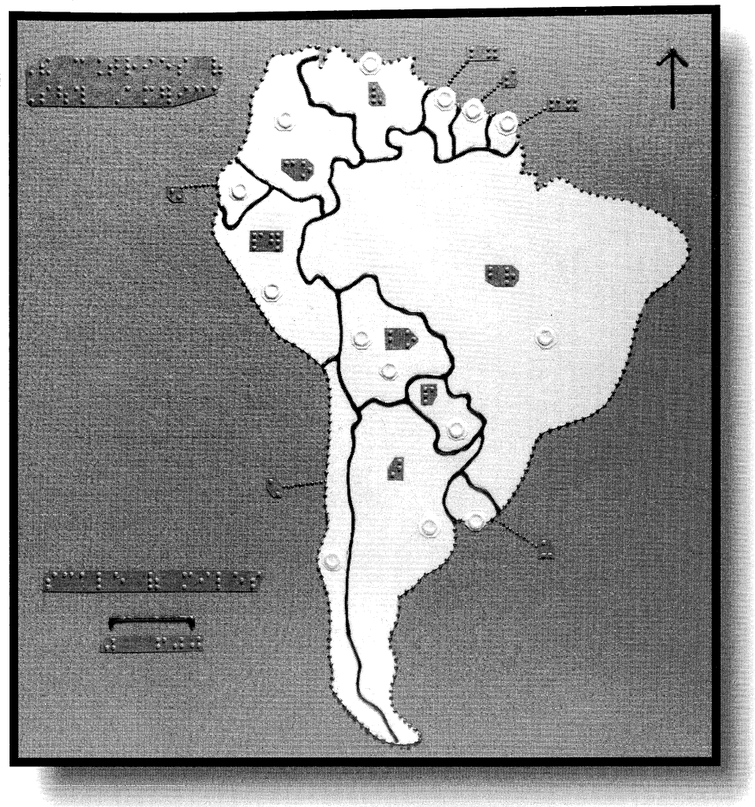


Tactile Graphics Starter Kit

• Guidebook •

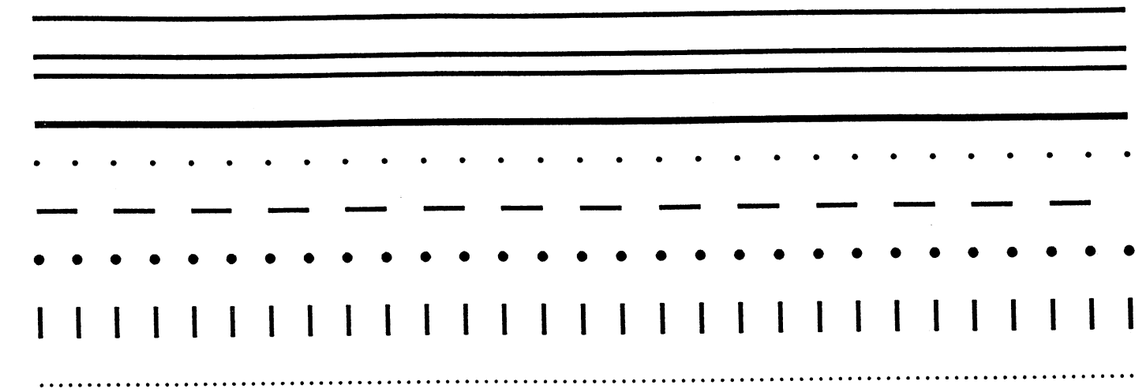
AMERICAN PRINTING HOUSE
FOR THE BLIND, INC.

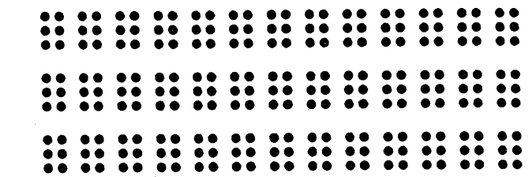
8-08839-00

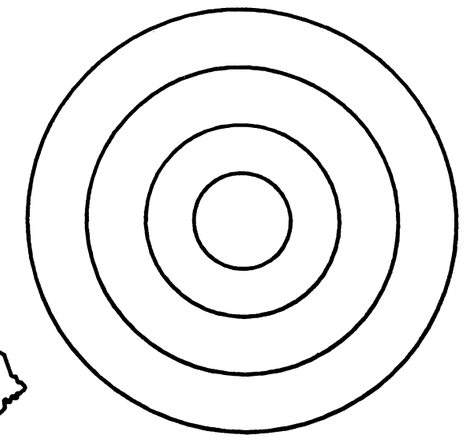
Tactile Graphics Starter Kit

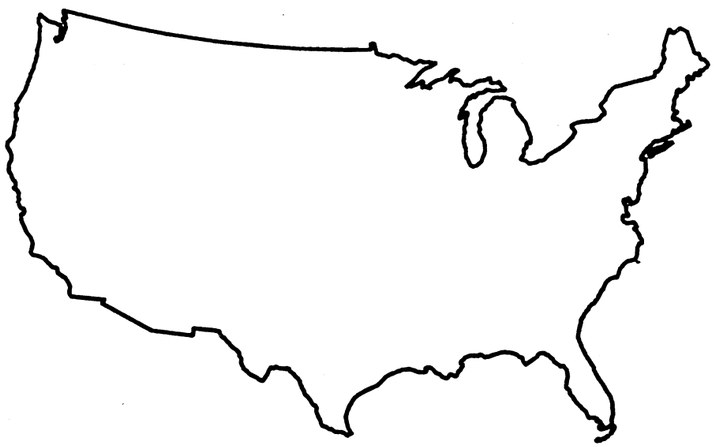
Project Directors: Tom Poppe and Frederick Otto

Make several copies of this sheet, then practice tracing the lines and figures with craft ink before making an actual graphic.









Tactile Graphics
Polly K. Edman
American Foundation for the Blind
15 W. 16th Street
New York, NY 10011

Polly Edman's book covers every aspect of tactile graphic design, based on her 30 years' experience in the field. It is extremely thorough (about 500 pages) but very readable and full of clear pictures and illustrations. She demonstrates numerous ways, from elementary to artistic, to present any concept tactually.

TACTILE GRAPHICS STARTER KIT

Introduction

The Tactile Graphics Starter Kit is intended for those who have little or no practical experience in making tactile graphics. The materials supplied or described are easy to use, yet they allow you to make graphic displays of almost any kind.

This set of materials will be a help to you if you have need for only a limited number of tactile displays. If you need to make a large number of graphics, you should invest some time in studying the research on tactile graphic design and obtain access to tools specifically made for tangible graphic production (see "For Further Reference" at the end of this booklet).

Tactile graphics may be used for maps of countries and continents, school campuses, or offices. They may be used for bar graphs, pie charts, or plotted curves. They can illustrate anything from children's books to anatomical charts to chemistry texts. With an understanding of the basic principle of tactile graphic design (i.e., *simpler is better*) and some practice, the sky's the limit!

The first section of this guide describes the use of the materials in the kit and suggests how other materials not included may be used. The second section is an adaptation of the *Tactile Graphics Guidebook*; it gives brief guidelines for designing tactile graphics, based on research showing what is effective for blind and visually impaired learners. (It should be noted that the research mainly reflects using lines and patterns *embossed* on paper, while the kit materials help you to lay designs *on top of* the paper. Some textures and lines are easily made with embossing devices but not with craft ink; likewise, the inks and areal patterns allow you to produce some designs that are impossible to make by embossing. In short, further research is needed to develop complete guidelines specifically for graphics made with raised ink and applied areal patterns.)

Section 1: Kit Materials

Craft Ink

The craft ink (also called fabric paint) included with this kit is one of several kinds available at craft stores or discount stores. It has been chosen for its ease of application (the smaller tips provide the best control and more consistent lines). When

you shop for more craft ink, be sure to examine the bottles for a fine tip and a comfortable feel.

When you draw lines with the ink, always pull the applicator back or toward you. This may mean turning the paper as you draw. If you try to push it away from you, the bottle tip will "plow" through the ink as it comes out and the line will spread out and be messy.

Leave time for a good deal of practice before placing the ink on an actual graphic; make sure you can produce even, smooth solid lines--and, of course, leave time for the ink to dry before using the graphic. See the sample card included with this kit for examples of raised ink lines, and then make copies of the sheet at the back of this guide and use them for practicing.

You can make dotted or dashed lines as well as thin or thick solid lines with craft ink. Lines of small dots are very prominent tactually, but they can be tedious to make and, if the ink forms sharp peaks, uncomfortable to the touch. A series of very short dashes may be an answer to both these problems. The second section of this guide tells how to choose the appropriate lines for your graphic.

You can draw a line right on top of a fabric or paper areal pattern, *provided the texture of the line doesn't compete with the pattern texture*. (A dashed line cannot easily be distinguished on a coarse or dotted background, for example.) The "Principles" section discusses the importance of *contrast* and *spacing* in tactile graphics.

Tools such as a straight edge, T-square, and French curve will help you in making good quality lines. As long as you angle the bottle tip away from whichever tool you're using, the ink won't flow under the tool's edge.

Fabrics and Patterns

The samples of fabric and embossed paper included in the kit are tactually discriminable, from each other and from plain paper. There are many other interesting textures, but these were chosen because they hold their shape well when you cut and fasten them (note that screen or mesh fabrics may need to be stapled rather than glued to your display.) All of them are easily made or obtained from fabric stores.

For Further Reference

This list is by no means comprehensive, but it describes items that are readily available and highly recommended that will help you make good graphics:

Guidelines for Mathematical Diagrams
Braille Authority of North America
Available from: National Braille Association
3 Townline Circle
Rochester, NY 14623-2513
(716) 427-8260

This booklet gives rules for adapting or transcribing mathematical figures in textbooks into tactual form. Contact NBA for individual or institutional prices.

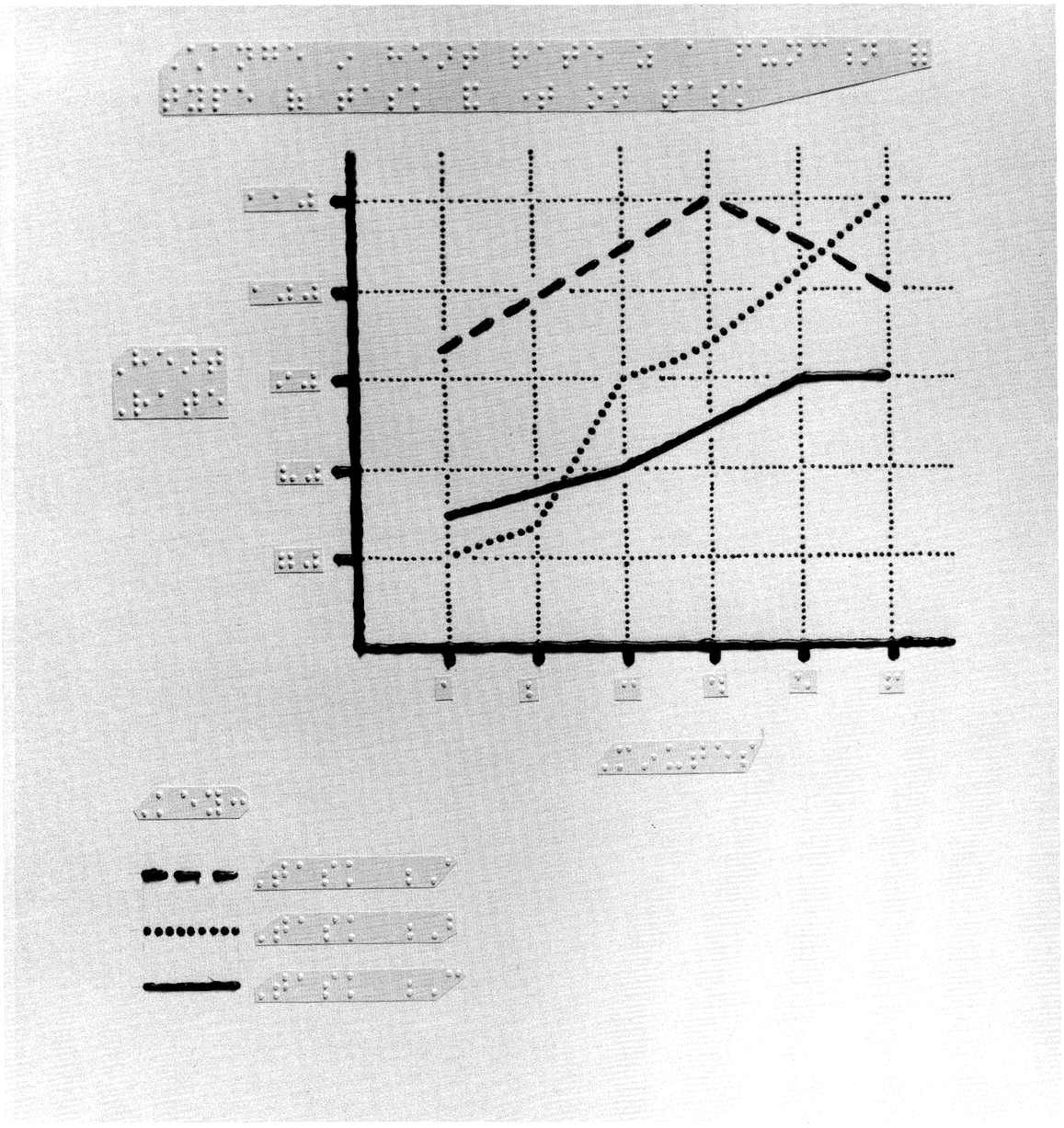
Tactile Graphics Guidebook (catalog no. 8-39100-00)
Graphic Aid for Mathematics (catalog no. 1-00460-00)
American Printing House for the Blind
P.O. Box 6085
Louisville, KY 40206-0085

The *Tactile Graphics Guidebook*, on which this guide is based, is sold separately or as part of the full *Tactile Graphics Kit* (cat. no. 1-08840-00). The kit and instructions assume the use of foil masters and a thermoforming process; the principles, however, are clear and applicable to other media.

The *Graphics Aid for Mathematics* lets students construct figures and graphs to illustrate math concepts. It consists of a cork board mounted with a rubber mat which has an embossed grid of 1/2 inch squares on it. The board measures 18 x 19 inches. Included are push pins, rubber bands for making lines, and flat spring wires for making circles and arcs.

APH also sells embossed or bold-line graph paper in packets of 100 in a variety of grid sizes.

GOOD:



The names of the fabrics included are *buckram* (the stiff white mesh) and *duck cloth* (heavy canvas). Sheets of embossed paper patterns are included as well. Also recommended but not included are tightly textured wallpaper or poster board, real or imitation leather, and plastic screen.

Point Symbols

The paper point symbols included in the kit may be cut out and glued to a graphic. All of the point symbols provided have been tested and shown to be tactually discernable from each other. Read the "Principles" section to learn the uses of point symbols.

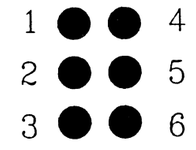
Alphabetical Index of Braille Signs

Braille labels are an essential part of tactile graphics. If you don't know the braille code, read the paragraphs that follow and study the Alphabetical Index of Braille signs; these steps should get you started, especially if you just need to make a few labels. Try to have an experienced braille reader check your work before you go public with it! An even better idea is to have the students or clients who will be using the graphic make the braille labels themselves--this lets them participate in making the display and anticipate the kinds of information they'll find on it.

A Very Short Course in Writing Braille

All braille letters have from one to six dots in them. Regardless of the number of dots, each letter is written in a single braille "cell." Think of a cell as a frame which can hold up to six dots, and which determines the spacing between dots.

The braille cell has two columns, with space for three dots in each column. The dots down the left side are called dots 1, 2, and 3, and those down the right side are called 4, 5, and 6:



To make the letter *a*, you write only dot 1. The letter *b* has dots 1 and 2 in it; *c* has dots 1 and 4; *d*, dots 1, 4, and 5. The reference booklet shows how to write all the

letters of the alphabet in braille. Notice, however, that there's a good deal more in the booklet.

Grade 2 braille, the proper form to use for writing your labels, lets you condense certain groups of letters and even whole words into a cell or a few cells. This saves both space and reading time. Words like *the*, *for*, and *with* are written in a single cell; so are the common letter combinations *er*, *ing*, *th*, *sh*, *ar*, and others. Some words take a special sign when contracted: to write *father*, you make a cell with dot 5 followed by a cell with the letter *f*. Other words just contract by omitting letters: *together* is written *tgr*.

Since there are a limited number of dot combinations possible, the Grade 2 code makes several uses out of each braille shape. For example, the shape with dots 1, 3, and 4 is the letter *m* when used in a word, but stands for *more* when it appears by itself. Put a dot 5 cell in front of the *m* and it becomes *mother*; put a cell with dots 4, 5, 6 in front of *m* and it becomes *many*.

The numerals 1 through 9 and 0 are written like the first ten letters of the alphabet. Place the number sign (dots 3, 4, 5, 6) in front to indicate that the next shape is a number and not a letter. Placing a dot 6 before a letter makes the letter a capital.

The reference booklet shows you all the configurations of the braille code, but not how or when to apply them. You can probably make readable labels just from careful attention to the sheet, but, as stated before, you'll be much better off finding a student or an experienced braille user to make labels for you if you don't know the code.

Slate and Stylus

The slate and stylus, in combination with the braille reference booklet, allow you to make braille labels for the features of your graphics. You'll probably find it easier to make labels on a separate sheet of stiff paper, cut them out, and glue them to the graphic, rather than position the slate directly on the picture.

Using the Slate

If you're not familiar with how a slate works, take a minute to study it. Note that it has rows of rectangular windows on one flap, and rows of small depressions which correspond with these windows on the other flap. Each rectangular window is a

6. The label for the Y-axis ("Heart Rate") is oriented vertically, making it hard to read.	6. Orient the label horizontally.
7. The display has no title.	7. Place a brief descriptive title at the top.

Graph: Change in heart rate as a function of type of task and time on task

Problem	Solution
1. The major drawback of this display is clutter, due to crowding and to the lack of contrast between lines used.	1. Enlarge the picture and take care to make the lines contrast with each other.
2. The axes do not contrast well with the grid lines or the braille numerals.	2. Use a wide solid line for the axes.
3. The braille numbers are too close to the axes.	3. Put unit markers along the axes and place numbers next to them, maintaining a 1/8 inch (3 mm) spacing.
4. The grid lines are too prominent and too close to the data curves, making it difficult to follow the curves tactually.	4. Use a finely dotted line or very thin solid line for the grid, and maintain 1/8 inch spacing between grid lines and data curves.
5. The lead lines connecting the labels to the curves cross grid lines and are hard to follow.	5. Use a key to identify the three types of lines.

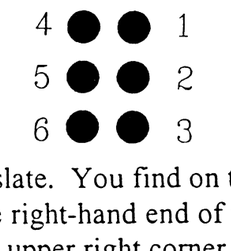
braille cell, and each depression is one of the six dots of the cell. The edges of the cells are ridged to guide the stylus to the dot positions.

Open the slate on a table, like a book, and place your paper in it. Align the top of the paper with the top edge of the slate, and the side of the paper close to the slate's hinge. Now press the slate closed so that its pins clamp the paper in place. The side with the windows should be facing up.

To write, you'll put the point of the stylus into a cell and press the paper into the dot depressions on the lower piece. This makes raised dots on the paper. But there's a hitch. Notice that, since you are pressing down to form the dots, they appear on the underside of the paper. When you take the page from the slate and turn it over, you'll have braille writing--but it will be backwards!

The solution to the reversal problem is to write from right to left on the slate. In this manner, the braille will read properly left to right when you turn the paper over. The key to writing this way is to re-envision the braille cell numbering when using a slate, picturing dots 1, 2, and 3 on the *right* side of the cell and dots 4, 5, and 6 on the *left*:

(The braille cell for slate writing)



As an example, say you want to write *ok* with the slate. You find on the reference booklet that *o* is made with dots 1, 3, 5. Go to the right-hand end of the slate and place the stylus in the first cell. Press it down in the upper right corner of the cell to make dot 1. Then press down in the lower right corner to make dot 3. Find the middle position on the left side of the cell for dot 5, and that completes your letter *o*. Move your stylus one cell to the left and make dots 1 and 3 for the letter *k*.

Some people may prefer to make braille dots with craft ink. Teachers have tried 10 lines per inch plastic canvas (used for needlework projects) or just the window half of the slate as a template to lay out the dots on paper. In either case, secure the template and use a sharp pencil to make the dots; then remove the template and go back over the dots with the ink. The practice sheet at the end of this guide lets you try making dots with craft ink.

The "Principles" section, below, gives special instructions for labeling graphics in braille.

Other Materials Used in Making Tactile Graphics

There are as many approaches and ideas for making tactile graphics as there are people making them, and they range from the very low-tech to the highly elaborate. On the assumption that users of this Starter Kit don't need or have access to expensive, computer-driven devices, thermoform machines, and the like, the paragraphs below focus on inexpensive, commonly available materials.

Numerous methods of making raised lines have been tried and proven effective. In addition to craft ink, you may try colored glue (such as Elmer's Glucolor™); the lines are not as consistent, but the colors are quite vivid. (Keep in mind that most visually impaired people have some degree of useful vision; visual contrast is thus a help in addition to tactual contrast.) Teachers have also reported success using a hot glue gun.

Some fabric paints have tiny specks of glitter in them which, when the paint dries, give the line a somewhat grainy texture. It provides a slight contrast to other craft ink lines.

Some varieties of fabric paint are "puff ink," meaning they expand when they're exposed to heat. These have a slightly rubbery feel when dry.

A tried and true method of making lines involves gluing lengths of string or heavy thread. Put some glue on your fingers and run them down the string to put a light coat on it. For contrast, put a series of knots in a string before gluing. For fuzzy lines on a child's picture, use pipe cleaners.

Office supply or art supply stores carry rolls of very thin colored tape. This tape comes in different sizes, and, although its adhesive doesn't seem too sticky, it holds to the paper surprisingly well. The tape that resembles fishing line is especially recommended for its tactual properties.

You can make simple, readable tactile graphics very quickly by embossing on sheets of plastic film if you use a rubber pad underneath. Transparency film (used in copiers) and other relatively heavy plastic sheets form raised images on the underside, while

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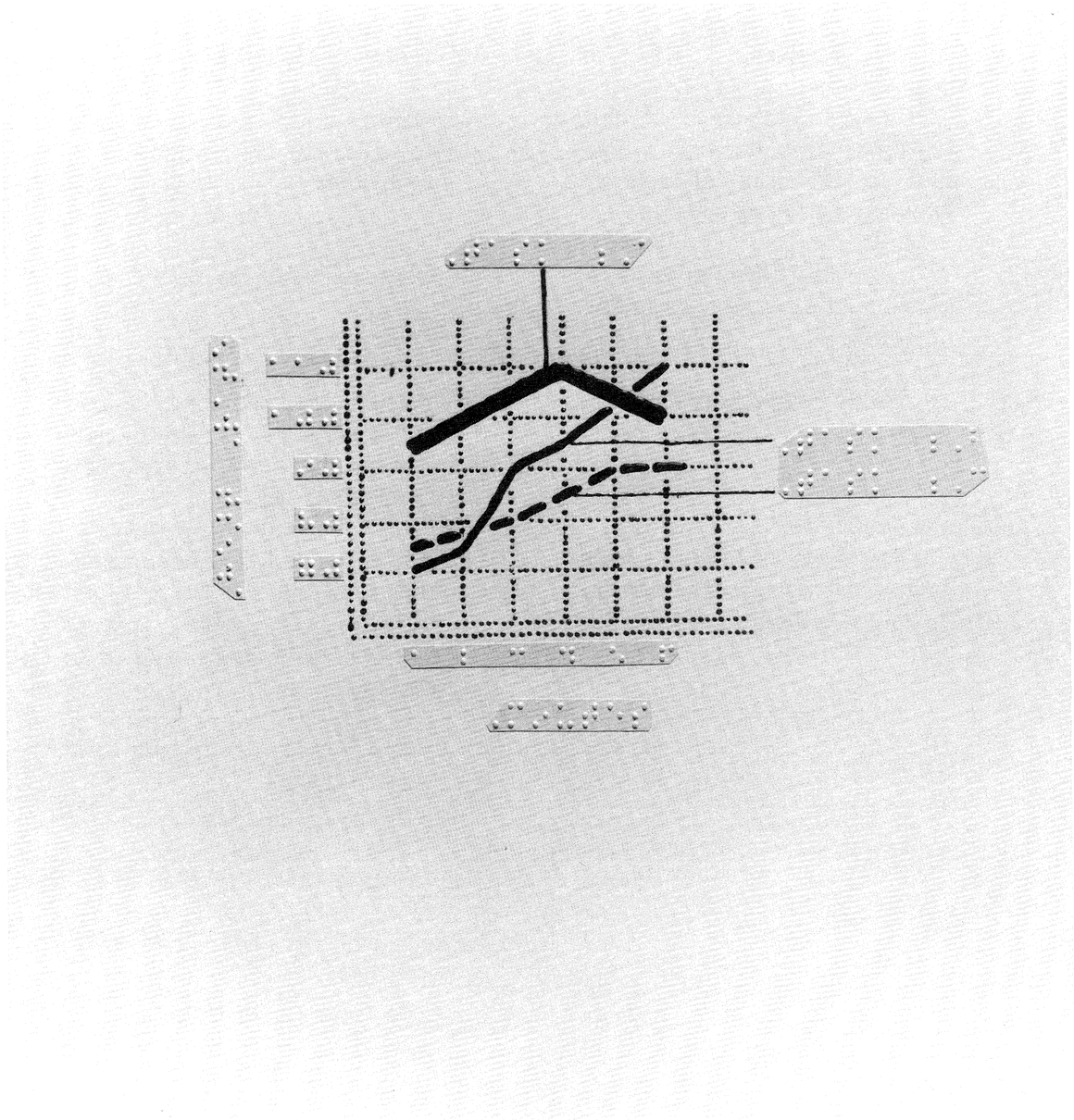
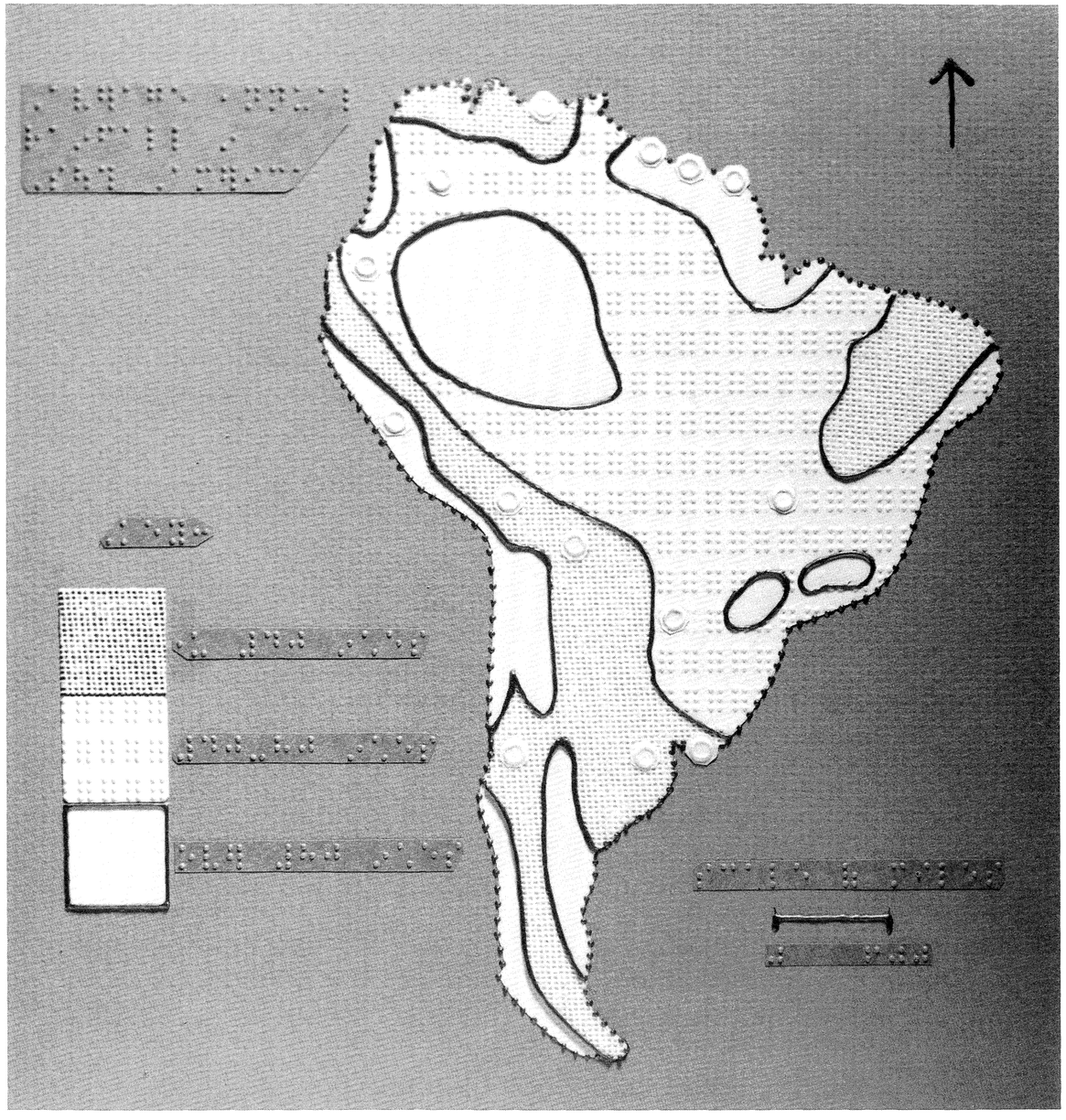


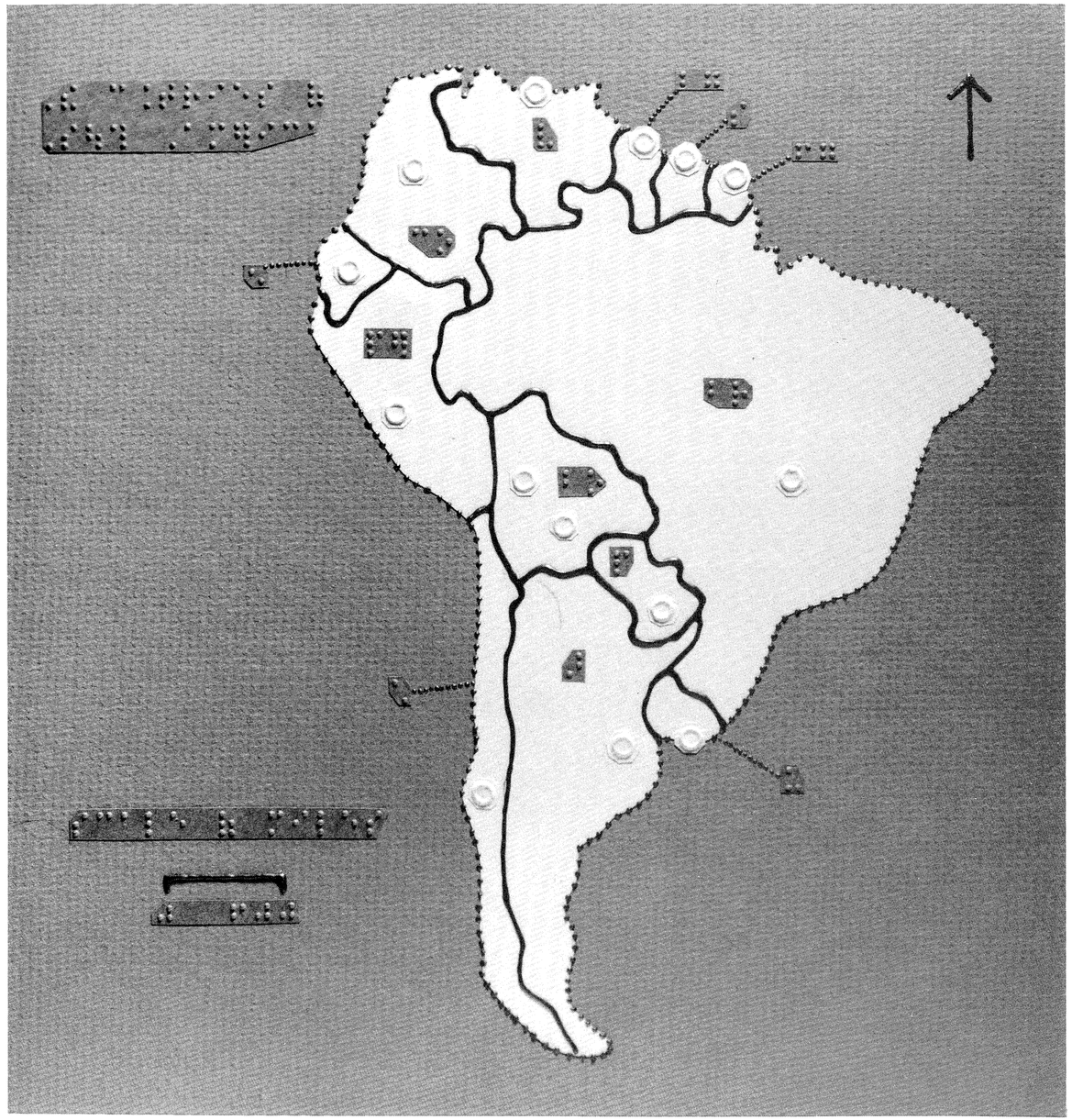
GOOD:



thin Mylar™ sheets "pucker up" and form a raised image on the drawing side. An ordinary stylus or ball-point pen works well as an embossing tool in all these cases. The advantage here is quickness; the disadvantage is the lack of visual contrast, tactual contrast, and height.

When teaching graphic concepts to young children, it may be helpful to attach actual objects or models of the things being pictured next to the images. This practice may help reinforce the connection between 3-dimensional objects and their 2-dimensional representations, which children need to develop to progress with tactile graphics.

GOOD:



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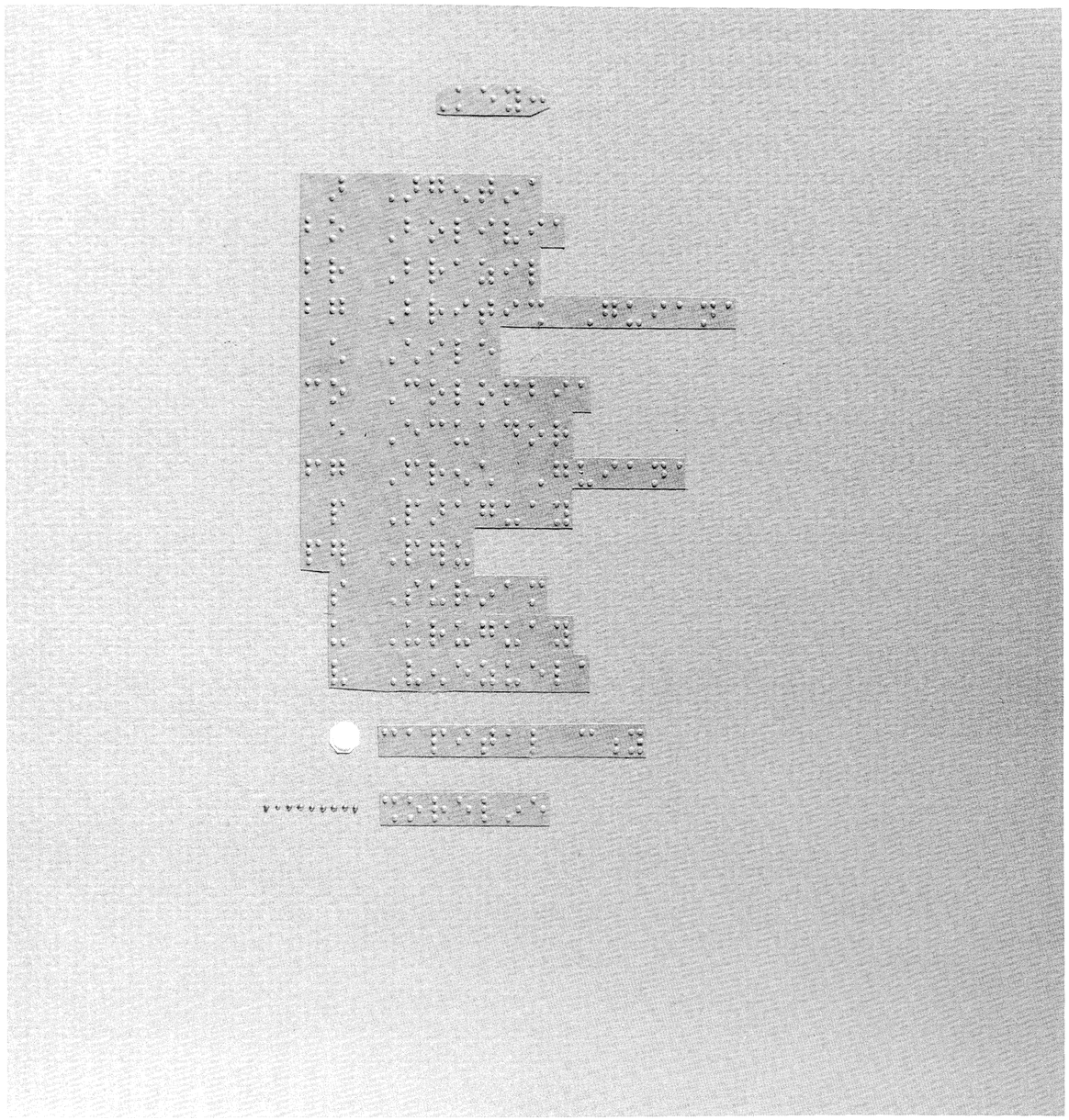

PRINCIPLES OF MAKING TACTILE GRAPHICS

General Rules

The first rule in making a tactile graphic is to PLAN AHEAD. Ask yourself: What's the main purpose of this picture and what's the simplest way to convey it?

Think of graphics as supplements to verbal or written instructions. Eliminate details that may enhance the visual picture but clutter up the tactile picture. Think tactile, not visual; consider how much the eye can process and how (relatively) little the fingertips can process at once. Remember to test your tactile graphics yourself--if they're not legible to you, they probably won't be clear to a blind person either.

If a picture presents several different concepts at once, break the tactile version into separate pictures, each one showing a different concept. One part may provide an overview. (See the examples in the accompanying photos.)

Present objects two-dimensionally. Where an object needs to be illustrated three-dimensionally or in perspective, try to produce separate front, top, and side views in two dimensions. Teachers may want to try exposing young students to three-dimensional representations to see if they can develop a true, transferable understanding of them, but the current assumption holds that only an exceptional few will benefit from a prolonged effort in this area.

Put all titles at the top of the graphic. Place scale bars and other indicators consistently, preferably at the top of the page. Put keys or legends where they can most easily be referred to (before or after the graphic, or on a facing page, but never on the back of the graphic).

Wherever possible, maps should be made with north toward the top of the page. If this isn't possible, indicate north with a simple arrow labeled N. (Arrows are described below under "Lines.")

Space at least 1/8 inch (3 mm) between adjoining symbols; more space is preferable. Anywhere one line crosses another, or a point symbol breaks a line, or a line runs through an areal pattern, etc., this 1/8 inch rule applies. Maintain this spacing even if you have to distort the visual accuracy of the picture somewhat.

Avoid using too many kinds of symbols in one graphic; remember the importance of tactual contrast (discussed below under "Lines") and spacing.

Colors

If your students or learners have some usable vision, use brighter colors for the most important features of the display. Keep in mind, however, the need for visual contrast--bright colors placed right next to each other may defeat the purpose.

Lines

Use different types of lines (thin, heavy, dashed, double) to convey different types of information (for example, state borders vs. international borders).

When only two kinds of lines are needed, or when lines intersect, use ones which feel very different: a solid and a dotted line, for example. When lines intersect, break one line enough to let the other line pass through.

Dotted or dashed lines are generally thought to stand out the best, so draw the most important features of the picture with dashed lines, followed by solid lines for the lesser features.

Use lead lines only when necessary; they can be mistaken for actual features of the graphic. A written label placed close to the item is preferable. When a lead line is needed, make a thin lead line (dotted or solid) very different from any other line used in the picture, with no arrow. The accompanying photos of sample graphics show how *not* to use lead lines.

When an arrow is required, make its shaft at least 1/2" inch long. The wings of the arrowhead should be 1/4" long and they should be at 45° to the shaft.

Point Symbols

Any point symbol (except the stair step) can be used to represent any item in your graphic you wish. Use them to indicate specific items on a display, such as major cities, features of a floor plan or map, points on a graph, etc. Be sure to provide a key

5. The north indicator used is a tactile version of a visual convention.

5. Use a simple arrow pointing north, with or without a label.

South America: countries and average annual rainfall

Problem	Solution
1. The major problem with this graphic is its complexity. Too much information is packed in, making it cluttered.	1. Make two separate maps, one showing the political boundaries of the countries, the other showing the rainfall areas. Include the capital cities in both maps so they can be used for cross references.
2. The point symbols used for the capitals are too close to the lines and areal patterns.	2. Enlarge the maps, using as much of the paper as possible, to leave more room between symbols. Note also that, on the "good" map, where a city symbol appears in the raised dot paper areal pattern, the dots around the symbol have been flattened to make the symbol more distinct.
3. The lead lines from the labels to the countries run through textures and other lines, which makes them confusing and difficult to follow.	3. Use one- or two-letter abbreviations for the countries and provide a key. Keep lead lines from crossing other lines.
4. The shapes of the rainfall areas represented by the areal patterns are not easily discernable.	4. Make lines around the boundaries of the rainfall areas.

for easy reference as to the meanings of the symbols (see "Labels," below), and be consistent in using symbols in graphics of the same type.

Notice that the stair step symbol has two distinct heights which are tactually discriminable. This symbol can be oriented in any way to indicate the direction of stairs. All the other symbols should keep the same orientation if they're used more than once in a display.

A fairly large dot or bead of craft ink makes a legible point symbol. The practice sheet at the end of this guide has some appropriately sized dots for you to try making into point symbols.

Labels

Use Grade 2 braille for all writing.

If space permits and the diagram isn't too cluttered with symbols, place braille labels on or next to items (but don't break up a line for a label). The placement should leave no doubt as to what's being identified.

When space is limited and a key is required, you may either: 1) use single letters in alphabetical order down the page for easy reference between the key and the labeled items, or 2) use a 2-letter abbreviation of the item being labeled. In either case, spell out the full label in the key.

Omit the capital sign in labels or abbreviations where meaning isn't at stake. Retain the capital sign in titles or captions where there is more room. In addition, when using abbreviations for labels, see that one of the braille cells contains a dot 3 or a dot 6 for clarity if at all possible.

Areal Patterns (Fabric and Textures)

Use written labels where possible to describe areas of your graphic. Use textures sparingly, only to add extra information; avoid "decorating" the graphic for visual appeal.

If you use a ribbed texture like corduroy, orient it the same way each time it's used in a graphic.

Choose textures for maximum contrast when more than one is used. Also, when several patterns are used, make lines defining the borders of the areas.

Texture is useful for distinguishing water from land on maps.

Graphs

Omit grid lines from a graph if the intent is just to show the shape of a curve; use them (made as small as possible) if specific numerical information is to be gained.

Use a large dot point symbol to mark a specific point on a data curve to be studied, as well as to mark the origin of a set of axes.

Put unit markers along the outside of each axis at equal intervals with a minimum of 1/2 inch space between; make them 1/4 inch long, or, if no grid lines are used, 1/4 inch on each side of the axis.

Leave space between the individual bars of a bar graph.

Samples of Good and Bad Tactile Graphics

The photos on the following pages depict graphics made with materials from this kit. The South America maps are examples of *layering* textures and lines on top of each other. The process is very time-consuming, but the finished product can be very informative and durable if it's done well. Consider this technique for graphics you'll want to keep for repeated use. The graph is more typical in that it is made only with ink and braille, with no need for areal textures.

Try studying the pictures on your own before referring to the discussions of "Problems" and "Solutions." See how many recommendations you can make for improving the poorly done graphics, and then compare your ideas with the suggested solutions.

POOR: