The major emphasis in all Unified Sciences and Mathematics for Elementary Schools (USMES) units is on open-ended, long-range investigations of real problems. Since children often design and build things in USMES, 26 "Design Lab" cards provide information on the safe use and simple maintenance of tools. Each card has a large photograph of the tool or tools on the top. The first frame on most cards is a photograph of a child holding the tool, providing the user with an understanding of how the tool is held. Remaining frames describe important skills in using the tool. Primary grade students or older students with reading problems should find the large photographs/illustrations useful in understanding the material presented with little reliance on accompanying word descriptions. Tools described include: electric tools (saber saw, electric drill, glue gun, soldering gun); handsaws (crosscut, coping, keyhole saws and hacksaw); other hand tools that cut (files, circle cutter, wood chisel, block plane, hand drill); holding tools (pliers, "C" clamp, screwdriver, hammer, size of nails); and measuring tools (combination square, rafter square, level). Additional cards provide instructions for maintaining a saber saw and electric drill and for making a sawhorse, tri-wall slot, and bend in a tri-wall.

(Author/JN)
HOW TO SERIES

DESIGN LAB

wood chisel
half-round file
mallet
soldering gun
c-clamp
block plane
hand drill

coping saw
slip-joint pliers
crosscut saw
WHAT IS USMES?

USMES challenges students to solve real problems within their school and community. Children tackle problems like a busy or unsafe intersection near their school, classroom furniture that doesn't fit them, or playgrounds that are crowded or uninteresting. These problems have immediate and practical impact on students. They have no established, correct solutions—students take or recommend action based upon whatever data they collect and analyze. Furthermore, the children themselves, not the teacher, direct the problem-solving process.

Solving real problems is interdisciplinary: skills, processes, and concepts from science, mathematics, social science, and language arts all play a part. For example, students conduct opinion surveys, build measuring devices, write letters, and make and use graphs. They also make decisions, work productively in small groups, and develop and clarify values.

The USMES curriculum is organized into twenty-six problems, or units, that have been developed in the classroom by teachers and students in a wide variety of schools. Most units can be used in grades K-8 although the level at which students approach a problem and develop a solution will vary according to age, ability, and interest.

RESOURCES FOR AN USMES PROGRAM

In addition to the USMES "How To" Series, there are--

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 of these guides to using USMES units 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.

Design Lab Manual: This guide helps teachers and administrators set up, run, and use a Design Lab—a place with tools and materials where students can build things they need for their work on USMES units. A Design Lab may be a corner of a classroom, a portable cart, or a separate room.

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

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.

The How To Series is a resource developed by the USMES Project. Earle L. Lummus, Project Director; Betty M. Beuk, Associate Director for Development; Thomas L. Brown, Associate Director for Utilization Studies; Quinton E. Baker, Associate Director for Administration.

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.

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THE USMES DESIGN LAB "HOW TO" SERIES

USMES and Skills

USMES students often see a need to learn new skills to help them get a problem-solving job done. Children seeking to improve a street crossing may want to learn how to use a stopwatch or how to make a trundle wheel. Children comparing different brands of paper towels may want to learn how to design an experiment and how to make a bar graph. The list can go on and on, but the pattern is clear: solving a real problem requires skills.

PURPOSE OF THE DESIGN LAB "HOW TO" SERIES

Children often design and build things in USMES. They may, for example, decide to build tables during a Classroom Design challenge, or they may build testing equipment while working on a Consumer-Research challenge. Whatever children decide to build, they will need to have skills with tools. The Design Lab "How To" series provides children information on changing saw blades, doing simple preventive maintenance, and, most importantly, using tools safely.

Primary age children or older children with reading difficulties should find that the large photographs and illustrations make it possible to understand most of the material being presented with little reliance on the accompanying word descriptions.

OTHER USMES "HOW TO" SERIES

Beginning "How To" Series: This series helps children learn skills like designing an opinion survey and choosing the appropriate measuring tool. Its cartoon-style format helps younger children and those with reading difficulties acquire the skills and knowledge they need to do things like redesign their classroom, find the best buy in potato chips, run a school store.

Intermediate "How To" Series: This magazine-style series covers in more detail essentially the same material as the cartoon-style series with a few booklets on additional skills. This series gives students a chance to read something they have a need to read.

HOW TO USE THE CARDS

Please look over all the cards in the Design Lab "How To" series before using them with children.

Hanging the Design Lab "How To" Cards on a bulletin board or on the wall near the tools is a good way to make the cards easily accessible to young builders. A clearly marked box of a loose leaf notebook kept near the tools are other good places to keep the cards.

Students should use the Design Lab series as the need arises. Give the students a brief explanation of how the cards can be used and leave the rest up to them (all electrical tools require an adult to be present when students are using tools).

When students do have questions, it might prove useful to know how the cards have been arranged.

- Each card has a large photograph of the tool or tools at the top.
- On most cards, the first frame is a photograph of a child holding the tool. This provides the young user with an understanding of how the tool is held.
- The remaining frames describe important skills in using the tool. Those skills which children have used most frequently have been placed first.
- As much as possible, directions, warnings, and types of arrows, etc., have been consistently used throughout the series. One problem is metric vs. English. Metric is used as much as possible, but lumber and many tools are still only available in the English system.
DESIGN LAB "HOW TO" SERIES

ELECTRIC TOOLS

HOW TO
Use a Saber Saw
Use an Electric Drill (Yellow)
Use a Glue Gun
Use a Soldering Gun

HAND SAWs

HOW TO
Use a Crosscut Saw (Blue)
Use a Coping Saw
Use a Keyhole Saw
Use a Hacksaw

OTHER HAND TOOLS THAT CUT

HOW TO
Use a File
Use a Circle Cutter
Use a Wood Chisel (Green)
Use a Block Plane
Use a Hand Drill

TOOLS THAT HOLD

HOW TO
Use Pliers
Use "C" Clamps (Brown)
Use a Screwdriver
Use a Hammer
Find the size of Nails

TOOL MAINTENANCE

HOW TO
Maintain a Saber Saw (gray)
Maintain an Electric Drill

MAKING A...

HOW TO
Make a Sawhorse
Make a Tri-Wall Slot (Orange)
Make a Bend in Tri-Wall

TOOLS THAT MEASURE

HOW TO
Use a Combination Square
Use a Rafter Square (Pink)
Use a Level

Created by Charles Donahoe, Barbara Low, and John Saalfield.

Photography by Jim Byler.

Thanks to the teachers who helped in the evaluation of these cards, and to Frank O'Brien, Wesley Perusek, Ed Manfre, and Peter D. Zevitas for their technical assistance.

Special thanks to the hands: Kern Donahoe and Kyle Gore.
HOW TO USE A SABER SAW

WARNING: ALWAYS HAVE AN ADULT PRESENT WHEN YOU USE A SABER SAW.

1. UNPLUG
2. OPEN THE BLADE HOLDER
3. CHOOSE A BLADE
4. INSERT THE BLADE
5. TIGHTEN THE SCREW
6. PLUG IN THE SAW
7. FEET SHOULD TOUCH THE TRIM WALL BEFORE YOU START
8. START THE SAW BEFORE CUTTING
9. A SABER SAW CAN CUT CURVES
10. UNPLUG WHEN FINISHED

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HOW TO USE AN ELECTRIC DRILL

WARNING: ALWAYS HAVE AN ADULT PRESENT WHEN YOU USE THE ELECTRIC DRILL.

1. UNPLUG DRILL
2. OPEN CHUCK
3. CHOOSE A BIT
4. INSERT BIT
5. CLOSE CHUCK
6. TIGHTEN WITH CHUCK KEY
7. UNPLUG WHEN FINISHED

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How to Use a Glue Gun

1. Plug in the glue gun.
2. Heat glue gun for 2 minutes.
3. Insert a glue stick.
4. Use the glue gun.

1. One way to glue: Zigzag the glue.
2. Another way: Glue one side...

1. Glue the other side.
2. Cooling off station.
3. Unplug.
4. Let it cool 1 minute.

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HOW TO USE SOLDERING GUN

1. CLEAN THE TIP WITH SANDPAPER
2. MELT SOLDER ON TIP
3. WEAR GLOVES
4. CLEAN WIRES WITH SANDPAPER
5. PUT WIRES ON A BRICK OR FOLI-COVERED BOARD
6. TOUCH SOLDEP TO THE HOT WIRES. IT WILL MELT ON THE WIRES
7. TWIST THE WIRES TOGETHER
8. HEAT THE WIRES WITH THE GUN
9. REMOVE SOLDER
10. PUT GUN ON A BRICK TO COOL
11. CHECK STRENGTH OF THE SOLDERED WIRES PULL GENTLY

CAUTION: DO NOT TOUCH THE FRONT OF THE SOLDERING GUN!

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HOW TO USE A CROSSCUT SAW

1. Draw a line
2. Sharp vs. Dull
3. Hold the saw
4. Pull
5. Lift
6. Pull again
7. Until you make a notch
8. Saw up and down
9. Saw until the end falls
HOW TO USE A COPING SAW

1. TO CHANGE A BROKEN BLADE...
2. TURN HANDLE TO UNSCREW...
3. DROP BLADE ENDS IN SLOT...
4. TURN HANDLE TO... TIGHTEN THE BLADE...

5. PULL DOWN...
6. PULL AGAIN TO MAKE A NOTCH...
7. SAW UP AND DOWN...

8. TO CUT A CURVE...
9. KEEP CHANGING THE TOP AND BOTTOM OF THE BLADE SO IT FOLLOWS THE LINE...
10. BACK-UP THE SAW...
11. TURN TOP...
12. TURN BOTTOM...
13. SAW UP AND DOWN...
HOW TO

USE A KEYHOLE SAW

1. WATCH OUT! THE POINT IS SHARP

2. YOU CAN CUT TRI-WALL

3. CUT A DOWEL

4. YOU CAN CUT WOOD

5. CUT CARDBOARD

6. TO CUT OUT A SHAPE...

7. DRAW SHAPE

8. DRILL HOLES

9. SAW EACH SIDE OF THE SHAPE

10. TO CHANGE A BLADE

11. TAP OUT THE CENTER PIECE

12. TO CHANGE A BLADE

13. OPEN SCREW

14. INSERT BLADE

15. INSERT BLADE

16. TIGHTEN SCREW

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HOW TO USE A HACKSAW

1. METAL
2. WOOD
3. DOWL
4. TRI-WALL

TO CHANGE A DULL BLADE:
1. LOosen THE WING NUT
2. PUT A NEW BLADE IN
3. TIGHTEN THE WING NUT

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HOW TO USE A FILE

1. PUSH
2. LIFT
3. PUSH
4. 
5. METAL
6. CUT OUTS AND CURVES
7. ROUGH EDGES
8. CLEAN FILES WITH A FILE CARD

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NOTE: CIRCLE DIAMETER WILL BE TWICE AS LARGE AS SETTING. A 15 MM SETTING MAKES A 30 MM CIRCLE.

BLADE FACES CUTTING DIRECTION BLADE GOES ¼ WAY THROUGH TRI-WALL.

FOR A CLEAN CUT GO AROUND 2 TIMES.

TO CHANGE BLADE: LOOSEN SCREWS.

INSERT BLADE.

BLADE FACES CUTTING DIRECTION BLADE GOES ¼ WAY THROUGH TRI-WALL.

TIGHTEN SCREWS.
HOW TO CHISEL WOOD

1. Always chisel with the grain going uphill. This stops splitting.
2. For a deep cut, the bevel should face up.
3. For a shallow cut, the bevel should face down.
4. To make a slot, measure the width and depth. Mark the board.
5. Saw to depth line.
6. Saw both sides.
7. Chop out the wood. Use a mallet to hit the chisel.
8. Turn the chisel over and lightly tap out rough wood.
9. Smooth the slot this way.
HOW TO

USE A PLANE

1. Adjusting Screw
   Finger Rest

2. Grooves Fit On The Notch

3. Plane Iron

4. The Cap Fits On Top Of The Blade

5. Slide Top Forward. Tighten Screw

6. Push Lever To Tighten Blade

7. Adjust Blade By Turning The Knob

8. The More The Blade Shows, The Deeper The Cut

9. Plane Until You Are Almost To The End

10. Lift Plane To Keep End From Splitting

FILE THE END

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HOW TO USE A HAND DRILL

1. Hold handle
2. Insert bit
3. Close chuck
4. Choose bit
5. Turn open chuck
6. Hold bit against board
7. Ready to drill
8. Turn handle
9. Keep drill moving as you pull it out
10. Keep drill moving as you pull it out

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HOW TO

1. SCRAPES STOP SCRAPES
2. STOP SCRATCHES
3. SCRAPES STOP DENTS
4. TRI-WALL

**G-CLAMP USES**
- CLAMP WHEN GLUING
- CALIPERS
- FLOW CONTROLLER

**MORE USES FOR G-CLAMPS**
HOW TO

HEAVY DUTY    LARGE    MEDIUM    SMALL    STUBBY    PHILLIPS    OFFSET

WOOD SCREWS

FLATHEAD

ROUND HEAD

PHILLIPS HEAD

BOLTS

MACHINE

STOVE

WASHERS + NUTS

FLAT WASHER

LOCK WASHER

HEX NUT

SQUARE

WING

FLAT SQUARE

START HOLE IN WOOD

Screw

PICK A DRILL BIT WIDER THAN THE SCREW

DRILL A CLEARANCE HOLE THROUGH THE TOP BOARD

PICK A DRILL BIT SMALLER THAN THE SCREW

DRILL A PILOT HOLE AS DEEP AS 1/2 THE SCREW LENGTH

SCREW BOARDS TOGETHER

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HOW TO

HOLD THE HAMMER AS CLOSE TO THE END AS IS COMFORTABLE.

TAP THE NAIL UNTIL IT STICKS IN THE WOOD

USE THE CLAW TO PULL NAILS OUT

1

2

3

4

5

6

7

8

BE CAREFUL! DON'T NAIL TOO CLOSE TO THE EDGE OR WOOD WILL SPLIT.

BANG! BANG! BANG!

BANG!

TWO NAILS HAMMERED TOWARDS EACH OTHER WILL HOLD BOARDS TOGETHER TIGHTLY.

THE NAIL SHOULD GO ABOUT THIS FAR INTO THE WOOD
HOW TO

HOW TO

COMMON NAILS

COMMON NAILS HAVE HEADS
USE A COMMON NAIL IF YOU WANT TO TAKE THE NAIL OUT LATER

COMMON NAILS ARE CALLED PENNY COMMON NAILS

PENNY NAIL GAUGE

IF YOU WANT TO KNOW HOW LONG A NAIL IS HOLD IT UP TO THE NAIL GAUGE CHART

THE LETTER d STANDS FOR PENNY
A 6d NAIL IS CALLED A 6 PENNY NAIL

FINISHING NAILS

FINISHING NAILS DO NOT HAVE HEADS
USE A FINISHING NAIL WHEN YOU DO NOT WANT IT TO SHOW

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HOW TO

MAINTAIN A SABER SAW

1. UNPLUG
2. UNSCREW THESE SCREWS TO REMOVE COVER.
3. CLEAN OUT SAWDUST WITH A CLOTH.
4. LOOK AT BRUSHES.
5. IF BRUSHES ARE LESS THAN 3mm REPLACE THEM *(FROM BLACK+DECKER)*
6. CLEAN HERE WITH SANDPAPER.
7. IS EVERYTHING IN PLACE?
8. REPLACE COVER.
9. OIL HERE EVERY FEW MONTHS.
How to Maintain an Electric Drill

1. Unplug
2. Unscrew these screws to take off the cover
3. Clean out dirt with a cloth
4. Take out brushes
5. If brushes are less than 3mm long, replace them (from Sears)
6. Oil here lightly
7. Clean here with fine sandpaper
8. Is everything in place?
9. Replace the cover
HOW TO MAKE A SAWHORSE

1. A 2" x 4" piece of wood will fit into the bracket.

2. Cut four legs to make the sawhorse. 60 cm legs work well.

3. Nail each board into the brackets.

4. Cut a piece for the top. 1 m is a good length.

5. Squeeze braces to the top piece.

6. Make two sawhorses and you can make these:

7. Nail top pieces to brackets.

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HOW TO

MAKE A WT WALL SLOT

DRAW LINE FOR THE SLOT
30mm ON EACH SIDE OF CENTER

CUT SIDES OF SLOT

TO MAKE A TABLE

CUT 2 PIECES FOR LEGS

CUT OUT SLOTS IN CENTER

PICT ATOP TO GLUE TO THE LEGS

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HOW TO MAKE A TRIWALL

WARNING: ALWAYS CUT AWAY FROM YOUR BODY

DRAW LINES ON EACH SIDE OF BEND LINE

DRAW LINES ON EACH SIDE OF BEND LINE

CUT LIKE THIS

BEND THE TRIWALL

TAKE OUT THE CENTER PIECE

DON'T CUT THE BOTTOM LAYER

BEND THE TRIWALL LIKE THIS

TO BEND TRIWALL LIKE THIS, CUT AT A 45° ANGLE

SOME THINGS TO MAKE

STRONG SHELF

TOTE BOX

DESK DIVIDER
HOW TO

NAIL EACH BOARD INTO THE BRACKETS

CUT A PIECE FOR THE TOP 1m IS A GOOD LENGTH

SQUEEZE BRACES TO THE TOP PIECE

MAKE TWO SAWHORSES AND YOU CAN MAKE THESE:
DRAW LINE FOR THE SLOT
7mm ON EACH SIDE OF CENTER

CUT SIDES OF SLOT

TO MAKE A TABLE:
CUT 2 PIECES FOR LEGS

CUT OUT SLOTS IN CENTER

PICK A TOP TO GLUE TO THE LEGS
HOW TO
MAKE
TRI-WALL

WARNING: ALWAY CUT AWAY FROM YOUR BODY

1. DRAW LINES ON EACH SIDE OF BEND LINE
2. CUT LIKE THIS
3. DON'T CUT THE BOTTOM LAYER
4. TAKE OUT THE CENTER PIECE
5. BEND THE TRI-WALL
6. TO BEND TRI-WALL LIKE THIS, CUT AT A 60° ANGLE
7. SOME THINGS TO MAKE:
   - STRONG SHELF
   - TOTE BOX
   - DESK DIVIDER

STAND THE TRI-WALL
HOW TO

USE A COMBINATION SQUARE

1. Pull out the ruler
2. The 90° angle can be used to draw lines like these
3. Draw lines like this with the 45° angle
4. If a board is level, the bubble is in the middle
5. If a board is not level, the bubble will look like this
6. To put the combination square together:
7. Push up the knob
8. Push ruler into slot
9. Keep holding knob up
10. Adjust by sliding ruler back and forth

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HOW TO

USE A RAFTER SQUARE

1. Place the rafter square on the corner to be measured.
2. This table leg is square.
3. This leg is not square.
4. This corner is square.
5. This corner is not square.

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HOW TO USE A LEVEL

A level helps you see if a board is tilted.

1. The level helps you see if a board is tilted.
2. The bubble is in the middle.
3. The bubble is not in the middle.

To make sure a level works, look at the bubble and remember where it is.

4. The bubble is not in the middle.
5. The level is in the same place on the table.
6. The bubble should be in the same place as before.

7. Turn the level around.
8. Make sure the level is in the same place on the table.
9. The bubble should be in the same place as before.

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