COLORS & CULTURES
INTERDISCIPLINARY EXPLORATIONS

COULEURS & CULTURES
EXPLORATIONS INTERDISCIPLINAIRES

Sämi Ludwig
Astrid Starck-Adler
André Karliczek

Sämi Ludwig
Astrid Starck-Adler
André Karliczek

[Editors]

Cover design, book layout and typesetting: a|~ arkée - science services | André Karliczek

Bibliographic information of the German National Library:
The German National Library lists this publication in the German National Bibliography:
detailed bibliographic data available at http://dnb.d-nb.de abrufbar.

Salana, Jena/Mulhouse 2022
Druck:
Printed in Germany.
ISBN 978-3-00-073026-9

CREATING A NEW CULTURE THROUGH DESIGN
A SUSTAINABLE METHOD OF USING COLOR IN TEXTILE PRINTMAKING PROCESSES

Marjan Kooroshnia
Swedish School of Textile, University of Boras, Sweden

Color can be applied to fabric using either chemical or physical processes; in the former, the color becomes part of the fabric, usually as a result of the use of a fixing agent when it is steamed or dry-heated. With the latter, pigment is bound to the fabric, which is then fixed or cured using dry heat (Briggs-Goode & Townsend). In recent years, the impact of the textile dyeing and printing industry on the environment has become a major issue, and a hot topic in relation to discussions of sustainability: it is one of the most chemical-intensive industries in existence, using "more than 8000 chemicals in various processes of textile manufacture including dyeing and printing" (Kant 23). To counteract this issue and perhaps gain some control over it, we must make a change. Growing awareness of the importance of achieving sustainability through environmentally friendly design has led to experimental textile and fashion designers and researchers working with this issue, and caused an inevitable cultural and methodological shift in the textile and fashion fields. This has involved returning to traditional approaches to dyeing and printing textiles, and selecting sustainable materials and coloring agents, rather than using synthetic materials and colors.

The 'Natural Dye Print' project (Mantel) is a significant example of a process involving printing with natural dyes. It was designed to explore the range of colors and designs that can be achieved by screen-printing with eight dye extracts: logwood, brazilwood, cutch, madder, weld, lac, chlorophyllin, and fustic. The fabrics were mordanted prior to printing with either alum or aluminium acetate, and the colors were altered through the addition of other natural dyes or color modifiers such as iron or citric acid. The collection of textiles produced shows how natural dyes react to one another, to fabrics, and to auxiliary chemicals during the creation of textiles with highly saturated colors.

The 'Scale, Void. Assemblage 001' project involved dyeing a garment using bacteria dyes. Within the context of bio-design, the bio-fabrication possibilities of organisms such as bacteria were explored in order to develop new materials, processes, and applications; parts of a silk garment were cut using pattern-construction methods, and bacteria was added to the fabric. This grew on the fabric, adding a layer of color. Each colony produces pigments, and the addition of more cells results in the production of more dyestuffs, which saturate the color further.

Nienke Hoogvliet's 'Sea Me' collection (Hoogvliet) extracted natural pigments from seaweed, which was used to dye yarns and fabrics. A variety of shades, ranging from browns and greens to greys, pink, and purples, was made using different species of seaweed. In order to best exhibit the potential of this exploration, Hoogvliet made a chair and table; the seat of the former was woven using yarn dyed with the natural seaweed pigments, and leftover pigment was used to paint both.

Stjernswärd's 'KAIKU' project resulted in a tool for converting plant-based waste into natural powder pigments. The plant-based waste is first boiled to release its color; the dye is then filtered and added to a reservoir, which is connected to a water pump, causing the liquid to move into the atomizing chamber. The liquid is kept at a temperature of above 100°C, causing it to vaporize; as a result, it can be applied as spray, and leaves behind a colorful residue. The pigment can be used for textile printing.

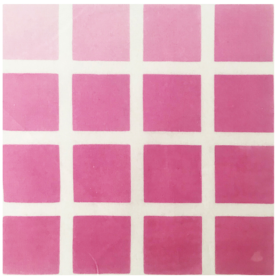
Studio Blond & Bieber design, run by Glomb and Weber, created the 'IKEA's virtual greenhouse' project, which resulted in a video showing the process of silk-screen printing using algae pigments. A tool for extracting a wide range of pigments, including different shades of blue, green, brown, and red, was developed. The project also highlighted the artistic value and design possibilities of using algae for silk screen printing, also concerning the creation of sustainable upholstery fabrics. Many of the plants and fruits we eat every day, such as avocados, onions, and oranges, have valuable pigments in their skins and peels, that can be extracted and used for textile printing.

These and other research and design projects have successfully established unique, craft-oriented methodologies for bio-fabricating or obtaining natural dyes for use with textiles. However, it may perhaps be presumptuous to assume that the current shift towards bio-materials is sufficient to achieve lasting change. The broader purpose of achieving sustainability through design should not be limited to the optimization of bio-materials within the context of design, and should instead include re-orienting design processes through new ways of thinking and doing things (Manzini). This paper aims to suggest changes to design processes by suggesting methods through which textile and fashion designers can create a new culture through design. It also proposes a new way of looking at the relationship between color and culture, focusing not on the historical relationship between the two—which has been interpreted in terms of color psychology, culture, geography, materials, activities, and symbolism—but on a culture of sustainable use of color in textile printmaking processes. Three case studies are presented, which cover the theoretical and practical implications of sustainable textile printmaking processes.

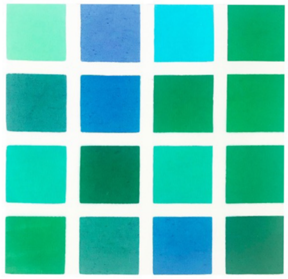
Case studies

The first case study references Julia Svantesson's 'Disclosed Color' project, which explored the use of the overprinting of colors in textile printmaking processes. Overprinting colors is a technique that is used frequently, and is a visually powerful method of creating vibrant, lively, and multicolored designs, as well as transparency and the illusion of space (Albers 29; Osborne 50). The technique involves the overprinting of base colors to create a new one, which is a blend. For example, blue can be overprinted with yellow to produce green. The function of this in the context of textile design can be to create a blended color, as an alternative to creating a gradient, or to show the beauty of errors in hand-printing—an added 'craft' value for a design, so to speak.

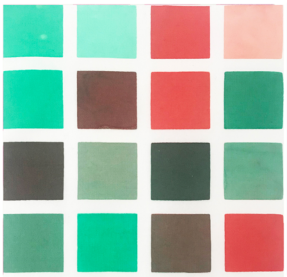
Existing textile prints which use the overprinting technique (see Norrman; Siirtolapuutarha; Bjarnestam) are rich examples which show that overprinted colors can be employed in order to do more than simply create an interesting visual aesthetic in the context of textile design. The producers also emphasize that this approach to using color in textile printmaking processes can be sustainable.



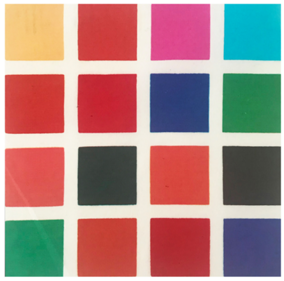
1 time	2 times	3 times	4 times
5 times	6 times	7 times	8 times
9 times	10 times	11 times	12 times
13 times	14 times	15 times	16 times



1 10% green	2 25% blur R	3 10% cyan	4 50%green
1+2	2+3	3+4	4+1
1+3	2+4	3+1	4+3
1+4	2+1	3+2	4+2



1 25% green	2 10% green	3 50% red	4 10% red
1+2	2+3	3+4	4+1
1+3	2+4	3+1	4+2
1+4	2+1	3+2	4+3



1 25% yellow	2 50% red	3 5% magenta	4 10% cyan
1+2	2+3	3+4	4+1
1+3	2+4	3+1	4+2
1+4	2+1	3+2	4+3

Fig. 1. (above): On the left; one of the color palettes, using 1% red (3BF). The palette suggests that a greater number of overprinted layers results in a more saturated hue. On the right; a color palette created using three adjacent colors on the color wheel in different saturations. Overprinting adjacent colors in different orders creates new blended colors, e.g., 1 (1st layer) + 2 (2nd layer), 2+3, 2+4, and 1+3, with slightly different saturations. The order in which the colors are overprinted does not affect the color mixture to a great extent, see 2+3 and 3+2.

Fig. 2. (below): On the left, one of the color palettes, created using two complementary colors on the color wheel in different saturations. The order in which the colors are overprinted affects the color blend, i.e., 2+3 results in a different color to 3+2. On the right; one of the color palettes, created using cyan, magenta, yellow, and red. Overprinting these colors creates the greatest number of color blends out of the three colors, giving a total of 10 different colors.

In her design process, Svantesson mixed magenta (red 3BF) (PANTONE 19-1955 TCX), red (PANTONE 18-1354 TCX), orange (PANTONE 15-1054 TCX), yellow (PANTONE 13-0648 TCX), blue R (PANTONE 18-4032 TCX), cyan (PANTONE 18-4537 TCX), and green (PANTONE 15-5534) reactive dyes and with CHT alginate thickener in order to create a reactive printing paste and desaturate the colors. Mercerised white cotton was chosen for printing on the basis that, when printing with reactive dye, the best results are achieved with cellulose fabrics. In order to establish a color palette using the overprinting technique, first each color (1% saturation) was overprinted with itself between 1 and 16 times. Then, three to four colors which were adjacent on the color wheel were then used in different saturations (1, 5, 10, 25, and 50%) and overprinted with one other in all possible configurations (Fig. 1).

Next, two complementary colors randomly chosen from the color wheel were overprinted in different saturations (1, 5, 10, 25, and 50%) and overprinted with one another in all possible configurations. Finally, in order to achieve CMY color combinations, cyan, magenta, and yellow in different saturations (1, 5, 10, 25, and 50%) were overprinted with one another in all possible configurations (Fig. 2).

If a multicolored pattern is being designed within a standard printmaking process, a separate screen must be used to apply each layer of color. In addition, the conventional process of creating a surface pattern usually starts with its design and

Fig. 3. Two complementary colors (green and red) in different saturations (left); the design was created using no more than four screens (middle); a close-up of the design (right).

form, after which colors are chosen. In rethinking both technical and design processes, Svantesson created color blends at the same time as the designs themselves. Her design method facilitated the use of no more than four screens in the printmaking process, which allowed more than eight different colors to be made in different tints, tones, and shades. Svantesson's method clearly shows that certain design decisions can make printmaking processes sustainable by reducing the number of colors and silkscreens used. For example, she designed a four-color repeating pattern based on the complementary colors of green and red in two different saturations (PANTONE, green; 16-5942 TCX and 14-6330 TCX) and red (PANTONE, red 18-1354 TCX and 15-1331 TCX; Fig. 3). By overprinting the four screens in different orders, she created a print with three different colors in nine tints, tones, and shades (Fig. 3). This is little, compared to the 13 screens and colors that the common method of designing a surface pattern would have required.

The second case study describes Lynn Tallvod's 'Made to Fade' project, which examined the idea of extending the lifetime of a garment through natural color printing in combination with flat-piece garment construction. Sustainable design in fashion has generally focused on minimizing waste during pattern-making (McQuillan), remaking or upcycling second-hand garments (Lidström), ethical garment construction, and the use of sustainable materials, largely in terms of organic fabrics (Goodone). Very few projects have explored the use of natural dyes in design processes with regard to either dyeing or printing on textiles. The ongoing 'DECAY' project, run by the Swedish fashion label Alice Fine, has produced a set of kimonos, the surface patterns of which were made using the eco printing method. The kimonos were first designed, then mordanted; plant material (flowers and leaves) was soaked to enhance the vibrancy of the dyes extracted as a result of the color-extraction process. The plant material was then placed on the garments. The garments were folded and rolled onto a pipe, and the bundles were then steamed or simmered for approximately an hour to fix the colors. Tallvod has contributed to this area by combining flat garment construction with upcycled fabrics and natural screen printing to create a bold, fashion-forward aesthetic, and to suggest a sustainable approach to using color in printmaking processes in fashion design.

After testing different kinds of mordant such as soy milk, tea, salt, chestnut, banana, alum, aluminium pot, different methods of using mordant, and using different qualities of fabric, Tallvod mordanted using a simultaneously mordent method using soy milk, which is mixed with dye and then printed onto textiles. The dyeing process was carried out with dyes extracted from madder root, brazilwood, turmeric, indigo, black beans, red cabbage, coffee, tea, beetroot, pomegranate seeds and skin, and avocado skin and pith. The printing paste was made by mixing different mordants, with the chosen dye, and a natural thickener called CHT alginate. After the printing was completed, the print was fixed using a steaming process. The prints were then washed 10 times in 30°C water to ensure color-fastness (Fig. 4).

Tallvod designed a series of garments using a modular design approach and the co-design method (Sanders & Stappers). The modular shapes and interlocking systems allow the wearer to participate in screen printmaking by breaking down the garments into separate parts, which are flattened and printed

Fig. 4. A color palette created using six different dyes; No. 1 is madder root dye, No. 2 is red cabbage, No. 3 is turmeric, No. 4 is brazilwood, No. 5 is coffee and tea, and No. 6 is black beans. Each dye was mixed with three different mordants; on the left with soymilk, middle with alum and left with aluminium pot. Each printing paste was tested on Spun rayon, Cotton, Tencel, and three different thickness of Linen. The result indicates that different qualities of fabric affect the obtained color, creating different shades.

with natural dyes to increase product versatility and longevity. Outfit No.4 (Tallvod) consists of two pieces: a naturally colored top and a skirt made from a second-hand linen bed sheet. They are made to be wrapped around the body using a flat garment-construction method and straps. As the lightfastness of natural dyes is poor, the color of the print will fade over time. However, the wearer can easily flatten the garments and print a new pattern on them. The project was designed with ease of maintenance and repair in mind, and the design allows the wearer a great deal of flexibility in terms of how the garments are used, and individuality with regard to self-expression and customisation. The possibilities with regard to changing the pattern and color of the print are endless (Fig. 5).

The third case study focuses on Jessica Rijkers' 'Color transitioning through bioplastic' project, which investigated printmaking using a single silk screen. Over the course of the last decade, bioplastics have begun to be used in textile design, attracting the attention of design researchers and practitioners who are interested in experimental and conceptual design approaches (see Franklin & Till; Myers). Several textile designers and researchers (i.e., Raff; Nitsche; Buet; Talep) have explored the endless possibilities that red algae, agar, and gelatine-based biopolymers offer textile design, and have successfully used natural dyes extracted from fruits and vegetables such as blueberries, purple cabbage, beetroot, and carrots in order to color bioplastics. To enhance her designs, Rijkers has not only created sophisti-

Fig. 5. A schematic illustration of the modular shapes and interlocking system of the top and skirt of Outfit No.4 (left). Two photographs of the outfit, showing the detail of the final print (right).

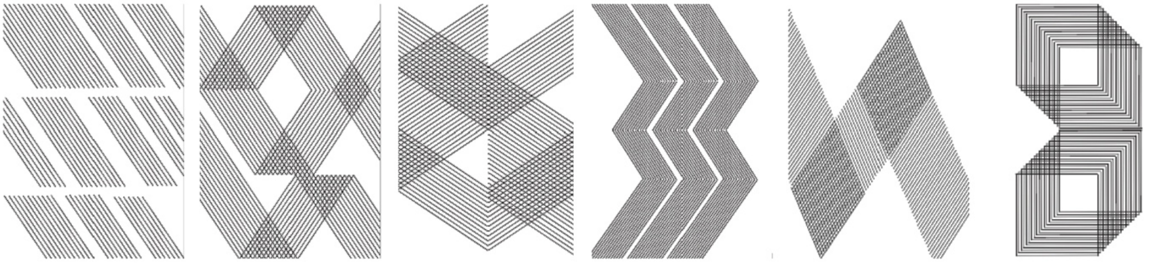
cated, soft, colored gradient bioplastics using food coloring, but also introduced a sustainable method of printmaking with bioplastics.

Rijkers began her design process with a question: is it possible to design a colorful repeating pattern using just one screen? A professional textile designer is aware that designing a colorful repeating surface pattern requires that each color be printed separately, and that each additional color used necessitates an increase in the number of screens. Rijkers tested different repeat-units to gain an understanding of which types of unit facilitate multiple overlays, and created forms and structures by rotating one screen and/or overprinting the unit. Color Transitioning (Rijkers) is a series of lampshades created using print, color, and light on the surface and inside of bioplastic samples. Soft, transitive gradients were created using pieces of agar-based bioplastic and food coloring. Stripes of the same thickness were then used to create a unit based on Wong's idea that "two straight lines can be brought together in numerous ways by changing their positions and/or directions" (157). In order to determine which type of pattern should be used for each type of colored bioplastic, a digital pattern library based on strip lines was first created (Fig. 6).

Patterns were chosen based on the shape of each lamp and printed on the bioplastic using textile pigment pastes and a single screen. This method also allowed Rijkers to customize the prints and place them precisely on the lampshades (Fig. 7).

Discussion

At present, the relationship between color and culture is generally seen in terms of a historical relationship between the two, which has been interpreted



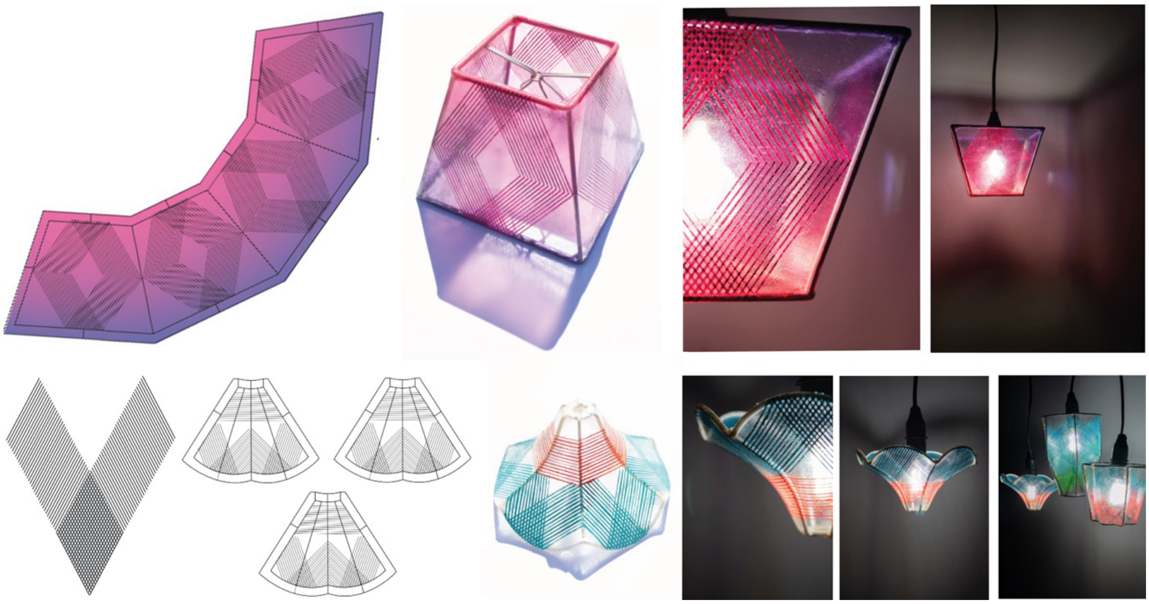


Fig. 6. (above): The digital pattern library demonstrates the wide variety of different surface patterns that can be created using only one screen and patterns of stripes.

Fig. 7. (below) Digital testing of the stripe pattern on a lampshade (left); the print on the bioplastic (middle), the lampshades (right).

in terms of color psychology, geography, materials, activities, and symbolism. Several aspects of this relationship remain unexplored, however, including one that takes a culture of sustainable use of color in design processes into account.

There are a number of reasons to suggest that many traditional textile printmaking processes should be challenged, particularly with regard to the textile screen printmaking process—one that creates a great deal of pollution due to the large number of screens and quantities of chemical-based pigments and water used to repeatedly clean the screens. How, then, can we make a change? This will undoubtedly involve not only replacing synthetic colors with natural ones, but rethinking how we design with colors. The responsibility to make a change belongs to designers, and relates to how they design their creations. The three case studies presented in this article suggest different approaches to sustainable design, and highlight the fact that the designer's role is not simply the technological aspect of design, but also incorporates sustainable principles in a sensible, practical manner without dismissing fundamental design concepts (Manzini).

Color is the most relative medium in art (Albers 1). Albers' Interaction of Color, first published in 1963, discusses the relativity of color; the way humans perceive color is influenced by the context of neighbouring colors and their size and quantity, lighting conditions, what we look at before and after, and many other aspects. The context of neighbouring colors, which suggests that one color can appear to be two different ones, for example, can be used as a sustainable solution in the design of a surface pattern. A textile designer could position colors in their design in such a way that one color can be used rather than two. Thus, fewer colors and screens would be needed to achieve a colorful surface pattern. Similarly, the Bezold effect (Albers 33), which is an optical illusion wherein adding or changing one color of a composition can alter the color of the entire design, could be a sustainable solution in the design of a surface patterns.

Another suggestion for achieving a culture of sustainable use of color is using RGB lights (Kooroshnia and Tepe). The subtractive combination of colored surfaces and colored lights proposes a large and dynamic pallet of colors, without the need for many colors to be in a design. The complex relationship between colored surfaces and RGB lights and differences between the behaviour of colors also suggest a method for creating novel dynamic surface patterns with smooth color and pattern transitions within the areas of textile and fashion design. The smooth color and pattern transitions of dynamic surface patterns suggest not only a culture of sustainable use of color but the value of incorporating the concept of storytelling in designs. The color and pattern transitions of dynamic patterns offer a story that can be followed by the owner of the textiles, creating stronger, deeper connections; it makes textiles more playful and extends the life cycles of textiles (Fletcher).

Using color in a more sustainable way is not the only method of steering the future towards sustainability; designs themselves should, from both aesthetic and functionality perspectives, serve the purposes of sustainability as well (Manzini)—and if they do not, a culture of sustainability through design will have a limited impact on the environment. Design itself should not create problems relating to a lack of sustainability; instead, it should offer new solutions to problems. In relation to this, designers can play very special and important roles, in that their creativity and skill as designers are crucial to the proposing of new strategies in relation to sustainability (Weenen). Shigeru Ban (Hara 27), for example, re-designed the conventional round roll of toilet paper by making square cardboard rolls; this change in shape makes pulling the paper from the roll more difficult, causing a decrease in paper usage. This kind of design has the function of reducing the consumption of resources.

We are at the dawn of a new age: one in which we should set aside all our ideas and design methods relating to what is acceptable within design processes, and propose new scenarios and criteria that focus on quality of life and are suitable for the environment, acceptable to society, and attractive to our culture. In the words of Manzini: "It is not a question of doing what we already do better. It is a question of doing different things in completely different ways" (8). Consequently, we need an entirely new visual aesthetic and functionality with regard to textiles as a reflection of textile designers and design processes.

Works Cited

Albers, Josef. Interaction of Color. New Haven & London: Yale UP, 2006.

"T-shape Jackets." Alice Fine. N.d. Web. 27 Oct 2021.

Briggs-Goode, Amanda, and John K. Townsend. Textile Design: Principles, Advances and Applications. Woodhead Publishing. 2011. Print.

Bjarnestam, Eva Atle. De formade 1900-talet: design A till Ö. Stockholm: NoK, 2005. Print.

Buet, Violaine. "MATERIALS." Seaweed Design. N.d. Web. 27 Oct 2021.

"Color Transitioning." Jessica Rijkers. N.d. Web. 27 Oct 2021.

Fletcher, Kate. Craft of Use. Routledge, 2016. Print.

Frank, Josef. Against Design. 2., überarbeitete Auflage. Ed. Jan Norrman. Birkhäuser, 2015. Print.

Franklin, Kate, and Caroline Till. Radical Matter: rethinking materials for a sustainable future. Thomes & Hudson, 2020. Print.

Hoogvliet, Nienke. "Sea Me." Nienke Hoogvliet Studio. N.d. Web. 27 Oct 2021.

"Goodone." Eco Fashion Talk. 2011. Web. 27 Oct 2021.

Glomb, Essi Johanna, and Rasa Weber. "Ikea's Virtual Greenhouse Project." Blond& Bieber, N.d. Web. 27 Oct 2021.

Hara, Kenya, Designing Design. Zurich: Lars Muller Publishers, 2018. Print.

Haines-Gadd, Merryn, Jonathan Chapman, Peter Lloyd, Jon Mason, and Dzmitry Aliakseyeu. "Emotional Durability Design Nine—A Tool for Product Longevity." Journal of Sustainability 10.6 (2018). Web.

Kooroshnia, Marjan, and Jan Tepe. "Using Colored Lights in Physical and Immersive VR Environments as Material for Design." Proceeding of The International Conference of the Color Society of Russia. Smolensk (2020). Web.

Kant, Rita. "Textile Dyeing Industry and Environmental Hazard." Journal of Natural Science 4.1 (2012): 22-26.

Lidström, Anna. Remake: design foundations. Licentiate thesis. University of Boras. Sweden. 2020. Web.

Mantel, Lara. "Matural Dye Print." Lara mantel dancewithcolor. N.d. Web. 27 Oct 2021.

Manzini, Ezio. "Viewpoint New Design Knowledge." Journal of Design Studies. 30.1 (2009): 4-12. Web.

McQuillan, H., 2019. "Hybrid zero-waste design practices. Zero-waste pattern cutting for composite garment weaving and its implications." Design Journal (2019): 803-19. Web.

Myers, William. Biodesign: London: Thames and Hudson Ltd., 2012. Print.

Nitsche, Tania. About Solving and Dissolving. MA thesis, Swedish School of Textiles, Borås. 2018. Web.

Osborne, Roy. Color Influencing Form. Morrisville, NC: lulu Press, Inc., 2019. Print.

Raff, Carolyn. "Algae experiment II." Carolyn Raff Studio. N.d. Web. 27 Oct 2021.

Sanders, Elizabeth B., and Pieter Jan Stappers. "Co-creation and the New Landscapes of Design." Journal of CoDesign 4.1 (2008): 5-18. Web.

"Scale, Void. Assemblage 001." FaberFuture. 2017. Web. 27 Oct 2021.

"Siirtolapuutarha." Marimeko. 2009. Web. 27 Oct 2021.

Stjernswärd, Nicole. "KAIKU Living Color: A System For Creating Color Pigments Derived From Plant Waste." Nicole Stjernswärd. N.d. Web. 27 Oct 2021.

Svantesson, Julia. TXTl (EXIT19). Disclosed color, exhibited at the Boras Textile Museum, Boras, Sweden, June to August 2019. Web.

Tallvod, Lynn. Made to Fade. Master level thesis. University of Boras. Sweden. 2020. Web.

Talep, Margarita. "Aia." Margarita Talep. 2021. Web. 27 Oct 2021.

Weenen, J.C. "Towards Sustainable Product Development." Journal of Cleaner Production 3.1-2 (1995): 95-100. Web.

Wong, Wucius. Principle of Form and Design. John Wiley & Sons, INC. 1993. Print.