Traditional Printing Processes

Unit: Work Flow

Problem Area: Processes

Lesson: Traditional Printing Processes

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Define basic printing terms.**
2. **Describe traditional print processes.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Klosowski, Thorin. "A Simple Guide to Screen Printing Your Own Shirts," *Lifehacker*. Accessed Sept. 18, 2018. http://lifehacker.com/5886483/simple-guide-to-screen-printing-your-own-shirts.

Leurs, Laura. "Printing Processes," *Prepressure*. Accessed Sept. 18, 2018. https://www.prepressure.com/printing/processes.

"Lithography," Encyclopaedia Britannica. Accessed Sept. 18, 2018. https://www.britannica.com/technology/lithography

"Print is Big," *PrintIsBig.com*. Accessed Sept. 18, 2018. http://printisbig.com/index.html#big.

"Printmaking Techniques," *Masterworks Fine Art*. Accessed Sept. 18, 2018. http://www.masterworksfineart.com/educational-resources/printmaking-techniques/.

"Stamps Take Flight: Classic Engraving," *Smithsonian National Postal Museum*. Accessed Sept. 18, 2018. https://postalmuseum.si.edu/stampstakeflight/classicengraving.html

"What is Gravure?" *Gravure Association of the Americas*. Accessed Sept. 18, 2018. http://gaa.org/what-is-gravure.

Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- digital printing
- electroplating
- flexography (flexo)
- gravure (rotogravure) printing
- image
- incise
- inkjet printer
- intaglio printing
- lithograph
- lithography
- offset printing (offset lithography)
- plate
- plating
- printing
- printmaking
- registration
- registration mark
- relief printing
- screen printing
- substrate

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *According to PrintIsBig, the global print industry is worth $898 billion and drives $3.8 trillion in related services. Direct and related services include: $133 billion in online advertising, $15 billion in music industry products, $102 billion in video game industry products, and $1.1 trillion in the U.S. auto industry. Print shapes a majority of the marketing effort by businesses and non-profits. Although digital marketing techniques can be effective, print marketing is still the most powerful way to promote products and services.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Define basic printing terms.

Anticipated Problem: What is printing? What are basic printing terms?

I. ***Printing*** is the production of an image onto paper or other substrate. ***Printmaking*** is an indirect means of creating art by transferring an image or design to a surface (typically, paper) by use of contact with a block, plate, stone, or screen.

A. SUBSTRATE: A ***substrate*** is the base material onto which an image is printed. Examples of a substrate include paper, fabric, glass, and metal.

B. IMAGE: An ***image*** is a visual representation, depiction, or likeness of a physical object or person. Images may be paintings, pictures, or digital displays. Various traditional printing methods create an image obtained from a printing element. Customarily, the printing element was a metal plate, an intaglio engraving, a wood block, or a metal plate cut in relief.

C. INTAGLIO: ***Intaglio*** (pronounced "in-TAL-ee-oh") ***printing*** is a printmaking technique where the image is engraved or incised onto the surface and the printing is done from ink that is held in the lines or sunken areas below the surface of the plate. ***Incise*** means to mark with a cut or series of cuts. An intaglio print is the opposite of a relief print. Intaglio is mainly used for stamps and paper currency.

D. RELIEF: ***Relief printing*** is a printmaking technique in which the image to be printed is raised from the surface of the printing plate. The surface around an image is cut away so the image appears "in relief" on the printing plate. The printing plate is inked and pressed onto a printable surface. This creates a relief print. The process is similar to using an ink pad and rubber stamp. Relief printing is sometimes referred to as block printing.

E. REGISTRATION: ***Registration*** is the precise alignment and placement of printed images. Proper registration means that any impression on the paper occurs in the exact position as intended. The images are positioned with reference to each other or to margins, folds, etc. Registration is affected by movement of paper as it runs through production equipment and by the mechanical settings on such equipment. Registration uses either visual reference lines (register marks) on the copy or mechanical methods of alignment.

1. <u>*Colored Ink*</u>: Printing presses are able to apply multiple colors or styles of ink onto the same surface. A registration system is always used when more than one application of ink is required. Registration marks ensure that the paper is aligned in the exact spot every time and that the colors of ink are applied in the proper place.

2. *Registration Mark*: A ***registration mark*** is a cross-hair line (target) outside the page or image area that is used to help align color separations or to align the printed images on the press sheet. The mark appears on all separations. The most common use of registration marks is in the production of multicolor documents, brochures, flyers, posters, T-shirts, etc. The manufacture of those items requires that each color is applied in a separate step. Registration marks are required on any substrate that is processed multiple times through an offset printer, a rotary press, or a screen.

F. PLATING: A ***plate*** is the tool that transfers an image onto paper or other substrate. Plates may be made of metal, paper, or plastic. ***Plating*** is the process of applying a metallic coating to a substrate material.

1. *Plating Technique*: ***Electroplating*** is a chemical process that uses an electric current to deposit a thin layer of metal onto the surface of a work piece (substrate). The process is performed at low temperatures and it can be used on various types of a substrate. Other types of plating include vapor deposition, vacuum, and sputter deposition.
2. *Usage*: Plating is used on plastics or other materials that require a protective coating or need a metallic finish. It is used on machinery parts to help resist corrosion, oxidation, and the effects of humidity. 3D printed plastic models can be plated to add metallic decorative coatings. The coating is also used to create reflective surfaces, add circuit paths (conductivity), and improve durability.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–A through VM–D to illustrate the basics of printing.*

Objective 2: Describe traditional print processes.

Anticipated Problem: What are traditional print processes?

II. The major commercial printing processes are lithography, screen printing, flexography, gravure, and digital printing. Each method is distinctive. The choice of method depends on such factors as the type of image to be reproduced, the production cost, the time frame for production, and the amount of printed material that is needed (size of the print run).

A. LITHOGRAPHY: **Lithography** is the process of printing from a smooth, flat plate (limestone or metal) on which an image is applied with a greasy medium. The image will repel water and accept oil-based ink. The blank area on the plate will repel ink. It is a method of printing based on the principle that oil and water do not mix. A ***lithograph*** is a picture created by using a smooth plate on which an image has been drawn with an oily, chemical substance that attracts ink.

1. *Traditional Lithography*: Traditionally, the image or artwork is drawn or painted on a flat surface with an oil-based ink or substance. Then, the work is fixed with a chemical solution. Next, the surface is covered with water that absorbed onto the surface in all areas *except* where the oil-based image is located. Oil-

based ink is then rolled onto the surface to rest only atop of the originally created image (that was drawn with oil based materials). Finally, paper is pressed onto the flat surface to absorb the ink and create the image. One color at a time is printed and, usually, one color is printed per day. This is a painstaking, time-consuming process performed by hand.

2. *Modern Lithography*: Modern lithography utilizes images that are transferred photographically and then prepared using a nontoxic chemical coating. The image can be printed directly onto paper or it can be offset by transferring the image onto a flexible sheet (rubber) for printing and publication. ***Offset printing (offset lithography)*** is a printing technique that transfers ink from a plate to a rubber blanket (an intermediary cylinder) to paper instead of directly from plate to paper. This damping, inking, and printing process is rapidly performed by a series of rollers. It is the most common form of commercial printing.
3. *Usage*: Tradition lithography has historically been used to create fine art prints and quality reproductions. Modern offset lithography is used for long to medium print runs of books, magazines, posters, and packaging products.
4. *Advantages and Disadvantages*: Offset printing produces a consistently high image quality, even on large print runs. However, the product image is of less quality than that produced by gravure printing. The set-up and production time is fast. Printing plates have a long life, since the plates only come in contact with the printing blanket rather than the more abrasive paper. The production costs are inexpensive. However, the costs for a small print run are high.

B. SCREEN PRINTING: ***Screen printing*** is a stencil method in which ink is wiped across a mesh screen, pressing the ink through the openings on the screen and onto the substrate below. One screen is used for each color printed. The screens must be registered to ensure that all the colors line up correctly. Each color is applied using a different stencil, one at a time, combined to achieve the final look. This method of printing is sometimes called serigraphy.

1. *Steps of Screen Printing*: There are few steps in screen printing. Basically, a graphic image is created in the form of a stencil pattern and applied onto a mesh screen. The screen is stretched onto a frame and fixed into a position on a press. Ink is placed inside the frame and rubbed across the surface, typically with a rubber squeegee. The ink passes through the open areas of the screen, printing the image onto the substrate.
2. *Advantages*: The screen printing process can be used on almost any material. T-shirts and other clothing, plastic items, signs, and posters may all be screenprinted. Screens are inexpensive and they are quickly produced. The same screen can be used multiple times and the graphic on the screen will not wear off easily.
3. *Disadvantages*: Because ink must be pushed through a screen, creating color gradients is difficult. Multiple steps are required to print individual colors. Complex details are few in screenprinted items. Screen printed images are of moderate quality.

C. FLEXOGRAPHY: ***Flexography*** **(flexo)** is a relief printing method in which an image on a flexible printing plate is inked and the inked image is transferred to the

substrate. This is a modern version of letterpress printing (using a stamp to transfer ink). Flexography uses a flexible rubber plate etched with a slightly raised design. These etched plates are wrapped around rotating cylinders on a press. At high speed, the cylinders rotate around a reservoir of ink and press the ink onto the substrate. The substrate can be paper, as well as plastic, metal, or other materials. Flexography has typically been used to print labels and packaging materials.

1. *Advantages*: This method is suitable for both absorbent and nonabsorbent materials. Flexography uses both water- and oil-based inks. Flexography is quick (quicker than gravure printing) and economical.
2. *Disadvantages*: Flexography produces less complex graphic images. The edges are not crisp and the colors are less bright. The product images are of lesser quality than those produced by gravure printing.

D. GRAVURE: ***Gravure (rotogravure) printing*** is a type of intaglio printing process in which an image is etched on the surface of a cylinder and paper is pressed against the inked cylinder on a rotary press. The image is transferred directly to the paper, unlike offset printing, which uses an interim cylinder. This is a quick and simple printing process that consistently produces high quality images but gravure is also expensive. The set-up cost and the cost of engraving the cylinder are quite high. Because the production costs are quite high, gravure is cost effective only for long runs. Like flexography, gravure is often used for long runs of high-quality, multicolor printing. Products printed by gravure include postage stamps, wallpaper, and gift wrap. Because gravure produces fine, detailed images, this process can be used for large runs of very high quality art and photography. Where photographs are being reproduced, this printing method may be called photogravure.

E. DIGITAL PRINTING: ***Digital printing*** is a method in which an image is sent from a computer file directly to a device that accepts texts and graphics. Digital printers put the image directly onto the substrate. Digital printing, unlike other printing methods, does not require a printing plate. The advantages of digital printing are low production costs and fast turnaround time. However, ink and substrate options are limited. This print method is ideal for short print runs and customized print media. Digital printing is commonly used for one-of-a-kind prints and posters, large-scale billboards and signs, photographic prints, and flyers. The two types of printers that dominate the field of digital printing are inkjet printers and laser printers.

1. *Inkjet Printer*: An ***inkjet printer*** produces an image by spraying liquid ink onto a substrate. The process leaves tiny dots of ink, which from a distance, appear as a continuous image. Typical inkjet printers produce copy with a resolution of at least 300 dpi (dots per inch). They are commonly used for documents, posters, and signage.
2. *Laser Printer*: A laser printer applies a charge that attracts toner and that toner is then transferred and fused into the paper. Laser printers are frequently used in offices to produce documents. They can also be used to produce small run printings of books, brochures, direct mailing materials, bank statements, etc.

Teaching Strategy: *Display a range of printed products that use traditional printing techniques. Use VM–E through VM–I to illustrate commercial printing processes. Demonstrate the screen printing process in preparation for students completing the lab activity. Assign LS–A.*

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the Review/Summary.

Application. Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. f
2. h
3. a
4. e
5. g
6. c
7. b
8. d

Part Two: Completion

1. image
2. incise
3. registration mark
4. offset printing
5. lithography
6. flexography
7. gravure printing
8. digital printing

Part Three: Short Answer

Answers may vary slightly but would be similar to three of the following advantages and three disadvantages of screen printing.

a. Advantages:
   (1) Usable on almost any material
   (2) Screens are inexpensive and they are quickly produced
   (3) The same screen can be used multiple times
   (4) The graphic on the screen will not wear off easily

b. Disadvantages:
   (1) Because ink must be pushed through a screen, creating color gradients is difficult.
   (2) Multiple steps are required to print individual colors.
   (3) Complex details are few in screenprinted items.
   (4) Screenprinted images are of moderate quality.

Sample Test

Name _____

Traditional Printing Processes

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. flexography
b. gravure printing
c. intaglio printing
d. lithography
e. printing
f. relief printing
g. registration
h. screen printing

_____1. A printmaking technique in which the image to be printed is raised from the surface of the printing plate

_____2. A stencil method in which ink is wiped across a mesh screen, pressing the ink through the openings on the screen and onto the substrate below

_____3. A relief printing method in which an image on a flexible printing plate is inked and the inked image is transferred to the substrate

_____4. The production of an image onto paper or other substrate

_____5. The precise alignment and placement of printed images

_____6. A printmaking technique where the image is engraved or incised onto the surface and the printing is done from ink that is held in the lines or sunken areas below the surface of the plate

_____7. A type of intaglio printing process in which an image is etched on the surface of a cylinder and paper is pressed against the inked cylinder on a rotary press

_____8. The process of printing from a smooth, flat plate (limestone or metal) on which an image is applied with a greasy medium

Part Two: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. A visual representation, depiction, or likeness of a physical object or person is a/an _____.
2. To mark with a cut or series of cuts is to _____.
3. A cross-hair line (target) outside the page or image area that is used to help align color separations or to align the printed images on the press sheet is a/an _____.
4. A printing technique that transfers ink from a plate to a rubber blanket (an intermediary cylinder) to paper instead of directly from plate to paper is _____.
5. The printing process that has historically been used to create fine art prints and quality reproductions is _____.
6. The printing process typically used to print labels and packaging materials is _____.
7. The base material onto which an image is printed is the _____.
8. The printing process commonly used for one-of-a-kind prints and posters, large-scale billboards and signs, photographic prints, and flyers is _____.

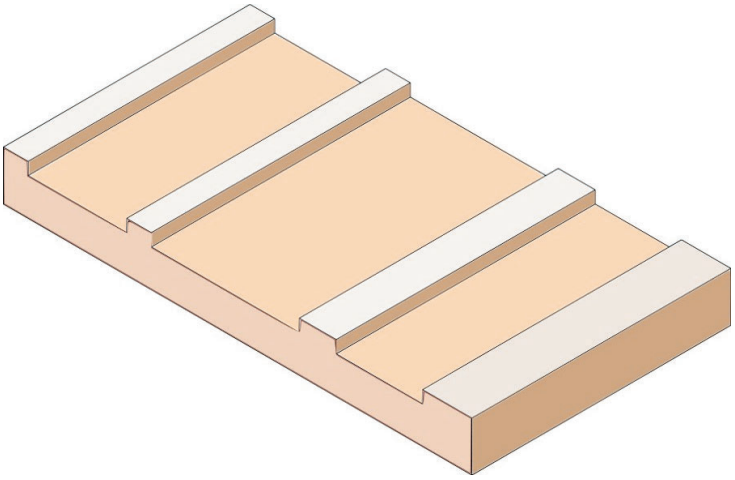
Part Three: Short Answer

Instructions: **Answer the following.**

List the advantages and disadvantages of screen printing.

INTAGLIO PRINTING PROCESS

STEP 1. Depressions are cut into a printing plate (not to scale): the grooves can be fractions of a millimeter wide.



STEP 2. The plate is covered in ink.

STEP 3. The ink is wiped off the surface of the plate, but it remains in the grooves.

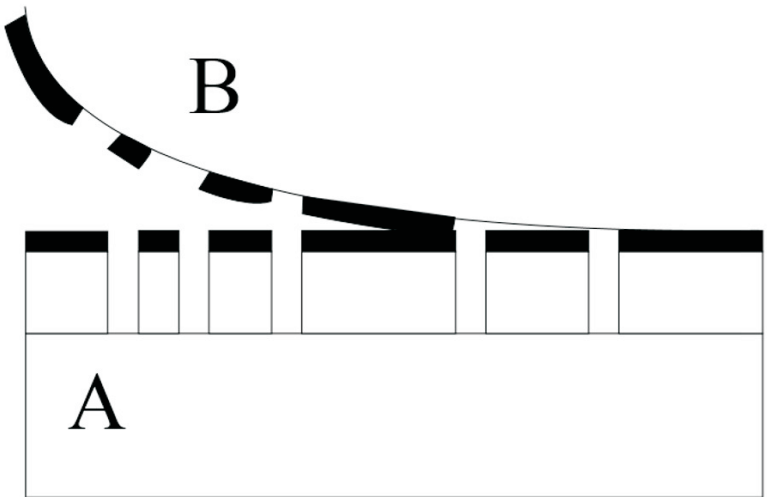
STEP 4. Paper is placed on the plate and compressed by a heavy roller.

STEP 5. The paper is removed and the print has been transferred from the plate to the paper.

POSTAGE STAMP PRINTING

The first stamp issued was the “Penny Black” printed in Great Britain. Postage stamps are made by the engraving method of intaglio printing.

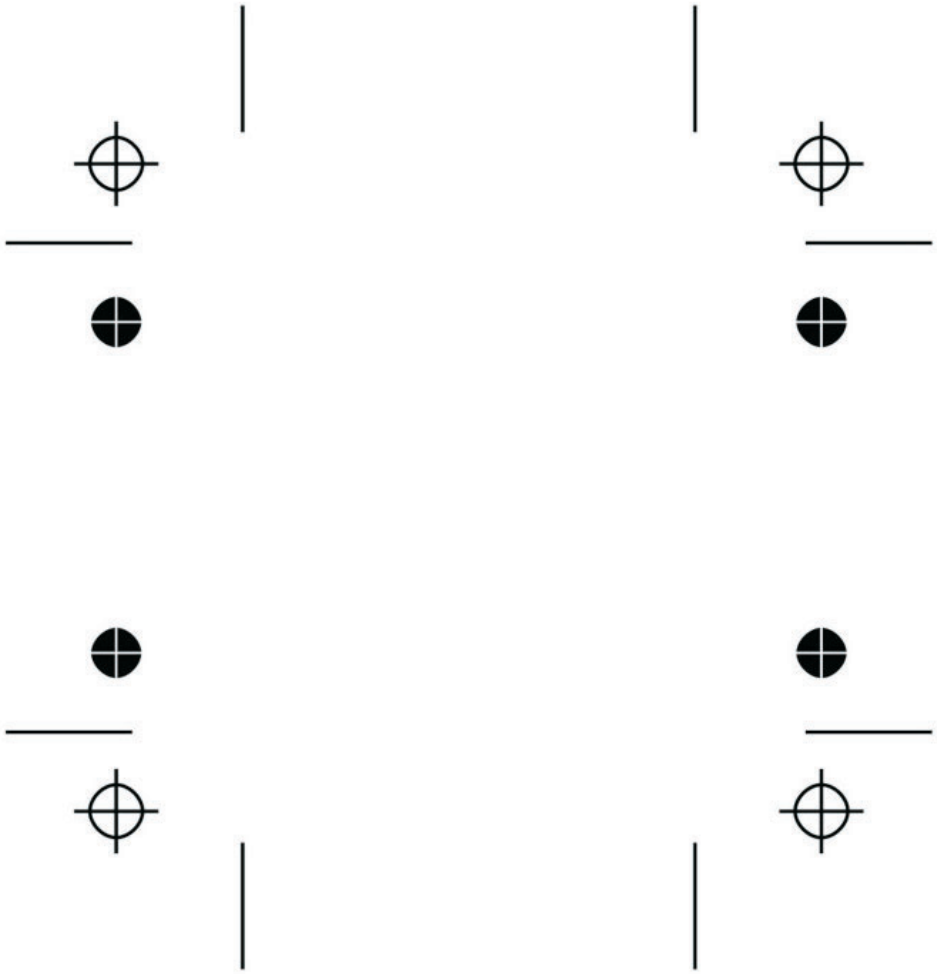
RELIEF PRINTING



Relief printing is a printmaking technique in which the image to be printed is raised from the surface of the printing plate. The surface around an image is cut away so the image appears "in relief" on the printing plate. The printing plate is inked and pressed onto a printable surface. This creates a relief print. The process is similar to using an ink pad and rubber stamp. Block printing, flexography, and letterpress are types of relief printing processes. In the sketched image, "A" is the block and "B" is paper media. In the second image, a traditional letterpress machine shows wood block type for a newspaper inserted into the slots. The wood block would be covered with ink and pressed down upon big sheets of paper to transfer the image.

REGISTRATION MARKS

A ***registration mark*** is a cross-hair line (target) outside the page or image area that is used to help align color separations or to align the printed images on the press sheet. The mark appears on all separations. Registration marks are required on any substrate that is processed multiple times through an offset printer, a rotary press, or a screen.



LITHOGRAPHIC PRINTING

Lithography is the process of printing from a smooth, flat plate (limestone or metal) on which an image is applied with a greasy medium. The image will repel water and accept oil-based ink. The two maps of Munich, Germany illustrate the negative lithography stone and the resulting positive print. Today, most lithography is rapidly accomplished by an offset printing press.

(Courtesy, Chris 73/Wikimedia Commons)
(https://creativecommons.org/licenses/by-sa/3.0/deed.en)

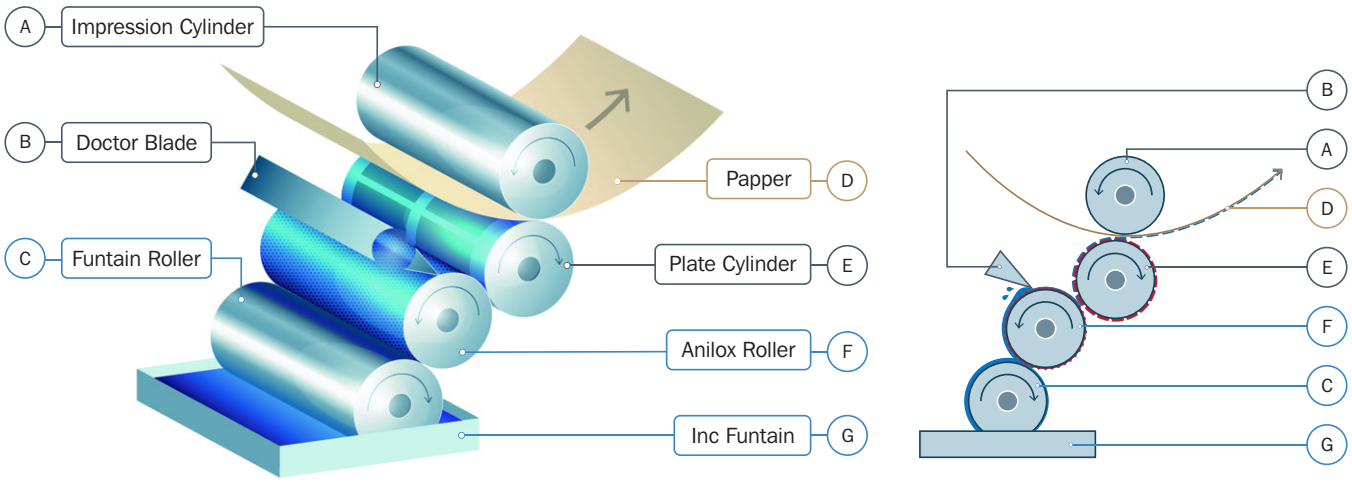
SCREEN PRINTING

Screen printing is a stencil method in which ink is wiped across a mesh screen, pressing the ink through the openings on the screen and onto the substrate below. A graphic image is created in the form of a stencil pattern and applied onto a mesh screen. The screen is stretched onto a frame and fixed into a position on a press. Ink is placed inside the frame and rubbed across the surface, typically with a rubber squeegee. The ink passes through the open areas of the screen, printing the image onto the substrate.

FLEXOGRAPHY PRINTING

Flexography (flexo) is a relief printing method in which an image on a flexible printing plate is inked and the inked image is transferred to the substrate. This is a modern version of letterpress printing (using a stamp to transfer ink). Flexography uses a flexible rubber plate etched with a slightly raised design. These etched plates are wrapped around rotating cylinders on a press. At high speed, the cylinders rotate around a reservoir of ink and press the ink onto the substrate.

Flexography



GRAVURE PRINTING

Gravure (rotogravure) printing is a type of intaglio printing process in which an image is etched on the surface of a cylinder and paper is pressed against the inked cylinder on a rotary press. The image is transferred directly to the paper, unlike offset printing, which uses an interim cylinder. A diagram of a rotogravure print unit can be viewed at: https://commons.wikimedia.org/wiki/File:Rotogravure_PrintUnit.svg

DIGITAL PRINTING

Digital printing is a method in which an image is sent from a computer file directly to a device that accepts texts and graphics. Digital printers put the image directly onto the substrate. Digital printing, unlike other printing methods, does not require a printing plate.

LS–A

Name _____

A Screen printing Project

Purpose

The purpose of this lab activity is to produce a product using screen printing technology.

Objective

Create and display a screen printed item.

Materials

- lab sheet
- pen or pencil
- computer with simple graphic software and printer
- screen printing supplies including:
- screen and frame
- silk screen fabric
- photo emulsion and sensitizer
- 250-watt light bulb
- latex gloves
- totally dark closet/room
- t-shirt or poster paper; if printing a solid surface, cardboard for backing
- squeegee
- tape
- ruler or T-square

Procedure

1. Review your class notes about screen printing.

2. Watch one or more of the following screen printing "how to" videos. For example:

   a. Screen Printing—One Color Screen Print with Plastisol Ink at https://www.youtube.com/watch?v=JRR5C2cciB0
   b. How To Screen Print—Step-by-Step Process at https://www.youtube.com/watch?v=gNWS6DrDOEM
   c. How To Screen Print on Athletic Hoodies at https://www.youtube.com/watch?v=cabL5WGW_F8

3. Create a simple graphic on your computer software for a local or school event. Print it as a solid black image on transparency film/paper. General steps include the following:

   a. Cover your screen with the appropriate mix of emulsion and sensitizer as described on the bottles. Coat the screen with a thin even layer.
   b. Place the screen in a dark room for about two hours or as required.
   c. Expose the screen to your image (in a dark room). Place the screen onto a black surface with the emulsion side up. Then, place the transparency film with the graphic and secure it in place.
   d. Locate the light source just above the film and expose for the time required (typically 15 to 20 minutes).
   e. Once exposed for the proper time, remove transparency from the screen.
   f. Clean the screen with cold water as required.
   g. Properly locate your t-shirt or poster under the screen and apply the ink by pressing it into the surface.
   h. When finished, remove the screen, backing, and materials. Allow ink to dry.

4. Consult with your instructor to ensure all the proper steps have been completed and the cleanup is completed.

5. Display your finished screen printing project.