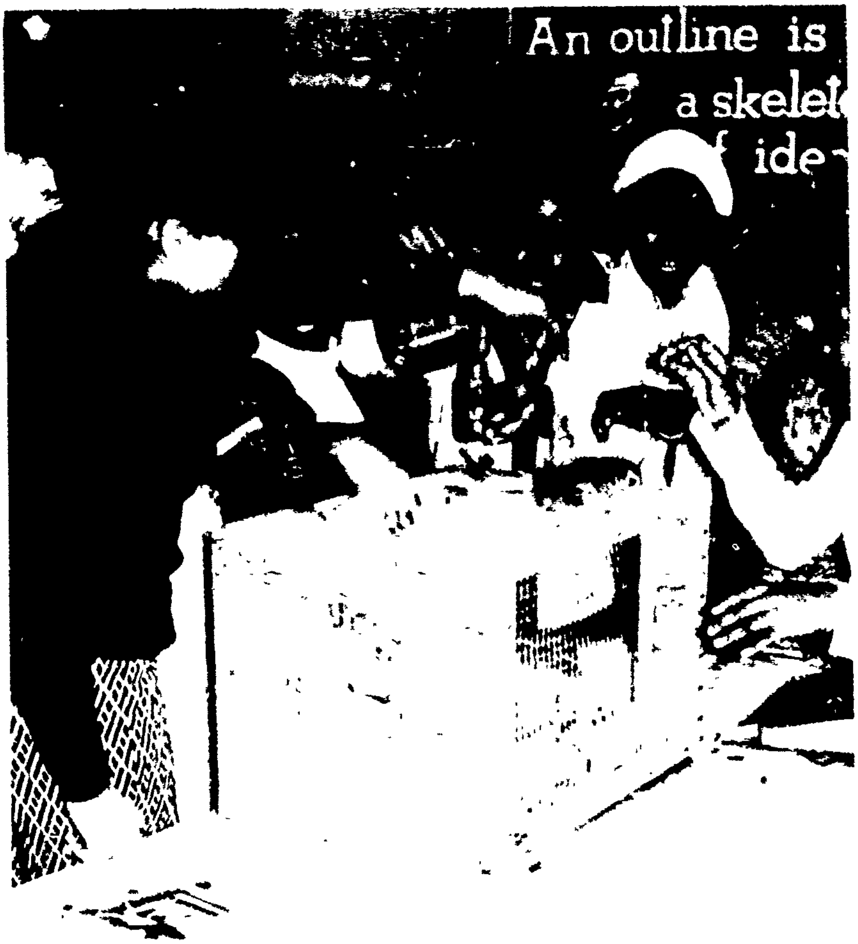


Electro-collector

To help pick up the dozens of nails and screws that inevitably ended up on the Design Lab floor, some fifth graders in Boston conceived and constructed this back-saving device. Working from their sketch, the six children needed assistance from the lab manager only in deciding how to cut a slot for the handle and how to hook up the electromagnet. The rest they figured out on their own, although they often debated among themselves such issues as whether to use hot glue or nails to attach the two wooden crosspieces. The sturdy instrument attracted small metal items with ease, but removing them was another story. When the manager pointed out this failing, the children immediately began studying switches that others had made. After the project was finished, one of the contributors, who was not used to such accomplishments, remarked in amazement, "Look how much work you can do in one afternoon if you really work hard." (Dearborn School)

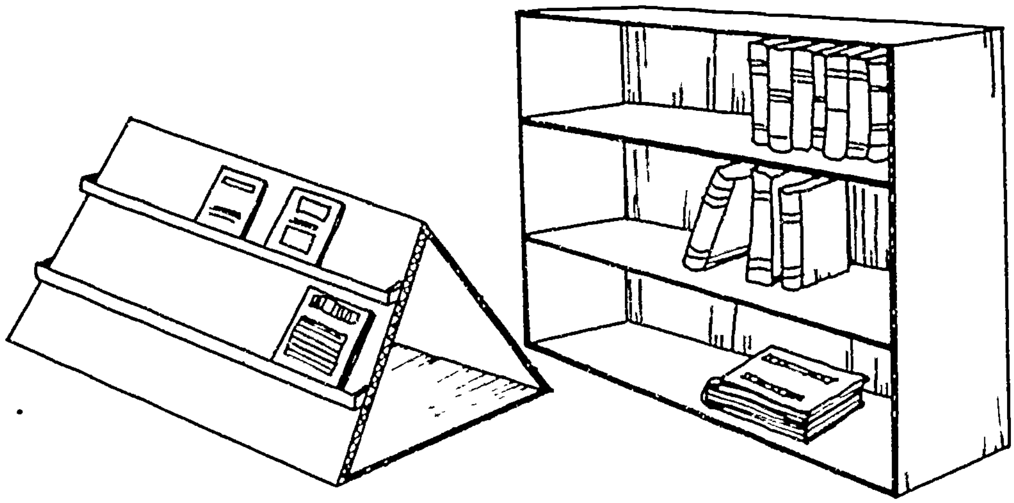
Bridge

Four months of designing, fundraising, and building by sixth graders in Portland, Oregon, resulted in a sophisticated span across an irrigation canal. The canal blocked access to an area that the children wanted to turn into an USMES nature trail. After the class determined that the bridge should be 1.5 meters wide and 6 meters long, each student designed a structure and built a scale model out of cardboard, lollipop sticks, and the like. The class selected one model, refined the sketch, and generated a list of needed materials. Funds for supplies came from a bottle drive, which had been initiated even before the first designs had been attempted. The effort yielded two hundred dollars, which more than easily covered costs. Thanks to a hefty donation of wood from a lumber mill, the builders had to buy only redwood, concrete, and a few minor items. Construction tasks varied. The children often worked in groups; for example, one group cleared land and dug holes while another group cut stakes. The class never tired of the seemingly endless measuring and remeasuring, mixing and pouring, marking and sawing, glueing and hammering. The project that had begun in January ended in late April as the side panels (not shown in photo) were attached and the redwood stain was applied. (Wilson Elementary School)



Cage

No animal should be without a home, at least according to fifth graders in Chicago who created a school zoo in their classroom. Besides the hamster cage shown in the photo, the youngsters made cozy dens for rabbits, gerbils, guinea pigs, and a turtle. With profits from a bake sale and some scrounging, the children supplied themselves with the necessary materials--for example, chicken wire, wood, and nails for the hamster home. Building that home entailed drawing a rough sketch, making a model from construction paper to ensure that the size would be right, and finally, measuring, sawing, and hammering. The final model turned out a little smaller than intended because of a sawing error that put crooked cuts on two sections of the wooden frame. After a couple of the girls realized that sanding wouldn't make the ends even, they decided to recut the pieces, making them 8½" instead of the planned 10". The hamsters didn't seem to notice the difference. (Horace Mann School)



Display Rack and Bookcase

At a school for handicapped children in Portland, Oregon, students with a variety of physical disabilities found that cooperative effort enabled them to build the display rack and bookcase they had designed for their school store. Because many of the children could not finish laying down a line of hot glue before it began to harden, two gluers worked simultaneously from opposing ends toward the middle, as seen in the photo. The students helped one another measure and mark the Tri-Wall and set it up for sawing. Saber saw technique varied depending on the user's mobility and motor coordination. Free walkers could stand and saw; some used only one hand. Students with forearm crutches could not sustain balance while moving with the saw; instead they sat on classroom chairs and, after making part of a cut, were moved forward to continue. Wheelchair students had pillows added to their seats to give them a clearer line of vision while sawing. (Holladay Center)

Planters

Visions of fruits and vegetables prompted first graders in Ganado, Arizona, to build two garden boxes out of lumber picked up from a scrap pile. Sizes were determined by the two largest pieces of plywood; one was 24" by 36" and the other 26" by 62". The smaller box was tackled first. The children measured the length and width of what would be the bottom of the planter and sawed four sides from long planks of wood. Because the plywood piece was not perfectly rectangular, the students had to measure and cut the sides a second time before getting a decent fit. Once that hurdle was overcome, the builders glued the sides together to form a frame, which was then nailed to the plywood bottom. The workers finished by sealing cracks with hot glue and lining the box with a plastic sheet. Construction of the second planter also entailed some problems. When the children nailed the bottom to the frame, for example, one of the sides split where there was a knot in the wood. Undaunted, the youngsters cut a new piece, reassembled the frame, and attached it to the plywood. (Ganado Elementary School)

SETTING UP A LAB

5. First things first:
   PLANNING A LAB

6. A lab to fit your needs:
   FORMS OF DESIGN LABS

7. Beg, borrow, and buy:
   DESIGN LAB TOOLS AND MATERIALS

Section Two

5 First things first:

PLANNING A LAB

There's no blueprint for setting up a Design Lab. Every lab is unique, because every school is unique. But from the hundreds of labs that have been established throughout the country, some guidelines have emerged. In this chapter you'll find the ideas to get you started on the right foot. Chapters 6 and 7 will give you enough information to get a successful lab going.

Plan

Like any project, setting up a lab requires planning. Thinking ahead helps you make the most of what you have to create an optimal lab, one that best meets the needs of those who use it and those who run it. Otherwise you may find yourself with a lab that's too small, or with a lab on wheels whose mobility ends at the staircase. You may get too much Tri-Wall and not enough tools, or too many hammers and not enough saws. You may use up your budget only to discover that many of the items you paid for could have been scrounged.

Assess needs

What needs must the lab fill? How many children will use it? How often? How many at one time?

You don't need exact figures; rough estimates are fine. Just take some time to get an idea of what's in store for the lab. This preliminary effort will make it a lot easier to decide which type of lab to choose, which tools and how many of them to get, and how to handle staffing and scheduling.

Identify resources

What and who is available? Is there unused space in the school? How much money has been allocated? Where can supplies be obtained for free? Who can help with scrounging? ...with staffing?

The more resources you muster, the more likely your lab will turn out the way you want it. People, of course, are the most versatile resource. Get them involved. Students, teachers, principals, parents, local businessmen, and other members of the school or community can help you overcome most any obstacle. Remember, enthusiasm is contagious.

Choose a format

Should the lab be part of the classroom?...a portable cart?...a separate room?...something else? The answer depends on the needs you've assessed and the resources you've identified. Chapter 6 describes and compares three general types of labs, so you can determine which is best for your situation.

Tailor the lab

In-class labs are alike, but no two are identical. The same is true for portable labs and for separate-room labs. After you've chosen a format, you have only an outline; the specifics need to be filled in. And that's when your lab becomes distinctive. Chapter 6 will help you decide what type of workbenches to get, how to arrange them, which kinds of portable carts are practical and cheap, what to use for a cheap but functional lab cart, what scheduling system to try, and many other particulars.

Stock the lab

The most important particulars are tools and materials for the lab: what to get and where to get them. Here's where planning really pays off, especially if money is tight. Chapter 7 contains suggestions on what sort of inventory to aim for: which items are necessary, which are optional, and how many of each will accommodate a typical school. You'll also find out how to stretch your funds and even how to get by without any.

After setup

Staffing the lab and familiarizing others with it are topics that may or may not apply to you. If they do, you'll find them discussed in Section III.

A LAB SHOULD BE SAFE
AND EASY TO USE
FOR THOSE WHO USE IT
AND EASY TO MAINTAIN
FOR THOSE WHO MAINTAIN IT.

3 A lab to fit your needs:

FORMS OF DESIGN LABS

IN-CLASS LAB

PORTABLE LAB

SEPARATE-ROOM LAB

No two Design Labs are identical. They come in a variety of sizes and shapes. Each lab should meet the needs of the school it's in and the children who use it. There are, however, three general formats for Design Labs: (1) in-classroom labs, (2) portable labs, and (3) separate-room labs. To tailor your lab for your situation, it's helpful to understand the purposes and advantages of the three types and to see how labs of the same format may differ.

In-class labs

An in-class lab--the simplest type of Design Lab--may sometimes be the only choice, particularly when just one or two teachers in a school work with USMES. All that's needed is a small area in which materials and a few tools can be kept, with enough space for a few children to work. If all the children want to use the lab during the same USMES session, the entire classroom can temporarily become the Design Lab.

When more than two teachers work with USMES units, in-class labs are no longer feasible (except as supplementary labs). They become oversupplied with a few basics at the expense of a well-rounded inventory. A hammer in every classroom, but not a pair of pliers in sight.

Inventory for an in-class lab will depend on what you can spend and what you can scrounge. For starters, be on the lookout for basic hand tools: screwdrivers, saws, hammers, and pliers. Then get some materials to use them on: wood, Tri-Wall, styrofoam. And don't forget nails, screws, and glue. (Refer to Chapter 7 and to the Design Lab inventory lists in Appendix E for tips and strategies about stocking a lab.)

LAB EXPERIENCES

In-class labs can arise in different ways and from different needs. Consequently, labs of this type will differ. The range of possibilities is wide, as indicated by the following reports. (The reports also include hints on scrounging--a topic covered in more detail in the next chapter.)

Letter leads to lab

One of the two USMES teachers at the Peirce School in Arlington, Massachusetts, realized that her students needed some sort of Design Lab to continue their work on the Weather Predictions unit. She couldn't rely on the full Design Lab that the school was due to receive, because she didn't know when the tools and materials would arrive. Furthermore, her classroom was in a portable at an inconvenient distance from the main building.

Setting up an in-class lab seemed to be the answer. A list of tools and materials was sent to each student's home along with a letter asking the parents to donate or loan any of the listed items. The letter also invited the parents to a meeting to see what USMES was all about.

Donations poured in, mostly after the meeting. The children soon had amassed an inventory ranging from goggles, gloves, and glue to sandpaper, saws, and screwdrivers--more than enough tools and supplies to construct the weather instruments they needed.

The lab continued to grow in size and purpose as well. Within six months it took up about one-sixth of the classroom and became a center for USMES and non-USMES activities alike.

Kids set it up

There's no reason why students themselves can't do most of the work in setting up an in-class lab. In Cotuit, Massachusetts, for example, a fourth-grade class in the Cotuit Elementary School put aside the Weather Predictions unit for a month to work on Design Lab Design. The children's decision to switch units resulted from their need to build weather instruments and from the lack of a Design Lab in the school.

The children brought tools from home, and workers at a nearby construction site donated scraps of wood. However, the students soon discovered that tools and materials were not enough. Workbenches were needed because classroom desks were too small and unsturdy to be used for hammering and sawing.

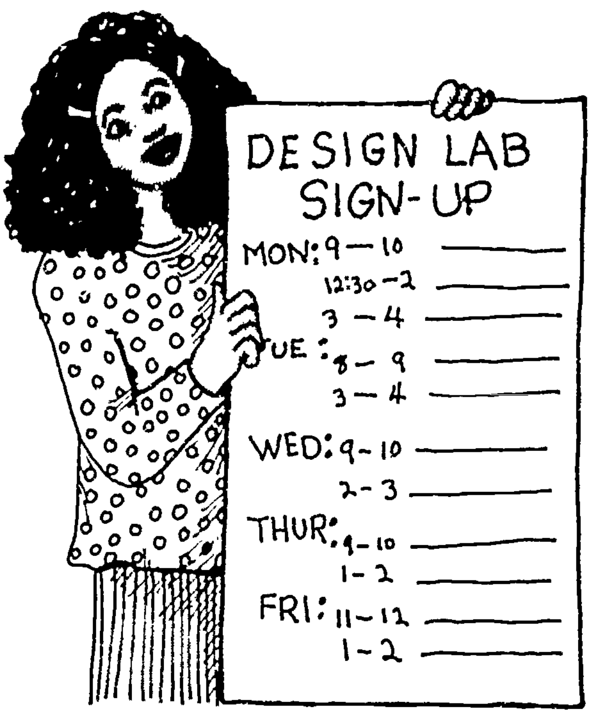
In response to those needs, two workbenches were designed and built by the students, who purchased the necessary wood with funds allotted by the school. Pairs of desks served as makeshift sawhorses during construction of the tables. Most hammering had to be done on the floor.

The clever designers made one workbench shorter so it would provide the correct leverage when used for sawing. Nails, driven into the side of one of the tables, allowed hammers and saws to be hung conveniently. Remaining tools and supplies were stored on a classroom shelf cleared off for that purpose.

With their in-class lab completed, the children returned to Weather Predictions. They built their instruments and later in the year used their lab for work on other units as well.

Sharing the wealth

An in-class lab can serve more than one class. Such is the case in the Revere School in Chicago, Illinois, where the only space for a Design Lab was in a large room that was needed as a classroom. One of the USMES teachers volunteered to move his class to this room and use it as a combined classroom/Design Lab.



The lab--in the rear of the classroom--is available for about two hours each day for other classes to use on a scheduled basis. To avoid having his class work disrupted, the teacher schedules other classes to use the lab during those times when his class is out of the room, at lunch or in the gym, for example.

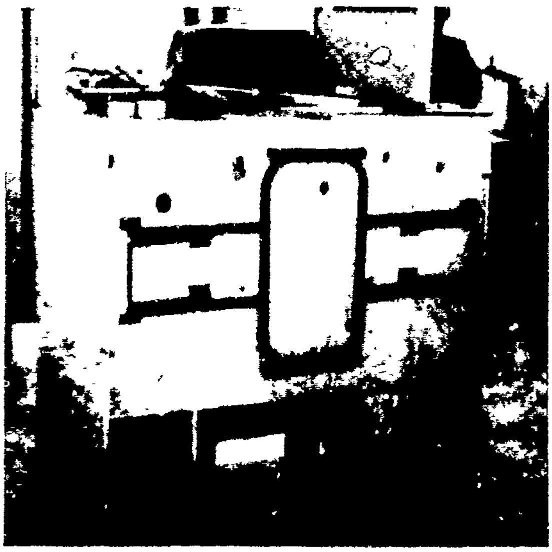
Although the school had received a complete Design Lab inventory, letters to parents and scrounging by students resulted in additional items: lumber, wire, hand drills, power saw, tin, paper cups, label maker, tape, drill bits, wrenches, rulers, dowels, files, nails, nuts, paint, and brushes.

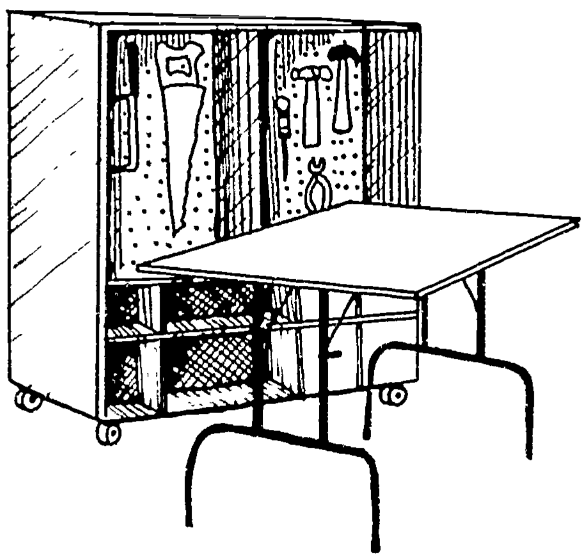
Portable labs

If a school has three or more USMES teachers but no space for a Design Lab room, what's needed is a lab that can travel from classroom to classroom--a portable lab. Two well-designed carts, one for tools and one for materials, can hold and transport a complete Design Lab inventory.

Depending on a school's needs and finances, a portable lab may be a complex and compact marvel of engineering or a simple hand-carried box. If you decide on the portable format, examine the examples below and on the following pages and then choose, build, scrounge, borrow, or buy one to fit your situation.

Keep in mind that stairs may limit the range of a lab on wheels. In buildings with two or more stories and no elevator, each floor should have its own cart, inventory, and storage space. Tote boxes or the like can be used to bring one-of-a-kind items from floor to floor.





Who can build it?

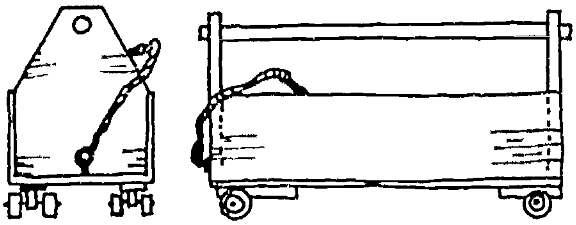
Anyone. Teachers, parents, custodians, Design Lab managers, children. Perhaps a shop class in a nearby high school would like to contribute time, talent, and materials.

Those who think a portable lab should have it all can build a cart like the one shown above, which contains its own folding worktable.

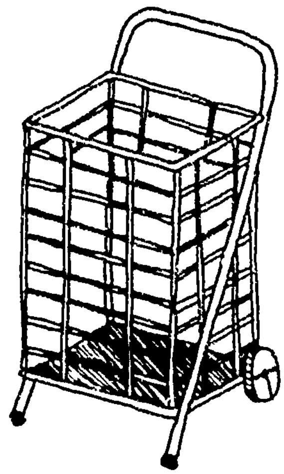
Experience is not necessary. The teachers and principals who designed and built the double-decker shown on the left had little or no experience working with tools prior to the two-day workshop effort that produced the functional and attractive cart.

CHEAP CART CHART

Because a teacher rarely needs to bring the entire Design Lab inventory into the classroom, some form of carrier may be all that's required for transporting tools and materials from room to room.

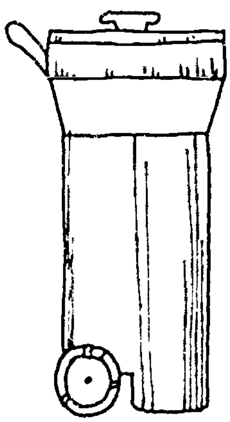


TOTE BOXES similar to ones used by carpenters function well as hand carriers, particularly up or down flights of stairs. Add roller skates on the bottom, attach a rope on one end, and you have a "convertible"--a tote box that doubles as a wagon.

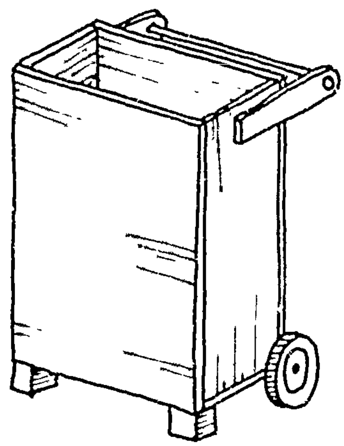


LAUNDRY CARTS that lay unused in homes may be loaned or donated by parents.

SHOPPING CARTS can usually be borrowed from local merchants friendly to the cause of education.



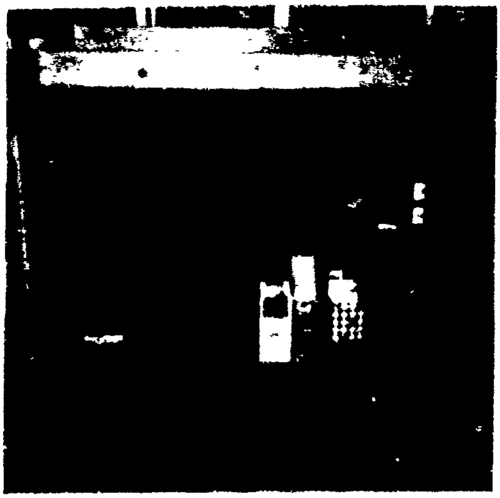
WASTE CARTS shouldn't go to waste when they can be wheeling supplies from one classroom to another.



HANDMADE CARRIERS need not be elaborate; a simple box on wheels with a handle and legs gets the job done.

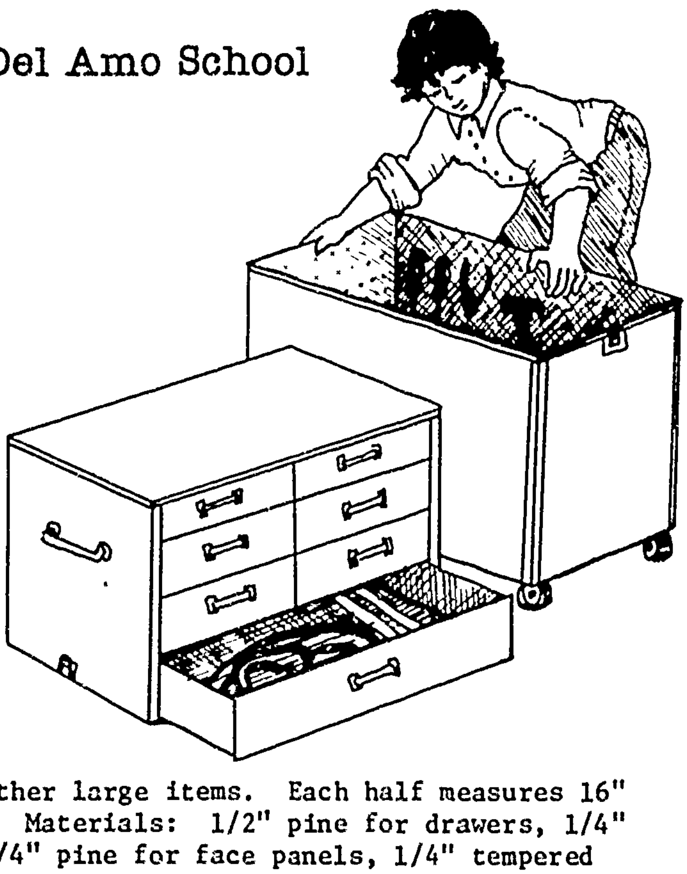
LAB EXPERIENCES

Ganado School



Plywood, pegboard, strips of pine, and a few hinges transformed a projector cart into a portable Design Lab for the Ganado School. The builder, an USMES teacher, stores the lab in her classroom. Other teachers can sign out the whole cart or just a few tools.

Del Amo School



Split-level feature adds versatility and efficiency to the portable lab constructed by an USMES teacher at the Del Amo School. Drawers aid the cause of organization while the open bin of the bottom section provides space for saws and other large items. Each half measures 16" high, 23" wide, and 32" long. Materials: 1/2" pine for drawers, 1/4" plywood for drawer bottoms, 3/4" pine for face panels, 1/4" tempered masonite over 3/4" plywood for top, and casters (two fixed, two rotating).

Hosmer School

The Toolcarrier

When we first went in the Science Lab the toolcarrier was a mess. Everyone had to look under things to find what they wanted. People had a very difficult time finding things. Finally, some boys in Mrs. Salah's fourth grade class decided to make it better. They nailed pegboards to the sides and put hooks on the pegboards so they could hang some tools. They put the pegboards on the carrier so they can hang screw drivers, saber saws, saws, drill bits, hammers, malets, gluesticks, etc. They worked on it for about one month. Now, when we have science, they take the expensive tools and put them on the top shelf of the carrier.

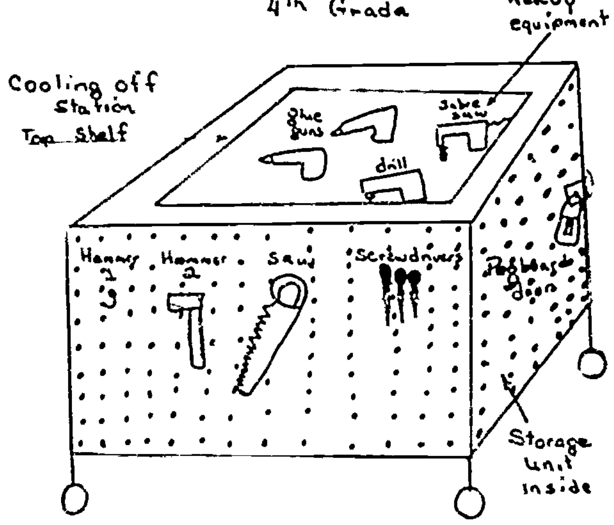
When science is over, the boys put the expensive tools in the bottom shelf of the carrier and lock it up. It is very useful to us in the Science Lab in the way of safety, the tools are not laying around. If they were laying around they might catch on fire. I do not think the toolcarrier needs any improvements. It is safe and tools cannot be stolen. It is fine for our class and the whole Hosmer School.

By
Deirdre Dowd
Mrs. Salah's class
Grade 4
Hosmer School
Watertown, Mass.
02172

Mobile Design Lab

Tool Carrier and Storage Unit

Marie Salah
4th Grade



Separate-room labs

When a school has three or more USMES teachers and some space to spare, a Design Lab room is the best bet. This type of lab can accommodate students from different classes at one time and can provide well-planned working space.

Where to look

Space in schools is usually scarce, but look again before you say there's no room for a separate Design Lab. Ask yourself--

- Can the basement, old boiler room, rubbish disposal area, or old coal bin be converted into a Design Lab?
- Can the cafeteria, music room, art studio, or somebody's office be used for a lab on a part-time basis?
- Is a classroom, resource room, garage, or storage area available for use as a Design Lab?

(These ideas have come from people's experiences; each of the places mentioned has served as a Design Lab room in at least one school.)

What to look for

There are certain criteria to keep in mind when choosing a spot for your lab. Although a Design Lab doesn't have to look good, it must be functional and safe. A lab room should have sufficient electrical outlets, adequate ventilation, a nearby supply of water, and enough working space for the children who use it.

Take into account both the size and shape of a room when determining its working capacity. Ten to fifteen children can work comfortably in a 30' x 30' room. A rectangular room of the same area on the other hand will accommodate only six to ten students. These figures are general; they may vary depending on the structure and staffing of a lab.

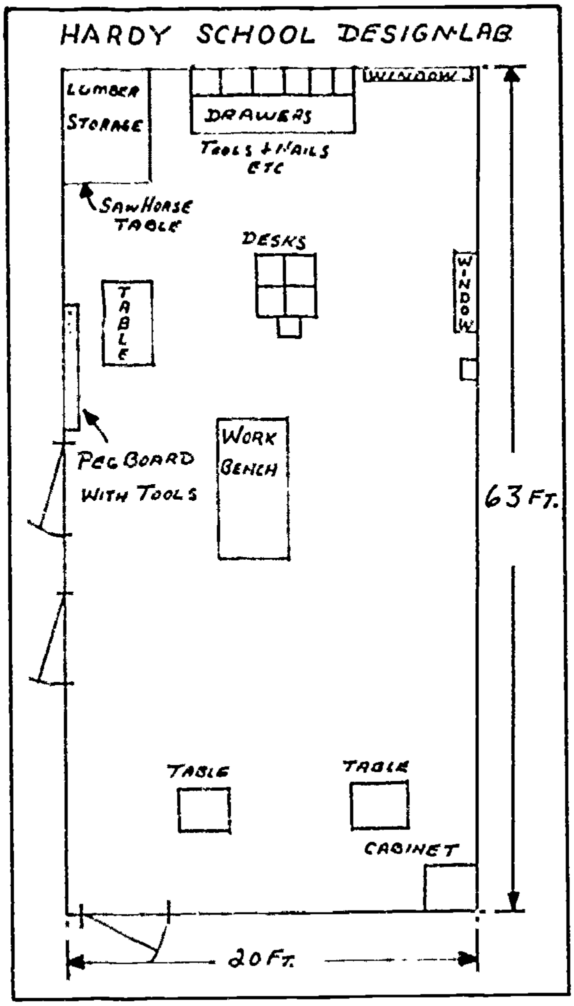
Once the room is set up, experience will dictate the maximum number of workers that can use it safely at one time. Never overcrowd a lab. If and when the demand on the Design Lab exceeds its capacity, consider these options:

- Add a second lab, if space permits. Distribute inventory and users between the two labs.
- Expand the lab. Possibly the adjoining room or coatroom can be incorporated.
- Use classrooms as labs. Much of the lighter work can be done in classrooms; children can use tote boxes or wheeled carts to carry to class the lab items they need.
- Find part-time space. Schedule times when the auditorium, cafeteria, or offices are available for lab work.

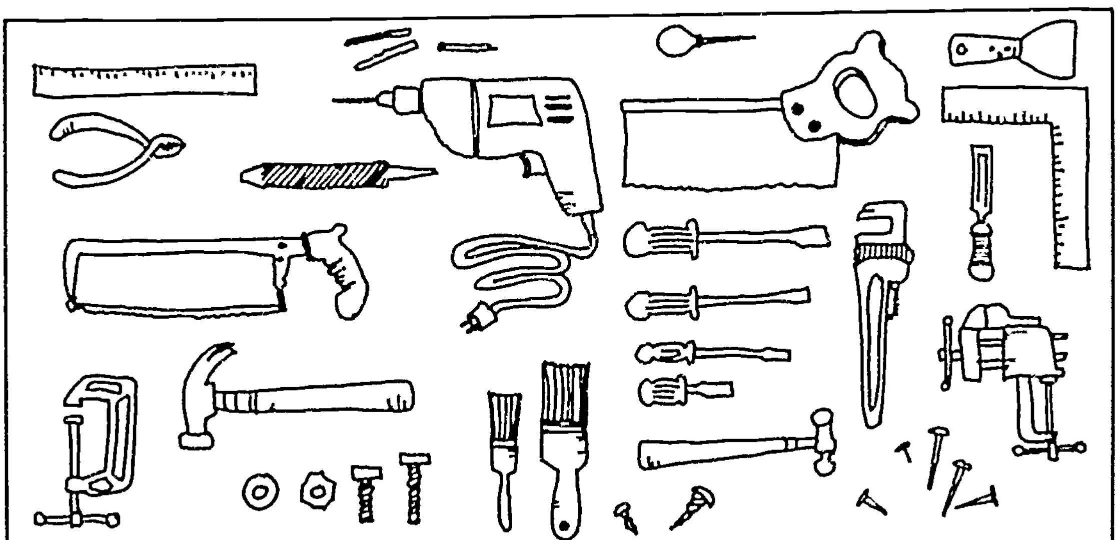
LAB EXPERIENCES

Hardy School

Some of the furniture in the Hardy School Design Lab was brought out of hibernation from the school system's storage area. Instead of just gathering dust, the sturdy workbench (foreground) and metal cabinets (rear) have served as many as 350 young builders in a week.

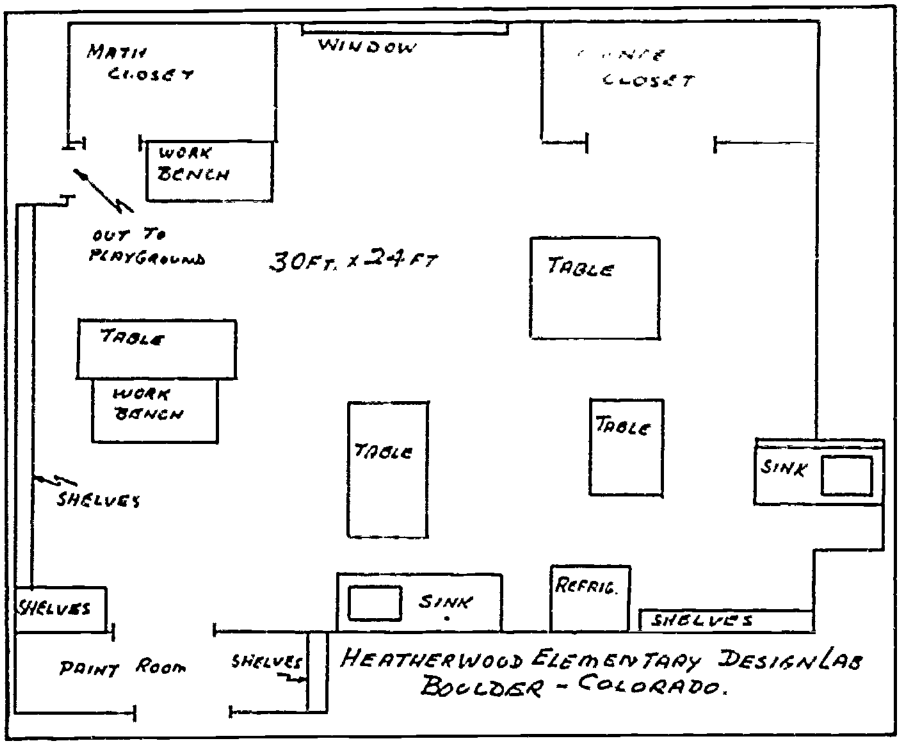


Thanks to the large dimensions of the Hardy School lab, a teacher can bring an entire class to the room without fear of overcrowding. At times five or six groups from different classes work comfortably in the spacious and organized lab. During its history the lab has been staffed alternately by parent volunteers, student teachers, and workers from a federally funded job project.



Time spent in writing to parents to request their aid in stocking the Design Lab proved an excellent investment for the Hardy School principal. Resulting donations included 33 hand tools, 3 electric drills, and pounds of nails, bolts, and other small necessities.

Heatherwood School

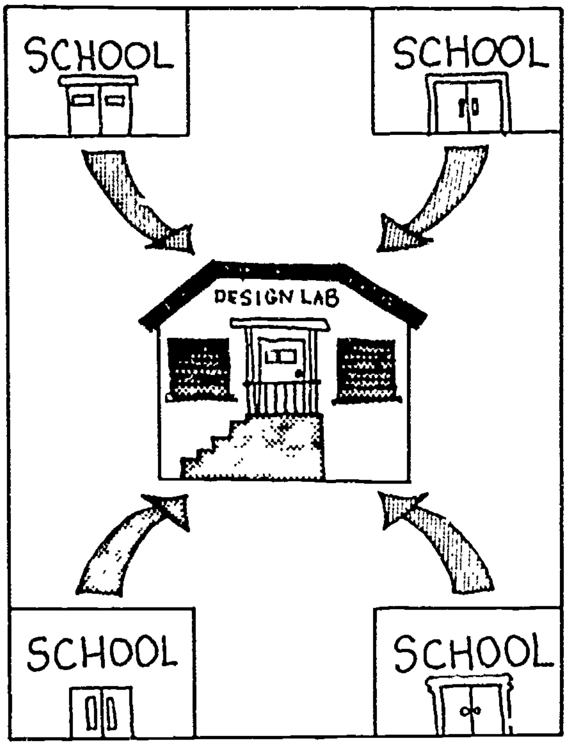


Only a few changes were needed to turn an unused science room into a Design Lab at the Heatherwood Elementary School in Boulder, Colorado. Most of the ingredients for an optimum lab room were already present: running water, adjacent storage areas, working space, some usable furniture, and, of course, availability.

Since its inception, the lab at Heatherwood has seen heavy use. Each week between 50 and 150 children from up to 15 classes design and build items they need.

Portland School

A Design Lab room can serve more than one school, particularly when USMES is in its early years in a school district and is spread thinly over several schools. Such a multi-school lab in Portland, Oregon, is used by teachers in four buildings within a mile of the centralized lab. Groups of usually 10-12 students, accompanied by adults, walk or are driven to the lab. Plans are for each school to get its own lab when the school has three or four teachers using USMES.



The multi-school lab is housed in a portable on the grounds of one of the participating schools. Because it's in a separate building, the lab can be kept open before and after school hours without much ado. Another advantage is the absence of neighboring classrooms; there are no complaints about noise. (Of course, a multi-school lab could just as well be within a school building.)

During an average week about 45 students use the lab, some of them more than once. The lab measures roughly 45' x 60' and its contents are similar to the full inventory listed in Appendix E.

ADVANTAGES CHART

IN-CLASS LABS

- The classroom can be used for Design Lab activities.
- There is no scheduling problem.
- The teacher is directly involved with all Design Lab activities.
- Scrounging can be geared to the needs of the class.

PORTABLE LABS

- One set of tools and materials can be used in classrooms throughout the school (when stairs are not an insurmountable problem).
- The teacher is directly involved with all Design Lab activities.
- The whole school can help buy or scrounge materials for the portable lab.
- When not in use, tools and materials can be wheeled into the safest storage area in the school.

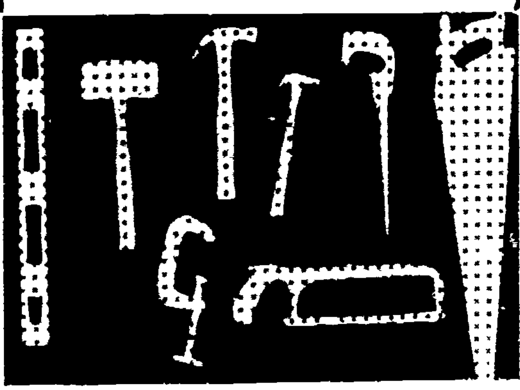
SEPARATE-ROOM LABS

- The room can include workbenches and workspace.
- The Design Lab can be used by members of many classes at one time.
- The whole school can help maintain the lab.
- Lab activities will not disrupt classroom work.
- Only one set of tools and materials is needed; this allows for a more diverse inventory.

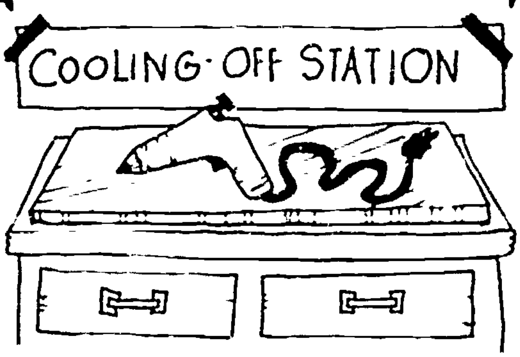
Tips on Setting Up a Lab

Tools hanging from peg-board are simple to find and simple to return, a lot more so than tools hidden in drawers or cluttered on shelves.

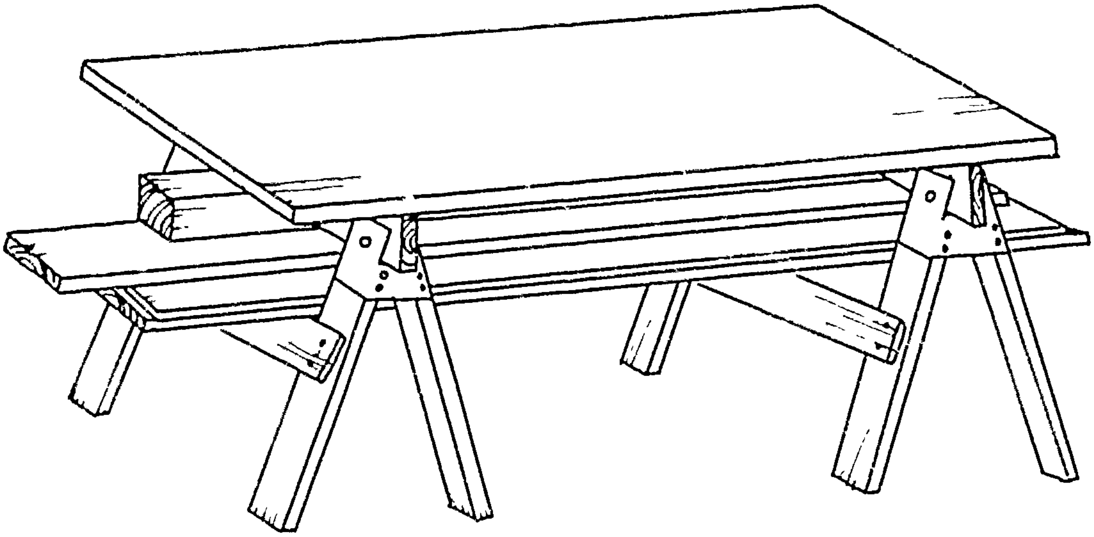
Nuts, bolts, and other small items cause fewer headaches when they're kept in labeled drawers. Large, easy-to-read labels, perhaps with pictures, help all lab users quickly find what they need.



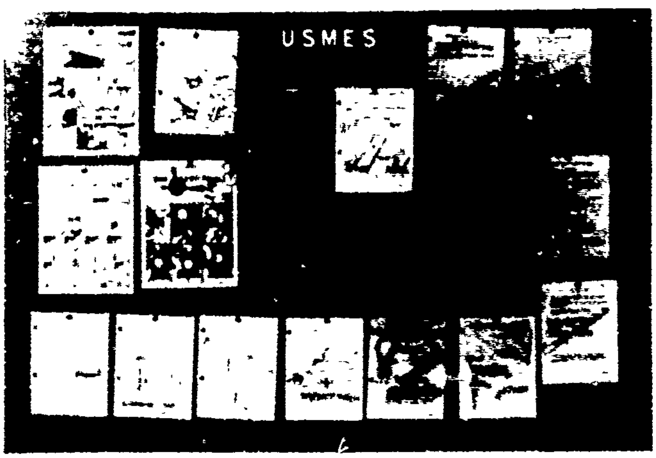
Which tools are out? Drawing outlines or painting silhouettes of hammers, saws, etc., makes it easy to see which items have not been returned.



Give hot tools a place to cool off--a safe place. Cover a piece of wood with aluminum foil or just put a few bricks side by side. A warning sign will also help keep fingers at the proper temperature.



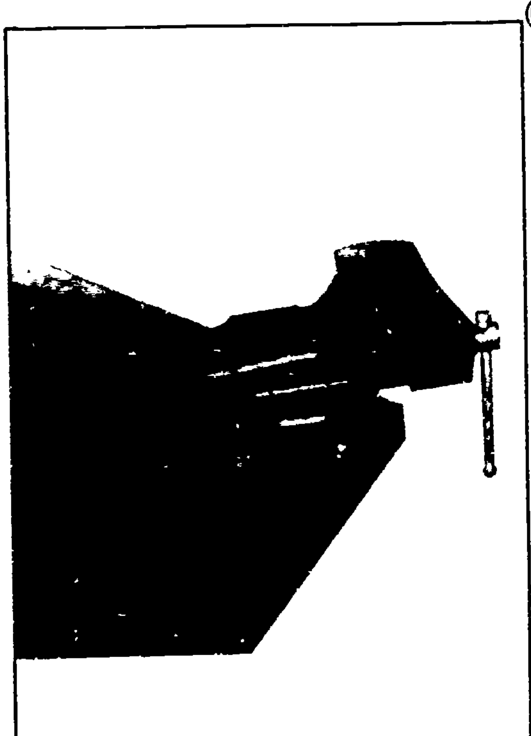
If you need a table, make one. Two sawhorses bridged by 3/4"-thick plywood make a sturdy workbench. Disassembly is no problem, particularly if screws rather than nails are used to attach the surface to the sawhorses. You can even store lumber under the table just by adding a couple of braces (1" x 3" or 1" x 4"). Sawhorses can be put together from two-by-fours and sawhorse brackets.



Design Lab "How-To" Cards have been hung up, put in boxes, glued and tacked onto Tri-Wall, laminated, arranged in loose-leaf folders, and more. Whatever system you choose, make sure that kids can readily find and use the cards they need.

Because children come in different sizes, so should tables. Furniture built for seventh graders can make first graders feel out of place. You may need to experiment to find the best table heights; or you can let the kids do it. The Designing for Human Proportions challenge fits nicely when tables don't.

Bench vises belong on a corner to give maximum working room. If you put a vise midway along the table edge, for example, you'll likely be banging into the table and getting sore as you saw.



NOTES

7 Beg, borrow, and buy:

DESIGN LAB TOOLS AND MATERIALS

Whatever type of Design Lab you've chosen, you're going to need tools and materials for it. What supplies to get and how to get them will depend on the number of classes that will use the lab, the amount of money you can spend, and your initiative. By devoting some time and energy to scrounging and fundraising you can compensate for low or no financing from your school or district. The guidelines and tips in this chapter--culled from experience--will help you make smart inventory decisions.

The inventory story

What tools and materials should you get for a Design Lab? Get what you can, but strive for diversity. The more varied the supplies, the more varied will be the things that children can build.

The three inventories depicted on page 49 indicate some useful assortments. Depending on your budget, your ability to scrounge, and your needs, you might aim for a small, medium, or full Design Lab inventory. (For item-by-item lists of these inventories with prices and other information see Appendix E.)

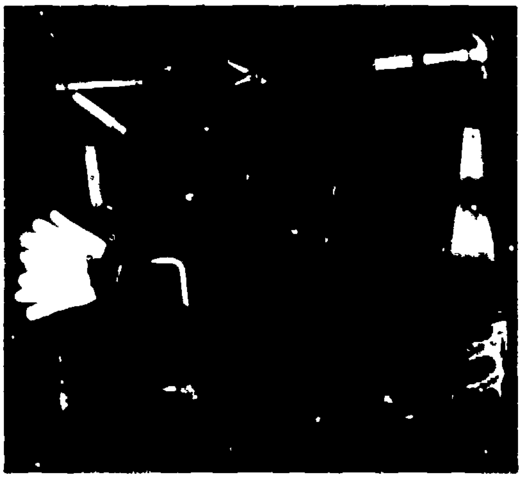
Starting small

The small inventory will suffice when no more than 10 children will use the tools at any one time, as is often the case with a school that has but one or two USMES classes. Construction possibilities are greater than you might expect from a limited collection of materials. For example, a child with only a crosscut saw, a hammer, some nails, and scrap wood, can turn out products like boxes, tables, chairs, and weighing balances.

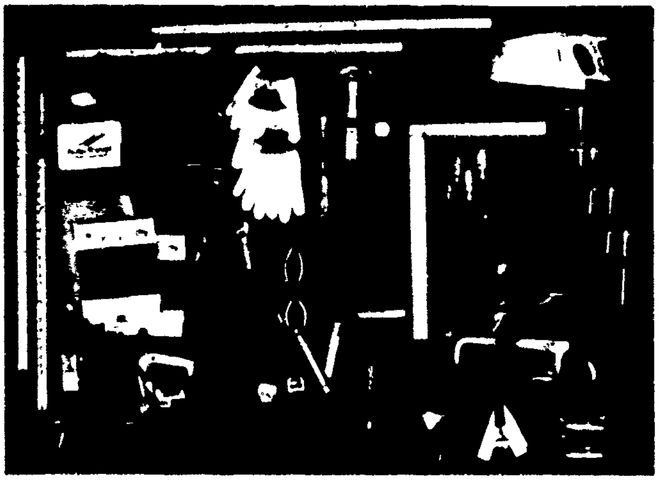
Adding more

The medium inventory increases these possibilities and lets more children work at one time. A lab so equipped enables up to 25 students to work at one time and the list of items they might build would easily run over this page. Some additions found in the medium inventory may improve children's work. Power tools like the saber saw and hot glue gun raise productivity, while instruments like the combination square and rafter square help kids mark, cut, and drill more accurately.

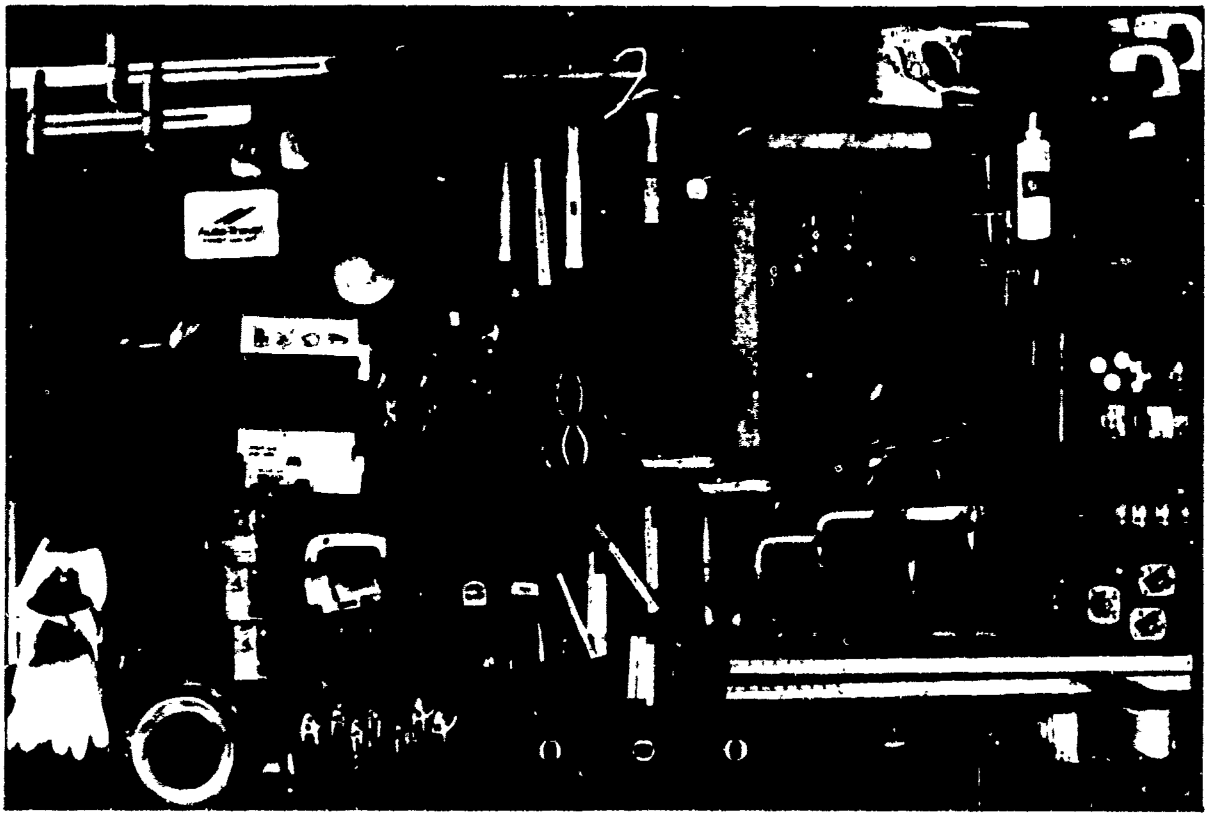
INVENTORIES AT A GLANCE



SMALL



MEDIUM



(Inventory photos: Omer Khan)

LARGE

*Items not shown include some tools, lumber, Tri-Wall, hardware, and odds and ends. See Appendix E for complete lists of all three inventories.

...And more

The full inventory, of course, offers still more diversity. The electric drill means faster work, the soldering gun opens the door for electrical projects, the level adds a new degree of precision, the Tri-Wall circle cutter can make round tables a reality, and odds and ends like tacks, wire, and clothesline can stimulate ideas and save time by being there when needed. The full inventory also offers more of the same. That means up to 75 designers and builders can work at once. Thanks to small, portable tool boxes, all 75 children need not be in the same room.

Whichever inventory you set as your goal, you don't need all of it to open the lab. Whether you start small or start big, the pursuit of supplies should be an ongoing activity. There's always room for improvement.

About costs

If you paid for it all, the small inventory (at late 1975 prices) would cost you about $65; the medium, about $380; and the full, about $990. Prices for lumber change too often and vary from place to place too much to give any definite figures, but about a hundred dollars is a possible expenditure for lumber yard items for one year for one school with 8-10 USMES classes. For up-to-date prices in your area, call or visit a local lumber yard and contact the nearest Tri-Wall supplier (see Appendix D for list of suppliers).

If these expenses seem overwhelming, bear in mind that you don't have to pay for everything. Scrounging leads to drastic reductions, and in some cases it can eliminate all costs.

Scrounging

Scrounge before you buy. That way, you can get your freebies first and use your finances to round out your inventory. If parents donate a few hammers, for example, the money you would have spent on hammers can go toward a saber saw or a drill that you may not have afforded otherwise.

If your lab is still wanting even after you've scrounged and used up your allocated funds, you can try raising funds. Get the kids and the PTA involved. Sponsor a movie, a dance, a bake sale, an everything sale. Proceeds can help fill gaps in the lab's inventory.

Newcomers to the art of scrounging are usually amazed at their results. Some schools have collected $500 worth of tools and materials for their labs. What you get depends on what you do. But don't do it all yourself; get the kids involved, recruit parents, high school students, and other volunteers. Once a scrounging campaign begins, the excitement of getting things free can keep it going.

Where to scrounge

The best things in life are free...if you know where to look. Start in the school. Classrooms, offices, storerooms, cafeterias may yield hidden treasures that can be turned into workbenches, odds and ends that can fill a cabinet, or perhaps even a cabinet. If your school system has a central storage facility, go there; it can be a gold mine.

Homes can be even more prolific. Parents are usually happy to lend or donate hand tools, power tools, wood, and assorted hardware. A letter on school stationery, notes written by your students, phone calls, PTA announcements, and open houses have all helped Design Labs in one place or another get off the ground. Be sure that parents get a list of things you may need; this will give them an idea of the variety of items you're after. Also, remind parents to check out their places of work; cardboard tubes and other scraps make good construction materials. If you cultivate a corps of helpful parents, keep in touch; you'll need help for specific needs that require scrounging blitzes.

LAB EXPERIENCES

This catchy appeal to parents was written by members of the USMES resource team after a formal letter had failed to produce any donations. The notice was taken home by children in the Wilson School in Owatonna, Minnesota, after they received a pep talk from the team members. Parents responded with gifts of tools, lumber, cardboard, and assorted small items. The Design Lab budget was then used for power tools and other equipment that couldn't be scrounged.

Dad!

This is a good time to clean that workbench !!

We need many more supplies for the Wilson School Design Lab! Your child, and the other children at Wilson need your help in gathering tools, boards etc. for their workshop.

If you help, your child can learn invaluable problem solving skills and practical training in the use of tools.

We have some funding for the supplies, but as you know it would take more funding than is immediately available to supply a lab large enough.

When you find something that you think we can use, will you please wrap it so your child can bring it safely with him to school?

I can give these things to my child and his friends, so that they can learn how to safely use them to create, and solve practical problems.

– sandpaper	– washers	– fishing line
– pliars	– plastic cement	– buttons
– screwdriver	– file	– dowels
– magnet	– funnel	– peg board
– rule	– electric tape	– thread
– drill set	– tacks	– tin foil
– brackets	– paint brush	– shears
– wrench	– die	
– plane	– vice grip	
– clamp	– wire	
– screws	– plastic tubing	
– nails	– needles	
– hammer	– cardboard	
– bolts	– scrap lumber	
– string	– batteries	
– clothesline		

CHECK ONE OR MORE AND RETURN, PLEASE!

My name is ___________

WHERE TO FIND IT:

For these items...

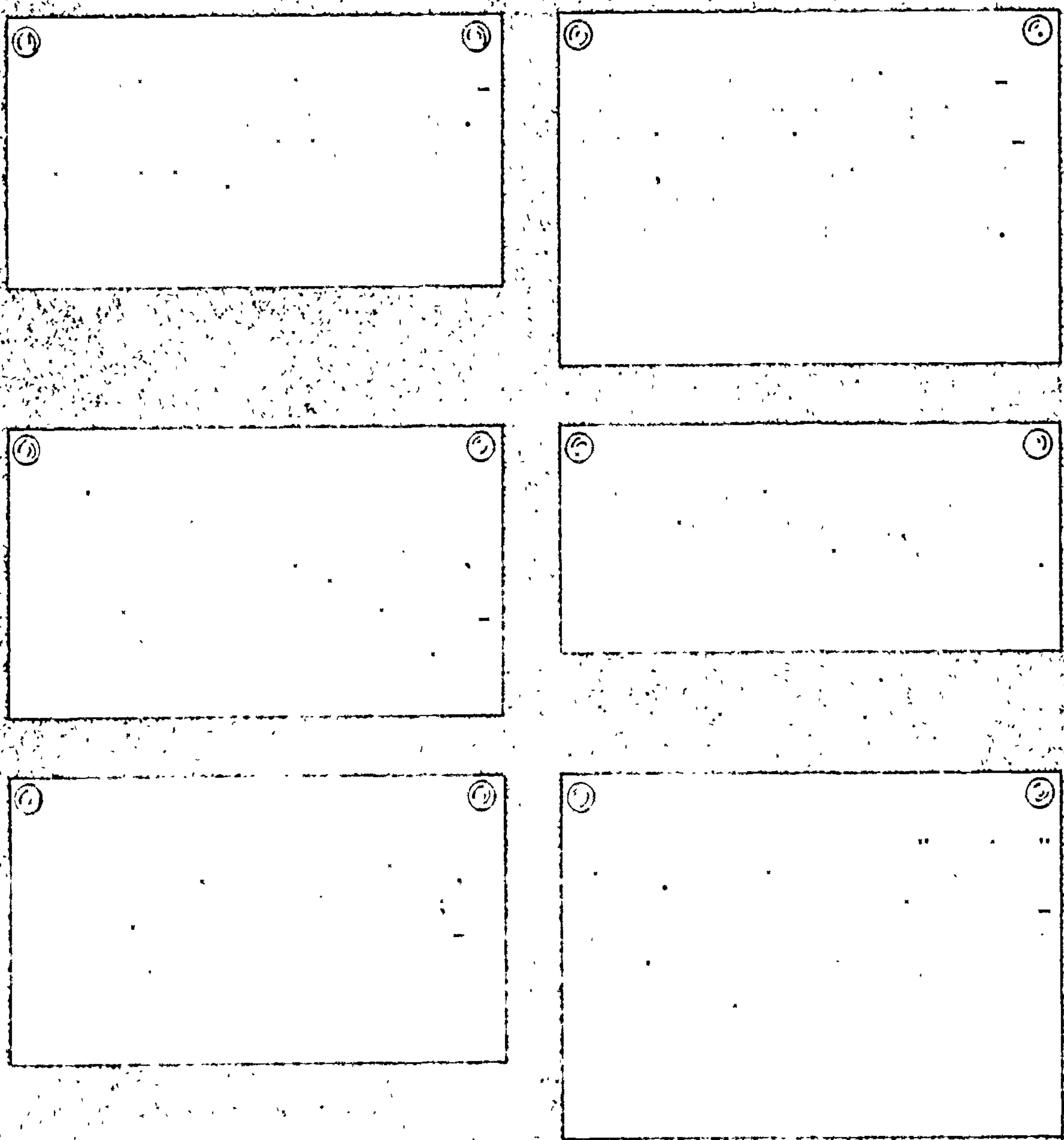
Glass	BOTTLES, JARS, SHEETS, MIRRORS
Plastic	SCRAPS, TUBING, CUPS
Wood	FINISHED LUMBER, DOWELS, PLYWOOD, PLANKS
Stone	CONCRETE, STONE, SAND, CRUSHED STONE
Paper products	CARBON PAPER, OLD TYPEWRITER RIBBONS, SCRAP PAPER, CARDBOARD BOXES, SHEETS, TUBES, OLD POSTERS, DRAWING PAPER
Tile and insulation	RUBBER, CORK, INSULATION, LINOLEUM, CERAMICS, CAULKING, ACOUSTIC TILE
Fabric	STUFFING, COTTON, RUGS, CANVAS, FABRIC ADHESIVES, CLOTH, LEATHER SCRAPS
Painting Supplies	PAINT BRUSHES, SCRAPERS, PAINT, ROLLERS, DROP CLOTHS, STIRRERS
Metal	RODS, PIPES, BRASS, COPPER, STEEL, ALUMINUM, NAILS, SCREWS, BOLTS, SHEET METAL, TUBES, SPRINGS
Car parts	OIL GREASE, TIRES AND TUBES, SPEEDOMETERS, TIN WIRE, HEAT EXCHANGERS, FAN BELTS, RADIOS, WATER PUMPS, METAL FILLER, PAINTS, WINDSHIELD WIPER MOTORS, PULLEYS, POLISHING GRITS AND COMPOUND
Electrical items	RADIO TUBES, 6- AND 12-VOLT BATTERIES, TRANSFORMER COILS, LIGHT BULBS, FIXTURES, SOCKETS, SMALL MOTORS, OLD TV SETS, RADIOS, WIRE, ELECTRIC OUTLETS, RESISTORS, CAPACITORS

A GUIDE TO SCROUNGING
try these places:

STORM WINDOW CO. CONSTRUCTION CO. HOMES AUTO GLASS SHOPS FRAME SHOPS	Glass
PLASTIC CO. PLUMBERS, PLUMBING SUPPLY CO. GROCERY STORES	Plastic
MODEL MAKERS CONTRACTORS ROOFERS LUMBER YARDS CABINET MAKERS	Wood
QUARRIES STONE CRUSHING CO. CONCRETE CO NURSERIES, FLORISTS TOMBSTONE CO.	Stone
ADVERTISING AGENCIES MOVERS PRINTERS PAPER CO. STATIONERY STORES ARCHITECTURAL FIRMS OFFICES	Paper products
ROOFERS TILE DEALERS INSTALLERS CONSTRUCTION CO.	Tile and insulation
UPHOLSTERY DEALERS SHOE REPAIR SHOPS AWNING CO. SAIL MAKERS RUG DEALERS CAR TOP DEALERS CRAFT, LEATHER STORES	Fabric
LUMBER YARDS HARDWARE STORES WALLPAPER STORES HOUSE PAINTERS CONSTRUCTION CO.	Painting supplies
MACHINE SHOPS PLUMBING SUPPLY CO. JUNKYARDS CONSTRUCTION CO. PLUMBERS HARDWARE STORES APPLIANCE REPAIR SHOPS VENETIAN BLIND DEALERS	Metal
JUNKYARDS CAR REPAIR SHOPS CAR DEALERS AUTO BODY SHOPS ANTIQUE CAR CLUBS	Car parts
ELECTRIC MOTOR REPAIR SHOPS ELECTRIC CO. APPLIANCE REPAIR SHOPS CAR DEALERS SEWING MACHINE CO. RADIO AND TV REPAIR SHOPS ELECTRICAL CONTRACTORS VACUUM CLEANER REPAIR SHOPS	Electrical items

Tips on Scrounging from Businesses

Give local businesses a chance to pitch in. It's good for their image and great for your inventory. Lumber yards, hardware stores, rug dealers, nearly every shop will have something useful. Don't forget to say that donations will be used in a school. Here are some other things to keep in mind as well when tapping the resources of the commercial sector.



Too much of a good thing

Ironically, scrounging can be too successful. You may get more than you can store. At an early stage in your scrounging campaign, determine the amount of supplies you'll be able to keep in school. In particular, check out fire regulations concerning inflammable materials like cardboard, wood, and paint.

To avoid becoming oversupplied, remember that a steady influx of donations is better than a one-time bonanza. Let donors know that you'd like to count on their help periodically because some lab items get used up regularly.

If you do get more than your school can contain safely, look elsewhere for storage space. Parents may provide room in their homes or garages.

Purchasing

Once your scrounging campaign is underway, it's time to consider where and how you'll buy the supplies that no one donates. Of course, the longer you wait, the greater the chance that someone will give for free what you planned to pay for. But sitting on the funds all year while lab users cry out for more tools is clearly overdoing it. Best is to wait only until scrounging passes its peak and donations begin to slacken. By that time you'll have a grasp of what to purchase. Until then you can shop around, so when you're ready to buy you'll know where to go to stretch your budget.

Don't chisel on tool quality

Buying top quality tools is your best bet, even if it means buying less quantity. A good hammer or saw is an investment--less expensive in the long run than several cheap replacements. Well-made tools are also safer.

We recommend that most of the hand tools listed in the complete inventory be purchased from Sears; should one of their Craftsman hand tools ever break, you get a new one free.

Tips on Getting Supplies

Discounts

Delivery

Prices

School supplies

Power tools

Tri-Wall

Stop watches

WASTE NOT, WANT NOT

To prevent Tri-Wall expenses from getting out of hand, do what you can to promote efficiency. Otherwise you may discover, as did some unfortunate managers, that almost every new sheet displays a hole where someone has cut out a small section. The cutout renders the huge piece nearly useless as a tabletop or a partition. Let children know that your budget is not bottomless and that they're the victims of wastefulness. You may even want to enlist a group to campaign for wise use of materials. Similar precautions may help save large sheets of plywood or long two-by-fours.

Fundraising

If your Design Lab budget is depleted or simply never existed and if scrounging has left holes in your inventory, it's time to try your hand at fundraising. As with scrounging, you'll need assistance. Students working on a Design Lab Design challenge may elect to hold a sale or sponsor an event if they feel that lack of funds is a major lab problem. Parents too can get into the act. When they do, the results may be very lucrative, as was the case with the Thompson School in Arlington, Massachusetts.

LAB EXPERIENCES

CURRENCY EVENTS

A movie for kids and a dance for adults netted $350 for the Thompson School Design Lab. That profit went into a petty-cash fund to help pay for replacement tools and assorted consumables like paint and Tri-Wall.

Two USMES teachers, who were also lab managers, had enlisted a group of parents to help improve and maintain the Design Lab. The enthusiastic volunteers did most of the work on the fundraising events. In fact, for the dance, the teachers only had to act as intermediaries between the parents and the school. To keep things organized, parents and teachers communicated daily.

The dance, which had a 1950s theme, was held at a hall near the school. The parents handled the publicity, procured the hall, arranged for entertainment and food, and took care of countless other chores.

The movie was more of a joint venture. There were two film showings; one for grades K-3, one for 4-6. Both took place in the school auditorium, where a donation of thirty-five cents was asked. Publicizing the event, printing tickets, ordering films from the library, and arranging for police officers at the street crossing were just a few of the details that added up to a lot of work, which in the end paid off.

STAFFING AND TRAINING

8. Personnel matters:
OVERVIEW OF STAFFING AND TRAINING

9. Tooling up teachers:
DESIGN LAB ORIENTATION

10. Who's minding the lab?:
DESIGN LAB STAFFING

11. The making of a manager:
TRAINING

Section Three

8 Personnel matters:

OVERVIEW OF STAFFING AND TRAINING

Physical setup is only part of the Design Lab picture. People are the other part. For example, once you've set up a lab, how will you help USMES teachers make the most of it? How will non-USMES teachers learn about and use the lab? Who will run it? How should that person be trained? Where will money for staff come from? What if there's no money? Whether you're in charge of establishing one lab in a school or a dozen labs throughout a district, you'll gain from this chapter a perspective on these questions. Chapters 9, 10, and 11 will then help you arrive at answers that will work for you.

Once a lab is set up, several major tasks remain: informing teachers about it; assessing whether you need a quarter-time, half-time, or full-time manager; deciding upon and carrying out a plan for acquiring the staff; and training that staff. Planning, of course, is critical. You don't want a full-time manager who's busy only four hours a week, nor a part-time manager trying to handle a full-time load. Planning will also help you avoid the situation where a lab is isolated from, rather than part of, the school program, where the faculty and administration think of it as a private club for one or two teachers. Planning in matters of personnel pays off--more kids will get the chance to use the lab.

Familiarize teachers

The best thing that can happen to a lab is for teachers in a school to know it's there, understand how it can be used, and feel welcome to let their students use it. Conversely, one of the worst things is for most of the faculty to view the lab as the restricted domain of a few teachers. Spend the time and energy to plan one or more teacher orientation programs and make sure all the teachers in school know they are invited. By opening the lab to the school in this way you'll prevent the friction that results when people think of the lab as an exclusive club. You'll also help spread USMES and you'll be bringing to the school something often lacking in elementary education--industrial arts. Moreover, the more teachers that are involved in the lab program, the easier it will be to get funding, staffing, and scrounging assistance. Chapter 9 will not only give you more reasons for running an orientation program, it will give you ideas on how to do it.

Assess need for staff

How often will the lab be used? If 75-100% of the time, you'll need a full-time Design Lab manager. If less, a part-time manager will suffice; that person's hours, of course, will be determined by your estimate of lab use. Unfortunately, it's impossible to offer much help on how to make such estimates. Non-USMES use of a lab varies tremendously from school to school and from year to year. Even USMES use fluctuates from unit to unit and from class to class. However, you can talk to teachers and get some ideas of their plans. An educated guess is better than proceeding blindly.

Choose and implement staffing strategy

Dozens of cost-free methods of staffing have been tried in labs across the country. High school and college work/study students, parent volunteers, a group of teachers sharing the managerial tasks; these are just a few of the options discussed in Chapter 10. You'll also find tips on getting funds for a manager's salary from your school or district, from state and federal agencies, and from foundations. Of course, if you're one of the fortunate few who already has money available for hiring, you won't have to spend much time figuring out a staffing strategy.

Whatever method of staffing you select, involve teachers. Ask them what qualifications they think the manager should have. You might even have the teachers make the final selection after they have talked with several candidates. Many of the no-cost staffing methods covered in Chapter 10 require input from teachers, administrators, and other school staff. The more you involve the rest of the school with the staffing issue, the easier it will be for the person or persons chosen to feel that the lab is an integral part of the school program.

Train staff

Whether your lab staff is a teacher aide, a high-school student, an USMES teacher, or a combination of school personnel, you'll want to give him, her, or them the knowledge and skills needed to run a successful lab. The same is true if you're training a dozen full-time managers at a regional workshop. Chapter 11 is all about training. It explains the manager's role, describes the necessary components of a training program, and suggests ways to carry out such a program.

9 Tooling up teachers:

DESIGN LAB ORIENTATION

For a school to get the most from its Design Lab, teachers need to know about the lab. USMES teachers need to know how the lab fits into real problem solving, so class work and lab work can reinforce one another. They need to know what kinds of activities children can do in the lab and how the manager can help. Non-USMES teachers, too, should know about the lab; it may be just what's needed for projects they or their students have in mind. They ought to know, however, that, once in the lab, their students will not be directed, only helped when needed. Most of all, teachers need to feel secure about their students handling saber saws, hot glue guns, utility knives, and the like. Young builders should have the support of their teachers.

Giving teachers what they need to make the most of the Design Lab is what lab orientation is all about. For teachers who have had USMES training you may only need to reinforce and expand upon the ideas and experience they already have. For non-USMES teachers, you'll probably need to explain USMES and the Design Lab concept and allay whatever apprehensions the teachers may have about students using sharp-edged and power tools.

Components of an orientation program

A Design Lab orientation should be more than a lecture, more than a quick tour of the lab, more than a set of written materials. These all play a part, but in fact there are six components that make up a successful orientation. Read through the descriptions of the components, and, if at all possible within your time and budget constraints, include each one in your orientation program.

Introductory component

Set aside some time at the beginning of your orientation program to give teachers an overview of the Design Lab concept: what a lab is, what it isn't, how it fits into the USMES program--basically, the points covered in the first chapter of this manual. To present this material you can use the Design Lab slide/tape show followed by a short question-and-answer period. If any of the teachers know little or nothing about USMES, you'll want to precede the lab overview with a brief description of the USMES program. You can also use the introductory time to explain what you expect the teachers to get out of the Design Lab orientation.

Skill session

Teachers will need to know what tools are in the lab and how to use them safely and effectively. Demonstrations are a good start toward giving them this knowledge. There are at least two efficient ways of organizing skill sessions: the stations approach and the lecture approach.

To use the stations approach, set up several tables or workbenches, each with a collection of related tools. Have someone at each station who can explain and demonstrate the tools there. Clearly, the number of stations is limited to the number of staff members. Which stations contain which tools is determined by how you wish to categorize; you might have power tools in one station, hand tools in another, hammers and screwdrivers in a third, and so on. Or you might simply arrange the tools to suit the talents of the instructors. Teachers circulate in groups from one station to another: watching demonstrations, listening to explanations, asking questions, and, when time allows, practicing some techniques.

If only one instructor is available or if you're concerned about organizational problems with the stations approach, then the lecture approach--a skill session directed to the whole group--may be best. Demonstrations, explanations, and questions still take place, but the chance for the teachers to practice is lost. However, the length of the session can be more easily controlled, and you can be sure that everyone sees and hears the same things. The lecture/demonstration need not be given solely by one person; if you have two or more staff people with different specialties, by all means have them share the lectern.

Hands-on work

Even with new knowledge gained from the skill sessions, teachers may not feel truly comfortable about letting their students work with sharp-edged or power tools. Hands-on experience is the best way to allay their fears. Hands-on work should be channeled toward useful ends. If you know, for example, that the faculty room in the school lacks furnishings, you might suggest that some of the teachers design and build a table. Another group might construct a bookcase or a set of shelves. If you can't make specific suggestions, make this general one: "Design and build something that will be useful in your classroom or school." Ask teachers to choose a project that requires the use of many tools: hands-on experience should be well rounded, not limited to just hammering nails. Also explain what materials are in the lab: a fish tank will not be a practical project if only Tri-Wall and plywood are available.

While the participants are hammering away, the workshop instructors should circulate among them and help out when needed--perhaps giving a short skill session or simply asking questions to help a perplexed builder get to the root of a problem. By questioning rather than telling, by guiding rather than directing, and by allowing learning through mistakes, the instructor models how an adult helps students in the Design Lab.

In summary, the hands-on component is a three-in-one experience for the teachers:

- By working with tools, teachers realize that with a little practice even the power tools and sharp instruments that once seemed forbidding are safe and easy to handle.
- By building something useful teachers get a feel for what the Design Lab is all about.
- By receiving help from an instructor, the teacher sees how a Design Lab manager aids students without directing them.

Children at work

To further allay any fears that teachers have about children working with tools, invite some students to the training session. Have them work in the lab alongside the teachers during the hands-on component. Children from classes that have already used the lab won't require any pre-training. They can continue on whatever projects they have underway or they can work on something new. If you can't get children with lab experience, then bring in non-experienced students, but give them short skill sessions before or, if you have sufficient staff, during the orientation program. However you arrange it, the effort will be worthwhile; teachers will see that young children can indeed use power tools and hand tools safely and competently. As an added benefit, teachers may get to see a workshop instructor helping children--a good demonstration of the manager-student interactions in the lab.

Discussion

Toward the end of the orientation, leave time for two discussions involving all the participants. One of these should center on the hands-on experience: each group presenting its project and describing the tools and construction methods used. During these presentations, solicit questions from the listeners. This "show and tell" gives teachers a chance to see and hear about tools and techniques that they didn't get a chance to use. It also gives them a chance to share how they felt during their entry into the world of tools. In addition, to turn some of the discussion toward student-adult interactions in the lab, instructors can ask questions like "How did the way I helped you illustrate how you might work with children?"

The second discussion should focus on Design Lab issues like scheduling, safety, and scrounging. Find out how teachers will be involved with the labs in their schools. This is a time when teachers can air specific concerns and get suggestions from the training staff and from other participants. This is a time for questions like "My students want to build glass homes for their gerbils; where can we scrounge the material?" or "We don't have a lab manager; what do I do if only five children need to use the Design Lab?"

SUGGESTED RESOURCES

Because you can't cover everything in an orientation program, it's useful to have resource materials to provide extra information. Except for the videotapes, the USMES resources listed below are necessary. If time allows and interest warrants, teachers can view one or two videotapes or discuss some of the written materials. You might simply hand out a list of what's available and let teachers browse as they wish.

USMES RESOURCES

- Design Lab Slide/Tape Show
- Design Lab "How To" Cards
- Design Lab Manual
- Design Lab Brochure
- USMES Videotape--How to Use Design Lab Tools
- USMES Videotape--Scrounging: The Best Things in Life Are Free

NON-USMES RESOURCES

- Further Adventures of Cardboard Carpentry (Workshop For Learning Things)
- Our Catalog (Workshop for Learning Things)
- Complete Do-It-Yourself Manual (Reader's Digest)
- Other catalogs and how-to books (see Bibliography, Appendix A)

Orientation program

Components are only parts; they need to be organized into a whole program. How you do that will depend on your facilities, the availability of participating teachers, and your own sense of logical sequencing. Various orientation formats have worked well; here is a rundown of four of them.

Design-Lab workshop

For in-service training, your best bet is a workshop held in a Design Lab and devoted solely to lab orientation. About five hours, which can be split into two or three sessions, can include enough of each orientation component. If your school or district has planning or professional days where students are in school for only half the day, the other half can be used for the Design Lab workshop. If not, you can try to get five hours of release time for each teacher or hold the workshop after school hours.

The Hardy School in Arlington, Massachusetts, used planning days (two half-days for primary teachers and two half-days for intermediate teachers) for Design Lab orientation sessions. Those who ran the workshop reported success, particularly concerning teacher attitudes toward the lab. Most of the teachers were skeptical at first about young children using tools. After the workshop, these teachers supported the lab concept enthusiastically.

There are two requirements for running an effective workshop: make plans carefully and follow through on those plans. Items to be considered include--

1. writing an agenda
2. getting materials (tools, construction supplies, audiovisual equipment, printed materials, etc.)
3. arranging for facilities
4. inviting participants
5. arranging for children to come to the workshop
6. arranging for staff
7. preparing the Design Lab

For guidance on handling these tasks, consult <u>Preparing People for USMES, An Implementation Resource Book</u>. Also read Chapter 11 in this manual, which contains more details on setting up and running a workshop.

Whatever agenda you prepare, try to include all of the components mentioned earlier. How you sequence the components depends on what you feel comfortable with and what you feel is the best way to meet the objectives of the workshop for the particular teachers you're dealing with. You might use the following sample agenda as a starting point or use it as it is. The agenda is for three 90-minute sessions or one 4½-hour session.

SAMPLE AGENDA

Session	Time	Activity	Description
FIRST SESSION	1 HOUR	INTRODUCTION	Brief overview of agenda. Design Lab slide/tape show. ass out Design Lab brochure. uestion-and-answer session.
	½ HOUR	HANDS-ON	Participants begin work designing and building something useful (for classroom, for Design Lab).
SECOND SESSION	1HOUR	SKILL SESSION	General introduction to all tools in lab. Demonstration of some processes, e.g., drilling pilot holes, making corners.
	½ HOUR	HANDS-ON	Participants continue work on constructions.
THIRD SESSION	½ HOUR	HANDS-ON	Participants finish constructions.
	½ HOUR	DISCUSSION	"Show and tell" about hands-on experience, including what participants did, what skills were used, and how staff interacted.
	½ HOUR	DISCUSSION	Concerns about scheduling, scrounging, staffing, and other lab issues relating specifically to labs in participants' schools.

LAB EXPERIENCES

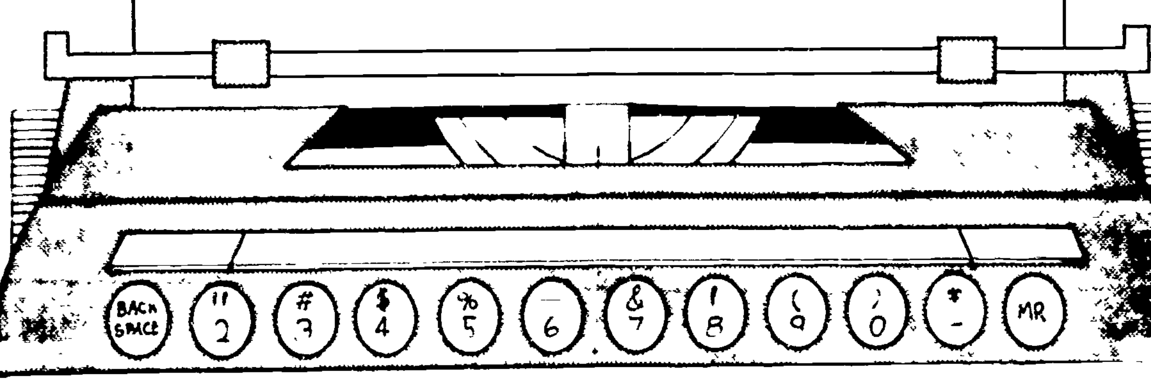
A Design Lab workshop for teachers in three schools in St. Paul, Minnesota, offers another example of a viable agenda. About 30 teachers attended the three two-hour sessions at the Parkway School and received in-service credit for their participation. Those who ran the workshop submitted a report containing the outline below.

[illegible]

A. Discussion of materials
   1. Budget and problems in ordering
   2. Materials that are available and places to obtain them in St. Paul, how to scrounge
   3. Possible uses and sources of Tri-Wall
B. Safety procedures
   1. How to present the concept of Design Lab safety to children
   2. Precautions, things to be aware of when children are using various tools
   3. Safe use of each tool
C. Possible uses of Design Lab for non-USMES teachers
   1. Design Lab is for everyone to use
   2. Cardboard Carpentry
   3. Play props
   4. Room design (could lead into Classroom Design unit)

[illegible]

A. Lecture
   1. Introduction of tools available in portable Design Lab
   2. Each tool was named and its use described
B. Station approach
   1. Station One: Vise, electric drill, and drill bits
   2. Station Two: Chisel, [illegible], rasps, files, plane, sanding block
   3. Station Three: Measuring devices (square, tape with metric conversion), nail sizes and what determines them
   4. Station Four: Saws, squares, C-clamps, and sanding block



SECOND SESSION (11/12/74)

I. Skill Session: Station approach

A. Station One: Glass cutting
   1. Flat surface
   2. Tubing
   3. Safety--wear gloves

B. Station Two: Sawing and cutting
   1. Sawing steel using hacksaw and vise
   2. Cutting tin sheet using sheet-metal cutter (tin snips)
   3. Safety--wear goggles

C. Station Three: Soldering copper wire
   1. Need for a separate area for soldering
   2. Safety precautions

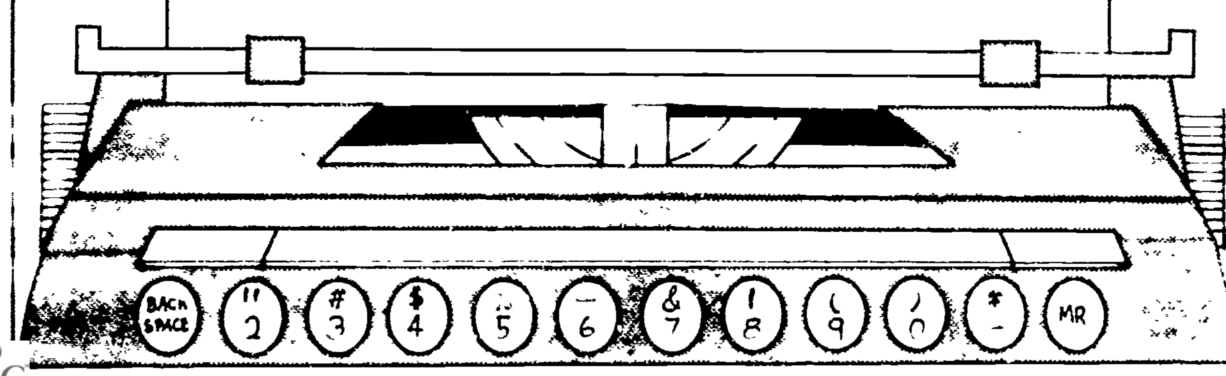
D. Station Four: Fasteners
   1. Nails: sizes and types of nails, driving and pulling, use of drill for nails, use of nailset
   2. Screws: how to identify, different sizes and types, washers, bolts, size of screwdriver appropriate for a task
   3. Drills: using drill when fastening two boards
   4. Brads
   5. Duct tape: expensive, but an excellent adhesive

II. [illegible]

To give everyone an opportunity to use the Design Lab tools, participants were asked to design and construct something that would be useful in their classrooms. Individual help from workshop staff was available for those teachers who needed it. Either singly or in groups, participants worked on projects ranging from desk-top files to a "book pool," a place where children could go to fish out their favorite books.

THIRD SESSION (11/19/74)

This entire session was spent working on the challenge. Participants eagerly used tools and materials, and by the end of the session, most projects had been completed.



Teacher/class orientation

If a workshop is not possible because of scheduling or other problems, you can bring teachers to the lab while they are with their classes. A half-hour session would allow a tour of the facilities and an overview of the Design Lab concept. Teachers and students could see what tools and materials are available, find out when the lab is open, and learn what it can be used for. A little more time would permit a skill session and perhaps some hands-on work. An interested teacher could come back during a lunch hour or after school for further tool-using practice.

At the Dearborn School in Boston, Massachusetts, the Design Lab manager invited every teacher in the school to make an appointment to bring his or her class to the lab for a one-hour orientation. The two USMES and five non-USMES classes that took advantage of the offer observed a skill session on power tools, learned the rules of the lab, and had the chance to practice sawing, drilling, and glueing. The manager, taking these opportunities to recruit scrounging help, gave examples of what tools and materials were needed to fill out the inventory.

Lab orientation at an USMES workshop

In workshops where teachers learn to use USMES, a Design Lab component is usually included to some extent. That extent, however, is often too small. If you rely on an USMES workshop to take care of lab orientation, then plan to incorporate all the components mentioned earlier in this chapter. The following suggestions will help you fit all the necessary parts of Design Lab training into a typical USMES workshop, one where participants work in unit groups on different adult challenges.

Introduction: Toward the beginning of the workshop, each unit leader brings his or her group to the lab for a 15- to 30-minute session that is similar to the introductory component at a Design Lab workshop. You may be able to handle two or three groups together.

Skill Session: You can bring in one unit group at a time or, depending on the size of groups, the number of staff, and the size of the lab, you might work with two or three groups together. Let each unit group decide when it wants to schedule its skill session. Ideally that should be after members of the group have worked in the lab and have lost any apprehension about using tools. Make sure each unit leader brings his or her group to the lab for a skill session sometime during the workshop.

Hands-On Experience: As they tackle adult challenges, most workshop participants will need to use the Design Lab, in the same way that USMES students need the lab during their work on USMES challenges. Hands-on activity in the context of a challenge is doubly valuable: teachers not only practice building, but they experience how the lab fits into real problem solving.

Children at Work: If children take part in the USMES workshop, they will likely use the lab while working on the challenge given to them by their unit group. When teachers accompany the children to the lab, they can watch the Design Lab staff model the adult's role in the lab. After observing how staff members interact with children, teachers can try helping the students work with tools.

Discussion: Competition for spots on the workshop agenda usually doesn't permit a scheduled discussion of Design Lab issues. Some topics, like safety, can be talked about during the introductory lab session and during the skill session. Teachers who have pressing concerns about scrounging or scheduling might open a discussion in their unit groups or talk to members of the Design Lab staff.

Generally you'll want to have one Design Lab staff member for every 25-30 workshop participants and a lab large enough to accommodate about one-third of the teachers at one time. If the workshop is held where there is no lab, you'll have to set up one. Do this as you would a lab in a school (see Chapters 5, 6, and 7) but keep in mind two additional pointers. First, order supplies sufficiently in advance to have them all delivered at least three days before the workshop begins. Second, because you can't predict what unit groups will need, arrange to have available someone with a car, perhaps a high school student, who can go out for supplies at a moment's notice.

College courses

If enough USMES teachers in one area want intensive experience with tools, you might arrange to have a Design Lab course offered at a nearby college or university. You could collaborate, for example, with an industrial arts division of the school's education department.

Design Lab training might also be given as part of a preservice course on USMES. A student taking the course could visit a Design Lab in the area and, as a course requirement, spend a specified time staffing a lab.

SPREADING THE WORD

You might spur interest in your program by inviting teachers for early-morning coffee and donuts in the Design Lab a week or two before the orientation session. At this informal breakfast, teachers can get a brief introduction to the lab, and those who want further details can sign up for the full program.

10 Who's minding the lab?:

DESIGN LAB STAFFING

Design Labs don't run by themselves. Someone must keep track of the inventory, buy or scrounge supplies when needed, make the schedules, supervise and assist children who use the lab, and handle whatever lab problems come up. This someone can be one person or several people, paid or unpaid, part-time or full-time, new personnel or part of the regular school staff.

If you have the funds to hire a full-time Design Lab manager, fine. Your staffing problems will be over and you can read about training in the next chapter. If, like most people coordinating a Design Lab program, you don't have money for staffing, you'll want to know more about the two options covered in this chapter: no-cost staffing and fund-seeking.

No-cost staffing

Staffing a lab without money is not easy. But many have done it. They have spent time and energy instead of dollars. Their methods have included using high school students from work/study programs, recruiting parent volunteers, working with education departments of nearby colleges, and arranging for faculty and staff members to share the lab duties.

Of course, each district is different, each school is different. The ideas, examples, and tips that follow will help you develop the method of staffing that fits your situation.

High school students

Many localities have high school work/study programs in which students receive course credit in place of payment for their services. Check this out if you're seeking unpaid help in the lab. Schools in three Massachusetts towns--Arlington, Lexington, and Watertown--used high school students as Design Lab managers. Although such managers usually can work only a few hours a week, several students taking different shifts could jointly cover a large block of time.

College students

Many schools have used students from nearby colleges or universities to run their Design Labs. The young men and women performed these functions to fulfill college course requirements. For example, Lesley College in Massachusetts and San Jose State College in California offered courses in USMES that required students to spend some time staffing a Design Lab. Education courses in math, science, or industrial arts also lend themselves to having a Design Lab requirement, perhaps as part of a student-teaching assignment.

If you decide to solve your staffing problem by working with the education department of a nearby college, here are a couple of things to keep in mind. First, semester breaks and final exams may take away your student managers at inopportune times during the year. Find out ahead of time if and when you'll be short-handed, so you can arrange for substitutes or at least warn users of the lab that it may not be open much during certain weeks. Second, someone will have to train students who are managing a lab for the first time. You'll probably have a new crew each semester, so figure on two training programs each year.

Colleges with work/study programs may agree to a cost-sharing arrangement with schools in need of Design Lab staff. The college would pay part, perhaps the bulk, of the students' salaries and the school would pick up the rest of the tab. If you staff your lab in this way, be sure to set up well-defined channels of communication among the three parties involved; the college, the students, and your school. Also, plan ahead for semester breaks and final-exam periods.

Parent volunteers

With a thoughtful recruitment strategy and solid training, it's possible to keep a Design Lab staffed by competent parents eight hours a day, five days a week. Should you go this route, a few pointers may help you avoid the pitfalls that some have learned the hard way.

Make sure parents know what's in store. That way you'll cut down on the number of volunteers who become disenchanted with the routine of coming in once or twice a week for an entire school year. The less dropouts you have, the less you'll have to search frantically for replacements and the less new training you'll have to provide.

Watch out for overenthusiasm. Parents naturally have a strong stake in education, but unless your volunteers understand what USMES is all about, their energies can become misdirected. Managers need to know how to let kids in the lab make mistakes and learn from those mistakes. Managers need to know how the school is organized so that supply requests and inquiries go through proper channels. Regularly held meetings with parents, teachers, and administrators should foster a cooperative and constructive spirit.

Provide the training and set the guidelines that will enable all volunteers to be competent and confident managers. The helpful parents need to feel comfortable with tools; they need to appreciate the value of learning by doing; and they need to know how they fit into the personnel structure within the school.

All this post-recruitment advice doesn't tell you how to get parents interested in the first place. That's up to you. Advertising in the town paper, asking students to bring a note or newsletter to their parents, and making a presentation during open-house session at school are just a few possible ways to let parents know about staffing needs. Two schools in Massachusetts got their best results with open meetings. The Hosmer School in Watertown arranged for one PTA night to be devoted to USMES; as a result seven parents volunteered to share the supervisory duties in the lab. The Thompson School in Arlington made its appeal for lab assistance at an orientation meeting for parents of new kindergarteners. Twenty members of the audience expressed interest in contributing some time. Fourteen of those attended a training session, and nine of those signed up to begin work the following week.

School personnel

Shifting the schedules and duties of school personnel may not be a simple task, but sometimes it's a feasible way to staff a lab without scrounging funds. Subject specialists, aides, and, to a limited extent, teachers and administrators are candidates for managerial positions.

Subject specialists

When a specialist in math, science, industrial arts, or some other curriculum area has his or her own room, you may be able to kill two birds with one stone. You might house the Design Lab in the specialist's room and ask him or her to act as lab manager. That arrangement worked well in the Stratton School in Arlington, Massachusetts. The Design Lab was incorporated into the math/science learning center and the science specialist in charge of that room agreed to manage the lab. Teachers were able to send small groups of children on short notice to the lab. Student teachers assigned to the learning center lightened the manager's load. On the rare occasions when the lab became overcrowded, the manager simply asked some students to return at a later time.

In a similar way, the Ray School in Chicago solved its staffing problem by setting up the Design Lab in a multidisciplinary learning center supervised by a resource teacher. He had enough time to handle the additional responsibilities of helping kids work with tools.

Paraprofessionals

If your school has teacher aides, whatever time they can spare will be invaluable to your cause. While a teacher accompanies a small group of kids to the Design Lab, a paraprofessional can take care of the children who stay behind. The Winthrop School in Boston has found this method practical because there are a lot of parents who assist teachers.

Classroom teachers and administrators

Although you're not likely to find one teacher, principal, or assistant principal who has time to run the lab singlehandedly, you may find a few who will contribute to the effort. Then you can form a managerial group to share the lab duties. Even if you uncover just one volunteer who can staff the lab for only a few hours each week, your efforts will have been fruitful. At least there will be some times when a teacher can remain in the classroom with most of the class while a few students go unaccompanied to the Design Lab.

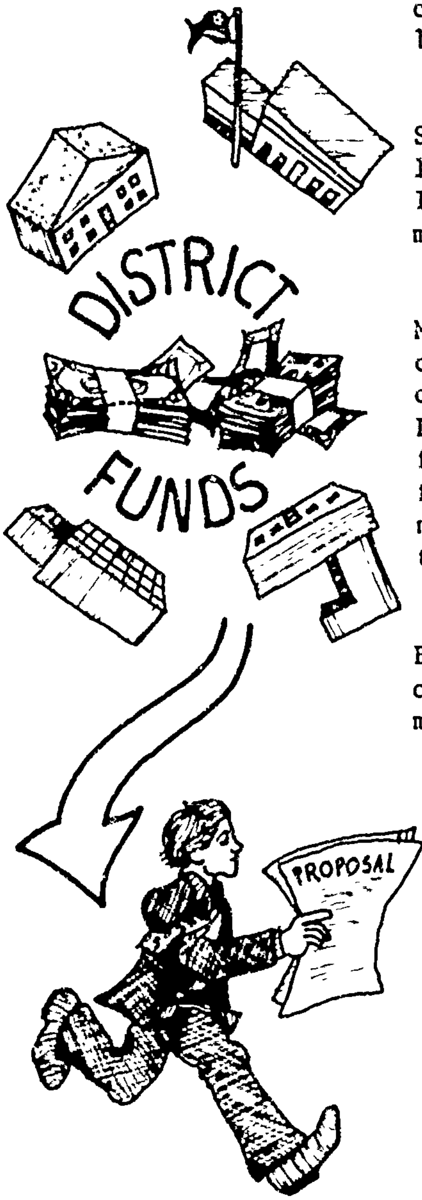
The principal of the Hardy School in Arlington, Massachusetts, handled the scheduling for the lab and worked in it part-time. At the Revere School in Chicago an USMES teacher agreed to have the lab in his room. During his free periods, when his class went elsewhere, he stayed in the room to supervise children from other classes who came to use the lab.

Finding the funding

For some people in some schools, getting money for Design Lab salaries may be easier than arranging for no-cost staffing. If you think this is true for you, then by all means give fund-seeking a try. Any experience you have in locating funding sources or writing proposals will help, as will the following suggestions gleaned from the experience of others.

Local sources

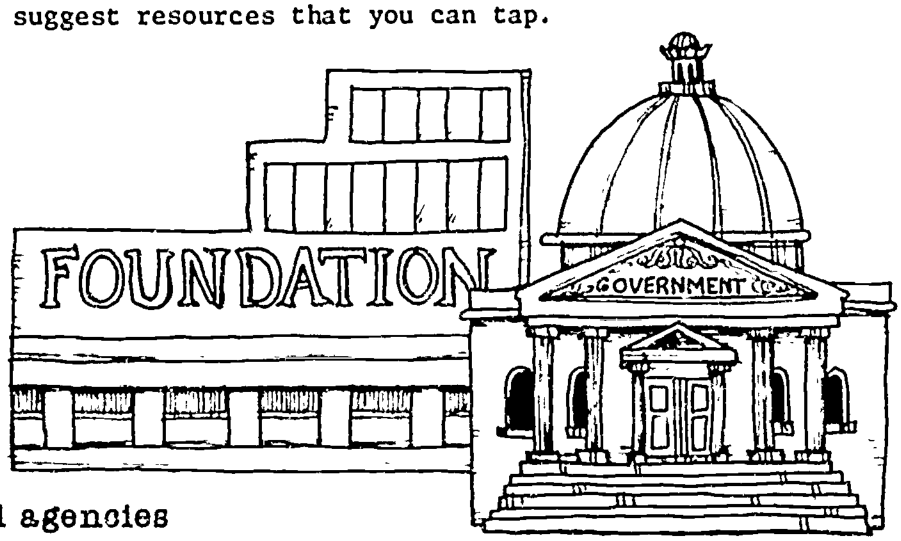
Start small and work your way up. Before you tackle foundations or state and federal agencies, look toward your district or community. Find out what district funds are available and which of these might be appropriate for Design Lab staffing. For helpful information, check with local funding officers, curriculum coordinators, or coordinators of special areas like career education and industrial arts.



There may even be money set aside for special programs. Such was the case in Silver Springs, Maryland, where the Weller Road Elementary School received funds from the district's Innovative Projects Committee to hire a full-time Design Lab manager.

Perhaps your schools are similar to those in Lansing, Michigan, where teachers can vote on how certain money allocated to their school will be spent. Thanks to this procedure, some funds were set aside to pay part-time Design Lab managers. Even if your district doesn't have the same fiscal policy as Lansing, you might muster enough support from the faculty to get financing for lab staff. Keep in mind that non-USMES teachers can also back you because they too are potential lab users.

If nothing turns up in your district, try the community. Business-oriented organizations like the Chamber of Commerce or local chapters of service clubs like the Rotary or Kiwanis may suggest resources that you can tap.



Foundations and agencies

If you've exhausted the local possibilities and still are empty handed, move on to foundations and government agencies. Because the number of such organizations is overwhelming, you'll want to streamline your efforts.

People who have sought funds for USMES have found it best to get an idea of the different funding categories into which a proposal may fit. For example, your State Education Department may be currently emphasizing metric education. In that case your proposal can stress how often children in USMES classes measure and calculate in the metric system. If the department's emphasis is career education, you can point out how USMES students frequently get information directly from engineers, firemen, government officials, and people in many other occupations. Also on the list of possible funding categories are environmental education, consumer education, vocational education, economic education, programs for the handicapped, education for the gifted and talented, and special programs and projects under the Emergency School Aid Act.

Once you know what types of funds you'll qualify for, you then need to know what's available. Books and people can help you focus your search. Get hold of a foundation directory. The reference section of a good public library should have books that not only list the names and addresses of grant givers but also tell what types of programs each institution will consider funding.

If someone in your district is in charge of grants, talk to that person. Or talk to someone in the superintendent's office who is familiar with the current emphasis in government funding and who may have contacts in the State Education Department. Even if you have to do it yourself, you can still get the information you need by writing to the Education Department in your state or to a federal agency like the National Institute of Education, Office of Education, and National Science Foundation. Such agencies usually give some priority to the needs of individual schools and districts. Several USMES-related grants have been received through the Office of Education's Elementary and Secondary Education Act, Titles III and IV.

When you get down to the actual writing of a proposal, you may want to consult a book on the subject if you've had little related experience. Better still, enlist the aid of an experienced proposal writer in your district.

To increase your chances of success, tailor your proposal to a specific funding category as described earlier. Another way to up the odds is to seek staffing funds that will cover a limited period of time. You might request salary for five Design Lab managers for three years. Be sure to say in your proposal how you plan to continue the funding after the agency or foundation grant runs out. You might outline the anticipated progress of USMES in your district, and explain that you expect staffing to be included in the district budget. (In fact, getting the district to pick up the tab will be easier once USMES is established and you already have Design Lab personnel who are salaried.) Staffing funds may also be sought as part of a larger proposal that might also include money for workshops and Design Lab supplies.

Most funders will send guidelines for submission of proposals. In one way or another they'll ask you to describe: (1) why your proposed program is needed, (2) what you expect to accomplish, (3) what you will do to accomplish your goals, (4) how you will assess whether you've met your goals, and (5) how much your program will cost. A sound proposal contains straightforward explanations of those five items. Detailed research and scholarly approaches are not usually necessary and often confuse rather than clarify your request.

10 The making of a manager:

TRAINING

A Design Lab manager who does a good job has a lot to do and a lot to know. Maintaining the inventory involves keeping records, arranging for repairs, ordering and organizing supplies, preventing theft and other forms of loss, and running scrounging campaigns. Scheduling involves knowing in advance about how many children from how many classes will be using the lab and how frequently they will need to use it. Aside from managerial know-how, a manager must understand USMES and how the Design Lab fits into the program. He or she must help children without directing them and yet ensure high standards of safety. A manager must interact with teachers, administrators, and other school staff because the manager is responsible for the Design Lab--an integral part of the total school program.

Giving someone the knowledge and skills needed to set up and run a Design Lab is the goal of manager training. Whether you're training a group of ten would-be managers at a regional workshop, three or four at a district training program, or just one manager for your own school, you'll need to plan carefully to accomplish that goal.

To help you plan, this chapter describes the necessary components of a training program, suggests possible agendas, and presents a report from a typical workshop.

Components of manager training

The components are described in the context of a workshop involving more than one trainee, but they apply equally well to the training of a single manager. Discussions and presentations will of course be more informal if only two people are involved.

Three components of manager training are identical or very similar to components of teacher orientation, described in Chapter 9. For a full description of these--Hands-On Work, Skill Session, Introduction to Design Lab Concept--see that chapter.

COMPONENTS OF LAB MANAGER TRAINING

2-DAY WORKSHOP	APPROXIMATE PERCENTAGE OF TIME	4-DAY WORKSHOP
5%	Introduction to USMES	5%
5%	Introduction to Design Lab Concept	5%
15%	Skill Session	10%
45%	Hands-on Work with Tools	25%
5%	Presentation of Written Resources	5%
3%	Discussion of Lab Management Issues	4%
5%	Setting Up a Design Lab	20%
10%	Working with Children	12%
2%	Classroom-Lab Correlation	2%
--	Scrounging (activity)	12%
--	Follow Up	--

Introduction to USMES

The USMES slide/tape show is a quick and sure way to get across what real problem solving is all about. Manager trainees will get a feel for the types of real problems kids work on and how they solve them. To supplement the show, hand out copies of the USMES brochure. For more detail, refer the participants to The USMES Guide, which you might even have them look through prior to this opening session. As another pre-workshop assignment, ask each trainee to sit in on a few USMES classes in the school in which he or she will work. This first-hand experience will impart the "flavor" of USMES and put much of the training program in context. If participants can't visit classes before the workshop, have them do it afterward.

Presentation of written resources

Explain how the following printed materials will help them do a better job: Design Lab Manual, Design Lab "How To" Cards, and books about building such as Reader's Digest Complete Do-It-Yourself Manual and The Further Adventures of Cardboard Carpentry from the Workshop for Learning Things. Make the resources available so trainees can look through them when they finish.

Setting up a lab

In a two-day program, you'll have to treat this as a discussion. Basically, you'll want to cover what's in Chapter 6 of this manual. Emphasize those topics that apply to your trainees; there's no need to go on and on about portable labs if the participants will all be managing Design Lab rooms.

If you're fortunate enough to be running a four-day program, you can afford to have trainees actually set up a lab and then discuss their experiences. Or, if you want participants to practice making inventory decisions, you can allocate hypothetical dollars with which the trainees must buy tools and materials from you. One group might be given $300 to set up a portable lab, and another group, $700 for a Design Lab room. After the activity participants should explain and justify their choices. When appropriate, you can ask questions like "Why didn't you buy any power tools?"

Working with children

Most of a manager's time is spent with children in the lab: helping students without directing them, teaching with questions more than lectures, and allowing mistakes from which children can learn. While abiding by this philosophy of hands-on for kids, hands-off for adults, managers must keep the lab safe.

To learn all this, participants should work with children as part of the training program. Invite some students, preferably from USMES classes, and let them continue their work on any projects they have underway or offer suggestions of things they might design and build for their classroom. The workshop instructors can demonstrate the appropriate style of helping children work with tools. Then the participants can try, while the instructors give on-the-spot feedback. Follow up with a discussion in which participants share their experiences. In a short time, trainees will have developed the confidence and competence to know when to leave a young builder alone and when and how to step in and help.

Scrounging

A four-day workshop allows time for more than just talking about scrounging. Have participants spend a morning or afternoon going to local businesses to solicit materials that will be useful in the labs they will be managing. Besides boosting their confidence and giving them valuable experience, this activity gives managers a head start in stocking their labs. At a workshop in Atlanta, for example, participants scrounged tools, lumber, hardware items like nuts and bolts, and assorted materials like plastic sheets and samples of rugs, cloth, and wallpaper.

In a two-day workshop you'll have to forgo the hands-on approach to scrounging. Instead, discuss the topic in detail during the component on lab-management issues. You might also show the USMES videotape "Scrounging: The Best Things in Life Are Free," which captures the "show and tell" of workshop participants after they had returned from a half-day scrounging spree chock full of supplies and useful tips.

Classroom-lab correlation

The success of a manager can hinge on whether the classroom and the lab mesh or clash. When the administration and faculty consider the manager an integral part of the school's USMES program, lab work and class work will likely reinforce one another. Channels of communication will be open; possible conflicts will be avoided. The manager can help generate respect by attending all USMES meetings and all school-staff meetings, and by visiting USMES classes.

In contrast, when the manager is isolated from the rest of the school program (or feels that way), teachers will think the lab program is irrelevant to what goes on in the classroom.

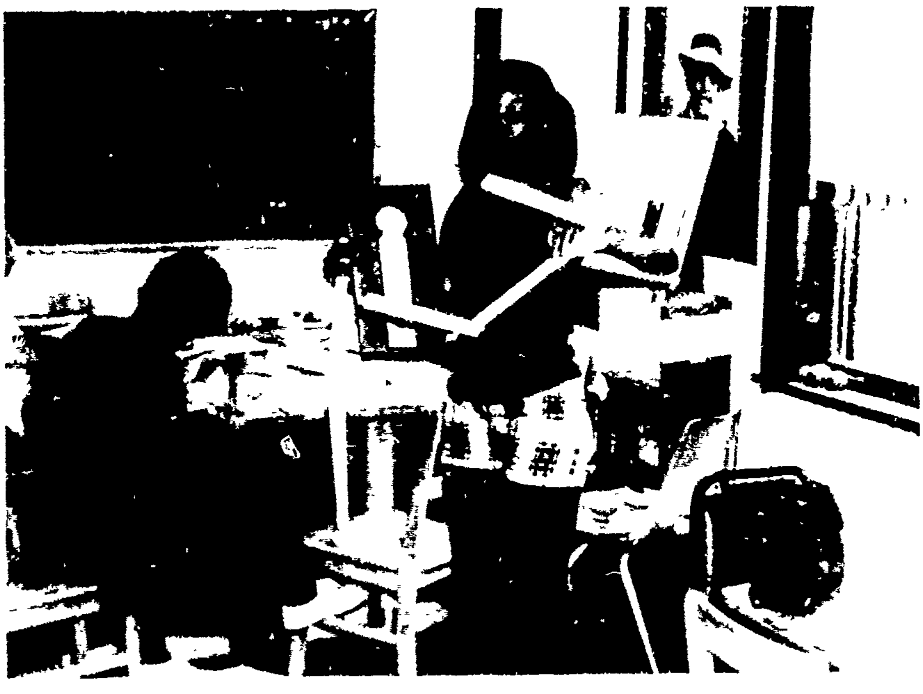
Time spent at the workshop discussing this issue will go a long way toward helping managers create positive relations with teachers. But there's more that can be done. Contact the principals or USMES coordinators involved and ask each to set up a teacher-manager meeting as soon as possible and to see that the meeting takes place. (The managers, if they wish, can set up the meetings themselves.) Attend each meeting and--

- Let the teachers and manager get to know one another.
- Help them discuss how they can assist one another.
- Have them agree that the manager will let the teacher know what students did during a particular visit to the lab and that the teacher will brief the manager on classroom activities before sending students to the lab. (A short talk at lunchtime, for example, is all it takes to keep one another informed.)

If you're training only one manager, you'll have time to help develop a list of more specific objectives for the meeting that you or the manager sets up.

Discussion of lab-management issues

Some topics, like safety and scrounging, will come up now and then during the workshop, but the fragments may not add up to the whole picture. Here's a chance to fill in the gaps and to reinforce some points that have already been raised. During this discussion participants can bring up whatever specific concerns they might have about the labs they will be managing. They may want advice on establishing a fair and easy-to-keep scheduling system or tips on preventing theft. To make sure the discussion is comprehensive, prepare a checklist. Thumb through this manual and write down all the administrative aspects of setting up and running a lab that you want to cover.



SAMPLE AGENDA OUTLINE

Here's one way of putting together the components into a workable two-day package that still leaves time for lunch. Although you might consider basing your agenda on this outline, remember that only you know all the particulars of your situation. Tailor your program accordingly.

FIRST DAY

9:00 - 9:30	Introduction to USMES
9:30 - 10:10	Introduction to the USMES Design Lab Concept
10:10 - 10:30	Presentation of Written Resources
10:30 - 12:00	Skill Session
1:00 - 4:00	Hands-On Experience with Tools and Materials

SECOND DAY

9:00 - 11:00	Hands-On Experience with Tools and Materials Continues
11:00 - 12:00	Discussion of Setting Up a Lab
1:00 - 2:00	Discussion of Design Lab Management Issues
2:00 - 2:20	Discussion of Classroom-Lab Correlation
2:20 - 3:20	Working with Children in the Lab
3:20 - 4:00	Discussion of Working with Children and Final Question-and-Answer Period

Follow-up to workshop training

Don't abandon your managers when the training ends. Schedule at least one visit to each manager during the first few months after training. When you visit, observe and then discuss. On-the-job feedback from you may mean the difference between success and failure for the manager and the lab.

If there's more than one manager in a school district or small geographical area, have the group get together with you two or three times a year. When managers discuss problems, exchange ideas, and share experiences, they and their labs function better.

LAB EXPERIENCES

To get a clear picture of the flow of events at a training workshop, it's best to attend one. That's probably impractical, so instead read this report from a two-day workshop held at the Horace Mann School in Chicago in which managers for thirteen schools were trained. Because many of the participants were teachers who had attended a two-week workshop on USMES just a few months earlier, there was little need for an extensive introduction to USMES. That left time for setting up a lab, an activity usually reserved for four-day programs.

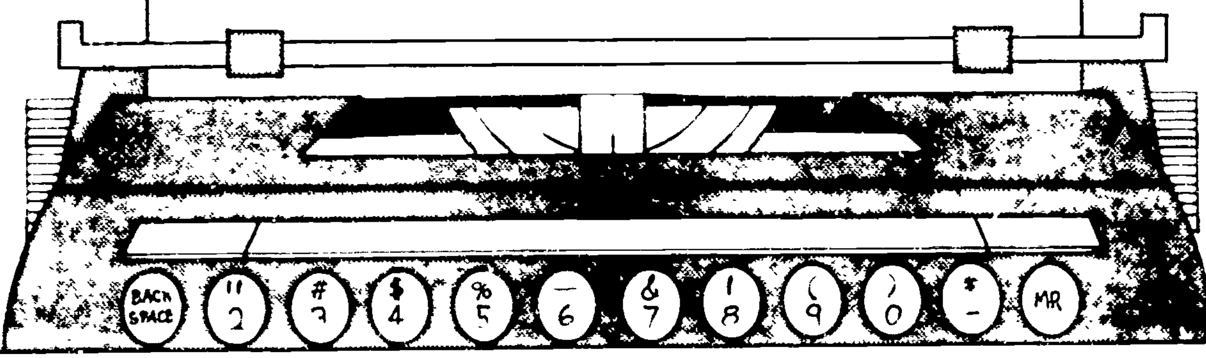
A brief review of the USMES philosophy and its role in the Design Lab started things off the first morning. This led to a discussion of specific concerns the participants had about their labs: "What stage of ordering has the Board of Education reached?" "How can we have a Design Lab when no room is available?"

An informal skills session followed. Participants experimented with those tools with which they weren't familiar, while the two workshop instructors circulated, offering help when appropriate. Because not all the typical lab tools were available, verbal descriptions and "How To" Cards sometimes took the place of hands-on experience.

Next came a detailed seminar on the elements of setting up and running a Design Lab: scheduling, scrounging, space and layout, teacher orientation, non-USMES use of lab, clean-up, safety, and storage. Participants explained how they handled or planned to handle specific problems.

Talk turned to action. Participants broke into two groups: one group staying at the Horace Mann School, the other going to the O'Keeffe School nearby. Each group had to set up a Design Lab by the end of the day, making sure it would be ready for the children scheduled to come in the next morning.

Setting up the two labs took most of the afternoon with different problems preoccupying the two groups. At the O'Keeffe School, where safe storage was the main concern, group members opted for a portable cart. They made plans to enclose the cart with pegboard; tools would hang on the outside and other supplies would go inside. The entire rolling lab could be stored in the school vault. The lab manager at O'Keeffe carried out these plans at a later date.



Space was the issue at the Mann School, where two small rooms had been allocated for the lab. Group members pondered over placement of work tables and designation of areas for specific activities like soldering and painting. Although work wasn't completed by the end of the afternoon, the rooms did look like a Design Lab.

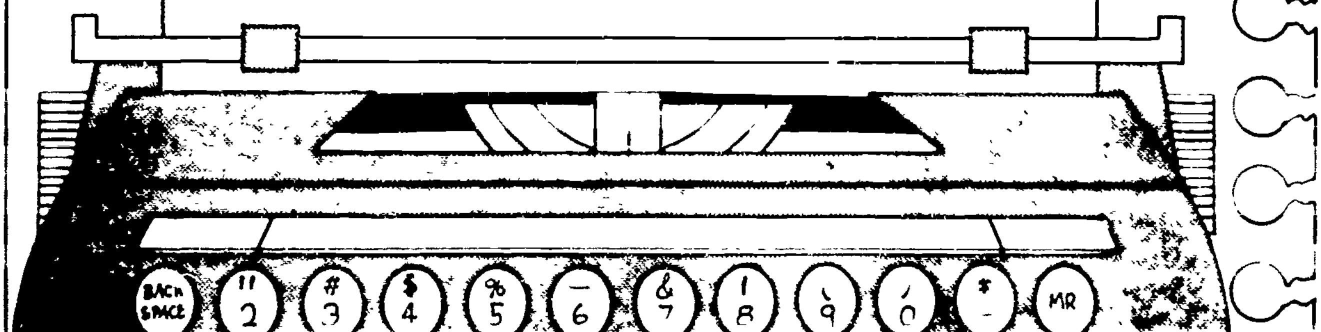
Earlier in the afternoon one staff member had talked about USMES with those participants who hadn't been at the two-week teacher-training workshop. He suggested they read a few Teacher Resource Books and, if possible, observe an USMES classroom. The participants mentioned that talking with USMES teachers had helped them understand the program.

The second day opened with a discussion of how the two labs had been set up. The participants said the experience had given them insights that would help them establish their own labs.

The discussion turned from the making of a lab to its use by children. Among the points stressed were 1) children should have a purpose when they use the lab, 2) managers should not be directive when helping students, and 3) managers can help children with more than building techniques; they can help them with skills and concepts in math and science as they relate to lab activities. A videotape of an adult working with students in a lab illustrated these points.

It was time to go from theory to practice. The participants again broke into two groups, each group going to a lab to work with fifteen USMES students. Because the children had no lab projects underway as part of their USMES work, they were asked to build things for their classrooms like games, puzzles, and boxes. As the participants talked with the young builders, helping them measure, sketch, cut, and glue, it was clear that the workshop was succeeding. The children's excitement was evident also; time didn't allow them to complete their projects, but they all planned to return the next day to put on the finishing touches.

The session with children had been videotaped, and viewing that tape provided a good focus for a discussion and enabled participants to analyze their styles of interacting with children. As the end of the workshop neared, the soon-to-be managers dealt with unresolved concerns they had about their upcoming responsibilities. They concluded their training by writing short reports describing their plans for setting up and running their own labs.



APPENDIX

A. Bibliography

B. Design Lab 'How To' Cards

C. What's USMES?

D. Tri-Wall ordering information

E. Design Lab inventory lists

BIBLIOGRAPHY

APPENDIX A

People involved in Design Labs have found it useful to keep handy these catalogs and how-to-do-it books. This list, however, is by no means exhaustive.

Adkins, Jan, Toolchest: A Primer of Woodcraft, Walker and Company, New York, 1973, 48 pages ($5.83)

This carefully illustrated excursion into the basics of woodworking not only explains techniques like measuring, drilling, sawing, shaping, and doweling, but includes handy charts on the properties and uses of different woods and on types of nails and screws.

Brookstone Company, Hard-To-Find Tools and Other Fine Things, 15 Brookstone Building, Peterborough, New Hampshire 03458, 68 pages (free)

This fascinating catalog includes many tools you won't readily find elsewhere. The handsaw sharpener and handsaw handle may make valuable additions to your inventory. Service is fast.

Koff, Richard, How Does It Work?, Signet, New York, 1961, 292 pages ($1.25)

From aerosols to zippers, this paperback reveals the workings of more than a hundred devices including clocks, doorbells, and switches. It also explains some non-devices like rain, thunder, and lightning.

Reader's Digest, Complete Do-It-Yourself Manual, New York, 1973, 591 pages ($16.95)

This is a best bet among the guides to choosing and using tools. It's comprehensive, clear, and loaded with illustrations.

Workshop for Learning Things, Further Adventures of Cardboard Carpentry, 5 Bridge Street, Watertown, Massachusetts 02172, 1972, 40 pages ($3.50)

This book is filled with ideas on building with Tri-Wall.

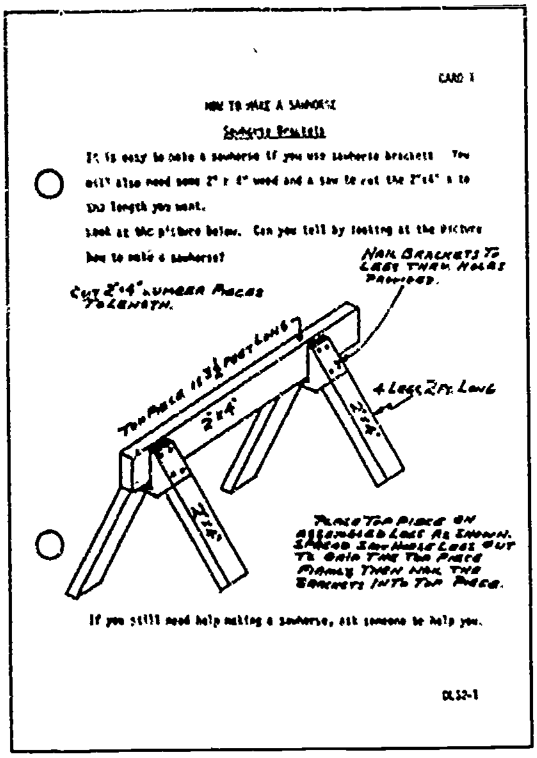
Workshop for Learning Things, Our Catalog, 5 Bridge Street, Watertown, Massachusetts 02172, 1972 ($.50)

Getting the current edition is a good way to keep up to date on how and where to order Tri-Wall. Some of the items in this catalog, like tools made especially for working with cardboard, you won't find anywhere else.

DESIGN LAB 'HOW TO' CARDS

APPENDIX B

Every Design Lab should have at least one set of Design Lab "How-To" Cards to help children (and adults) learn how to use tools safely and effectively. Stacked in a box or tacked on the wall, the cards are an easy-to-use reference for a variety of construction techniques. As explained in Chapter 3, the cards work best when they are used as needed. Becoming familiar with all the titles and contents of the set will make it easier to refer a puzzled builder or designer to the appropriate cards. Although cards dealing with hand tools may teach a child all he needs to know for a particular situation, those dealing with power tools should never take the place of adult demonstrations or supervision.



CARD 1

HOW TO MAKE A SAWHORSE

Sawhorse Brackets

It is easy to make a sawhorse if you use sawhorse brackets. You will also need some 2" x 4" wood and a saw to cut the 2"x4" s to the length you want.

Look at the picture below. Can you tell by looking at the picture how to make a sawhorse?

If you still need help making a sawhorse, ask someone to help you.

DL32-1

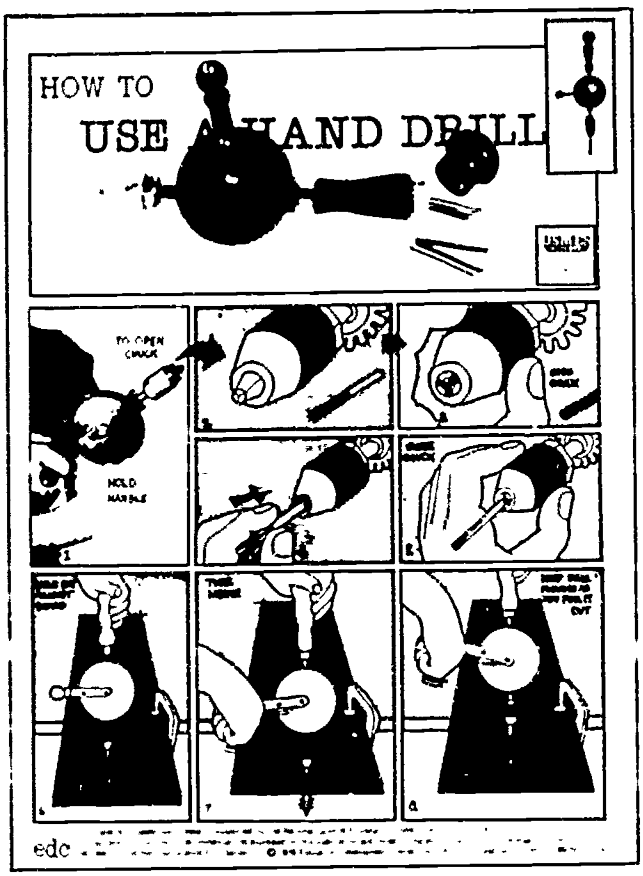
List of Titles (Each title contains between one and five cards)

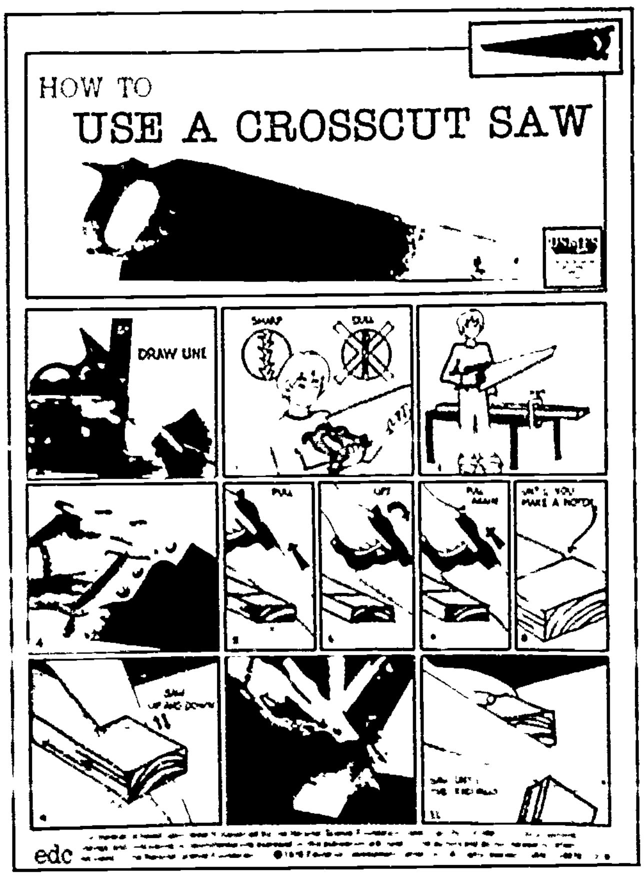
DL 1	How To Make Straight Cuts in Three-Layered Cardboard
DL 2	How To Make Curved Cuts in Three-Layered Cardboard
DL 3	How To Cut Slots in Three-Layered Cardboard
DL 4	How To Make Holes in Three-Layered Cardboard
DL 5	How To Glue Three-Layered Cardboard
DL 6	How To Make a Corner With Three-Layered Cardboard
DL 7	How To Cut Grooves in Three-Layered Cardboard
DL 8	How To Hold Three-Layered Cardboard While You Work On It
DL 9	How To Make Straight Cuts in Wood
DL10	How To Make Holes in Wood
DL11	How To Nail Wood
DL12	How To Make Curved Cuts in Wood
DL13	How To Glue Wood
DL14	How To Hold Wood While You Work On It
DL15	How To Cut Grooves in Wood
DL16	How To Make Wood Smooth
DL17	How To Put Wood Screws in a Piece of Wood
DL18	How To Put Screws in Hard-To-Get-At Holes
DL19	How To Put Screws in Two Pieces of Hard or Soft Wood
DL20	How To Hold Two Pieces of Sheet Metal Together
DL21	How To Put Two Pieces of Wood or Metal Together with Nuts or Bolts
DL22	How To Loosen or Tighten Nuts or Bolts

DL23 How To Loosen Hard-To-Move Nuts and Bolts
DL24 How To Cut Thin Pieces of Tin
DL25 How To Cut Steel Rod
DL26 How To Cut Glass
DL27 How To Cut Wire
DL28 How To Solder Two Pieces of Wire Together
DL29 How To Use a Straight Edge When Cutting Wood or Three-Layered Cardboard
DL30 How To Cut Straight Across a Piece of Wood
DL31 How To Tell If Things Are Level
DL32 How To Make a Sawhorse

Primary Version of Design Lab 'How to' Cards

As this manual went to press, an additional set of Design Lab "How-To" Cards was under development. Although these newer cards rely more on illustrations and photos than on text, and although the titles are different and the content reorganized, the primary version covers essentially the same material as the regular version.





What's USMES?

APPENDIX C

Summary of the Program and Its Resources

The USMES Program

Second graders in Massachusetts convince town authorities to install a warning sign to reduce traffic speed at a crossing near their school. Fifth and sixth graders in Michigan take over a faltering breakfast program and make it successful. Fourth graders in Washington, D.C., submit a proposal and are granted funds to select and purchase playground equipment for their school.

These young problem solvers vary in age, race, and socioeconomic background. They have identified problems that are real to them, problems they have a stake in solving. They have suggested ideas, organized tasks, set priorities, collected data, analyzed results, created solutions, and made changes.

They are using a curriculum called USMES. It is a program that has brought the school and community into thousands of K-8 classrooms. A program organized into twenty-six problems, or units, that have been developed in the classroom by teachers and students in a wide variety of schools.

USMES Resources

In addition to this Design Lab Manual and the Design Lab "How-To" Cards (see Appendix B), the following materials are available from USMES:

The USMES Guide: This book describes the USMES project, real problem solving, classroom strategies, the Design Lab, the units, and the support materials as well as ways that USMES helps students learn basic skills.

Teacher Resource Books (one per unit): Each book is a guide to using an USMES unit; it describes a broad problem, explains how students might narrow that problem to meet their particular needs, recommends classroom strategies, and presents logs from teachers whose classes have worked on the unit.

"How To" Series: These booklets help children learn skills they commonly need to solve real problems, for example, using a stopwatch, finding an average, and making a bar graph. There are two versions: the primary series has a cartoon format; the intermediate series, a magazine style.

Background Papers: These papers, correlated with the "How To" Series, provide teachers with information and hints that do not appear in the student booklets.

Curriculum Correlation Guide: By correlating the twenty-six USMES units with other curriculum materials, this book helps teachers integrate USMES with other school activities and lessons.

Preparing People for USMES: An Implementation Resource Book: This guide contains suggestions for conducting (1) informational meetings to acquaint parents, teachers, and administrators with USMES, (2) workshops to train teachers to use USMES, and (3) workshops to train Design Lab managers.

TRI-WALL ORDERING INFORMATION

APPENDIX D

Bulk Orders

Workshop for Learning Things
5 Bridge Street
Watertown, Massachusetts 02172
617-926-1160

Will deliver (for a fee) in Boston area any order of 20 or more sheets. Smaller orders (even 1 sheet) may be picked up.

Manufacturer's Distribution Points:

Tri-Wall Containers, Inc.
Educational Sales
100 Crossways Park West
Woodbury, New York 11797
516-364-2800

Tri-Wall Containers, Inc.
Educational Sales
Butler, Indiana 46721
219-868-2151

Tri-Wall Containers, Inc.
Educational Sales
7447 North Blackstone Avenue
Pinedale, California 93650
209-439-5222

If you plan to buy less than 100 sheets, write or call to find out the minimum order. If you want less than the minimum, check the list of retail sources for an outlet near you.

When ordering, specify TW-61 Tri-Wall to take advantage of the educational rate.

Tri-Wall Sizes and Prices

Prices apply only to the Workshop for Learning Things and the three manufacturer's distribution points.

PRICE PER SHEET*		
SIZE	LESS THAN 100	100 OR MORE
3½ x 4½'	$3.50	$2.36
4 x 5'	not available	$3.01
4 x 6'	$5.45	$3.64
4 x 8'	$7.45	$5.07

*Prices about 8% higher in Arizona, California, Colorado, Idaho, Missouri, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

*Prices do not include shipping charges; write or call to find out what these will be.

NOTE: Because Tri-Wall was the most readily available brand of three-layered cardboard at the time the project began, USMES has used it at workshops and in schools; consequently, references to Tri-Wall can be found throughout the Design Lab Manual.

Retail Sources

Before ordering, write or call to find out about prices and delivery. Prices will be somewhat higher than those in the chart. But convenience and a smaller shipping charge may offset the higher price.

California

The Learning Company
5th & Junipero Street
Carmel, California 93921
408-624-0157

Open Space Environmental Center
4940 Sepulveda Boulevard
Culver City, California 90230
213-391-5215

Corrugated Service Western
P.O. Box 4515
250 West Ivy Avenue
Inglewood, California 90302
213-678-5974

Sunflower Source
1360 Church Street
San Francisco, California 94114
415-647-9333

Corrugated Service Western
1331 San Mateo Avenue
South San Francisco,
California 94080
415-583-9777

Colorado

Colorado Container Corporation
5945 North Broadway
Denver, Colorado 80216
303-893-9000

Georgia

Kine Paper Corp. of Georgia
Building 413, Wilson Airport
Macon, Georgia 31201
912-788-4454

Hawaii

Service Packaging Corporation
P.O. Box 17714
Honolulu, Hawaii 96817
808-847-1531

Illinois

Riley, Geehr, & Schmidgall
Packaging Corporation
1350 West Fullerton
Chicago, Illinois 60614
312-327-8100

Pierce Box and Paper Company
1505 Kishwaukee Street
Rockford, Illinois 61103
815-963-1505

Indiana

Kelly Box and Packaging Corp.
2300 McKinley Avenue
Ft. Wayne, Indiana 46804
219-432-4515

Maryland

Nelson Company
2116 Sparrows Point Road
Sparrows Point, Maryland 21219
301-477-3000

Massachusetts

Workshop for Learning Things
5 Bridge Street
Watertown, Massachusetts 02172
617-926-1160

Michigan

Holle Wood Products
24501 Hoover Road
Warren, Michigan 48089
313-758-3420

Minnesota

National Packaging Corporation
3075 Long Lake Road
St. Paul, Minnesota 55113
612-636-1200

Toys 'N Things
560 Van Buren
St. Paul, Minnesota 55103
612-227-8478

Missouri

Duro-Flex Products, Inc.
P.O. Drawer 6
Foristell, Missouri 63348
314-673-2216

The Learning Exchange
2233 Grand
Kansas City, Missouri 64108
816-471-8450

The Learning Center
4504 Westminster Place
St. Louis, Missouri 63108
314-361-1908

New Jersey

George H. Swatek, Inc.
1095 Edgewater Avenue
Ridgefield, New Jersey 07657
201-941-2400

New York

Teacher-Parent Resource Center
Cornish Hall C-11
SUNY at Cortland
Cortland, New York 13045
607-753-2326

Portable Living or
"Refer Switchboard Inc."
Box 207, Route 150
East Shodack, New York 12061
518-477-7868

Creative Teaching Workshop
115 Spring Street
New York, New York 10012
212-431-7710

Central Packaging Supply, Inc.
P.O. Box 705
Easthourne Dr. & Meade Rd.
Syracuse, New York 13201
315-432-1300

Ohio

Greater Cleveland Teacher Center
1685 Magnolia Drive
Cleveland, Ohio 44106
216-721-1541

Ohio (cont.)

Lewisburg Container Company
Lewisburg, Ohio 45338
513-962-2681

Rhode Island

Greene Industries, Inc.
Rocky Hollow Road
P.O. Box 66
East Greenwich, Rhode Island 02818
401-884-7530

Educational Realizations
28 Main Road
Tiverton, Rhode Island 02878
401-624-3322

Texas

General Packaging Corporation
13400 Harry Hines Boulevard
P.O. Box 34217
Dallas, Texas 75234
214-241-2147

Advisory Center for Teachers
Waxahachie Independent School Dist.
Waxahachie, Texas 75165
214-937-4631

Washington

Thomas I. Sill Company
5554 N.E. 55th
Seattle, Washington 98105
206-622-1792

Wisconsin

American Paper Company
627 South 12th Street
Milwaukee, Wisconsin 53204
414-645-2003

Canada

Smith Packaging
111 Eastside Drive
Toronto, Ontario, Canada
M8Z 5S3
416-231-9261

DESIGN LAB INVENTORY LISTS

SMALL DESIGN LAB INVENTORY
(Approx. cost $66)

From Sears

QTY.	ITEM		UNIT PRICE	TOTAL
1	claw hammer (13 oz.)	(HT)*	$ 8.95	$ 8.95
1	crosscut handsaw (8 tooth)		$ 9.95	$ 9.95
1	hacksaw		$ 3.99	$ 3.99
1	pkg. of hacksaw blades		$ 1.98	$ 1.98
1	4-piece screwdriver set		$ 5.67	$ 5.67
1	hand drill	(HT)	$ 3.95	$ 3.95
1	slip joint pliers		$ 2.57	$ 2.57
1	folding ruler (6')	(HT)	$ 1.77	$ 1.77
2	6" "C" clamps	(HT)	$ 5.77	$11.54
1	flexible goggles		$ 1.89	$ 1.89
1	work gloves		$ .66	$ .66

From Hardware Store

QTY.	ITEM	UNIT PRICE	TOTAL
1	utility knife set	$ 2.45	$ 2.45

Miscellaneous

	scrap lumber and cardboard	--	--
	1-lb. of each size: 4-, 6-, 8-, 12-penny common nails	variable	variable
	1-lb. of each size: 2-, 4-, 6-, 8-, 12-penny finish nails	variable	variable

MEDIUM DESIGN LAB INVENTORY
(Approx. cost $380)

From Sears

QTY.	ITEM		UNIT PRICE	TOTAL
2	claw hammers (13 oz.)	(HT)	$ 8.95	$17.90
1	crosscut handsaw (8 tooth)		$ 9.95	$ 9.95
1	hacksaw		$ 3.99	$ 3.99
1	pkg. of hacksaw blades		$ 1.98	$ 1.98
1	4-piece standard screwdriver set		$ 5.67	$ 5.67
1	hand drill	(HT)	$ 3.95	$ 3.95
2	slip joint pliers (6 3/4")		$ 2.57	$ 5.14
1	linesman's pliers (7")		$ 5.77	$ 5.77
1	longnose pliers (6")		$ 4.87	$ 4.87
1	diagonal cutting pliers		$ 4.87	$ 4.87
1	vise grip pliers (7½")	(HT)	$ 3.59	$ 3.59
1	6" adjustable open end wrench	(HT)	$ 4.97	$ 4.97
1	8" half round file	(HT)	$ 1.95	$ 1.95
1	10" flat bastard file	(HT)	$ 1.95	$ 1.95

*(HT) indicates item can be found in Sears Power and Hand Tool Catalog.

QTY.	ITEM		UNIT PRICE	TOTAL
1	block plane (7")	(HT)	\$ 7.47	\$ 7.47
1	folding ruler (6')	(HT)	\$ 1.77	\$ 1.77
2	10' tape measures	(HT)	\$ 4.97	\$ 9.94
1	50' tape measure	(HT)	\$ 5.47	\$ 5.47
1	rafter square	(HT)	\$ 9.95	\$ 9.95
6	2" "C" clamps	(HT)	\$ 1.27	\$ 7.62
4	6" "C" clamps	(HT)	\$ 5.77	\$23.08
2	3½" bench vises-light duty		\$11.89	\$23.78
1	set of sawhorse brackets-medium duty	(HT)	\$ 2.47	\$ 2.47
1	electric glue gun-heavy duty	(HT)	\$10.77	\$10.77
1	box of glue sticks (27/box)	(HT)	\$ 3.59	\$ 3.59
1	pkg. of fine sandpaper		\$ .59	\$ .59
1	pkg. of medium sandpaper		\$ .59	\$ .59
1	pkg. of coarse sandpaper		\$ .59	\$ .59
1	25' extension cord		\$ 4.97	\$ 4.97
2	flexible goggles		\$ 1.89	\$ 3.78
3	work gloves			\$ 1.97

From Hardware Store

QTY.	ITEM	UNIT PRICE	TOTAL
1	saber saw (Black and Decker Model #7524)	\$39.89	\$39.89
1	heavy duty screwdriver (8")	\$ 3.45	\$ 3.45
1	utility knife set-adjustable	\$ 2.45	\$ 2.45
1	pair of tin shears	\$ 5.95	\$ 5.95
2	meter sticks	\$ 2.20	\$ 4.40
2	yard sticks	\$ .50	\$ 1.00
1	roll of electric tape	\$ 1.50	\$ 1.50
1	dozen ½" long screweyes	\$ .60	\$ .60
1	gross of each size round head wood screws: ½", 1", 1½" long		\$ 5.25
1	gross of each size round steel bolts (2" long): 6-32, 10-32, ¼-20		\$12.00
1	gross of each size nuts: 6-32, 10-32, ¼-20		\$ 6.22
1	gross of each size flat steel washers: #6, #10, #¼		\$ 7.30
1	ball of strong string	\$ 1.90	\$ 1.90

Miscellaneous

QTY.	ITEM	UNIT PRICE	TOTAL
	scrap lumber	--	--
1	stop watch	\$15.00	\$15.00
1	first aid kit	\$ 8.00	\$ 8.00
15	sheets of Tri-Wall (4'x6')		\$83.00

All prices (except where noted) are based on Fall 1975 data.

FULL DESIGN LAB INVENTORY
(Approx. cost $990,
plus cost of lumber)

From Sears

QTY.	ITEM		UNIT PRICE	TOTAL
1	claw hammer (16 oz.)	(HT)	$ 3.95	$ 3.95
2	claw hammers (13 oz.)	(HT)	$ 8.95	$17.90
1	claw hammer (8 oz.)	(HT)	$ 4.95	$ 4.95
1	crosscut handsaw (3 tooth)		$ 9.95	$ 9.95
2	hacksaws		$ 3.99	$ 7.98
1	pkg. hacksaw blades		$ 1.98	$ 1.98
1	coping saw	(HT)	$ 2.47	$ 2.47
1	pkg. coping saw blades	(HT)	$ .59	$ .59
1	pkg. saber saw blades		$ 2.49	$ 2.49
4	4-piece screwdriver sets		$ 5.67	$22.68
1	scratch awl	(HT)	$ 1.19	$ 1.19
1	electric variable speed drill-3/8"		$19.99	$19.99
1	drill set-1/16"-1/2" (15 pieces)	(HT)	$22.99	$22.99
1	hand drill	(HT)	$ 3.95	$ 3.95
1	set of drill bits (for wood)	(HT)	$ 7.99	$ 7.99
4	slip joint pliers (6 3/4")		$ 2.57	$10.23
1	linesman's pliers (7")		$ 5.77	$ 5.77
3	diagonal cutting pliers		$ 4.87	$14.61
1	longnose pliers (6")		$ 4.87	$ 4.87
1	vise grip pliers (7½" length)	(HT)	$ 3.45	$ 3.45
1	6" adjustable open end wrench	(HT)	$ 4.97	$ 4.97
1	8" half round file	(HT)	$ 1.95	$ 1.95
1	10" flat mill cut file	(HT)	$ 1.65	$ 1.65
1	10" flat bastard file	(HT)	$ 1.95	$ 1.95
1	block plane (7" long)	(HT)	$ 7.47	$ 7.47
1	set of wood chisels		$11.97	$11.97
1	putty knife-flexible blade	(HT)	$ 1.37	$ 1.37
2	folding rulers (6')	(HT)	$ 1.77	$ 3.54
4	tape measures (10')	(HT)	$ 4.97	$19.88
1	tape measure (50')	(HT)	$ 5.47	$ 5.47
2	combination squares (12")	(HT)	$ 4.97	$ 9.94
1	rafter square	(HT)	$ 9.95	$ 9.95
1	24" level	(HT)	$ 5.47	$ 5.47
4	2" "C" clamps	(HT)	$ 1.27	$ 5.08
4	6" "C" clamps	(HT)	$ 5.77	$23.08
2	3½" bench vises-heavy duty		$24.79	$49.58
2	sets of sawhorse brackets-medium duty	(HT)	$ 2.47	$ 4.94
1	heavy duty glue gun	(HT)	$10.77	$10.77
6	boxes of glue sticks (27/box)	(HT)	$ 3.59	$21.54
1	quart of white glue	(HT)	$ 2.89	$ 2.89
1	roll of rosin core solder (10" roll)	(HT)	$ 1.25	$ 1.25
1	can of soldering paste (3 oz. can)	(HT)	$ .59	$ .59
4	pkgs. of fine sandpaper		$ .59	$ 2.36
4	pkgs. of medium sandpaper		$ .59	$ 2.36
4	pkgs. of coarse sandpaper		$ .59	$ 2.36
1	25' extension cord		$ 4.79	$ 4.79
4	flexible mask goggles		$ 1.89	$ 7.56
3	work gloves			$ 1.97

From Hardware Store

QTY.	ITEM	UNIT PRICE	TOTAL
1	saber saw (Black and Decker Model #7524)	$39.89	$39.89
3	keyhole saws	$ 2.90	$ 8.70
1	wooden mallet (2¼" face)	$ 3.50	$ 3.50
2	heavy duty screwdrivers	$ 3.45	$ 6.90
4	utility knife sets	$ 2.45	$ 9.80
1	tin shears	$ 5.95	$ 5.95
1	soldering gun (Weller Model #8200-N)	$14.85	$14.85
3	meter sticks	$ 2.20	$ 6.60
3	yardsticks	$ .50	$ 1.50
2	1" paint brushes	$ .50	$ 1.00
2	rolls of nylon filament tape	$ 2.25	$ 4.50
3	rolls of electrical tape	$ 1.50	$ 4.50
1	roll of duct tape	$ 5.50	$ 5.50
2	dozen ½" long screweyes	$ .60	$ 1.20
1	box of carpet tacks	$ .35	$ .35
1	gross of each size round head wood screws: ½", 1", 1½" long		$ 5.25
1	gross of each size round head steel bolts (2" long): 6-32, 10-32, ¼-20		$12.00
1	gross of each size nuts: 6-32, 10-32, ¼-20		$ 6.22
1	gross of each size flat steel washers: #6, #10, #¼		$ 7.30
25	feet of ¼" ID plastic tubing (flexible)		$ 7.50
50	feet of baling wire (coat hanger size)		$ 1.90
2	balls of strong string	$ 1.90	$ 3.80
50	feet of clothesline		$ 1.50
2	6-volt doorbells	$ 2.50	$ 5.00
1	medium funnel (16 oz.)	$ .79	$ .79

From Electronic Supply House (priced from 1974-75 local catalog)

QTY.	ITEM	UNIT PRICE	TOTAL
8	pkgs. "D"-size nickel-cadmium batteries (2/pkg.)	$ 3.16	$25.28
1	"D" battery charger	$ 7.96	$ 7.96
15	"D"-size battery holders (2-cell)	$ .40	$ 6.00
10	"D"-size battery holders (1-cell)	$ .33	$ 3.30
2	boxes of #41 flashlight bulbs (10/box)	$ 2.40	$ 4.80
1	6-volt battery	$ 2.90	$ 2.90
48	small alligator clips	$ .12½	$ 6.00
1	pkg. of fahnestock clips (100/pkg.)	$ 2.20	$ 2.20
1	1000' roll of #22 plastic insulated wire (stranded)	$16.00	$16.00

From Stationery Store

QTY.	ITEM	UNIT PRICE	TOTAL
2	desk staplers	$ 9.95	$19.90
2	boxes of staples	$ 1.25	$ 2.50
8	scissors	$ 3.45	$27.60
10	pencil compasses	$ .69	$ 6.90
4	plastic protractors	$ .39	$ 1.56
4	30°-60° plastic triangles	$ 1.00	$ 4.00
4	45° plastic triangles	$ 1.50	$ 6.00

6	red felt tip markers	$ .79	$ 4.74
6	black felt tip markers	$ .79	$ 4.74
6	rolls of 1" wide masking tape	$ 2.75	$16.50
12	rolls of clear Scotch tape	$ .69	$ 8.28
1	box of 1000 paper clips	$ 3.00	$ 3.00

From Discount Store (priced February 1974)

QTY.	ITEM	UNIT PRICE	TOTAL
1	dustpan and brush	$ 3.00	$ 3.00
1	can opener	$ 1.00	$ 1.00
3	tubes plastic cement	$ .60	$ 1.80
1	spool heavy black thread	$ .42	$ .42
1	pkg. of 24 assorted sewing needles	$ .79	$ .79
1	box of 1000 common pins	$ .30	$ .30
1	box soda straws	$ .80	$ .80
1	package of 50 paper cups	$ .79	$ .79

Miscellaneous

QTY.	ITEM	UNIT PRICE	TOTAL
2	stop watches	$15.50	$31.00
1	first aid kit	$ 8.00	$ 8.00

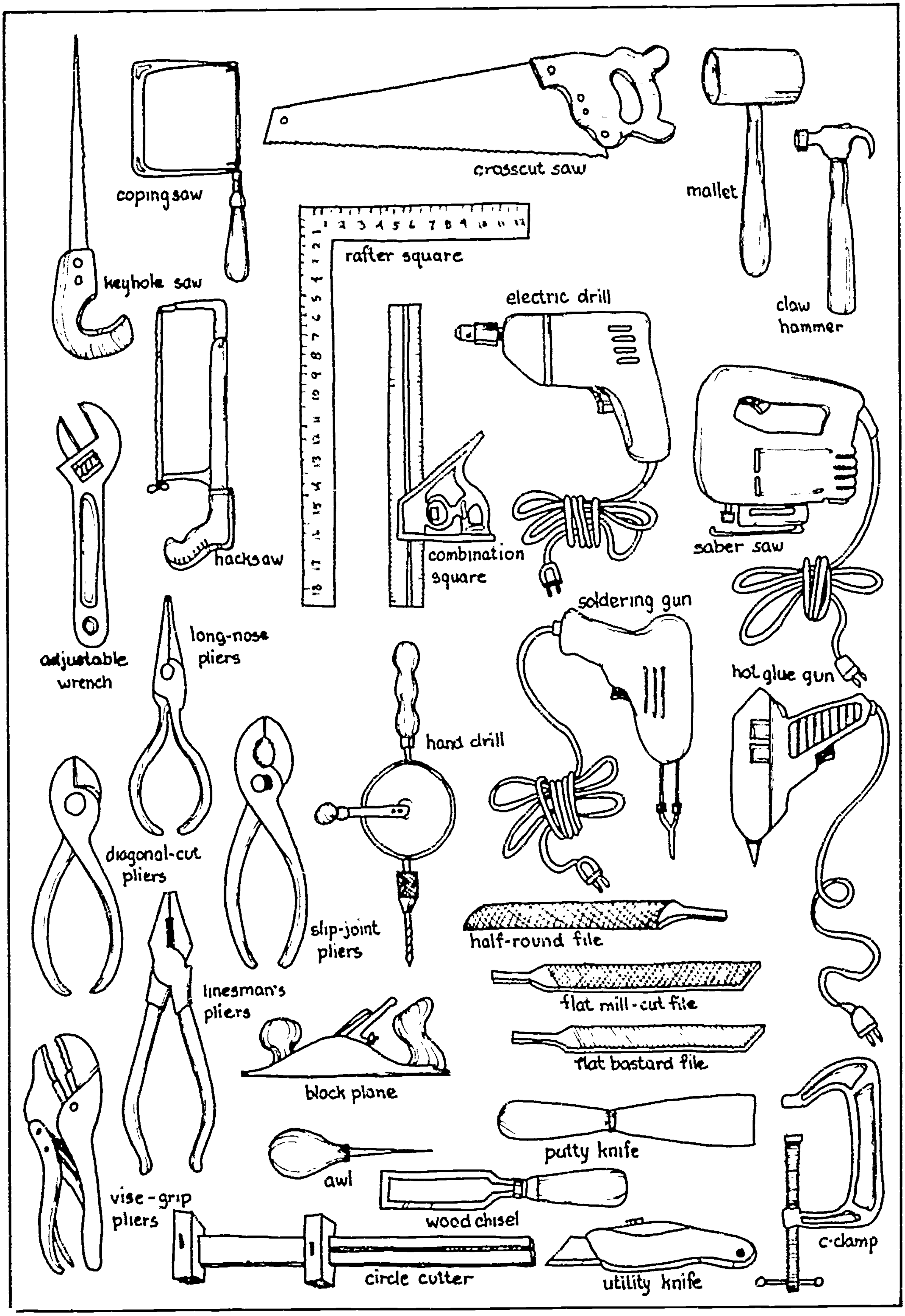
From Workshop for Learning Things

QTY.	ITEM	UNIT PRICE	TOTAL
1	small adjustable circle cutter	$ 8.25	$ 8.25
1	large adjustable circle cutter	$ 8.75	$ 8.75
30	sheets of Tri-Wall (4'x6')		$166.00

From Lumber Yard (Call a local yard for latest prices.)

QTY.	ITEM	UNIT PRICE	TOTAL
6	2"x3"x8' pine boards		
4	2"x4"x8' pine boards		
3	1"x4"x10' pine boards		
2	1"x6"x10' pine boards		
2	1"x8"x10' pine boards		
2	sheets of 3/4" plywood 4'x8' (exterior)		
1	sheet of 1/2" plywood 4'x8' (exterior)		
1	sheet of 1/4" plywood 4'x8' (exterior)		
1	sheet of 1/4" masonite pegboard 4'x4'		
5	lbs. of each size: 4-, 6-, 8-penny common nails		
2	lbs. of each size: 2-, 4-, 6-, 8-penny finish nails		
3	lbs. of galvanized shingle nails		
6	wooden dowels of each size: 1/4", 1/2", 3/4" (3' long)		
3	boxes of each size #16 brads: 3/4" and 1 1/4"		

NOTES


coping saw
crosscut saw
mallet
keyhole saw
rafter square
electric drill
claw hammer
saber saw
hacksaw
combination square
soldering gun
adjustable wrench
long-nose pliers
hot glue gun
hand drill
diagonal-cut pliers
slip-joint pliers
half-round file
linesman's pliers
flat mill-cut file
flat bastard file
block plane
putty knife
awl
vise-grip pliers
wood chisel
c-clamp
circle cutter
utility knife