Color

Unit: Science of Textiles and Manufacturing

Problem Area: Fabric Construction

Lesson: Color

Student Learning Objectives.

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

1. **Identify color-matching tools.**
2. **Explain color-dyeing processes.**
3. **Explain the chemistry of color pigmentation.**

Resources.

The following resources may be useful in teaching this lesson:

"Batik Fabric," *Easy Fun School*. Accessed Feb. 7, 2012. www.easyfunschool.com/article1635.html.

Briot, Alain. "Composing with Color," *The Luminous Landscape*. Accessed Feb. 7, 2012. http://www.luminous-landscape.com/columns/composing1.shtml.

Collier, Billie J., Martin Bide, and Phyllis G. Tortora. *Understanding Textiles*, 7th ed. Pearson, 2009.

"Color Theory Power Point Presentation," *Cave Spring Middle School: Roanoke, Virginia*. Accessed Feb. 7, 2012. www.rcs.k12.va.us/csjh/pppintro.htm.

James, Owen. "Simple, Practical Color Theory," *tutorial 9*. Accessed Feb. 7, 2012. http://www.tutorial9.net/articles/design/simple-practical-color-theory/#2.

Kadolph, Sara. *Textiles*, 10th ed. Pearson, 2011.

"K-W-H-L Chart," *North Carolina State University*. Accessed Feb. 7, 2012. http://www.ncsu.edu/midlink/KWL.chart.html.

Liddell, Louise A., and Carolee S. Samuels. *Apparel: Design, Textiles, and Construction*, 10th ed. Goodheart-Willcox, 2012.

"Munsell Color System for Color Mixing," *YouTube*. Accessed Feb. 7, 2012. http://www.youtube.com/watch?v=kTSrdGKC6SA.

Newman, Leah. "Instructions to Transfer a Heat Press," *eHow*™. Accessed Feb. 7, 2012. www.ehow.com/info_8089863_instructions-transfer-heat-press.html.

Saw, James T. "Design Notes: Color," *Palomar College*. Accessed Feb. 7, 2012. http://daphne.palomar.edu/design/color.html.

"Sessions—Color Theory: Color Wheel," *YouTube*. Accessed Feb. 7, 2012. http://www.youtube.com/watch?v=59QGexKdFUI&feature=related.

"Tertiary Colours," Colour Therapy Healing. Accessed Feb. 7, 2012. http://www.colourtherapyhealing.com/colour/tertiary_colours.php.

"Tie Dyed T-Shirt," *National Geographic Kids*™. Accessed Feb. 7, 2012. http://kids.nationalgeographic.com/kids/activities/crafts/tie-dyed-t-shirt/.

"What Is Color?" *RGB World*. Accessed Feb. 7, 2012. www.rgbworld.com/color.

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):

- analogous
- batik
- Bezold effect
- bonding agents or binders
- catalysts
- chroma
- color
- colorfastness
- colorants
- color systems
- complementary
- compound hues
- cross dyeing
- digital printing
- dye
- dye bath
- dye penetration
- electrostatic charge
- fastness properties
- fiber dyeing
- garment and product dyeing
- heat transfer printing
- hue
- inorganic
- insoluble
- light
- metameric
- monochromatic

- Munsell Color System
- organic
- piece dyeing
- pigment
- polymer chains
- primary colors
- roller printing
- RYB color system
- saturation
- screen printing
- secondary colors
- split complementary
- stock dyeing
- tertiary colors
- tie dyeing
- triad
- vat dyeing
- value
- water soluble
- wavelength
- yarn dyeing

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.

> *Write the term "metameric" on the board. Ask students to offer explanations of what the word means. Then share the definition.* ***Metameric*** *is a situation in which colors appear differently under different light sources. Show students four identical fabric swatches. Place one swatch under a warm fluorescent light bulb, and let the students observe the swatch color. Then place the other three swatches under the following light sources: a cool fluorescent light bulb, an incandescent bulb, and a black light. Ask students to describe what happens to the colors. What changes? Discuss the differences.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Identify color-matching tools.

Anticipated Problem: What color-matching tools are used in textile and design settings?

I. Color-matching tools

A. Without light, there would be no color. Therefore, it is necessary to understand light and how the eye perceives light to understand color. Many color-matching tools exist to match paint colors, apparel colors, interior colors, car paint, print for computer printers, etc. Many of these color-matching tools are available via free software on the Internet.

B. The color matching tools addressed in this lesson plan are Munsell's Color System and the RYB Color System color wheel. Both are a basis for color selection. These two color-matching systems provide a basis for further investigation and study of color.

C. Color theory

1. ***Color*** is what the eye sees when light strikes an object. Color is comprised of light of different wavelengths and frequencies. Sir Isaac Newton is credited with understanding the rainbow by an experiment that refracted white light with a prism and resolved light into its component colors: red, orange, yellow, green, blue, and violet. Newton proved that light was responsible for color, and he also created the first color wheel. The mnemonic device ROY G. BIV is the colors of the rainbow (spectrum) in order: red, orange, yellow, green, blue, indigo, and violet.
2. ***Light*** is a type of electromagnetic wave; it is small bundles of energy that operate on different wavelengths. Light travels in the form of waves (light waves), and these waves have high and low points. A ***wavelength*** is the distance between the same locations on adjacent waves. Long waves have low energy (low frequency), and short waves have high energy (high frequency). Light waves are visible and invisible. Visible waves include the colors of the spectrum—red, orange, yellow, green, blue, indigo, and violet. What the eye sees are wavelengths of the visible colors—a rainbow spectrum. The invisible part of light can be absorbed, reflected, or transmitted.
    a. White light is what the eye sees when all the visible light colors on the spectrum are combined. A prism separates white light into individual colors of the rainbow spectrum. White light is commonly referred to as light or visible light. Some sources of white light are the sun, the stars, and incandescent light bulbs.
    b. When all light is absorbed and no light is reflected, one sees black. Most solid objects reflect light, and human eyes see that reflected color. Also, light passes through transparent objects.
    c. Color is not a fixed property, so color looks different under different light situations. Therefore, color is metameric or appears differently under different light sources. Under one light source, a color may match another color. However, under another light source, it may not match. For example, fabric colors differ under cool light fluorescent bulbs and warm light fluorescent bulbs. Daylight is the best light for matching colors.
    d. Different individual human eyes see colors and shades of color differently. The cones and rods in eyes cause humans to see colors differently. The human brain and eyes perceive color in a three-color code: red, blue, and green. Eyes discern various colors by sensing different wavelengths. Red, blue, and green are “mixed together” in the brain to enable humans to see other colors.

D. ***Color systems*** are scientific methods of organizing color information.

1. Developed by Albert A. Munsell (1858 to 1918), the ***Munsell Color System*** was the first organized system to accurately identify colors. It was and is currently recognized as the global standard for color notation. He named five principle colors: red, yellow, green, blue, and purple. In addition, he named four intermediate colors: yellow-red, green-yellow, purple-blue, and red-purple. This

system makes it possible to discuss color scientifically across industries: art, business, science, government, education, etc.

a. ***Primary colors*** (colors from which other colors are made) in the Munsell Color System are red, yellow, blue, green, and purple. ***Compound hues*** are combinations of the primary colors to form the following:
   (1) Yellow-red
   (2) Green-yellow
   (3) Purple-blue
   (4) Red-purple

b. ***Hue*** is the name of the pure spectrum colors: red, orange, yellow, green, blue, and violet (e.g., a specific wavelength of light). Munsell defined hue as, "The quality by which we distinguish one color from another."

c. ***Value*** is the relative lightness or darkness of the color; the gray level of the color. Munsell defined it as "the quality by which we distinguish a light color from a dark one."

d. ***Saturation*** is the intensity or the brightness or dullness of a color. A saturated color has high intensity and is, therefore, very bright. In contrast, an unsaturated color has low intensity and is, therefore, very dull. ***Chroma*** is another name for saturation (e.g., the color's weakness or strength). Munsell stated that, "Chroma is the difference from a pure hue to a gray shade."

e. A Munsell color tree demonstrates the differences between hue, value, and chroma. (See http://www.luminous-landscape.com/columns/composing1.shtml for information and an image of the color tree.)

E. The ***RYB Color System*** is a color matching system used primarily in art, art education, textiles, and design settings. RYB stands for red, yellow, and blue—the primary colors in the RYB system. The three colors form a primary color triad and are located equidistant from each other on the color wheel.

1. ***Secondary colors*** are colors formed by mixing two primary colors. The secondary colors are orange, purple, and green and are located equidistant from each other on the color wheel. Secondary colors form a secondary color triad.
   a. Red and yellow form orange.
   b. Red and blue form purple.
   c. Yellow and blue form green.
2. ***Tertiary colors*** are colors formed by mixing a primary and a secondary color that are adjacent to each other on the color wheel. Two tertiary color triads are formed on the color wheel because six tertiary colors exist. (See http://www.colourtherapyhealing.com/colour/tertiary_colours.php to view a color wheel showing tertiary colors.) Combining two secondary colors results in a "wheat" color being formed from green and orange and "brick" being formed from orange and violet. There are six tertiary colors formed by the primary colors:
   a. Red-orange
   b. Yellow-orange

c. Yellow-green
d. Blue-green
e. Blue violet
f. Red-violet

3. Color schemes are methods of putting colors together so they are pleasing to the eye. Color schemes using the RYB color system include the following:
   a. ***Monochromatic*** is a color scheme that uses one hue with variations from light to dark (e.g., dark brown, medium brown, and beige).
   b. ***Analagous*** is a color scheme that uses three colors located next to each other on the color wheel (e.g., yellow-orange, yellow, and yellow green).
   c. ***Complementary*** are colors located directly across from each other on the color wheel (e.g., red and green).
   d. ***Split-complementary*** are colors located directly opposite (the color's complement); this color scheme uses the two colors on each side of the complement. For instance, red (whose complement is green) is paired with blue-green and yellow-green.
   e. ***Triad*** is a color scheme that uses three colors that form an equidistant triangle on the color wheel (e.g., orange, purple, and green).

Teaching Strategy: *Use VM–A and VM–B to aid in a discussion.*

Ask a physics teacher or another guest speaker to make a presentation on the physics of light and color. Provide the speaker with a copy of VM–C to use as an outline. Distribute VM–D so students can complete it during the presentation. Allow time for questions and answers at the end of the presentation. Then show a video about the Munsell Color System at http://www.youtube.com/watch?v=kTSrdGKC6SA.

Make copies of "Simple Practical Color Theory" and "What Is Color" from the Resources section. Have your students read and take notes on the articles in order to write two quiz questions with answers for use in a "Color Bee Quiz." Divide the class into two groups. Conduct the "Color Bee Quiz" using the quiz questions written by the students.

Assign LS–A.

Finally, conduct a brainstorming session with the class to answer the following question: "Why is it important to understand light and color before adding color to textiles?" List ideas on the board, and transition to Objective 2 about color processes.

Objective 2: Explain color-dyeing processes.

Anticipated Problem: How are textiles colored?

II. Textile color-dye processes

A. ***Colorants*** are substances used to color a material.

1. ***Dye*** is a chemical substance used to stain and color materials. Dye molecules are smaller than pigment molecules and are typically in solution or paste forms. Dye is usually ***water soluble*** (a substance that dissolves in liquid) and ***organic*** (carbon-based from once living matter). Dye is expensive colorant as compared to pigment.
2. ***Pigment*** is finely ground, insoluble particles of color held on the surface of a fiber with the help of bonding agents. The ***bonding agents*** or ***binders*** are substances that act like glue to hold color particles on the surface; they are necessary for pigmentation and are used to impart color to:
   a. Fabrics
   b. Plastics
   c. Paint
   d. Ink
   e. Cosmetics
   f. Food

B. Dye-coloring textiles

1. Dyes bond chemically with fibers by clinging to and penetrating them due to an ***electrostatic charge***—a negative and positive charge that attaches the dye to the fiber. Dye color does not last as long as pigment color. However, dyes have great color strength in that a small amount colors a large amount of fabric. Dyes are applied selectively to fibers because certain fibers (e.g., polyester) do not accept dye well. Dyes have good ***fastness properties***—the ability of the fabric to hold the dye and not fade in the laundry, dry cleaning, or sunlight.
2. Tell your students the dye process includes the following steps:
   a. Use water, heat, and steam to dissolve or disperse dye. (Place the dye in solution.)
   b. Add ***catalysts*** or agents that speed up reactions (e.g., acids, salts, or bases) to increase the ability of the dye to penetrate the fiber or fabric.
   c. Agitate the dye and fibers or fabric while in solution.
   d. Apply heat to the dye and fibers or fabric in solution. The temperature of the solution is raised to a point at which the fibers absorb the maximum amount of dye.
   e. Dye reacts with surface molecules first during the dyeing process. Next, moisture and heat cause ***polymer chains*** (a large molecule composed of

repeating structural units) to swell and expand. Expanded polymer chains allow the dye to penetrate the interior of the fibers.

f. Cool the dye. When the fiber cools, the dye is trapped inside the polymer. (Dye has permeated the fiber.)

g. Rinse the dyed fiber or fabric.

h. Dry the dyed fiber or fabric to "lock" the dye into the polymer.

3. Dyeing stages

a. ***Fiber dyeing*** (or ***stock dyeing***) is the application of dye directly to fibers before being spun into yarn. An early addition of color at the fiber level adds to the uniformity of color in the yarn, fabric, garment, or product. For humanmade fibers, the dye is added to the solution prior to being forced through spinnerets.

b. ***Yarn dyeing*** is the application of the color after fibers have been spun into yarn. The yarn is wound on tubes and is placed in a ***dye bath*** (dye in a solution). Yarn dyeing may result in some variation in color in the fabric, garment, or product.

c. ***Piece dyeing*** is the application of the color after the fabric has been woven or knitted. Most piece-dyed fabrics are solid colors.

d. ***Garment and product dyeing*** is the application of the color after the item is constructed. Buttons, zippers, and thread may pose problems as they may dye differently than the garment or product.

4. ***Cross dyeing*** is mixing two dyes in one dye bath to color different fibers and produce a multicolored fabric. In these blended fiber fabrics, one dye colors one fiber and another dye colors the other fiber. The result may be a blue and green striped fabric when using blue and green dye.

5. ***Dye penetration*** is the depth at which the dye enters the item being dyed. Dye penetrates best when loose fibers are in a free moving liquid dye. Dye penetration is best in the fiber stage and adds uniformity to the yarn, fabric, garment, or product.

6. The ***Bezold effect*** is a merging of two colors that produce a third color when viewed from a distance. This effect is often noted in small prints and in yarn-dyed fabrics.

7. ***Colorfastness*** is the retention of the original hue. It is typified by color remaining fast, not running and fading very little if at all. The color remains consistent when a garment is dry cleaned or is exposed to sunlight, perspiration, and/or abrasion. Colorfastness is one desirable attribute of a dye.

C. Dyeing techniques

1. ***Vat dyeing*** is the use of chemically complex vat dyes (a special class of dyes) that are insoluble in water. These ***insoluble*** (does not dissolve in water) dyes are incapable of dyeing fibers when used alone. When chemicals are added to the vat dye, it changes to an alkaline solution, and this makes dyeing possible. Dye is absorbed into the fibers and is converted again to an insoluble state. As a result, dye has excellent wash and fastness properties. Vat dyeing usually occurs in a large bucket or tub. Indigo is the original vat dye.

2. ***Batik*** is a hand-dyeing process that uses wax to make the design on fabric. The batik process steps are:
    a. Step 1: Drip a wax design onto the fabric.
    b. Step 2: Place the fabric in a dye solution.
    c. Step 3: The fabric is dyed except for the area of the wax design.
    d. Step 4: Rinse the dye out of the fabric.
    e. Step 5: Remove the wax using a solvent by boiling or by pressing the fabric between paper towels with a hot iron.
3. ***Tie dye*** is a mechanical treatment in which a fabric design is produced by preventing parts of the fabric from having access to the dye. The steps to tie dye fabric or garments are:
    a. Step 1: A section of fabric is wrapped with rubber bands or tied with string (the mechanical treatment).
    b. Step 2: The tied fabric is submerged in the dye solution.
    c. Step 3: The fabric is removed from the dye solution.
    d. Step 4: The rubber bands or string are removed to reveal a design where the fabric did not receive dye.
    e. In mass production settings, the tie dye process is:
        (1) Step 1. The fabric is twisted like a rope and is tied.
        (2) Step 2: The tied fabric is submerged in the dye solution.
        (3) Step 3: The design is produced when the fabric is "untwisted."

Teaching Strategy: *Define colorants as they relate to coloring textiles, and discuss the various ways textiles are colored. Have a "Q&A" session to determine if students understand. Assign LS–B and LS–C.*

Objective 3: Explain the chemistry of color pigmentation.

Anticipated Problem: How are pigments used to color textiles?

III. The chemistry of color pigmentation

A. Pigments are finely ground, insoluble particles of color held on the surface of a fiber by bonding agents or binders—in the form or liquid or paste—that act like glue to hold color particles on a surface. The bonding agents or binders are activated by a catalyst or by heat to hold the pigment on the surface. The color is obtained by gluing the pigment to the surface of the fabric or whatever is being colored.

1. Pigments reflect and scatter (rather than absorb) light to give a fabric or product color. They can be applied at the fiber, yarn, fabric, and garment or product stage. Pigments are added to manufactured-fibers during the liquid spinning stage. Pigments may be inorganic or organic.
    a. If the pigment is ***inorganic***, it is a substance made of chemical elements that contain no carbon atoms.

b. If the pigment is ***organic***, it is a substance derived from living matter and contains carbon atoms.

2. Pigment characteristics

a. The mechanical application to fibers and fabrics makes them more versatile than dyes.

b. They cost less than dyes to apply.

c. Pigmentation does not require a rinse cycle to remove excess pigment, so it is more environmentally friendly than dyeing.

d. It offers an extensive color range.

e. Pigment has greater color control than dye.

f. Pigment has excellent fastness properties.

B. Printing techniques

1. ***Roller printing*** is a printing process to add design to a fabric by printing the design on a roller. Several rollers may be used on a single fabric. Each roller has a different color and/or design. In this process, fabric is passed through rollers to add the various layers of colors and/or designs.

2. ***Screen printing*** is a printing method in which an ink pigment is directly applied to the surface of the fabric to create an image. The ink pigment is pressed through a very fine mesh screen with areas blocked off by a stencil. The blocked off stencil areas create the design.

3. ***Heat transfer*** is printing fabrics by transporting a printed design from paper to fabric via heat and pressure. The steps in heat transfer printing are:

a. Step 1: The dye transfer is printed on paper.

b. Step 2: Paper is placed on fabric.

c. Step 3: Heat and pressure are applied to the paper on the fabric.

d. Step 4: The dye on the paper changes to gas.

e. Step 5: Gas moves from paper to fabric to print the design.

f. Step 6: Heat transfer techniques are common in the T-shirt industry.

4. ***Digital printing*** is the creation of a design on a computer that is then printed on fabric or other media. Digital printing is efficient and uses no water. The steps in digital printing are:

a. Step 1: Digital designs are made on the computer.

b. Step 2: Designs are transferred from the computer to a fabric-printing machine.

c. Step 3: Ink-jet printers transfer the ink to the fabric.

Teaching Strategy: *Demonstrate fiber, yarn, fabric, and garment or product dyeing to clarify the differences. Assign LS–D and LS–E.*

- **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. e
2. b
3. d
4. f
5. c
6. a

Part Two: Multiple Choice

1. b
2. d
3. a
4. d
5. d
6. c

Part Three: Short Answer

1. Dye penetration is the depth at which the dye enters the item being dyed. Dye penetrates best when loose fibers are in a free moving liquid dye. In addition, dye penetration is best in the fiber stage and adds uniformity to the yarn, fabric, garment, or product.
2. Cross dyeing is mixing two dyes in one dye bath to color different fibers and produce a multicolored fabric. In these blended fiber fabrics, one dye colors one fiber and another dye colors the other fiber. The result may be a blue and green striped fabric when using blue and green dye.
3. Batik is a hand-dyeing process that uses wax to make the design on fabric.

Sample Test

Name _____

Color

Part One: Matching

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

a. fiber dyeing
b. colorfastness
c. organic
d. water soluble
e. dye
f. pigment

_____1. A chemical substance used to stain and color materials
_____2. The retention of the original hue
_____3. A substance that dissolves in a liquid
_____4. Finely ground, insoluble particles of color held on the surface of a fiber with the help of bonding agents
_____5. Carbon-based from once living matter
_____6. The application of dye directly to fibers before being spun into yarn

Part Two: Multiple Choice

Instructions: **Circle the letter of the correct answer.**

1. A bonding agent _____.
   a. speeds ups reactions in a solution
   b. is glue that holds pigment on a fiber
   c. causes fibers to dye quickly
   d. prevents bleeding in a fabric
2. Colors that match in one light and may not match in another light are _____.
   a. pigments
   b. color models
   c. subtractive
   d. metameric

3. Agents that speed up the dyeing process are _____.

   a. catalysts
   b. light waves
   c. colorants
   d. polymer chains

4. Wavelengths _____.

   a. have high and low energy (frequencies)
   b. are the distance between the same locations on adjacent waves
   c. are what the eye sees when it distinguishes color
   d. All of the above

5. When light hits an object, it can _____.

   a. be absorbed
   b. be reflected
   c. pass through the medium
   d. All of the above

6. A scientific color model was developed by _____.

   a. Sir Isaac Newton
   b. Bezold
   c. Munsell
   d. Howitz

Part Three: Short Answer

Instructions: **Answer the following.**

1. Describe dye penetration.

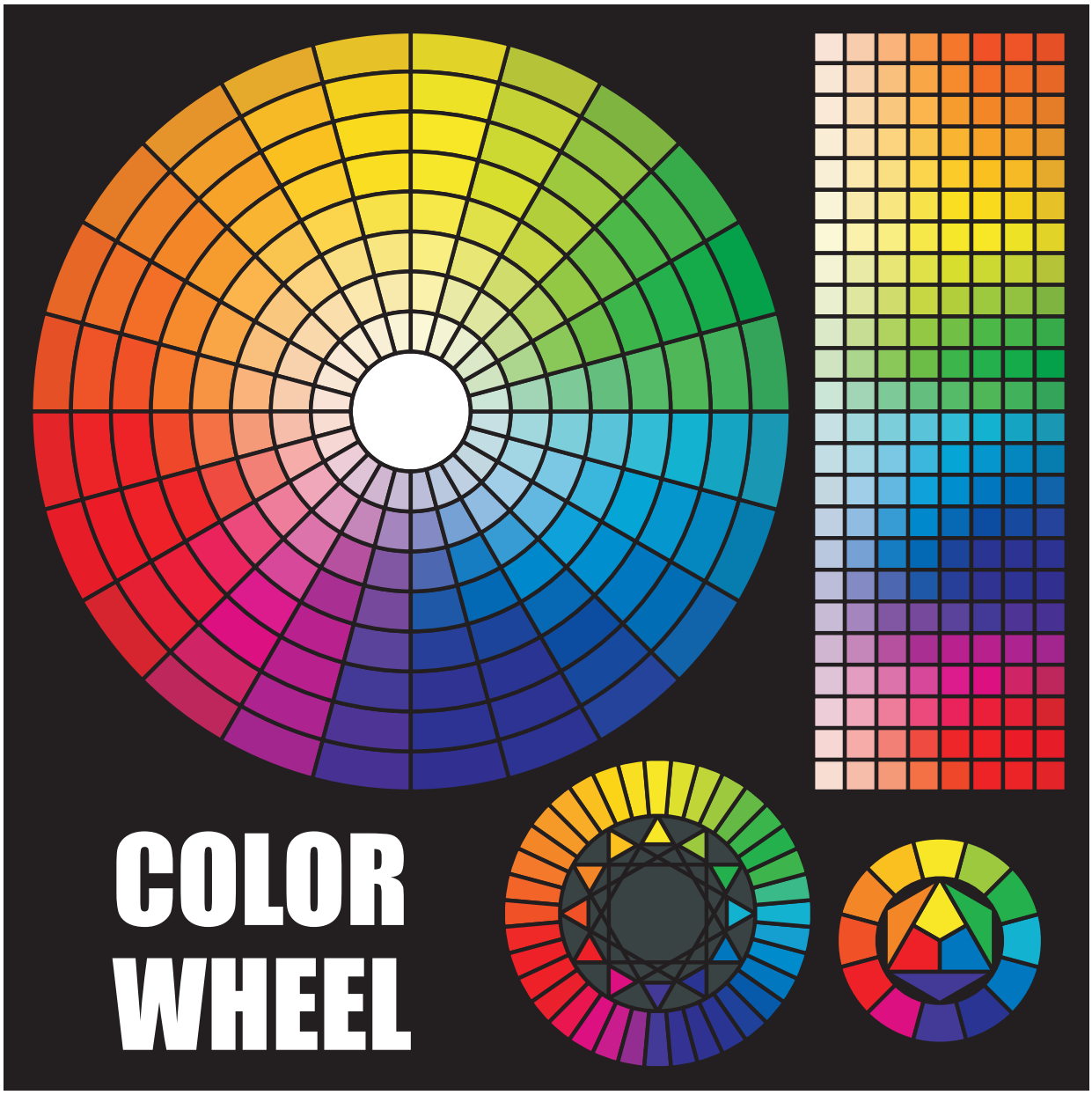
2. What is cross dyeing?

3. How is batik fabric produced?

A SIMPLE RYB COLOR WHEEL

Can you point out the three primary colors in the RYB Color System? What are the secondary colors? Name the tertiary colors.

MUNSELL'S COLOR SYSTEM: HUE, VALUE, AND CHROMA



This is the color wheel demonstrating Munsell's Color System: Hue, Value, and Chroma.

THE PHYSICS OF LIGHT AND COLOR— GUEST PRESENTATION OUTLINE

I. Prism, light, and color

- A. Sir Isaac Newton's contribution to light/color theory
- B. Show light through a prism
- C. Discuss and show the rainbow spectrum—ROY G. BIV
- D. Discuss white light from the sun

II. How light travels (Use a visual.)

- A. In waves
- B. Waves have high and low points
- C. Distance between the high and low is a wavelength
- D. Long waves have low energy (low frequency)
- E. Short waves have high energy (high frequency)

III. Light transfer (Demonstrate if possible.)

- A. Reflected
- B. Absorbed
- C. Transmitted

IV. The way light "hits" an object determines its light transfer.

- A. Black—light is absorbed; no light is reflected
- B. Most solid objects reflect light.
- C. Transparent—light passes through

V. The human eye and light/color (Use a visual.)

- A. The color of an object depends on light sent to the eyes.
- B. What the eye sees are wavelengths of visible colors.
- C. Visible waves can be seen; invisible waves cannot be seen.
- D. Cones and rods in the eye cause humans to see colors differently.
- E. Light is necessary if we have any perception of color.
- F. An object has color because of the light reflected off of it. (For example, a lemon is yellow because of a yellow light wave reflected off of it.)
- G. The brain and eyes perceive color by a three-color code: red, blue, and green.
- H. Individual human eyes see color/shades of color differently.
- I. Eyes discern various colors by sensing different wavelengths.
- J. Color is not a fixed property.
- K. Color looks different in different places.

VM–D

STUDENT NOTE SHEET FOR GUEST SPEAKER PRESENTATION: THE PHYSICS OF LIGHT AND COLOR

Directions: Use this outline to take notes on the guest speaker's presentation.

A. Define the term light.

1. How does light travel?

2. What three things happen when light hits an object?

B. Define the term color.

C. What is the relationship between light and color?

D. What is white light?

E. What is the color spectrum?

F. What is meant by the statement, "Color is not a fixed property?"

G. How does the eye see color?

H. Why do different people see color differently?

WHLH CHART

Directions: Use this chart with your group to help gather information on your research topic. Fill in this chart with notes, calculations (if applicable), and ideas rather than complete sentences. Use this chart to help you think through your topic and how the group will present it to class.

1. State your topic or problem.

2. State the goal of your presentation.

3. State your central research question or problem.

(NOTE: Everything you include in the chart below should help you answer the central research question or problem.)

W **What I Want to Know**	**H** **How I Will Find Information** (List resources, web pages, texts, formulas, methods, etc.)	**L** **What I Learned**	**H** **How I Will Present the Information**

(SOURCE: Adapted from Midlink Magazine.)

RUBRIC FOR POWERPOINT PRESENTATION: APPEARANCE AND CONTENT

CATEGORY	4	3	2	1
Sequencing of Information	Information is organized in a clear, logical way. It is easy to anticipate the type of material that might be on the next slide.	Most information is organized in a clear, logical way. One slide or item of information seems out of place.	Some information is logically sequenced. An occasional slide or item of information seems out of place.	There is no clear plan for the organization of information.
Content Accuracy	All content throughout the presentation is accurate. There are no factual errors.	Most of the content is accurate, but there is one piece of information that might be inaccurate.	The content is generally accurate, but one piece of information is clearly flawed or inaccurate.	The content is typically confusing or contains more than one factual error.
Use of Graphics	All graphics are attractive (size and colors) and support the theme/content of the presentation.	A few graphics are not attractive, but all support the theme/ content of the presentation.	All graphics are attractive, but a few do not seem to support the theme/content of the presentation.	Several graphics are unattractive AND detract from the content of the presentation.
Cooperation	Group tasks are delegated; shared responsibility is evident.	Group tasks are delegated; shared responsibility is evident most of the time.	Group tasks are delegated; shared responsibility is evident some of the time.	The group often is not effective in delegating tasks and/or sharing responsibility.
Slide Background	Background does not detract from text or other graphics. Choice of background is consistent from slide to slide and is appropriate for the topic.	Background does not detract from text or other graphics. Choice of background is consistent from slide to slide.	Background does not detract from text or other graphics; some inconsistency of slide background throughout.	Background makes it difficult to see text or competes with other graphics on the page.
Spelling and Grammar	Presentation has no misspellings or grammatical errors.	Presentation has 1 to 2 misspellings but no grammatical errors.	Presentation has 1 to 2 grammatical errors but no misspellings.	Presentation has more than 2 grammatical and/or spelling errors.
Text—Font Choice and Formatting	Font formats (e.g., color, bold, italic) have been carefully planned to enhance readability and content.	Font formats have been carefully planned to enhance readability.	Font formatting has been carefully planned to complement the content. It is a little hard to read.	Font formatting makes it very difficult to read the material.

(SOURCE: Adapted from the Rubistar website.)

LS–A

Name _____

RYB Color Wheel and Color Schemes

Purpose

The purpose of this activity is to create RYB color schemes.

Objectives

1. Create and describe five RYB color schemes.
2. Mount fabric swatches for each color scheme.

Materials

- lab sheet
- colored pencils
- compass
- paper
- ruler
- solid color fabric swatches in primary, secondary, and tertiary colors
- textbook
- class notes
- computer with Internet access
- stapler

Procedures

1. Work independently.
2. Find a RYB Color Wheel in your text or on the computer as a reference.

3. Draw a RYB Color Wheel.

   a. Use a compass to draw a color wheel (circle) on paper. Then divide the circle into 12 equal segments.
   b. Color in and label the primary colors. Red, yellow, and blue should be equidistant on the wheel.
   c. Next, color in and label the secondary colors. Orange, green, and purple should be equidistant on the wheel.
   d. Finally, color in and label the tertiary colors: yellow-orange, red-orange, red-purple, blue-purple, yellow-green, and blue-green.
   e. Check your work against the reference color wheel.

4. Review your notes or research the following color schemes. Then write a definition in the space provided.

   a. Monochromatic—

   b. Analogous—

   c. Complementary—

   d. Split-complimentary—

   e. Triad—

5. Use fabric swatches to create each of the RYB color schemes. Staple swatches in the spaces provided below. Describe each color scheme you create.

Color Scheme	Color Scheme Description
Monochromatic	
Analogous	
Complimentary	
Split Complimentary	
Triad	

6. Participate in a class discussion of each RYB Color Scheme.
7. Display your RYB Color Schemes.
8. Turn in your completed lab sheet to your instructor.

Name _____

Tie Dyeing

Purpose

The purpose of this activity is to tie dye a T-shirt.

Objectives

1. Experience vat dyeing.
2. Explain how the tie-dye design is produced.

Materials

- lab sheet
- 100% cotton T-shirt (prewashed), white
- fabric dye (any color)
- hot water
- large bucket
- large pot
- rubber bands
- rubber gloves
- tongs
- water
- heat source

Procedures

1. Introduction and a caution: Japanese tie-dye, or shibori, is more than 1,000 years old. Peasants used the technique to brighten old clothes. Tie-dye was fashionable among royalty. *Caution!* Dye can stain anything, even the sink. Cover your work area with plastic,

and read the instructions on the dye package. Always wear rubber gloves and use a pot holder if moving the pot of boiling water as the boiling water *and* the steam can burn you.

2. Work individually or in pairs. Collect your tie dye supplies and materials.
3. Read the directions on the dye package, and boil the amount of water needed in a large pot. Again, use caution! Use the measurements on the dye package, and stir in the dye.
4. Dampen the T-shirt. Then determine which pattern you will produce.
   a. For a random pattern, twist and scrunch the fabric, using rubber bands to hold the T-shirt in that position.
   b. For a circular pattern, grab part of the T-shirt and twist it into a long, skinny rope. Tie several equally spaced rubber bands around the fabric. Each rubber band will form a circle.
5. Use the tongs to dunk the shirt into the hot water. (*Caution!* Steam and boiling water can burn your skin.) Stir constantly for about 10 to 15 minutes. (The T-shirt will appear slightly darker when it is wet.)
6. Rinse your T-shirt under cold water. Then remove the rubber bands, and rinse it until the color runs clear. Dry it in a clothes dryer to help set the color.
7. Display your tye-dyed T-shirt.
8. In the space provided, write a paragraph that explains how the tie-dye process works.

9. Turn in your completed paragraph to your instructor.

(SOURCE: Adapted from Kids National Geographic website.)

Name _____

Batiking Fabric

Purpose

The purpose of this activity is to create a batik fabric.

Objectives

1. Demonstrate the dyeing steps in the batik method.
2. Melt paraffin (without setting it on fire).
3. Make patterns on fabric using melted paraffin wax.

Materials

- lab sheet
- aluminum foil
- cold-water dye (Dylon Permanent Dye or Procion MX Dye)
- double boiler (or similar set-up)
- a few yards of plain fabric to batik (or a 12-inch square of white cotton fabric per pair)
- iron
- ironing board or heat-proof flat surface
- large, flat pan of cool water
- large, flat, non-metal pan to hold dye
- paintbrush (various sizes)
- paraffin
- running water (indoors or out)
- old towels or paper towels
- old newspapers

Procedures

1. Work individually or in pairs.
2. Collect your batik supplies and materials.
3. Cover your work area with the old newspapers. Place a piece of aluminum foil on the work area you just covered. Place the 12-inch white cotton fabric on top of the foil. The foil is used to keep the paraffin-coated fabric from sticking to the newspaper that is protecting the workspace.
4. Melt the paraffin in a double boiler or in a similar system (e.g., a coffee can and a water-filled frying pan). [NOTE: Never melt paraffin unless you are using one of these "double" methods. Paraffin is flammable, and the double-boiler keeps the paraffin from getting too hot too quickly and combusting.]
5. When the paraffin wax is melted, dip the paintbrush into the wax. "Paint" a picture on the fabric with the wax. You could do a geometric pattern, a landscape, a plaid pattern, a floral print, etc. Dip the brush back into the wax as often as necessary as the wax cools quickly. Now, the fabric's batik pattern is complete.
6. Place the batiked fabric in cool water for a few minutes to harden the wax.
7. Prepare your choice of dye according to the directions.
8. Remove the batiked fabric from the cool water and place it in the dye. The longer the fabric sits in the dye, the darker and/or brighter the color will become.
9. When the desired shade is reached, remove the batiked fabric from the dye bath. Rinse the fabric under running water until the water runs clear.
10. Place the batiked fabric on old towels or paper towels to remove excess water. Do not "ring" fabric out.
11. Heat your iron. Place the batiked fabric on the ironing board or other flat, heatproof surface. Cover the fabric with newspaper and iron it.
12. The paraffin wax will melt into the paper and away from the fabric. Change the newspaper and continue ironing, repeating the process until all the wax is fully removed.

(SOURCE: Adapted from www.easyfunschool.com/.)

13. Answer the following questions in complete sentences.
    a. Why is the paraffin melted in a double boiler?

b. Why is the fabric placed in cool water after the wax is applied to the fabric?

c. How did you prepare the dye?

d. Why did you place the fabric between newspapers and then iron it?

e. What caused the design on the fabric?

f. What part of the fabric was dyed and not dyed?

14. Display your batiked fabric, and turn in your completed lab sheet to your instructor.

Name _____

Create a Color Processing PowerPoint Presentation

Purpose

The purpose of this activity is to produce a color-processing PowerPoint presentation.

Objectives

1. Research and organize color-processing material: dyeing and/or pigmentation.
2. Develop a PowerPoint presentation on one dyeing or one pigmentation topic.
3. Present the PowerPoint to the class.

Materials

- lab sheet
- paper
- pencil
- computer with Internet access or class notes and texts
- computer with PowerPoint software
- VM–E
- VM–F

Procedure

1. Work in pairs.
2. Select a color-processing topic from those shown below:
   a. What Are Dyes?
   b. The Dyeing Process

c. Dye Penetration, Cross-Dyeing, and Colorfastness
d. Vat Dyeing
e. Batik and Tie Dyeing
f. Coloring Textiles with Pigments
g. The Role of Bonding Agents in Pigmentation
h. Roller Printing
i. Screen Printing
j. Digital Printing
k. Other topic as designated by your instructor

3. Conduct research on the Internet or in the media center on the selected color processing topics. This research will include information on the science of dyeing and color pigmentation. Use the W-H-L-H Chart to record research findings (VM–E).

4. Review the PowerPoint Presentation Rubric (VM–F).

5. Organize your group and determine roles (each person's responsibility). Work independently on the topic or role that is your responsibility. Possible roles are:

   a. Research discovery: Find library, Internet, and/or text information.
   b. Research analysis: Consolidate and identify key concepts and issues to be presented to the group.
   c. Write and compile a draft presentation.
   d. Review and evaluate the draft, and make suggested changes to the presentation.

6. After all of the research has been completed, get together as a group to decide which slides will be developed.

7. Develop the PowerPoint presentation slides and individually insert your slides into the presentation.

8. Determine the roles during the presentation. Practice the presentation.

9. Make your presentation to the class. Answer questions from classmates and from the instructor.

10. As presentations are given, take notes about the dyeing and pigmentation processes gained from the presentations. Keep notes in your notebook for future reference.

11. Turn in your completed PowerPoint presentation to your instructor.

Name _____

Heat Printing Fabric

Purpose

The purpose of this activity is to transfer pigmentation to fabric using heat.

Objectives

1. Transfer a design to fabric using the heat transfer method.
2. Discuss how pigmentation differs from dyeing.

Materials

- lab sheet
- one 12-inch × 12-inch cotton square per pair (plus a few extras)
- iron
- ironing board or hard, heat-resistant, and flat surface (several set-ups to be shared)
- heat transfer paper with design
- soft cloths (one each)

Procedure

1. Work in pairs.
2. Collect the heat transfer supplies and materials.
3. Turn the iron on the highest setting (cotton/linen); let it preheat for 10 minutes.
4. Select a heat transfer design to place on the square.
5. Use the iron to preheat the fabric only. Then place the heat transfer sheet face down on the cotton square.

6. Place the iron on the transfer, pressing with moderate pressure and then lifting straight up. Repeat this on several areas of the transfer sheet to ensure that these sections adhere to the fabric and hold the design in place.
7. Use a circular motion and light pressure to ensure that the remainder of the heat transfer sheet adheres to the fabric.
8. Set the iron aside, and rub the paper backing gently with a soft cloth for about 15 seconds. Then peel off the paper backing.

(SOURCE: Adapted from "Instructions to Transfer a Heat Press" at eHow.com in the Resources section of the lesson plan.)

9. Display your heat transfer-decorated square.
10. Write a paragraph that describes how coloring by heat transfer differs from dyeing.

11. Turn in your completed lab sheet to your instructor.