ABSTRACT

Focusing on the production and utilization of printing processes in constructing effective visuals for teaching, this bulletin contains articles on the silk screening stencil process, use of a similar process with a portable mimeograph, and the hectograph process. The first article lists equipment needed to make a silk screen, steps in building the printing outfit, three methods for constructing stencils, recipes for film adherent liquid and water soluble adherent liquid, directions for paint application, screen cleaning procedures, and drying of finished silk screen prints, including instructions for building a drying rack. The second article illustrates use of the portable hand-operated mimeograph, and the third describes a hectograph and gives instructions for its construction and use. The final article briefly describes more expensive processes, i.e., typeset, intaglio, planography (offset), electrostatography (xerography), and diazo. (JB)
Colorful, good quality, well-designed visuals will call attention to your projects and make your teaching more effective. An easy, inexpensive process for making these colorful posters, leaflet covers, flip charts, flash cards, and similar objects, is silk screen.

Essentially, silk screening is a stencil process whereby ink or paint is applied through a stencil onto a surface to receive the print. You can use it on paper, cards, plastic, glass, or metal, and on curved surfaces as well as flat.

The equipment you need consists of:

- A base to support the paper or cardboard to be printed.
- A silk-covered frame hinged to the base, with removable pin hinges.
- A paper or plastic stencil fixed to the side of the silk that contacts the underside of the screen.
- A squeegee with a rubber edge to spread the ink or paint over the silk screen.
- Ink or Paint.

**STEPS IN MAKING THE PRINTING OUTFIT:**

Make a frame from smooth, non-warping, firm wood, and hinge this to a 'slightly larger base made from the same quality material.' Use only hinges with removable pins so the frame can be taken off for cleaning.

**Down the middle of the frame, on the sides that contact the base, make a groove 1/8 inch (4mm.) wide and 3/8 inch (10mm.) deep.**

Lay the silk evenly over the grooved side of the frame and attach it in the following manner: Place a cord on the silk directly over the groove. Tap it lightly with a hammer to force the cord and silk into the groove. To give the silk proper tension, use a wooden wedge to drive the cord little by little toward the bottom of the groove. Keep...
Attach the silk to the frame by using a cord. To give the silk the proper tension, use a wooden wedge to drive the cord and the silk into the groove.

To test the tension, drop a quarter or similar coin (20 to 25 mm. in diameter) on the silk from about a foot high (30 cm.). When the coin will bounce to almost the same height from which it was dropped, the silk will have the proper tension. You must then discontinue pushing the cord any further because greater tension might tear the silk.

Thumb tacks may be used instead of the cord, but this makes it difficult to stretch the silk evenly and you damage the frame when you change pieces of silk.

THREE POPULAR METHODS FOR MAKING STENCILS

1. For simple work, designs may be cut from paper and the paper stencil adhered to the screen (the silk).

2. Stencils for very detailed designs or illustrations are usually made photographically. This process consists essentially of exposing transparent positive copy to light-sensitive gelatin film. Portions of the gelatin protected from light during exposure remain soluble in water while areas exposed become insoluble. Unexposed areas are then washed away and the remaining gelatin is adhered to the mesh of the screen, forming a printing stencil.

3. For most situations, you will probably want to use the knife-cut film system. The idea is quite similar to the paper stencil method, except you use a film consisting of lacquer, acetate or gelatin-coating adhered to a waxed paper or film to be cut.
plastic backing. By knife-cutting this film, you can prepare more intricate stencils than you can prepare with paper.

**STEPS FOR USING THE KNIFE-CUT FILM METHOD**

Since this is the method you will use in most situations, probably, let's look at it in more detail. There are basically 4 steps involved.

1. Cut the film with a knife to form the design to be printed.

![image of cut film and stenciling process]

The film is transparent, so you can place it over a copy of your design in order to have a pattern to follow when you are cutting the film. Take care not to cut through the backing paper or plastic, though. As you cut the areas to be printed, peel them away from the backing paper and discard them.

2. Soften the film with a solvent and press it into the mesh of the screen.

![image of softened film and screen printing]

After drying, you can peel away the paper or plastic backing, leaving the desired film stencil adhered to the screen.

Here are 2 recipes for making solvents in case these are not readily available commercially.

**Film Adherent Liquid**

- 1 gallon paint thinner
- 2 teaspoons castor oil

For slower action, increase amount of castor oil; decrease for faster results. Overdoing will cause failure.

**Water Soluble Adherent Liquid**

- 1 gallon Methylated Alcohol
- 2 teaspoons sugar

Amount of sugar can be increased to slow action but may damage stencil during process.

3. When dry, peel away the backing paper.

4. Print the copies you want. After the stencil is completed, place the screen over the material to be printed.
Put a couple spoonfuls of paint in a line across one end of the screen. The paint should be like auto transmission grease, not thin enough to fall through the screen on its own accord. Use a squeegee (stiff rubber blade) to draw ink across the screen, forcing it through the open areas in the stencil and onto the surface to be printed. Lift the screen. Remove the print and replace it with the next piece to be printed. Pull the paint back the other way for the next print. Place an amount of paint on the screen which, together with the blade pressure, will produce an acceptable print with one stroke of the squeegee.

If you are printing on an extremely absorbent surface, such as clay-coated stock or blotter type paper, it will help to use some binding varnish in fast drying poster inks.

Either oil soluble or water base paints can be used, but water base has easier cleanup. Mrs. Benjamin Cox, VITA participant, lists the following recipes for making silk screen inks.

**Recipe #1**

- ½ cup llinit starch (not instant)
- ¼ cup boiling water
- ½ cup soap flakes

Mix starch with enough cold water to make a smooth paste. Add boiling water and cool until glossy. Stir in soap flakes while mixture is warm. When cool, add coloring such as tempera powder, food color, ink or a water-soluble dye.

**Recipe #2**

- ½ cup cornstarch
- 2 cups water
- 1/8 cup soap flakes

Bring water to a boil. Mix cornstarch with a small amount of cold water and stir the two together. Bring to a boil and stir until thickened. Add soap flakes while warm. Color.

**Recipe #3**

- Dissolve ½ cup cornstarch in 3/4 cup cold water
- Dissolve 1 envelope gelatin (1 tablespoon, unflavored) in ½ cup cold water


**SOME OBSERVATIONS**

Paints that were colored with powdered tempera are more brilliant than those colored with food colors or ink. Presumably many types of water soluble dyes could be used.

Recipe #2 seems quite lumpy but this does not affect the printing quality.

When stored in jars with tight fitting lids, these paints should have a shelf life of several months.

One or two teaspoons of glycerine added to any of the above recipes would make the paint somewhat easier to use. This is not necessary.
Never let dried particles of paint fall on the screen or get mixed into the paint as they may puncture silk during printing. (A small hole in silk may be repaired with a small drop of shellac.) These recipes have been tried and found effective in a temperate climate.

REGISTRATION

A two-color effect is possible by using colored paper with colored ink, of course. But for additional colors, more than one stencil must be used, and registration becomes very important. Registration is matching the stencil and printed page so that each color falls exactly where it is wanted. VITA participant John Tomlinson offers these suggestions for achieving proper registration:

(a) Print the first color using registration guides. Registration guides are thin pieces of cardboard or several layers of tape placed on the base of the silk screen to show you where to put the paper to be printed. Keep guides thin, as thick guides can cause silk to break when the squeegee blade presses the silk against the guides.

(b) Tape a piece of wax or thin translucent paper on one edge of the baseboard beneath the second screen to be printed.

(c) Print a trial image of the second screen onto this paper.

(d) Raise the screen.

(e) Slide the sample of the first printing into position beneath the taped wax paper until the desired registration with the first printing is achieved.

(f) Once registered, carefully hold the first printing sample in position, and remove the wax paper.

(g) Tape new registration guides on two sides of the first printing sample.

(h) Now proceed to print the second color. Subsequent colors are printed by returning to Step (b).

CLEAN THE SCREEN WHEN FINISHED

Immediately remove and save surplus paint with a small square of cardboard. Then wash the screen with water if you are using a water base paint, or clean it with kerosene or the appropriate paint solvent if you are using oil paints. When cleaning rags stop picking up color, the screen may be stored for future use. If no further use is to be made of the screen, apply the appropriate solvent to remove the stencil and then wash with soap and water and a soft flat brush.

DRIYING YOUR SILK SCREENED PRINTS

Silk screening is good for 25 to 200 copies, but drying these can sometimes be a problem. This is especially true if temperature or humidity influence drying speed.

One of the easiest ways to dry your work is to lay the copies on a table or the floor until they are dry. This is cheap too, if you have plenty of space and don't need the area for other work. But this usually isn't the case. Besides, there's the ever-present hazard of a stiff breeze messing things up. Cleanliness considerations also discourage this practice.

VITA participant John Tomlinson supplies this diagram of a drying rack that occupies nominal floor space, is easily put together, and costs very little to make. It consists of 2 inch x 2 inch upright pieces of lumber, with 1 inch x 1 inch cross bars about an inch apart.
Hanging the copies, as shown in the picture, could also be a good inexpensive solution. Care must be taken to keep a breeze from blowing the copies against each other, though, as this could smear the paint.

---Silk Screen ideas from:
Organization of American States
Indiana University
The Multiplier Handbook

Jamaican participant Frank Mitchell, right, demonstrates his silk screen skills to his Indiana University instructor, Mr. Taylor, center, and a friend. Note newly-printed posters hung to dry in the background.

---THE PORTABLE HAND-OPERATED MIMEOGRAPH---

The portable hand-operated mimeograph is similar to the silk screen process. The stencil is placed under the silk and held there with Scotch Tape or other adhesive. Then the paper is set in place on the printing area and the silk screen frame is lowered over it. Ink such as Gestetner is rolled on a separate spreading surface (or inking surface), and then the inked roller is passed back and forth over the silk screen.

---Diagram---

- Rubber roller approximately 8 1/2” in width
- Inking surface made of same material, set in lid of case
- Printing surface of hardwood, metal or plate glass, smooth and flat, slightly larger than frame
- Stand and holder for the roller
- Fine grade of silk or organdy, a bit larger on each side than inside measurement of frame
THE HECTOGRAPH...A Simple, Useful Duplicator

The hectograph is one of the cheapest and easiest methods for making 50 to 100 copies of drawings or writing. So little equipment is needed that you can carry the hectograph on field-trips to make teaching materials as you need them.

A special ink is used to make a master copy of the item to be reproduced. When this master copy is placed face down on the gelatin surface of the hectograph, the ink transfers to the gelatin and then copies can be lifted from the gelatin.

MAKING A HECTOGRAPH

Get a shallow container approximately 9½ inches wide, 14 inches long, and ½ inch deep. Many stores have cookie sheets or other cooking utensils that work quite well. Prepare a gelatin mixture to fill this container using 66 grams of fish (or animal) glue, 209 cubic centimeters of glycerin (about one-fifth liter), 130 cubic centimeters of warm water (.14 liter), and 4 ounces of sugar. Break the glue into small pieces and put them in the water for two hours, which will be sufficient for the glue to soften and absorb sufficient water. Place the pan containing this glue and water mixture inside another larger pan with hot water (to make a double boiler); be careful that no additional water spills into the glue pan. Allow the glue to totally dissolve, stirring constantly. Add the glycerin, stir, and add the sugar. Heat for 20 minutes. When the mixture becomes hot, pour it into the shallow pan, straining it through a piece of thin cloth to remove hard particles and any dirt that may have fallen into the mixture. Use a piece of paper to brush away any bubbles that appear. Set the pan on a completely level table so the gelatinous mixture will harden with a smooth surface. If this makes too much liquid for the container you are using, simply reduce the quantity of ingredients, but maintain the proportions found in the recipe. In this case we are using approximately 1 part glue with two parts water and four parts glycerin. This relationship should be maintained.

OTHER RECIPES

Two other basic hectograph recipes come from Guatemala, and a third from U.S. Peace Corps volunteers in Bolivia. You may want to use them if the ingredients are more readily available. Increase quantities to make the amount you need, but maintain proportions.

Recipe #1

- Glue 12 grams
- Gelatin 2 grams
- Water 7½ grams
- Sugar 2 grams

Recipe #2

- Gelatin 10 grams
- Sugar 40 grams
- Glycerin 120 grams
- Barium Sulfate 8 grams

Recipe #3

- 12 sheets of gelatin
  (approx. 3" x 8")
- 1 cup sugar
- 1 liter glycerin
- 1 liter water

PURCHASE OR MAKE HECTOGRAPH INK

Hectograph pencils, typewriter ribbons, carbon paper, and inks are manufactured in various colors. However, if these are not available in your country, you can make your own ink by mixing 22 cc alcohol, 14 cc water and 2 grams Indigo blue. Other colors can be made by using dyes such as saffron (yellow-orange), and green of methyl instead of Indigo blue.
HOW TO USE THE HECTOGRAPH

Write or draw on a piece of bond paper, using the special hectograph pencil, ink or typewriter ribbons. Use only inexpensive fountain pens, as hectograph ink will ruin the pen in a few months. When the ink has dried, wet the gelatin with a slightly warm sponge or rag. Then remove excess water by blotting the surface with newspaper. Carefully apply your original, face down, to the gelatin. Use a piece of cardboard to smooth out all bubbles under the paper. After the original has been in contact with the surface of the gelatin for at least thirty seconds, remove it rapidly. You are now ready to make copies.

TO MAKE COPIES

Place a sheet of bond paper on the gelatin. Rub lightly with a piece of cardboard to insure perfect contact. Then immediately remove the paper. Repeat until you have printed the desired number of copies. Time is important, so work rapidly. You will find that it is easier to remove the copies without damaging the gelatin if you lay down paper strips on the gelatin at the margins of the printing surface. You will be able to produce at least fifty copies, and, with care and speed, one-hundred.

CARE FOR THE HECTOGRAPH

Immediately after removing the final copy, rinse the gelatin with a rag and plenty of cold water. Remove the bubbles from the surface and store in a cool place. In twelve hours the ink will sink to a lower level, and the Hectograph will be ready for use. If the Hectograph is kept covered and dirt-free, it will be usable for many publications. If small pits from bubbles or scratches appear, or if the gelatin is severely damaged, melt in a double-boiler arrangement and pour it back into the shallow pan.

SPIRIT OR FLUID HECTOGRAPH PROCESS

Essentially, this is a refinement of the hectograph process just described. A master copy is made using special carbons, pencils or dyes, with lettering or drawing done by hand, with stencils, or on the typewriter. By using colored carbons, you can add color to your work at little extra cost, and all colors are printed simultaneously (again hectograph-spirit duplication is the only process with this feature). Each master will reproduce only a limited number of copies, however, usually less than one hundred.

To make the master for spirit duplication (Ditto, Banda, Repro), letter or draw directly on the dull side of the master sheet, with the shiny side of the master facing the carbon. Make firm lines and eliminate unnecessary details. You can change carbons at any time to add a different color.

The master is then placed on the machine. Copy paper is passed between moistening rollers and then pressed against the master to pick up a fine layer of the carbon or dye that was used to make the master.

"A low-cost spirit duplicator is an excellent investment, wherever small quantities of duplicated materials are needed," says Indiana University Audio-Visual Center.

THE SPIRIT OR FLUID HECTOGRAPH PROCESS
Simone O'Malle, Cameroun, learns to use a spirit duplicator from Eugene Rankin of the Indiana University Audio-Visual Center Staff. Spirit duplication gives inexpensive, quick copies from a master copy made with specially treated carbon-like papers. You can draw, write or type to make a master, and various colors can be simultaneously printed on a single page if different colors are used to make this master.

**MIMEOGRAPH — Gestetner, Ronco**

Mimeograph is one of the most popular means of duplicating announcements of meetings, examinations for students, and leaflets describing a process, procedure, or new product. The initial investment in equipment is small, and it is practical to operate whether you need twenty copies or several hundred.

Typing, hand lettering, or free hand drawings can be used on a mimeograph stencil and the finished product is quite nice (see sample at the bottom of this page).

The mimeograph stencil consists of a porous tissue covered with a material that ink will not pass through. This is usually attached to a protective paper backing.

As you draw or type on the stencil, the coating is pushed aside, exposing the porous tissue. Be careful not to tear this tissue as you make your design. If you make a mistake, a correction fluid quickly coats the tissue again and you can then re-type or make other changes to correct your error.

The stencil is then placed on the ink cylinder of the machine. As the cylinder rolls across the paper being printed, ink is squeezed through the porous tissue and the written or drawn material is reproduced on the paper.

It is possible to print in different colors by changing ink and running each color separately. This can get rather complicated and is not recommended for normal use.

Stencils may be used over and over as long as they remain in good condition. An easy way to store them after use is to put them between layers of newspaper.

A new electronic process allows you to type your original on plain paper and add line or screened illustrations by the "paste-up" method. This means simply cutting out illustrations you want and pasting them on the original manuscript. The "paste-up" is scanned by a moving light source in a special stencil-cutting machine, and a stencil is cut by an electrical spark. The electronic stencil is then run the same as an ordinary stencil.
OTHER PRINTING PROCESSES

So far we have been discussing printing methods anyone can use in his office. To complete this issue on printing processes, we will now look briefly at processes requiring larger, more costly equipment. Since special training is needed to operate and maintain this equipment, we will only discuss general characteristics without detail.

RELIEF—Letterpress, Typeset

In relief printing, the image is produced from a relief, or raised, surface similar to a rubber stamp or a typewriter key. Rollers deposit ink on the raised surfaces, paper is pressed against them, and the ink is transferred to the paper.

Types are available in a wide variety of sizes and styles. Equipment ranges from simple hand machines to fast automatic rotary machines. High speed, high quality, and large-quantity runs are features of this process. Colors are printed in separate runs.

INTAGLIO—Etchings, Engravings, Gravure

The intaglio process prints from an image below the surface of the printing plate. Plates can be made by hand or photographically. When printing, the plate is inked and wiped clean, leaving ink in the depressions. The paper being printed then absorbs the ink from these depressions, giving the copy.

Equipment ranges from simple hand machines to rotary presses capable of running up to 10,000 copies per hour. Each color is run separately.

PLANOGRAPHY—Offset, Lithography

This process is based on the principle that grease repels water but holds greasy ink. An image that will accept greasy ink is put on the plate either by hand or photographically. The background holds water but not the ink. The inked image is transferred from the plate to the paper by pressure.

Equipment ranges from hand presses to fully automatic rotary machines. Plates can be paper, plastic or metal. Depending upon the plate and equipment used, runs can be from a few hundred copies to many thousand.

ELECTROSTATOGRAPHY—Xerography

Electrostatography includes all processes using electrostatic charges to record and reproduce patterns in a visible form. Basically, the process consists of forming a latent electrostatic image by light rays, making this image visible by the attraction of a powder and "fixing" the image by a solvent or by heat. The major uses are copying documents and pages of books and preparing offset masters for printing multiple copies.

Equipment is elaborate and quality falls short of photographic processes. Improvements are taking place rapidly, however, and it does give a quick way to make copies.

(left to right) Gezatchew Yirgou, Ethiopia, Anthony Anga, Tanzania, Julius Omotethina, Nigeria, Clement Macha, Tanzania, Jonathan Sokomba, Nigeria, Sadler Jensen and Jonathan Adeka look at offset press during their training at Indiana University.
Diazo processes depend on the fact that diazonium salts "diazo" can combine with a colorless coupler to form a dye. When ultra violet light strikes a diazo, it is decomposed and cannot combine to form a dye. To make a print, diazo sensitized material is exposed through a translucent or transparent master. Light passing through the base destroys the diazo salt. Where the material is protected from light by the image on the master diazo, salts remain which can be developed to form a dye image.

Several colors are available and transparent, translucent, or opaque bases can be used. This process is particularly good for making prints from large drawings on tracing paper or cloth, and for making transparencies for display or projection.

Adapted from Indiana University training handouts.

Of Interest...

Wonder Board

Madison A-V Company, 62 Grand Street, New York, New York, 10013, U.S.A., announces a new substitute material for chalkboards which can be used as a writing surface, projection screen, wall covering and as a magnetic panel. It comes in 50 yard rolls 54 inches wide at $210.00 per roll, in sections 50" x 50" at $14.00 each, or $4.60 per yard in 54 inch width.

Magnetic sections 34" x 48" (and other sizes are available) costs $18.00 per section.

The manufacturer states that the material is impervious to stains, cleans easily with a damp cloth and can be used as a substitute for a normal wall covering or finish. Water soluble inks, "permanent" inks and all kinds of paints may be used and removed with solvents without damage to the surface. It is claimed that Wonder Board is practically indestructable.

Low Cost 16mm TV Projector

Kalart Co., Inc., Plainville, Connecticut 06062, U.S.A., has a new low cost 16 mm TV projector for use in a TV film chain. It can be used with an optical multiplexor or as a regular 16 mm projector.

The Model STV-TH projector is designed to meet the growing demand for a reliable, flexible and moderately priced TV projector for television distribution systems which show films in the educational, broadcasting, industrial and military markets.

It features as standard equipment a complete solid state circuitry, lamp brightness controls, optical sound pick-up with provisions for adding magnetic sound, an audio output of 600 ohm impedance, a built-in monitor speaker with volume control and a 2000 foot reel film capacity. Optional features are: remote control, magnetic sound playback and different lenses for filling various TV systems requirements. Basic model lists at $1,250.00.

Portable Copying Machine

The 3-M Casual Compact weighs 12 lbs. and can be carried in an attaché case. This is a low-volume copier that provides quick, high quality copies. It uses no liquids or powders. Copying is done on photo sensitive papers. The Casual Compact sells for $69.95 and should be purchased directly from Minnesota Mining and Manufacturing Company. The address for the International Division is P.O. Box 3800, St. Paul, Minnesota 55101.

Message to AAACE Members Overseas

Pledger Carmichael, President, American Association of Agricultural College Editors, says the high cost of air mail is forcing them to start using surface mail for the AAACE Newsletter and other materials. If this causes problems for any of you, Mr. Carmichael wants you to write to him and he will see what he can do to keep using air mail. His address is College of Agriculture, University of Georgia, Athens, Georgia 30601 U.S.A.
INTERCOM NEEDS ARTICLES ABOUT YOUR WORK

The purpose of Intercom is to let you share your experiences and ideas with other information people around the world. If you have found an easy way to do something, maybe someone else can use the same idea.

Take this issue for example. We are discussing printing processes, and the silk screen information came largely from the Inter-American Institute of Agricultural Sciences of the Organization of American States in Costa Rica. The adaptation of the silk screen to make a portable mimeograph came from Brazil. Plans for the silk screen drying rack were supplied by a VITA participant, while the idea of letting pieces dry by clipping them to a wire came from Indiana University. We can all benefit from using each other's ideas and experiences.

Why don't you write me a letter telling what you are doing? We can work your ideas into an article for this newsletter. Or, you write the article yourself. Pictures can be interesting and can help tell your story, so send a picture and we'll try to include it also. My address is: David P. Winkelman, IAMS, U.S. Department of Agriculture, Room 3510-S, Washington, D.C. 20250, USA. I'll be counting on something from you for the next issue.

A "HELLO"

Since this edition of Intercom is my first contact with many of you, I want to take these last few lines to say "hello" and to introduce myself. I am the new U.S. Department of Agriculture Communications Training Officer in the International Agricultural Development Service. Robert Doan, who formerly had this position and published Intercom, is now a Program Specialist in the Foreign Training Division.

To further introduce myself, I have an Illinois livestock-grain farm background, with B.S. and M.S. degrees from the University of Illinois for work in agricultural communications. As a student I was active in the College of Agriculture's Student News and Information Bureau. SNIB is a student replica of Hadley Read's Extension Information Office, and disseminates news about agricultural students and their activities. For 1½ years I was Director-in-Chief of SNIB, which then had 85 members working in its six divisions (photo, radio, TV, press, publications, and exhibits).

After receiving my M.S. degree, I spent 2½ years in South America, working largely in extension information. Now, of course, I am with USDA.

If there's ever any way I might--assist you in your work--perhaps by sending you a publication on some information dissemination technique, or maybe by getting USDA information specialists to answer some of your questions--let me know.

We will also be glad to send you extra copies of Intercom if you can use them, or to add anyone to our mailing list that would like to receive Intercom regularly.

Sincerely,

David P. Winkelman
Communications Training Officer

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