

CONSTRUCTION KNITTING

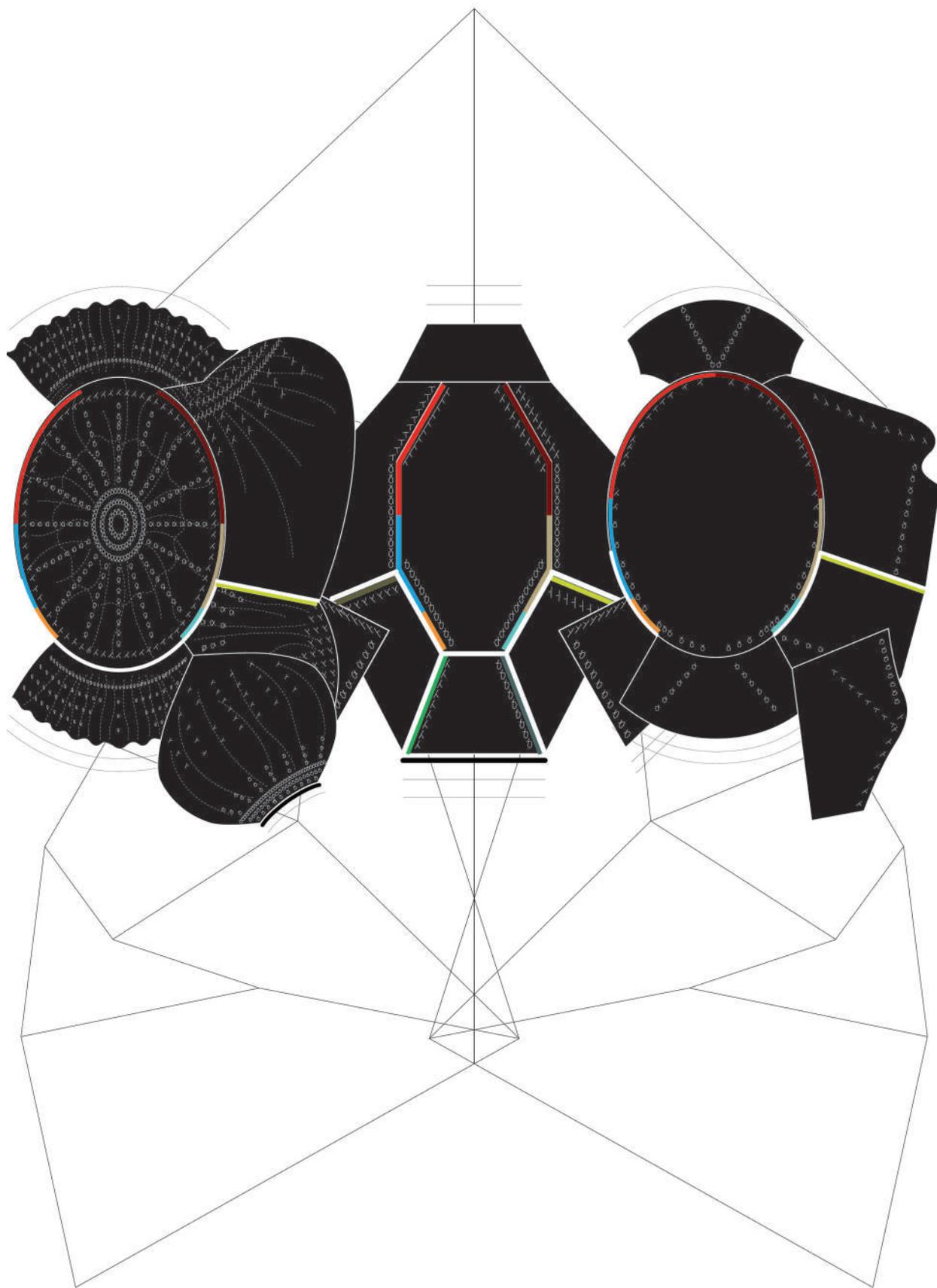
KNITWEAR DESIGN WITH GEOMETRIC SHAPES



NIKKI GABRIEL

BLOOMSBURY

Construction Knitting



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Knitwear Design with Geometric Shapes

Nikki Gabriel

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PREFACE

The idea of *Construction Knitting* comes from a series of handknitting patterns that I created as a visual format, to make knitting easier to follow.

I represented the garment parts as geometric shapes where the sleeves and body segments were knitted as squares, rectangles or triangles. These shapes became interchangeable pieces that could easily be customized. Parts could be altered, added or removed when composing a garment. I called this a ‘construction’ process, because the knitting is formed from separate parts like building blocks that can be assembled or fitted together. This enables the maker to engage in a design process, so that they can design their own knitting rather than just follow a pattern.

Subsequently, the ‘Construction Knitting’ workshops have attracted diverse participants, from brand new to expert knitters, and student designers from a wide range of backgrounds such as graphics, architecture, jewelry, fashion, and industrial design; viz. those interested in making. When I surveyed the reason for this broader than usual knitting audience, the attendants revealed the appeal lay in the visual graphic representation. Compared to a conventional knitting pattern written in an old-fashioned jargon that is difficult to understand, these patterns made the idea of knitting more accessible. But, particularly through the use of geometric shapes, a more connectable design language to describe and explain knitting enhanced the experience of knitting

for these participants. For most, a union of ‘design’ and ‘knitting’ was new.

The idea of making garments with geometric shapes is not new; but in this book the integration of knitting with geometric concepts brings about a relationship with design principles that are not usually associated with the features of knitting. There are very few books on design-it-yourself approaches to knitting, but none are as design-centric in the way this book is. The geometric can be linked to established design provenance, and has historically been employed as an aid for visual organization for all design composition. This book borrows some of these themes for knitting.

The knitting compositions in this book expand on the former ‘Construction Knitting’ projects by adding a wider scope of shapes to the knitting pattern designs. Patterns start with simple assemblages where pieces align by matching proportional sides. The projects gradually become more complex, where shapes curve and ruffle, merge and morph, thereby highlighting the logic of cause and effect in the building and creating of knitting. The illustrated guides enable the reader to easily grasp the progression of garment construction ideas, in a step-by-step format. But there is more to this method than joining shapes, for the geometric acts as a design conduit, to bridge dimensional reasoning with knitted structure.

Section One of the book covers knitting technique through some of the fundamental rules of hand

knitting's jargon, tools and materials, accompanied by knitted swatches that provide the reader with a comparative summary of stitch structures. The stitch language of hand knitting is discussed in comparison to the technical stitch language of industrial weft machine knitting, to provide insight to a more holistic view of knitting and its production processes.

As the making of clothing is the main context of knitting, its alignment with fashion is discussed in this chapter. Hand knitting is central to my own fashion practice, and so this book leans towards themes of sustainable fashion concepts that are prevalent in this type of making, and which reflect the spirit of the time. This topic is explored within the context of broader design movements, such as the newly founded DIY and maker cultures, to propose to the reader the relevance of a more multidisciplinary design language for knitting.

This visual language comes from geometric concepts so Section Two explores these themes as they apply to knitting projects. Emphasized as a practical tool, the geometric is observed as a type of device to guide the calculation, construction and arrangement of knitting elements in making shapes.

This leads to Section Three, which supplies patterns of how to make and assemble shapes as garment prototypes that a reader can modify by applying the variables as set out in the book.

The variables that the reader can reference in this book, in order to diversify or adapt the prototype garment designs, include re-arranging, re-sizing, omitting, adding or morphing shape modules. Stitch structure and yarn choice is also referenced as a variable to adapt a design. Photographic images of the garments are accompanied by illustrated patterns to demonstrate the modular garment construction process, along with knitting directions and notes on making.

Overall, these projects cover the very basics of knitting to engage the novice, and also work towards more complex themes and ideas through which the beginner can advance their knowledge; there are also further concepts that will appeal to the more experienced knitter. This book is for the design student or enthusiast of knitwear, fashion and textiles, and is a helpful substitute for conventional textile learning for the student who seeks to integrate a wider design literacy into an explanation of their knitting project.

FOREWORD

Connections between textile design, knitting and maths have often been recognized, but Nikki Gabriel integrates some particular mathematical concepts into knitwear design that creates a logical but endlessly variable modular design and construction process that she has made her own.

Starting with the basic notion of tessellation applied as patchwork – as utilized in quilting in the two-dimensional plane – Nikki’s ‘construction knitting’ creates new three-dimensional forms. She exploits the unique qualities of knitted fabrication to enable the creation of not only flat surfaces, but curved and ruffled surfaces that apply and interpret three surface geometries – plane (Euclidean), spherical and hyperbolic. The latter has been inspired by the amazing Crochet Coral Reef project, started in 2005 by scientist Margaret Wertheim and her sister Christine Wertheim, that in turn was inspired by mathematician Daina Taimina’s original 1997 experiments showing that crochet could be utilized to visualize and make tangible the concept of the hyperbolic plane.¹

Nikki has developed a design language and creative logic that works with the fundamental structures and capabilities of knitted textiles, designing concepts that function *because* this is knitted structure and not (like many fashion applications of knitwear) *despite* its being knitted. She takes a dynamic approach to the creation of knitted garments in three dimensions with an eye to movement and flow formed by the directions of the stitches and the consequent drape of the fabric created.

Nikki’s method diverges from flat pattern techniques to embrace the nature of knitted fabric and its potential for generating unusual three-dimensional form, especially when creatively constrained by seams joining modules together.

Fundamental Ideas: Straight, Diagonal, Curved, Hyperbolic

Nikki explains the basics of her concept and its tools, techniques and materials in the first section, and goes on in the second to outline knitting’s relationship with wider theories of design, which are not often applied to knitted textiles, thus illuminating her approach. A clear connection is made between the knitted stitch, row and fabric and the geometric concepts of point, line and plane. Nikki’s thorough approach includes defining and discussing terms and precedents, and by building on her previous work, she fills a gap she identifies in knitwear design with this fascinating new scheme. Section two then outlines her methods and gives patterns for seven master module shapes: square, quadrilateral, circle, triangle, pentagon, hexagon and octagon, all shaped by increasing or decreasing stitches one stitch from the edge of the piece.

The application of design geometries based on the classic straight-edged flat shapes, from three-sided triangles to eight-sided octagons, acts in Nikki’s words

‘as a design conduit, to bridge dimensional reasoning with knitted structure’. A fundamental idea is to adapt the surface geometry of knitted structure from the basic plain knitted horizontal rows and vertical lines of stitches (Straight), through changing the angle of the stitches by regular decreasing in the body of the fabric, balanced by increasing stitches elsewhere (Diagonal), to expanding the surface area through increasing stitches then decreasing in the same way within the body of the fabric (Curved), and finally to extreme expansion of the surface area into positive and negative space through intensive increasing and decreasing that creates a wavy surface (Hyperbolic).

Construction knitting is based on a modular system of assembling knitted geometric pieces together using Nikki’s uniquely visual language and diagrams as well as written patterns for the pieces and descriptions of the assembly process. This system allows for new variations to be built upon a foundational garment such as a sweater based on repeating the same modular form, and then adding more complexity stage by stage to make for example a tunic, a cardigan or a dress. The third section of the book is devoted to the garment patterns themselves with instructions for creation of eighteen variations on assemblages based on triangles, squares, quadrilaterals, pentagons, hexagons and octagons, showing three variations on each modular shape. A key innovation is the ‘merged’ shapes that are based on a combination of individual modules, such as five pentagons or fourteen

octagons, thus creating a central piece to which the other modules can be attached. There is huge creative potential for a knitter to expand on and experiment with these ideas, by adding or varying the modules and also the stitch structures used within the shapes. This is encouraged by including some stitch variations in the illustrated patterns plus the added enticement of many stitch patterns illustrated with their knitting instructions, ready to be applied.

Nikki Gabriel’s *Construction Knitting* demonstrates a unique and inventive approach to creating knitwear, based on a set of logical principles, visualized in both informative instructional diagrams and photographs of finished pieces. The ideas and examples provide a wealth of possibilities to intrigue a curious knitter to make these or similar garments for themselves. It will also attract the more adventurous knitter to apply and adapt their own variations using the process outlined and create one-of-a-kind individual pieces with dynamic flow and movement. *Construction Knitting* adds a highly distinctive voice and design philosophy to the canon of hand knitting design and production.

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NOTE

1. See also the work of Hinke Osinga and Bernd Krauskopf (2004): ‘Crocheting the Lorenz Manifold’, *Mathematical Intelligencer*, 26 (4): 25–37. This work developed a computer crochet programme for Osinga to create a physical realization in crochet of a classic phenomenon in Chaos theory.

SECTION ONE

Knitting Techniques



1.1. Big Knitting.

1.1 Hand Knitting – Overview

A basic fabric can be constructed quickly by hand with big needles, which is an accessible and enjoyable introduction to knitting. Big needles are a fairly recent intervention where the novelty has led to ‘extreme knitting’ – a term coined by hobbyists to describe styles using thick yarns and extra-large needles, or even with arms instead of needles. In recent years, this trend has become so popular that the Craft Yarn Council has even begun to adapt industry measurement standards for this style of knitting. This new, robust image – along with the gratification of quicker projects – has been pivotal to refreshing interest in the craft, and while some trace its origins to anti-capitalist and feminist activism (Bratich and Brush, 2011; Dawkins, 2011), others suggest that a more context-specific definition of knitting is responsible (Kelly, 2014: 133).

Another enticement is the sense of purpose and happiness that a hand-knitted item affords with a ‘look’ characterized by serendipity and personalization; substituting what’s missing from bought knitting and offering a more ethical alternative to mass-manufactured goods (a change from the past, when the aim of hand knitting

was often to replicate more expensive, fashionable, mass-produced clothing at home). At this mutational moment in fashion, luxury design brands have ushered in a contemporary high-end image for big hand knitting, inspiring a new wave of chunky knitwear and supporting Francesco Morace’s view that future fashion must adapt to consumers’ needs for a more authentic and meaningful experience (2010).

It is now common to see handmade knitwear as a strong design feature of fashion collections. So, contrarily, hand knitting is currently prevalent as an exclusive product created by skilled artisanal practice – a term that refers to regional and traditional practices, as well as handmade luxury and bespoke creations produced within a sub-system of the wider fashion system.¹

In these ways, hand knitting is even more accessible and inclusive as a DIY project than it has been for a while and during the global pandemic of 2020, some luxury brands even began to participate in this trend. This was led by JW Anderson, when the brand shared an online tutorial for Harry Styles’ patchwork cardigan after the garment became an internet sensation, with websites such as Show Studio and the Woolmark Company also participating. Design Historian Paul Atkinson refers to

this as ‘Open Design’ – a type of ‘internet enabled collaborative creation’ that enables the ‘sharing of knowledge between the professional and amateur designer’ (Atkinson, 2011: 20).

Regardless, the charm of hand knitting is its status as a highly emotionally invested process and a toil embodying care, perhaps inevitably popularized by a histrionic notion of grandmothers and mothers mentoring this knowledge (Black, 2012b).

It is perhaps due to this wholesome view of hand knitting that it is so aligned with influential movements such as Slow Fashion that advocate ethical, sustainable and caring ways of making clothes. Indeed, scholars including Fletcher (2010), Pookulangara and Shephard (2013) and Štefko and Steffek (2018), argue that Slow Fashion represents a philosophy of mindfulness rather than a pace of making, promoting a conscientious transparency of the production process, and educating consumers about the process and craft of making clothing. The discourse on this type of making also blurs the boundaries of home-made and high-end whereas, customarily, these spaces have sat at opposite ends of the fashion spectrum. This overlapping is partly influenced by newly adapted DIY strategies that encourage self-reliance and empower individuals and communities to explore alternatives to market imperatives controlled by big businesses (Deibert, 2014; Spencer, 2008).

Skill and information sharing has been driven by our immersion in personal technology and has contributed to the development of Slow Fashion and other aligned subcultures like the Maker Movement – a technology-based extension of DIY culture that makes use of forums, websites and social media networks (Kayler, Owens and Meadows, 2013). Hand knitting is now more frequently learned through online tutorials than matriarchal mentorship. Furthermore, following the mood of the aforementioned Maker Movement, this knowledge distribution on websites and social media platforms shifts between digital realms and actual physical spaces. But this is a different setting from the traditional knitting circle or the knitting guild, for many textile spaces have emerged as incubation hubs where craft and technology meet. Typically, knitting is excluded from multidisciplinary maker spaces but recent conversations and projects have begun to address this.

For example, Estonian artists Varvara and Mar created the Circular Knitic (2014) – a circular knitting machine for which all parts can be made from digital fabrication tools found in maker spaces. This research and the artists’ project helped integrate soft object production into maker spaces (Varvara and Mar, 2014).

These textile spaces² provide support for individualized clothing production for the hobbyist wanting to professionalize their craft, for professionals to share facilities, or for the leisure maker to just partake. They operate as either organized or informal outlets that run peer-led workshops and share patterns and skills. Hubs with equipment and machinery are made accessible to individuals, with educational programmes in knitting by hand or with small domestic knitting machines, semi-industrial knitting machines and, in some cases, industrial three-dimensional computerized knitting machines. In New York, the Textile Arts Centre runs studio workshops for hand and machine knitting while in London Knitworks has a ‘machine knitting school’. Many other institutions (including Auckland University of Technology, the Swedish School of Textiles at Borås University, the Textiel Lab at the Textiel Museum in the Netherlands, and the Fashion Design Hub at Curtin University, Western Australia) boast Knitting Labs that are housed as research centres used by students as well as industry partners and textile enthusiasts.

Because knitting technology has generally only been available on a mass-production scale, there has always been a context gap between hand knitting and machine knitting. But there is potential for this gap to be narrowed with new, small digital knitting machines on the market that are now within the reach of any knitting enthusiast. This includes the The Kniterate™ knitting machine – a ‘consumer-level industrial style’ desktop machine designed to emulate the expediency and self-sufficiency offered by traditional three-dimensional printers (Narayanan et al., 2018: 1–14) and initially launched as a kickstarter campaign by Gerard Rubio.

These developments can foster a wider appreciation and understanding of the links between the hand-knitting process, its appropriation for technology and the design process of knitting. This was explored by the students of the Politecnico di Milano Fashion School, when they began the design process for industrial garments by hand knitting swatches first, transitioning

from hand to machine thinking and ‘generat[ing] interest in ... knowing how to make’. This project was run in collaboration with the knitwear giant Missoni, Woolmark and yarn producer Zegna Baruffa Lane Borgosesia, and is described in the academic paper ‘New Vision on Knitwear Design. How the Traditional Craft Methodologies are Evolving into Fashion International Scenarios’ (Affinito, Conti and Motta, 2017).

1.2 Tools and Workings for Hand Knitting

FABRIC STRUCTURE

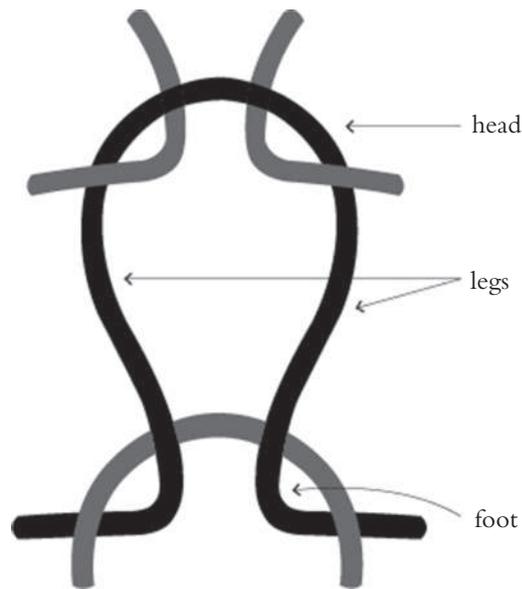
Hand knitting can provide foundational knowledge for all knitting, as it is built manually, stitch by stitch.

The handknitting process develops an understanding of the basis of the grid structure³ of knitting, and the way in which stitches are formed and function. Knowing the four primary stitch functions that determine all knitted fabric structure is one of the important development steps of knitting.

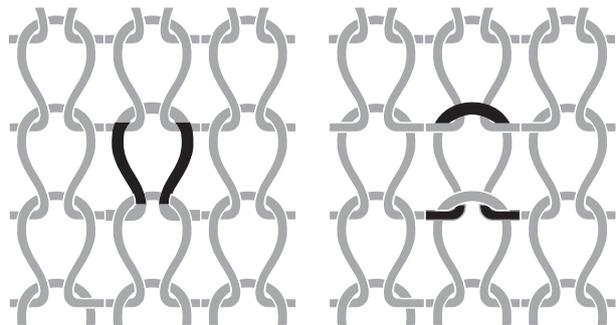
In technical terms these stitches are noted as the ‘stitch configuration’ that delineates a knitted textile. These configurations are the knit, slip, tuck and transfer stitches.⁴ To understand how these stitches affect the physical properties of knitted fabric cultivates knitting knowledge. The term knowledge is applied here in its literal sense as being acquainted with facts or principles from study or investigation, which is distinct from skill, or know-how, which means a type of competence or manual dexterity, of which knitting is commonly referred to exclusively. This knowledge builds the ability not only to follow a pattern with greater proficiency, but it also equips a knitter with the thinking tools to design, adapt and reverse-engineer stitch structures, and therefore knitted fabric patterns.⁵

The first stitch configuration to realize is the knit stitch, which is born by the needle looping the yarn into a type of continuous knot that embodies feet, legs and a head. The perception of this stitch anatomy is relevant even in the most basic knitted fabric construction where the front of the fabric can be identified by the visibility of feet and legs, and the back (purl side) shows the heads. This is a necessary insight for a new knitter

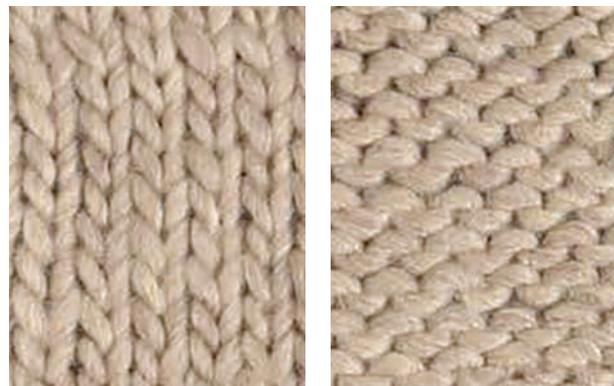
when needing to identify and articulate the back from the front of the fabric, and which side to knit or reverse-knit as a purl stitch.



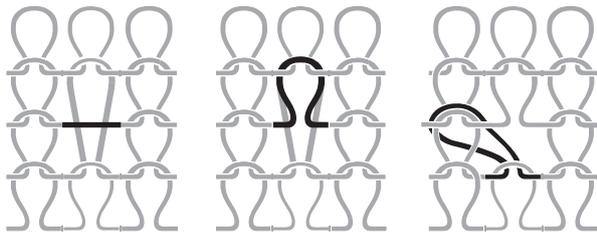
1.2 Stitch head, legs and feet.



1.3a Knitted Fabric. Front and Back.



1.3b Knitted Fabric. Front and Back.



1.4a, 1.4b, 1.4c. Slip, Tuck and Transfer Stitches.

The other stitches – slip, tuck and transfer – are stitches that are held to be worked on later, and which consequently affect the loop configurations differently.

Yarn floats over one or more loops when slipping a stitch, so it forms neither head, feet nor legs, and this is why it is sometimes called a missed stitch. The loop legs are elongated in the tuck stitch as it is held and then lifted into subsequent rows later. The transfer stitch technique makes the loop absent as it is moved to an adjacent needle, therefore a gap or hole is left where that loop formation was.

Stitch techniques that fill gaps and reconstitute loops, or accentuate gaps and distort loops, are considered ‘other’ techniques; such as wrapping and twisting yarn loops that generate overlapping and layering of stitches, or groups of stitches. These techniques can decrease or increase the amount of working stitches,⁶ and are all accounted as ancillary stitch functions.

The arrangement features of the four primary stitches, i.e., knit, slip, tuck and transfer stitches, in combination with surrounding neighbouring stitches can create an immense variety of knitted fabric patterns. Knitting technologist, David J. Spencer (2001) writes about stitch interrelation in weft knitting technology, where ‘The properties of a knitted structure are largely determined by the interdependence of each stitch to its neighbours on either side and above and below it’ (16).

Patterns are conveyed by knitting notation that state stitch composition, alongside charts with symbols, and descriptive paraphrasing.

- Notation: As there is seemingly no single authority source on hand knitting notation, it exists in various forms but has cultivated as a type of aggregate technical language. This language prescribes routine steps that are mechanical in

nature, and is designed to be followed like a recipe. Supplementary techniques, those that describe the less mechanical performance of knitting such as creativity, spontaneity and individuality, are usually represented through photographs and illustrations and/or video tutorials, generated as a type of storytelling devised by the author of the pattern.

- Symbols: These vary between countries and represent knit stitches visualized in a grid format. It can be a difficult tool to read and follow, but as the chart closely resembles the knitting production process it can initiate an understanding of the basis of the grid structure of knitting, and therefore the steps of repetition and variation that is conceivable in knitted fabric. However, as this system of symbols is exclusive to hand knitting, this book does not include chart symbols as a mode of pattern instruction. Instead, this book applies a descriptive and illustrative style of knitting pattern, for the aim is to provide for the designer some hand knitting ‘knowledge’ that can be extendable by aligning it to machine modes and therefore a more holistic application of knitting language.
- Paraphrasing: This is a way of phrasing more complex notation to make knitting easier to understand, and is a method known in hobbyist realms as ‘knitting phraseology’, which means to re-phrase a knitting notation, where the notation is colloquially referred to as ‘knit speak’.

The names that define knitting patterns, such as cable and lace, are expressions that originate from historical epithets, national identity and nicknames.

The knitting terms ‘cable’ and ‘lace’ come largely from previous centuries’ domestic craft industries. The cable-stitch pattern is derived mainly from the Irish tradition of Aran knitting, which historically was developed to make fishermen’s jumpers for enduring harsh climate. The technique of crossing over layers of groups of stitches was designed to make the wool fabric warm and dense as a decorative detail, now commonly referred to as the Aran cable. Variations in these cable motif patterns are imbued with nineteenth-century

Celtic folklore which, as portrayed by Carden (2018), are romanticized as carrying messages in a ‘pre-literate world’, differentiated by region, clan lineage, fisherman hierarchy, and even talismanic odes (67). Modifications to traditional cable patterns traverse knitting practices in hobbyist and fashion textile industries, and are identified by name extensions that give clues to the way the textile looks. These are seen, for example, in the resemblance to nature and natural objects, or mathematical, geometric and architectural forms, such as Tulip Cable, Sea-Shell Cable, Gothic Cable, Arch Cable, etc. There are supplementary names that give some indication of technique, such as Five Cable Knit, or Six Strand Cable, suggesting how many stitches or bands of stitches are crossed over.

Other names give less indication of the visual appearance or production technique of the textile, which, as with lace terms, are derived broadly from geography, literature, royal reigns, religion, food and even industries. Patricia Frost (2000) describes the origins of the word ‘lace’ as coming from the Latin word ‘noose’, of which the literal English translation is ‘loop’. Loop means opening, or hole, which in old French is ‘Las’, and this suggests how the lace technique acquired its label. However, the supplementary variant names make these knitting terms a bit more arcane. In her book *Lace Knitting*, Helen James (2019) explains that the first appearance of knitted lace is a fine silk hosiery now housed at the Dresden Museum, Italy, displaying a

‘diagonal faggot pattern dated back to the mid 1500s’. As a verb, the origin of ‘faggoting’ for lacework seems to be mainly conjecture, but *The Merriam-Webster Dictionary* references it as coming from an iron-smithing tradition, of forging metals together (‘Fagot’, n.d.). ‘Faggot stitching’ is defined as a needlework technique in the *Oxford English Dictionary* with the earliest reference being *Godey Lady’s Book* 1854, which describes cloth bound together with ‘an open fagot stitch’ (‘Faggot stitch’, 2021). Such techniques were taught through generational knowledge in master-and-apprentice situations, and so authorship and design sources become ambiguous.

Today, many of these designs are open source, and stitch-by-stitch instructions for knit fabrics such as lace and cable patterns are available in the public domain, as they are either vintage techniques that are beyond print copyright laws, or they are free patterns that people share on the internet.

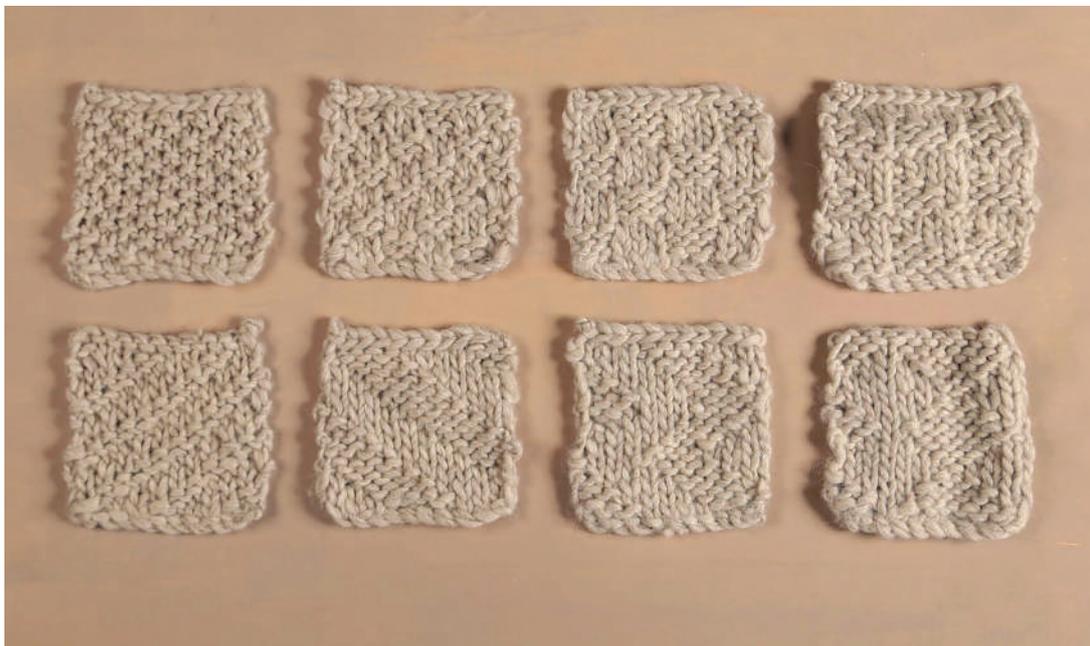
These pattern names do not necessarily define technique; it is the ‘stitch configurations’ that do. For example, a lace knitting pattern is made by a slip stitch technique, and the term lace is rhetorical, referring to the effect or style of the knitted textile. Thus, to generate a more specific association between the textile and the technique, hand-knitted fabric construction can be categorized and referenced by its stitch configuration. Knitted fabric types can be grouped into principal stitch functions, while also observing the role of ancillary connecting and surrounding stitches as per Table 1.1.

STITCH CONFIGURATION

Knitted Swatches:



1.5 Knit Stitch Swatches. Combinations of the knit stitch and its reverse stitch; the purl stitch. There is a push/pull tension between the two stitches which is pronounced when they sit next to each other; of which a good example is a rib, which creates extra elasticity and spring in the knitted fabric. You can see how the purl stitch rises and the knit stitch recedes, which is emphasized more when the knit and purl are in a variety of pattern formations as per Images 1.6 and 1.7.



1.6 Knit Stitch Swatches. Examples of arrangements of the knit and purl stitch that exploit the patterning and structural features of these stitches.



1.7 Knit Stitch Swatch. Examples of arrangements of the knit and purl stitch that exploit the patterning and structural features of these stitches.





1.9 Slip Stitch Swatches. Shows slip stitch formation when the stitch is passed over another stitch to create a hole. This is the action of removing a stitch from the knitting cycle. When a hole is created in the fabric, a re-fill stitch is required to maintain the width of a fabric. The swatches show techniques of 'removing' a stitch, and 'reconstituting' a stitch; which are arranged to create pattern formations.

Left: 1.8 Slip Stitch Swatches. The reverse side swatches on the top row show how the thread floats as it is slipped, and passed onto the next working stitch. The front side swatches on the bottom row show how the slipped stitch elongates when it is knitted in the next row, which creates a welt in the fabric, and is emphasized when the action is repeated in a pattern formation.



1.10 Tuck Stitch Swatches – Front of fabric. The tuck stitch is also a stitch that is not worked, as it is suspended or held to be knitted in a row above later. It is dependent upon the stitches around it. One technique of tucking a stitch is to slip it, and suspend it along with the yarn float. A yarn float occurs because it has to be passed across the slip stitch to work the next stitch. Then the slip stitch and yarn-over are knitted together in a row above. Marchant, N. (2017), *Tuck Stitches: Sophistication in Handknitting*.



1.11 Tuck Stitch Swatches – Back of fabric.



1.12 Transfer Stitch Swatches. The transfer stitch technique is the action of moving a stitch or group of stitches from one place to another in the knitting cycle. As a decreasing technique stitches do not need to be reconstituted. As a decorative technique where stitches cross over each other to create three-dimensional patterning effects, this is also known as a cabling technique as a style of patterning. These swatches show pattern repeats of crossing over two stitches, beginning with simple formations and build to more pattern complexity.



1.13 Transfer Stitch Swatches.

Table 1.1 Knit, Slip, Tuck and Transfer Stitch Configuration

KNIT STITCH	SLIP STITCH	TUCK STITCH	TRANSFER STITCH
<p>Stitch Function A knit stitch is the most basic stitch, formed by working the needle through the front of the stitch. A purl stitch is the reverse of the knit stitch, formed by working into the back of the stitch.</p> <p>Appearance & Fabric Properties Garter stitch, also known as a plain stitch, or basic stitch fabric, is where the knit stitch is repeatedly made on both the front and back rows. This creates a flat fabric with wavy lines, with a slightly stouter form in comparison to a stocking stitch fabric.</p> <p>Stocking Stitch Made by alternating knit and purl rows. On the right side the knit stitch resembles repeated 'V' shapes vertically and horizontally. The purl back side intermeshes in the opposite direction, and resembles wavy horizontal lines.</p> <p>When repeated, this creates a flat smooth fabric, also called jersey fabric. The handknitting term is stocking or stockinette stitch fabric. This fabric tends to roll at the edges on the reverse side edges. On the right side of the fabric, it rolls on the top and bottom edges.⁷</p> <p>Alternating Knit & Purl Stitches Rib stitch fabric: Made by alternating knit and purl stitches, repeated. A typical rib</p>	<p>Stitch Function A slip stitch is made by passing a stitch from one needle to another without knitting it. Stitches can also be slipped for more than one row.</p> <p>Appearance A single slip stitch will cause the yarn to float over the back of the stitch, which explains why this is sometimes called a float stitch, or a missed stitch. The float stitch will have the appearance of a U-shape on the reverse of the fabric, and will elongate when it is knitted in the next row.</p> <p>Ancillary Stitches *YO – (yarn-over) **K into back and front of stitch. A secure hole is created by slipping a stitch over another stitch. This is like a casting-off action. The stitch is reconstituted by the addition of another stitch, either by casting on a stitch, *looping yarn over a needle to make a stitch, or **knitting into another stitch twice.</p> <p>Stitches can be dropped after knitting to create a ladder, which is the appearance of a vertical row of floating U-shaped stitches.</p> <p><i>Wrn: Wrapping Yarn over Needle</i> *K2tog **SSK ***PSSO</p>	<p>Stitch Function A tuck stitch is a held stitch, suspended to be worked on in a row above later.</p> <p>Appearance The resulting stitch produces an elongated stitch (lengthwise) on the front of the fabric, while on the back of the fabric the tuck stitch appears as an inverted 'V'. The stitch can be elongated for two or more rows, depending on how often the stitch is tucked.</p> <p>A tuck stitch can also be formed by picking up stitches from rows below.</p> <p>Ancillary Stitches *Slip Stitch. Yarn-Over. Knit Stitch. **Brioche Stitch. *A tuck stitch can be done by slipping a stitch, and then carrying the yarn over the needle and the slipped stitch (instead of behind the knitting). This keeps the yarn moving along the row, getting it to a working point for the next stitch. When the accumulated slip stitch and yarn-over are knitted together in another row, this creates a gathered effect in the knitting; which is exaggerated over more rows. **The action of knitting the slipped stitch and accumulated yarn-overs together is called a brioche stitch.</p>	<p>Stitch Function A transfer stitch is taking a stitch out of action, and moving it elsewhere to be knitted out of sequence.</p> <p>Stitches are usually relocated in the same row. A single stitch, and groups of stitches, can be transferred to the left, right or back of the knitting.</p> <p>Appearance, Ancillary Stitches, and Fabric Properties <i>Tuck Stitch. Slip Stitch. Knit Stitch. Purl Stitch</i> A combination of knit, purl, slip and tuck stitches create cabled fabrics. The transfer action is done via an additional needle.⁸ This forms textures that overlap, cross and zig-zag to make plaited or granite effects.</p>

<p>repeat is single (k1/p1) or double (k2/p2), where chunkier rib repeats with (k4/p4) or (k5/p5) are also popular. This vertically compresses the knitted fabric, but adds elasticity in the width. A rib fabric has a flatter edge⁹ than its stocking stitch relative and, overall, it is a compact and stable fabric which can be used as borders, collars, cuffs, etc.</p> <p>Moss Stitch</p> <p>This consists of alternating knit and purl stitches, diagonally positioned with respect to the row below, which creates a pebbly effect.</p> <p>Notation: K (knit) P (purl) St st (stockinette stitch or stocking stitch – K1 row, P1 row)</p>	<p>Also makes holes, and is similar to yarn-over (YO) but this is wrapping yarn over needle more than once; the more wraps, the larger the hole. This increases the stitch count, which is balanced by decreasing a stitch by *knitting two stitches together, or **slipping two stitches onto the needle, knitting into the second stitch, then slipping the first stitch over. Another way of doing this is knitting two stitches, and slipping the first stitch over the second stitch (k 2, sl 1 st st over 2nd). ***Or, quite commonly, the first stitch is slipped, the second stitch is knitted, and the slip stitch is then passed over the knit stitch: (sl, k1, pss0).</p> <p><i>Make Stitch.</i></p> <p>To reconstitute a hole, a thread from the bottom row can be picked up and knitted as a stitch. (M1)</p> <p>Fabric Properties</p> <p>Slip stitches enlarge the size of the stitch in the front, which together with the reverse float creates a textural surface to the fabric on both sides.</p> <p>When slipping a stitch over another stitch this creates holes, which can generate gossamer, meshed fabric structures that tend to fragment and lighten the weight of knitted fabric.</p> <p>They are likely to be firmer and less rigid compared to other knit structures.</p>	<p>Fabric Properties</p> <p>The tuck stitch technique can condense and compress fabric, making decorative welts, folds and ridges where stitches are accumulated.</p> <p>It tends to narrow knitting, but has good stretch capability along the width of the fabric.</p> <p>Woven Fabric Looks</p> <p>In combination with the slip stitch, the tuck stitch creates woven-like fabrics, some very textured, some with quite smooth surfaces.</p>	<p>Notation T (transfer) Sl st (slip stitch) Cn (cable needle) CF (cable front) CB (cable back)</p>
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(Continued)

KNIT STITCH	SLIP STITCH	TUCK STITCH	TRANSFER STITCH
<p>NOTES:</p> <p>A knit/purl stitch has a universal function in knitting, acting as a binder for other stitch functions:</p> <ul style="list-style-type: none"> • The knit/purl stitch forms a flank between miss/slip stitch structures, to catch floating threads. • It can be a stabilizer at edges and forms a frame or selvage for most fabric types. 	<p>This is because floating/missing stitches make the fabric thinner than, say, tuck-stitched fabrics, as there is no yarn accumulation* . Fabric is lighter in weight due to the minimum amount of yarn being used in construction.</p> <p>Missed stitches also influence the narrowing of a fabric as there is no looped configuration, and hence the whole structure is pulled to minimum width.</p> <p><i>Tuck Stitch. Knit Stitch.</i></p> <p>A slip or missed stitch is usually bound to the fabric by a bordering tuck or knit stitch on both sides.</p> <p>← →</p> <p>Notation</p> <p>Sl (slip stitch)</p> <p>Psso (pass slip stitch over)</p> <p>YO (yarn-over)</p> <p>Wrn (wrap yarn to make 1)</p> <p>M (make stitch)</p> <p>NOTES:</p> <ul style="list-style-type: none"> • A slip stitch is used to create smooth borders; where stitches are slipped instead of being knitted, or are slipped on every alternative row. • As knitting is formed through the interlooping of yarn, the yarn making of loops or knots; where a loop is missed neither a loop nor a knot is formed. 	<p>Notation</p> <p>K1B (knit stitch in row below)</p> <p>Sl yo (slip stitch and yarn over)</p> <p>Brk or Brp (knit or purl the slipped stitches and yarn-over together as one stitch)</p>	

1.3 Types and Classification of Yarns and Fibres

Knitting is so commonly associated with its champion fibre, wool, that it would be difficult to embark on the topic of yarns without beginning there. Outside of the specialized knowledge domain of textiles, wool commonly gets mistaken as the term for all knitting yarn. In the mainstream, wool is the sensorial, material dimension that brings tactility, weight, scale, texture, grain and smell into the thing being knitted, whether made by hand or machine.

Beyond wool, the range of yarns produced for knitting is vast, and for the hand knitter usually the main premise for choosing yarn is the temperature suitability for the end use of the product. So, generally, yarns are divided seasonally, into winter and summer fibres – in other words, essentially, warm and cool fibres.

- **Warm fibres** tend to be constituted of animal fleece fibres and amongst wool popularly include mohair, angora, cashmere, camel and alpaca.
- **Cool fibres** ordinarily include vegetable fibres such as cotton, linen, rayon, bamboo, soya, hemp and ramie. Silk is a cool fibre but as it is harvested from the silk worm and is a protein fibre, it therefore falls into the animal fibre category.
- **Synthetic fibres** are purposefully modified during production so they can be either cool, warm or trans-seasonal. Synthetic fibres typically include nylon, polyester and acrylic.

These yarns possess different qualities, and bear characteristics that include a distinct look and feel, some of which is explored in the table of variations of natural fibres when knitted (see Table 1.2, Comparison of Fibre Features and Yarn Characteristics).



1.14 Yarn Skeins from Purl Soho, from left to right: Warm Fibers – Wool, Alpaca, Kid Mohair, Mohair & Silk blend. Cool Fibers – Silk, Cotton, Bamboo, Linen.



New developments in the area of synthetic fibre production are constantly generating superior features for knitting. However, there is a resurgence of interest in natural fibres, small batch, and hand-produced yarns, as they present a more ecologically sustainable product with the use of fewer chemicals in their manufacturing process. It can be said that this is also testament to the popularity of bespoke or homespun production influencing the shaping of this trend commercially.

Small-batch yarn production includes the operation of a 'mini mill', which is a cottage-industry mill that spins fibre into yarn, and generally services exotic fibre animal farms that turn their fleeces into finished product. Such farms may include alpaca, cashmere and mohair, but this machinery can also spin wool. The machinery is more or less a scaled-down version of a large manufacturing configuration and is by no means a budget set-up. However, the product that comes from this type of production is different from the mass-produced spun yarn, as this process infuses an element of the human touch and serendipity into the outcome.

Another valid form of small batch yarn production is hand spinning by groups and individuals. Hand spinning is the art of twisting fibres into yarn using a spinning wheel or hand spindle. Spinning by hand offers enormous creative scope, much more vast than automated spinning systems. Fibres can be short or long, synthetic and natural, and can be spun bulky or fine. Coming from an ancient textile art, spinning has largely been a guild practice and hobbyist activity. But hand spinning is also burgeoning as a creative practice, driven by artistic individuals who have contemporized the form of the hand-spun yarn as a visual expression of textile culture.

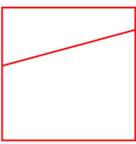
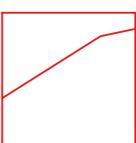
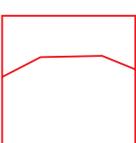
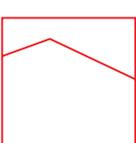
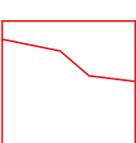
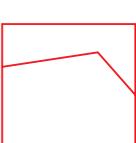
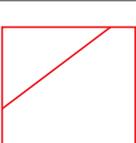
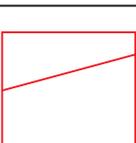
The recycling of synthetic compounds for knitting fibres is addressing the unwholesome view of factory or machine-made garments and is becoming more intrinsic to fashion practices.

The growing designer-maker practice that combines sensory approaches to making with intellectual engagement is part of this shift towards responsible use of resources. Designers are resourcefully utilizing the benefits of opposite ends of hand and industrial material production, leading to an emphasis on a new design term known as 'materiality'. Drawing on classical philosophy, materiality has developed as a modern concept in the area of arts and humanities, and refers not only to the physical aspect of things, but also anything that can be composed, even non-physical products like music or a computer program. But in this thinking, the material only comes into existence through the combination of the technology, the ideas of the author and the final product. Therefore, it is proposed that materiality constitutes all matter involved in the process of a thing being made. This concept is also referred to as 'new materialism'.

New materialism brings a new perspective of materiality into textiles, to mean more than simply the surface texture of cloth. The term is used to describe the creative entanglement of the designer, the fabric, the finished object and the technology used to make it, as well as the user, or the wearer of the finished object. All these things are made up of energy, of matter, that has some sort of action on the object. New materialism is also a term that specifically describes recycling or upcycling in fashion practice. In a philosophical sense, it translates as matter becoming-more or becoming-other.

Left: 1.15 Drape: Knitted Mohair/Silk blend. (Circles)

Table 1.2 Comparison of Fibre Features and Yarn Characteristics

		WARM						COOL			
		Wool	Mohair	Cashmere	Alpaca	Angora	Cotton	Silk	Linen	Bamboo	Hemp
Look											
		SMOOTH, MIDSHEEN	FLUFFY, LOFTY	FUZZY, MATTE	SMOOTH, LIGHT BRUSH, HIGH LUSTRE	FLUFFY	Mercerized: SHINY Brushed: LIGHT BRUSH, MATTE	Spun silk: SMOOTH & SHINY Noil (waste silk, short fibre): TEXTURED AND NUBBLY	High quality: SMOOTH Lower grade fibres: WRINKLY & SLUBBY	SMOOTH, SHINY	SMOOTH, MID-SHEEN
Feel											
		SOFT, ELASTIC, HIGH ELASTICITY	LIGHTWEIGHT, HOLDS SHAPE	SOFT, LOW ELASTICITY, HIGH DRAPE	SILKY, HEAVY, HIGH DRAPE, INELASTIC	SOFT & SILKY, LIGHT, INELASTIC	Mercerized: SOFT & SMOOTH Brushed: CRISP	Spun: STIFF Noil: DRY HANDLE	DRY HANDLE, BUOYANT, INELASTIC	SOFT, DRAPEY, INELASTIC, CAN HOLD SHAPE	LIGHT BRUSH to DRY HANDLE

1.65.1 – 1.65.20
 Angora 1.65.9&1.65.10, Cotton 1.65.11&1.65.12, Silk

NATURAL				SYNTHETIC					
Animal	Plant			Natural Polymers			Synthetic Polymers		
Fur Fibres	Cellulose Fibres			Cellulosic Fibres			Petroleum Fibres		
FIBRE	SOURCE	FIBRE	SOURCE	FIBRE	SOURCE	FIBRE	SOURCE	FIBRE	SOURCE
WOOL	SHEEP	COTTON*	COTTON PLANT	RAYON/ LYOCELL	REGENERATED WOOD PULP	POLYESTER	COAL	GLASS	MINERAL
MOHAIR	ANGORA GOAT	SILK	SILK WORM	ACETATE	COTTON LINT OR WOOD PULP	NYLON	COAL, NATURAL GAS, LIME	METALLIC	STEEL
CASHMERE	CASHMERE GOAT	LINEN	FLAX PLANT <i>Linum usitatissimum</i>	TRIACETATE	ACETATE + WOOD PULP			PET	PLASTIC (recycled plastic bottles)
PASHMINA (CASHMERE)	CANGTHANGI GOAT	RAYON	REGENERATED WOOD PULP	PLA	FERMENTED PLANT STARCH (potatoes, corn)				
CASHGORA	CASHMERE-ANGORA CROSS GOAT	BAMBOO	BAMBOO PLANT						
CAMEL	CAMEL	SOYA	SOYBEAN	CHITOSAN	INSECT & CRUSTACEAN SHELLS				
ALPACA	ALPACA – LLAMA GLAMA PACOS (DOMESTICATED)	HEMP	BAST FIBRE <i>Cannabis Genus</i> PLANT	RUBBER	RUBBER TREE				
LLAMA	LLAMA GLAMA GLAMA (WILD)	RAMIE	BAST FIBRE <i>Boehmeria nivea</i> , THE WHITE CHINA PLANT						
VICUNA	LLAMA VICUNA (WILD)	TENCEL	WOOD PULP						
ANGORA	ANGORA RABBIT	CORN	CORN COB						
		MILK	MILK CASEIN (COW'S MILK)						

(Continued)

NATURAL			
Animal	Plant		
Fur Fibres	Cellulose Fibres		
FIBRE	SOURCE	FIBRE	SOURCE
MUSK	MUSK OX	NETTLE	BARK Nettle Plant
YAK	BOVINE	KENAF	BARK OF <i>Hibiscus cannabinus</i> L.
POSSUM	NZ BRUSHTAIL POSSUM	SEACELL	SEAWEED
		COCONUT	COCONUT HUSK
		PINEAPPLE	PINEAPPLE HUSK

RECYCLABLE, Dominant area of research and development on textile fibre production industries to develop an alternative recyclable yarn option, either available now as specialized yarn, or is transitioning to become widely available in the near future.

ORGANIC OPTION, widely available.

Marketed as low environmental impact, as these fibre productions are small, specialized industries or are alternatives to highly chemically processed fibre productions.

RECYCLED OPTION easily available.

*Cotton comprises 24% of the world's textile fibre production (besides petrochemical fibres). Cotton is a thirsty plant associated with water depletion and toxic pollution, due to intensive use of pesticides (Sandin and Peters, 2018).

MEASUREMENTS FOR HAND-KNITTING YARN

The measurement of hand-knitting yarn varies between countries and there is no formal standardized system between manufacturers. However there is a general averaging table of yarn weights and knitting gauge ratios as a guideline.

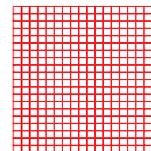
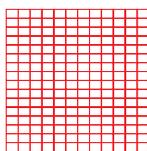
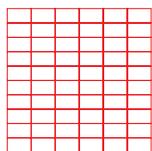
(See Table 1.3 Measurements for Hand-Knitting Yarn)

Hand-knitting yarns are usually packaged as balls or skeins, and the manufacturer's labels provide useful information including the weight, recommended gauge and needle size, fibre content, yardage, colour number and dye lot for matching consistency of colour in a project, as well as care instructions for washing. This information can be used to work out if a yarn is suitable, or substitutable, for a knitting project.

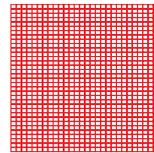
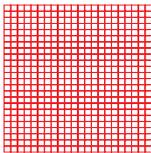
Table 1.3 Measurements for Hand-Knitting Yarn

NEEDLE SIZE	STANDARDIZED YARN WEIGHT	US	UK/EUROPE	AUSTRALIA/NZ	WPI	YARDAGE PER 100G (YD/M)	GAUGE/TENSION (STITCHES AND ROWS PER 4 IN/10CM)
0 – 4 2mm – 3.5 mm	0 Lace	Thread Cobweb Lace Light Fingering	1 ply 2 ply 3 ply	1 ply 2 ply 3 ply	35–29	1500 to 650 /1370 to 730	28–34 and 42–48
4 – 5 3.5 – 3.75mm	1 Superfine	Fingering Baby	Sock 4 ply	4 ply	29–27	600 to 440 / 550 to 400	26–28 and 40–42
5 3.75mm	2 Fine	Sport	Light DK 5 ply	5 ply	27–24	500 to 350 / 450 to 320	24–26 and 38–40
6 4mm	3 Light	DK Light Worsted	DK 8 ply	8 ply	22–20	260 to 230/240 to 210	22–24 and 32–34
8 5mm	4 Medium	Worsted Fisherman Aran	Aran 10 ply	10 ply	20–18	230 to 210/210 to 180	18–20 and 30–32
10.5 – 15 6.5mm – 10mm	5 Bulky	Bulky Roving Polar	Chunky Polar	14 ply	14–12	150 to 100/140 to 90	12–16 and 16–22
– 15mm – 25mm	– Super Bulky	Super Bulky	Super Chunky	Super Chunky	10–5	90 to 45	6–10 and 10–14

NEEDLES AND GAUGE



1.16 Super bulky to Fine yarn gauge.



NOTES

1. Fashion's systems and sub-systems are documented in academic papers by Niessen (2010), Vertica Bhardwaj and Ann Fairhurst (2010), Niinimäki et al. (2020) and Jennifer Craik (2009). They explain artisanal fashion as the antithesis of fast fashion, which is classified as mass-produced fashion.
2. Sociologist Bertram Niessen's (2010) research report asks 'is the emergence of DIY production a rearrangement of previous social practices or is it something new?' Niessen's paper discusses the development of collaborative platforms for fashion that share 'knowledge and skills as legitimate resource' for creative enterprise (Niessen, 2010: 7). Here, the Textile Space, built on the foundation of the Knitting Club with its old-fashioned ethical and social practice values, can be situated on the same playing field.
3. A knitting graph looks like a grid that has cells or little boxes, where each box represents a stitch. Bernasconi, Bodei and Pagli (2007) define this visual representation of knitting as something that 'can be seen as a matrix of stitches (columns) and needles (rows), and it is usually repeated many times horizontally or vertically' (10).
4. The mechanisms of hand knitting can be compared to weft knitting technology, and the stitches of knit, tuck and slip stitch are described by knitting technologist Wolfgang Trumper as the 'four distinguishable basic bindings' of knitting (Trumper, 2016: 221). In the book *Manufacturing Process for Textile and Fashion Design Professionals* (2014) by Rob Thompson and Martin Thompson, the weft knitting process is illustrated to demonstrate the distinction between the four main stitch functions that generate fabric structure, where these too are identified as a knit, slip, tuck and transfer stitch (Thompson and Thompson, 2014: 129).
5. Knitting engineer, Trumper, alludes that this knowledge is a comprehension of 'realizing bindings'. Bindings is a term used in industrial knitting to describe how stitches connect to each other. He follows on to say that this enables a logic of the 'knitting-technically feasible sequence(s) of binding elements' that are possible on the needles (Trumper, 2016: 221).
6. Stitch functions for increasing and decreasing are referenced here with respect to creating structural and decorative knitted fabric effects. The knitting techniques of increasing and decreasing are also essential to the shaping of knitting; and therefore the making of geometric knitted shapes, which is covered later in this book in the 'Knitting Geometric Shapes' section.
7. In the book *Textile Materials for Lightweight Construction*, academics Beata Lehmann and Claudia Herzberg (2016) provide an engineering explanation for the cause of the jersey stitch curling at the edges of the fabric. They explain that the yarn is in a 'stress state' when pushed into a curve shape to make a stitch. This effect ripples through the surface area of the fabric to the threshold, where it furls in 'the attempts of the fabric to attain a state of lowest possible stresses' (104). The states of yarn stress in machine knitting are, of course, higher than for hand knitting, so the edge curl is more yielding when hand-making a stocking stitch. Nevertheless, it is still a feature of this type of knit/purl knitting.
8. This hold/transfer slip stitch mechanism is done with a stitch holder, which is like a big safety pin, or a cable needle which is a double-pointed needle, used in addition to the two working needles. Sometimes many cable needles can be used with this technique where multiple bands of stitches are held in one row.
9. The tension that Lehmann and Herzberg (2016) describe, as referred to in note 7, above, is remedied in a rib fabric. They explain that 'Due to the opposing arrangement of two knitted fabric layers in a knitted fabric, the forces introduced by yarn deformation neutralize one another at an exact geometry of the two layers. The knitted fabrics will therefore display a less pronounced tendency to curl' (Lehmann and Herzberg, 2016: 105). The layers refer to a machine-knitted rib being a double fabric, working the front (knit) and back (purl) bed of needles together at the same time. A hand-knitted rib emulates this by moving the yarn thread back for the knit stitch and forward for the purl stitch to perform the knitting actions.

SECTION TWO

Construction Knitting Methods



2.1 Construction Knitting Kit.

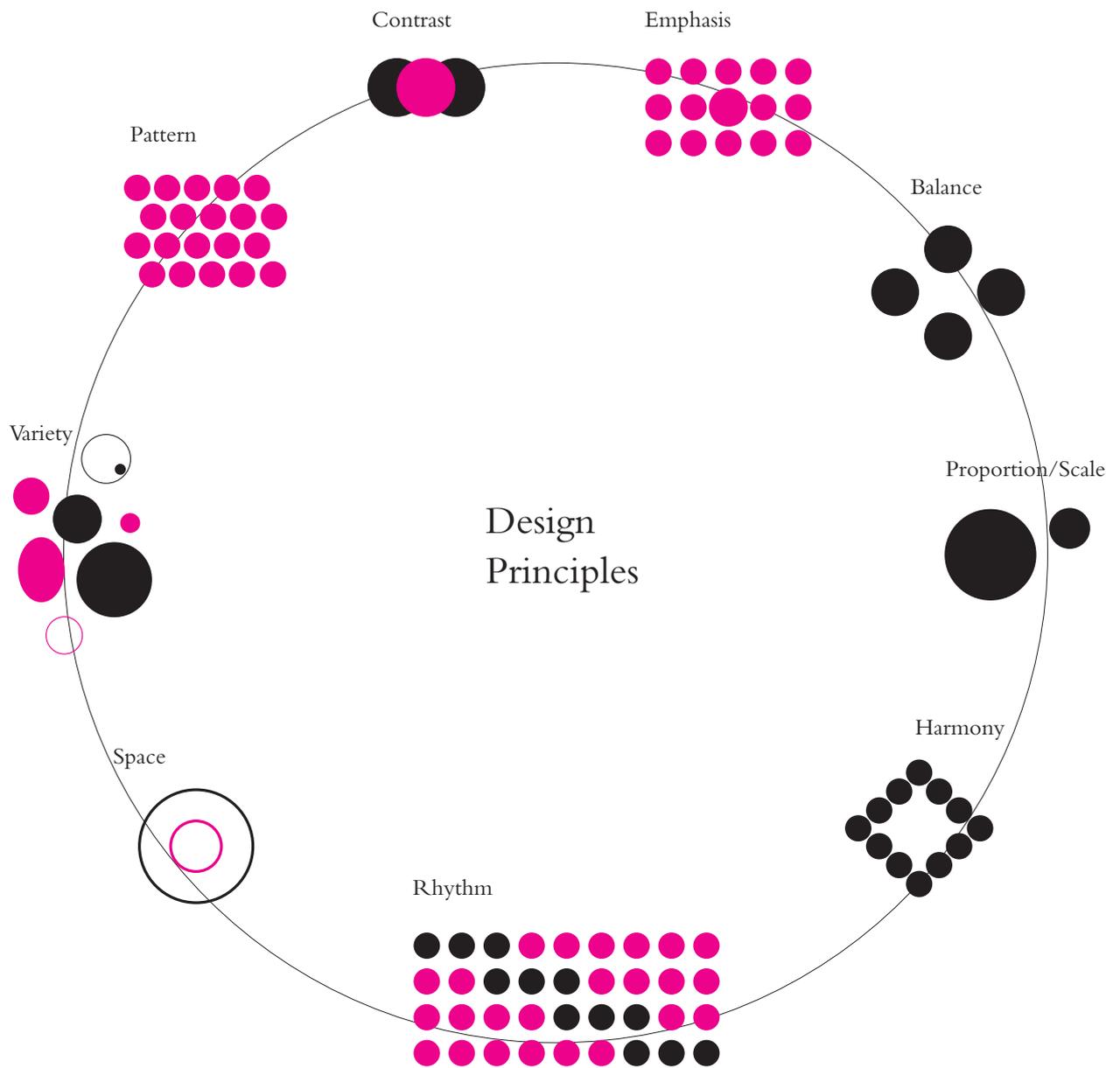
2.1 Knitting and Principles of Design

In wider design discourse, the arrangement of design elements is governed by design principles. Design principles are a set of core values that guide good design composition, namely: pattern, contrast, emphasis, balance, proportion/scale, harmony, rhythm, space and variety.

Design principles and geometric shapes appear to commingle across design history. The design writer and educator Ellen Lupton explains that since the advent of design, geometric principles have been applied as a way to 'lend insight into design process, as they possess the formal laws underlying all visual expression' (Lupton and

Miller, 1993: 5). Applying this type of design language to knitting supports the idea that knitting as a craft and making activity is a physical participation in design process. The acknowledgement of using hand knitting as a useful design tool for manufactured knitting raises a notion of progress, affirmed by academic papers that state: 'knitting is now facing its decisive change from hobby into design project' (Affinito, Conti and Motta, 2017: S2760). This viewpoint may defy mainstream associations of knitting, which position it primarily as a hobbyist interest outside of design activity.

The current popular perception of knitting as an informal hobby is largely due to its history. Knitting was one of the first handcrafts to be mechanized, when subsequently



2.2 Design Principles.

the industrial revolution followed. As the author Vesna Marija Matkovic (2010) expresses: ‘the parallel development of design and technology is traced back to the emergence of the knitting frame in 1589’ (122).

The separation of craft and design in creative industries ensued. However, within some influential artistic circles, the disengagement of hand-making and machine-making was met with dissent. These artistic movements believed that the integration of the two processes led to better design and product. The Bauhaus is described as being one of the most influential schools in ‘elevating the

role of design in production’ in which, directly, by the 1950s, ‘design and modernity were irrevocably linked’ (O’Connor, 2013: 149). Nevertheless, in an advancing modernity, ‘traditional associations of craftsmanship’ were eventually rejected (O’Connor, 2013: 154).

Textiles fell into the category of applied arts, along with the crafts of pottery, woodworking and glass-making. But generally, the culture of needlework (that broadly constituted weaving, tapestry and knitting), broke off from professional creative practices to become women’s work at home.



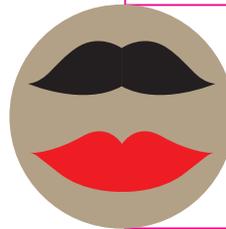
WILLIAM MORRIS and the ARTS & CRAFTS MOVEMENT
Around 1880, this movement emerged in Britain as social activism against the effects of industrialization on design and traditional craft. This led to a unified art and craft approach to design, which was structured more by a set of ideals, rather than a prescriptive style.



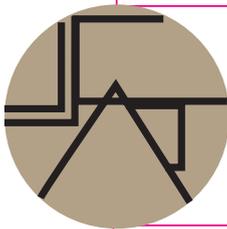
ISOTYPE
Considered an offshoot of linguistics (the study of language) and semiotics (the study of signs), isotype is a theory developed by Viennese philosopher Otto Neurath. Neurath created a visual communication system in the 1920s, of simplified images with a utopian aim of neutralizing the social and cultural hierarchy of language.



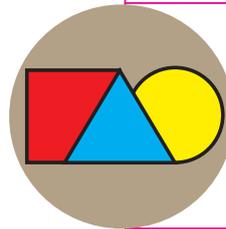
WEINER WERKSTATTE
Weiner Werkstatte formed in Vienna, Austria, and existed from 1903 to 1932. As a declaration of modernity, the primary goal was to bring good design into all areas of craft. The Wiener Werkstatte manifesto had a social emphasis on averting the tide of low-quality mass production by improving design.



SEMIOTICS
Semiotics is the recognition of signs and symbols through visual icons. It is a branch of study of communication, and a theoretical underpinning of visual literacy in design education.



BAUHAUS
Considered an offshoot of the Wiener Werkstatte, the Bauhaus was founded in 1919 in Germany, as an educational institution that ushered Modernism into the twentieth century. One of the main objectives of the Bauhaus was to unify art, craft and technology, and this approach was incorporated into the institution’s teaching.



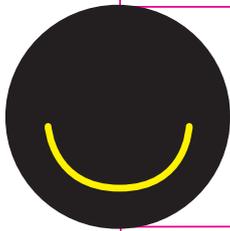
SQUARE, CIRCLE, TRIANGLE
Considered to define the most fundamental shapes associated with design teaching, in the 1960s the Italian design legend Bruno Munari published a visual case study on Square, Circle and Triangle. Munari endows the three shapes with specific qualities, as a type of universal visual shorthand that artists and designers use.

2.3 Design Movements.

Since that time, knitting in particular has been popularized as a domestic craft, disconnected from industry and technology, and therefore from design. But as currently observed by fashion academics, creativity and innovation in (home) knitting still remain a source of inspiration for manufactured knitting designed in professional studios. Professor Sandy Black, author of academic books on knitting, insists that novelties in hand knitting still influence the designed product made through industrialized knitting. Black tells us that 'Designing for knitwear and knitted textiles requires an interplay

between craft, design, technology, fashion and aesthetics' (Black, 2012a: 9). More recently, it has been argued that knitting as a creative process requires an updated and integrated design language, to be understood 'against wider design practice' (Steed, 2016: 143).

Across the practice of design, there is a type of unified visual language to explain design. These visual expressions are drawn broadly from the history of creative practices. They are the philosophical and social backdrops that have informed the visual literacies of design from the early twentieth century to the present.



UTOPIAN

An idealistic version of society that seeks to balance human need with consumption for the purpose of happiness and fulfilment. Utopian ideals refer to solving design problems to address manufacturing and construction issues for positive humanitarian and environmental effect.



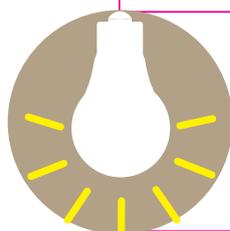
CO-DESIGN

Co-design is considered a type of human-centred design; originating from corporate policy, it focuses on processes and procedures and is not a design style. Branded as a model of social design, the object is to be inclusive and accessible, as opposed to being elitist or applying design for selective expensive taste.



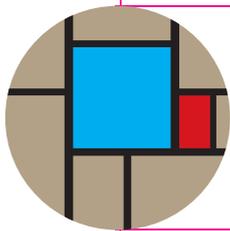
DESIGN

Design is the planning of the construction of an object, system or measurable human interaction. It is also the making of an object. Thus, design may be a noun for a created thing or things (the design of something), or a verb for the process of creation.



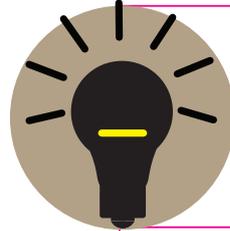
NEW MODERNISM

A current debate among intellectuals asks whether, since the 1990s, we have existed in a time that has moved past Post-Modernist ideals. This present time is influenced by developments in technology and greater access to it. This has led to the more active participation of individuals in the authorship and shaping of cultural products.



MODERNISM

Modernism is a term that describes an artistic and cultural movement that emerged in the early twentieth century and lasted into the 1970s. It was translated as a design style as minimalist, clean lines and functionality, but essentially it was a way of thinking, as an affirmation of the power of people to make, improve and reshape their environment.



POST MODERNISM

A broad movement defined by an attitude of scepticism towards grand narratives and ideologies and therefore a departure from Modernism, influenced by philosophies such as the deconstructionist theory founded by Jacques Derrida in 1967. This theory translated to design characteristics of dislocation, distortion and fragmentation.

ELEMENTS AND PRINCIPLES OF DESIGN

If knitting can be viewed as being constructed, and made up of parts or elements, these elements can be considered as structural components.

Generally, knitted textile materials are referred to as decorative fabrics, as they have low structural and performance requirements (Underwood, 2009). Dr Jenny Underwood addresses knitting as having ‘structural components’ to introduce a more expansive conception of the fabrication process of the knitted textile, beyond just how it looks or feels.

By definition, the term ‘structural’¹ is the organization and arrangement of parts; it is the way a composition is held together. In classic design principles, the themes by which elements are organized and arranged come with a particular design language. This language can be borrowed for knitting to generate deeper insight into design process.

DESIGN ELEMENTS

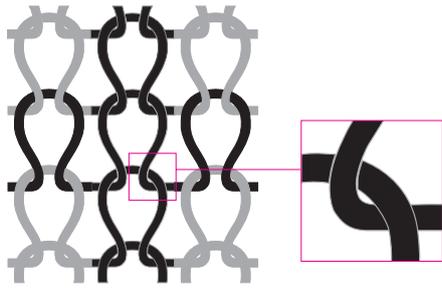
Some of the earliest writing on design principles reveal that the fundamentals of design process are ‘point’ and ‘line’. The acclaimed teacher and writer on design education from the 1960s, Maurice de Sausmarez, states that points and lines, not only ‘provide location

and direction, or measurement in design’, but they also ‘activate the surrounding space when they expand or contract’ (de Sausmarez, 2002: 22).

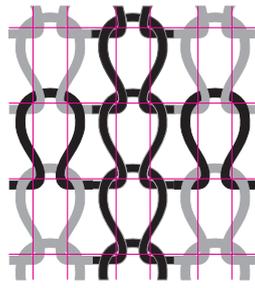
- A stitch can be treated as a point in knitting. A line is a chain of connecting points; therefore, a chain of stitches can be considered a line.² This is called a ‘row’ in knitting. Stitches and rows are the elements that initiate or start the function of growth in knitting. They are the source, or the cause of knitting. As points, they provide location and measurement. They tell us where the knitting starts, and at what ratio and direction knitting builds.
- When knitting grows, by way of de Sausmarez’ explanation, this is an ‘activation of surrounding space’. As knitting grows or builds, it is expanding or contracting, through the addition or subtraction of stitches and rows. This affects how the overall knitted shape develops, and the direction and movement of the fabric.
- This highlights two distinct occurrences to design process, i.e., two types of design elements. One is cause, and the other is affect.

According to design theory, these occurrences are called ‘conceptual elements’ and ‘relational elements’.

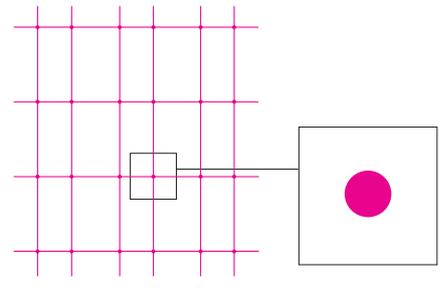
Point, Line, Plane, Volume



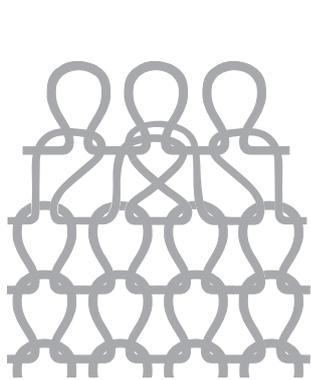
2.4 Connection points occur where stitches intersect.



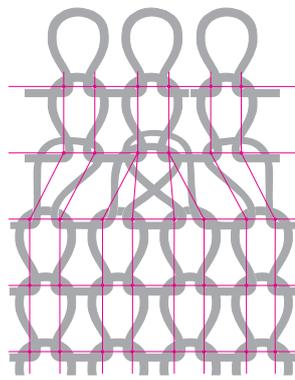
2.5 The vertical and horizontal grid of Knitting.



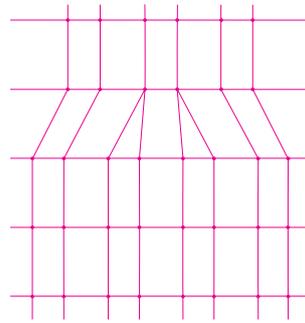
2.6 The connecting point in the knitting grid – POINT.



2.7 Decreasing of knitted stitches.



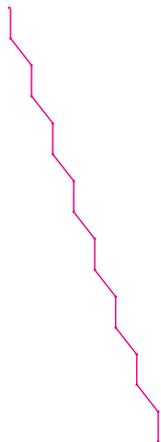
2.8 Decreasing of knitted stitches shown in a grid.



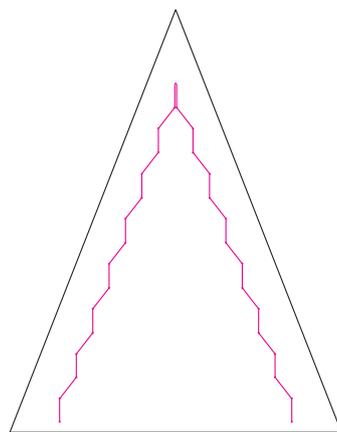
2.9 The grid of decreased stitches.



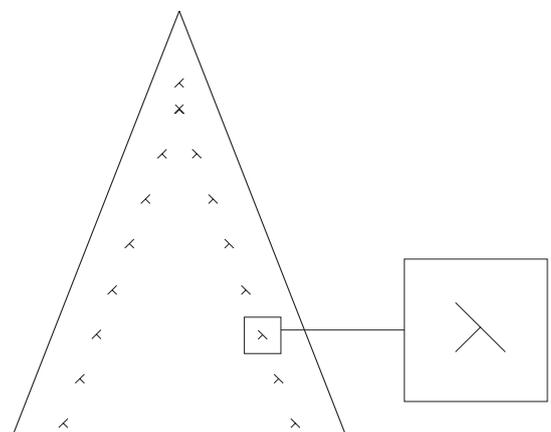
2.10 The line that is altered in the grid, that changes direction from horizontal to diagonal.



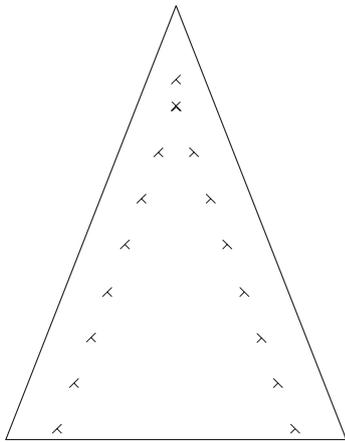
2.11 A repeated action of decreasing – LINE.



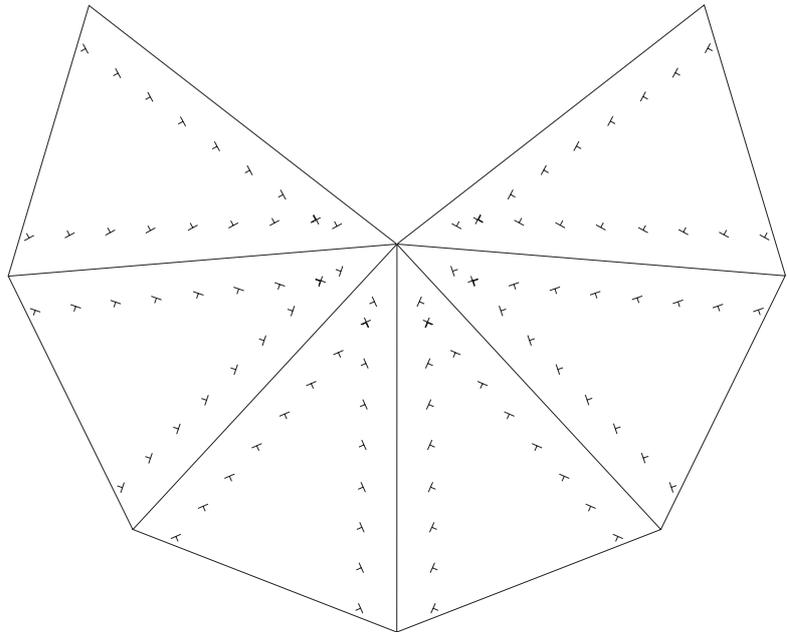
2.12 How these lines form within a shape.



2.13 POINT visualized as a decrease knitting symbol. The decrease frequency generates a LINE within the knitting, and forms the knitted SHAPE.



2.14 Knitted Triangle – SHAPE/PLANE



2.15 Joined Knitted Triangle Shapes – VOLUME



2.16a, 2.16b The knitted version of Illustration 2.14 and 2.15, taking SHAPE and VOLUME.

CONCEPTUAL ELEMENTS AND RELATIONAL ELEMENTS

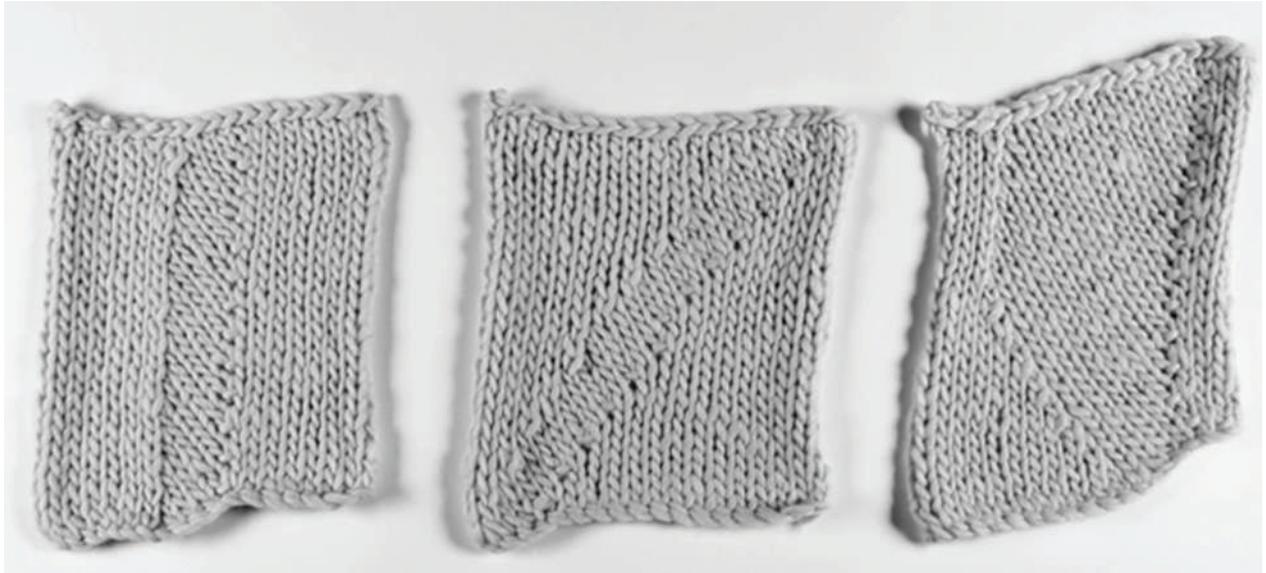
The design theorist Wucius Wong (1993) describes the conceptual elements of design as ‘point, line, plane and volume’ (18). An applicable meaning of the term ‘concept’³ is the mental combination of characteristics and particulars⁴ of a design. To make analogies for knitting, we could say our conceptual elements, i.e. the characteristics and particulars of knitting, are ‘stitch, row, shape and garment’.

Relational elements caption the connections or associations that occur between the elements. It makes sense,

then, that Wong (1993) terms the relational elements of design as: ‘positions of direction, space and gravity’ (18).

In summary, the conceptual elements which are the combination of stitch, row and fabric, are the cause of knitting. These affect the relational elements which are certain directional, spatial and gravitational impulses in the knitted form, in the way it moves, envelops and drapes in space.

Conceptual Elements	Relational Elements
Point, Line, Plane, Volume	Direction, Space, Gravity



2.17a, 2.17b, 2.17c Square shape with types of shaping that affect directional, spatial and gravitational impulses in the knitted form.

How lines are represented in a knitted geometric shape illustrate the relationship between the conceptual and relational elements of design, i.e., cause and effect. In the *Crochet Coral Reef* project book, the scientist Margaret Wertheim writes about ways of understanding geometric surfaces in terms of mathematical lines. She explains there are three types of geometric surfaces: flat, spherical and hyperbolic (Wertheim, 2015). Colloquially, the lines in these surfaces can be perceived as straight, curved or wavy.

Cause: Conceptual Elements. Point, Line, Plane/Stitch, Row, Fabric.

- Adjusting a line of a knitted structure to appear either straight, curved or wavy is performed

through expanding and reducing the surface area of the knitting.

- This is done by increasing or decreasing stitches regularly at a certain frequency. This can be worked at the edge, or internally/in the middle of the knitting. It can be implemented from the bottom of the knitting up, from the top down, or from the inside outwards.
- The ratio of the frequency and position of increasing/decreasing in the knitted shape will determine the orientation of the lines/rows, and the type of geometric shape this makes.



2.18a, 2.18b, 2.18c Types of Shaping. The first method of shaping is knitted from the bottom-up, with increasing and decreasing of stitches performed at the edges to create a circle shape. The second circle shape is created by knitting from the inside-out, increasing stitches at a frequency that forms a flat or even surface area. The third type of circle shape is created by knitting from the inside-out, increasing stitches more rapidly, which causes the surface area to distort and ruffle and form a hyperbolic surface area.



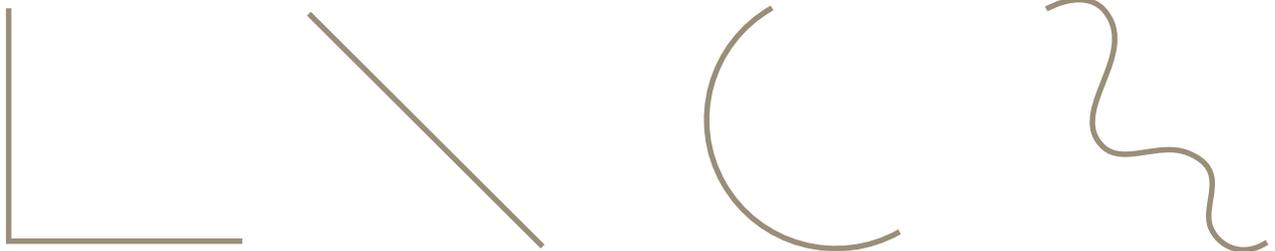
2.19, 2.20 Knitted rectangles that shows the variation in shape that occurs with different frequencies of shaping. The shaping makes either straight, curved or hyperbolic forms.

Affect: Relational Elements. Position of Direction, Space, Gravity.

- The orientation of lines (rows) in knitting implies the directional impulse, energy or movement in a fabric.

Additional expressions from design literature can enhance these descriptions of lines. Design educator and writer de Saumarez (2002) expresses lines in terms of the characteristics they bring to a design composition.

- Horizontal and vertical⁵ lines ‘introduce the principles of balance and tension’ (de Saumarez, 2002: 21).
- Diagonal lines introduce new and additional directional impulses.
- Curved⁶ lines introduce an extra spatial dimension by expanding surface area with positive curves, adding new structural forces and dimension to a fabric.
- Hyperbolic lines introduce both an additional spatial dimension and new directional impulses by expanding surface area with negative curves such as ruffled three-dimensional shapes, bringing more movement and energy to a fabric.



2.21 – 2.25 Straight, Diagonal, Curved and Wavy (Hyperbolic) Lines.

KNITTING GEOMETRIC SHAPES

The previous section emphasized that the direction of rows of knitted fabric can be visualized as lines. Based on this reasoning, geometric shapes can be categorized according to the types of lines that naturally occur within such shapes. Drawing on basic formal laws of design, and design language, geometric shapes can be grouped into three types of physical structures for the knitting projects in this book.

1. Angled shapes implement straight edges and straight lines. These shapes show a clear direction in the knitted grain, usually vertical, horizontal or diagonal. Angled shapes are created by knitting straight without any shaping, or by shaping on the edges of

knitting. Shaping occurs by increasing or decreasing stitches.

2. Curved shapes deviate from straight lines. Curves expand the surface area of knitting by adding dimension into positive space. Curved shapes are made by increasing or decreasing in the internal/middle area of the knitting.
3. Hyperbolic shapes are the deformation of straight lines. Hyperbolic shapes expand the surface area by adding volume and depth with both positive and negative curves. They add new direction, impulse and movement into the knitted surface. Hyperbolic shapes are made by rapid increasing or decreasing of stitches so the knitting ruffles.



2.26a-b, 2.27a-b, 2.28a-b Angled edges where increasing and decreasing is performed on the edge of the knitting, followed by contoured shapes where the increasing and decreasing actions are carried out on the internal face of the knitting which curves these forms; then rapid increasing and decreasing on these same shapes creates hyperbolic forms.

These types of geometric shapes each possess different structural integrity.

‘Structural’ as a general term refers to the way a composition is held together. In terms of a knitted shape, this would be the way in which the stitches and rows increase and decrease (expand and contract the surface area). ‘Integrity’ refers to how this affects the conditions of the shape in becoming straight, curved or hyperbolic.⁷

Each type of geometric shape brings forward different processes at work and therefore different attributes in the final knitted form. ‘Processes at work’ refers to the conditions of the shape that affect the performance of the knitting. Meanwhile, ‘attributes’ might include flat shapes with straight angled edges that tend towards

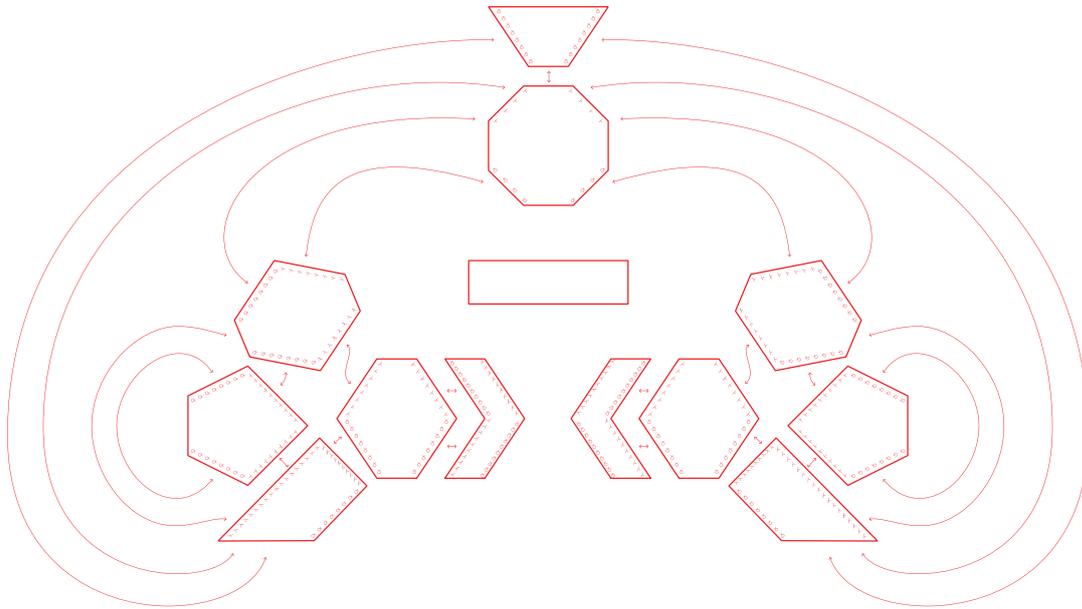
symmetrical alignment. Curved shapes bring new dimensions to a form and therefore require a different spatial reckoning, and hyperbolic shapes – with their ruffles – bring new kinetics, volume and movement to a form, and require a different dimensional reasoning.

This is where the foundational design knowledge that is discussed in the previous chapters can be put to use. With this knowledge, a knitter can work with these processes from the viewpoint and understanding of a design DNA, or a skeletal design system at work beneath the knitting.

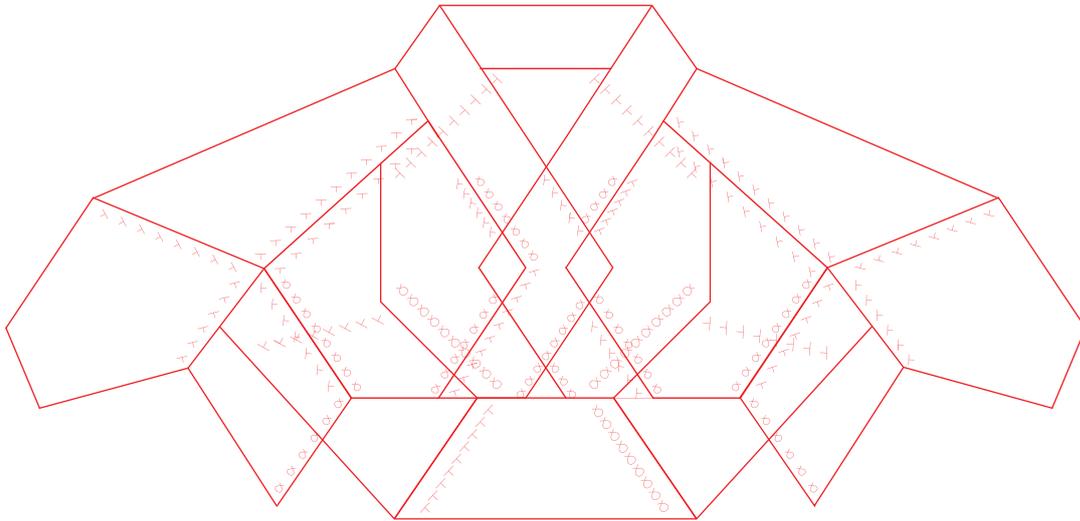
Classic design principles such as pattern, contrast, emphasis, balance, proportion/scale, harmony, rhythm, space and variety, come into play in the work as demonstrated in the images on the following pages.



2.29a, b and c Garments on mannequin facing profile/side. Angles, Curved and Hyperbolic shapes.



2.30 Angled Shapes.

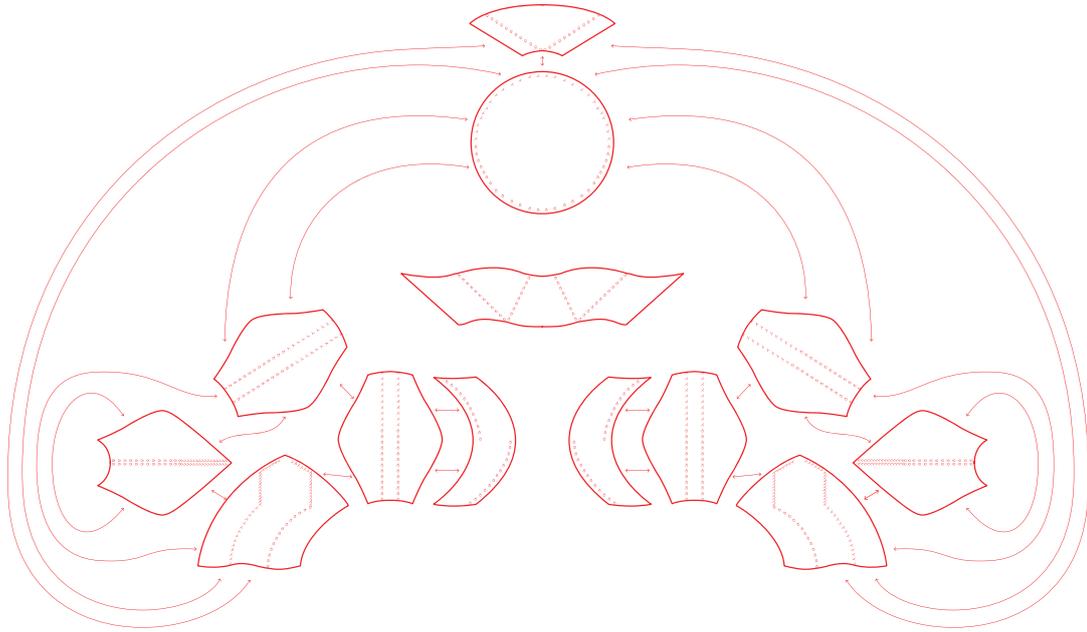


2.31 Angled Shapes assembled into Garment.

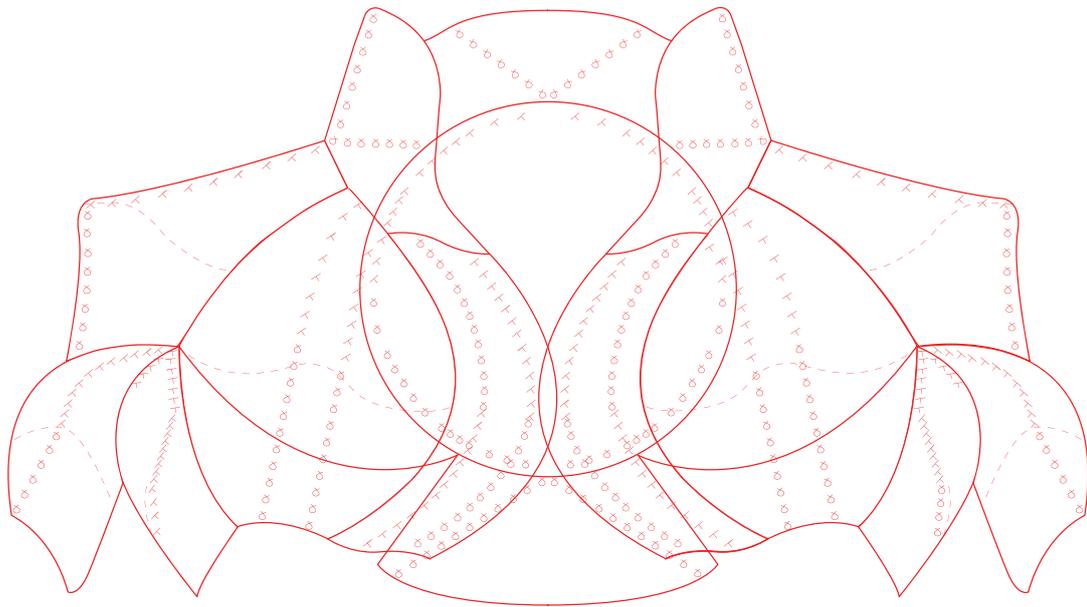
Angles – Modular Features

Angled shapes designate the use of the geometric planes that have straight edges such as squares, triangles and variations of those. These shapes activate the design principles of proportioning, rhythming and patterning that develop direction, motion and sequence in a design. The tendency towards grouping angled shapes – with their proportional sides and repeating

formations – reflects a more general human inclination towards grouping similar objects together. In turn, this is underpinned by Gestalt theory, which states that the whole of anything is greater than – and inseparable from – its parts.⁸ Similarly, the natural grouping of angled shapes often aligns with tessellation⁹ or tiling, which has mathematical provenance. Such angled shaping makes the design characteristics of grouping and symmetry especially visible.



2.32 Curved Shapes.

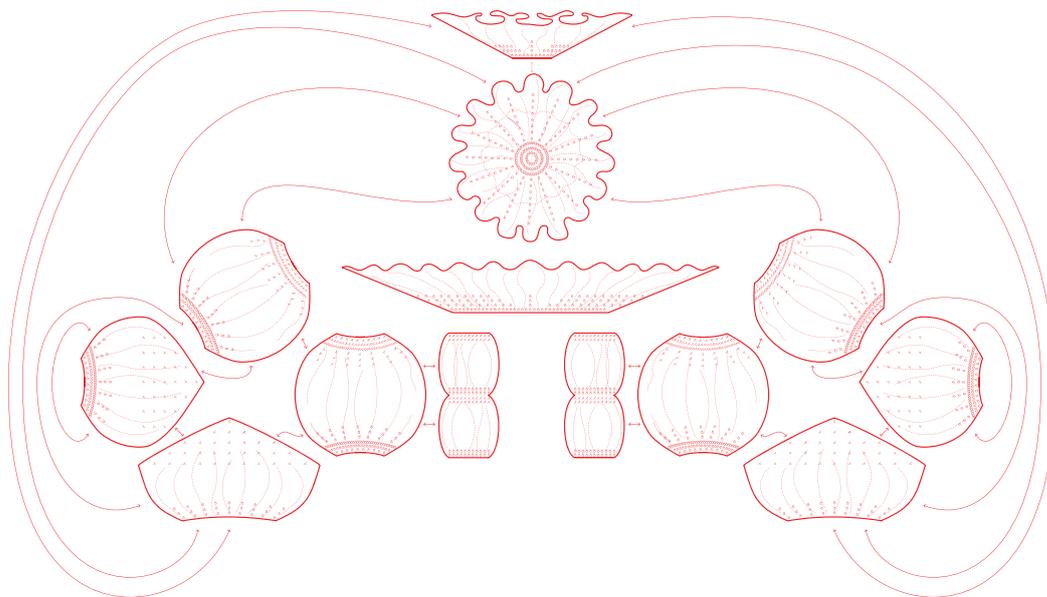


2.33 Curved Shapes assembled into Garment.

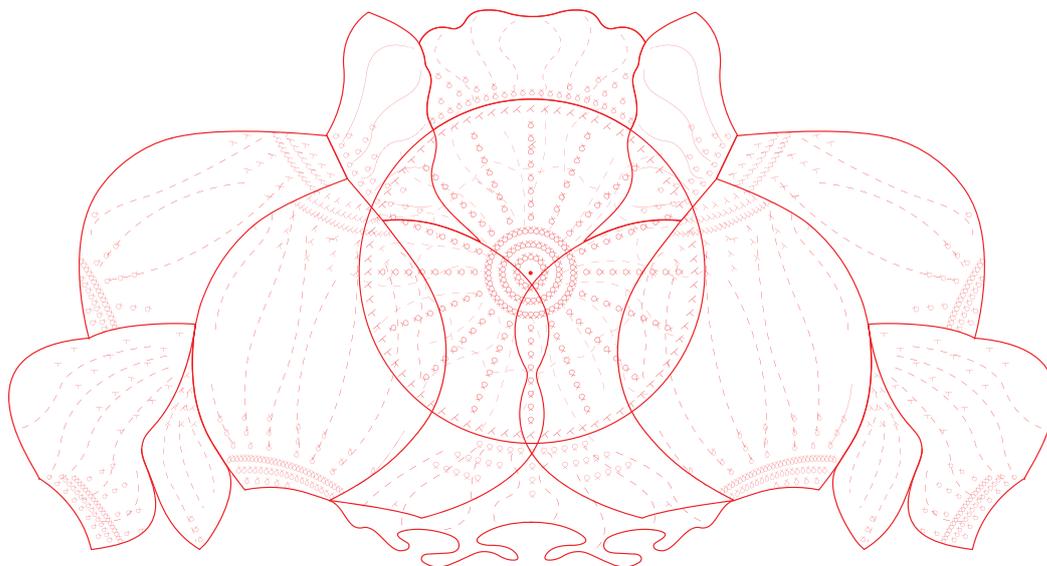
Curves – Spatial Features

Curves alter the conditions of straight lines, whereby such shapes activate the spatial and dimensional conditions of knitting. Curved shapes bring into function the design principles of balance and space, and develop

proportion, scale, weight and body in a design. This type of shaping makes visible the design characteristics of mass and unity. Mass can be thought of as positive space, and means the illusion of bulk in a form. Unity means harmony, where there is a sense of all the pieces belonging together as a whole.



2.34 Hyperbolic Shapes.



2.35 Hyperbolic Shapes assembled into Garment.

Hyperbolic – Structural Features

‘Hyperbolic’ refers to topological deformation of lines and planes, for example twisted, crumpled and bent shapes. These shapes activate the design principles of contrast and emphasis, add volume, and highlight positive and negative space, texture and colour in design, which makes visible the design characteristics of dominance and attraction. The terms ‘dominance’ and ‘attraction’ describe certain elements that assume more importance

than others in a composition. While some features are emphasized, others are subordinated.

Hyperbolic shapes are found throughout nature, in forms such as corals kelps and sponges (Wertheim, 2015). They are typically soft and pliable and so, in 1997, mathematician Dr Daina Taimana proposed using crochet to physically represent these. The suggestion was taken up by the Institute for Figuring and led to the creation of the ‘Crochet Coral Reef Project’, which became a participatory craft event and exhibition hosted all over the world.

2.2 Geometric Shapes to Garments



2.36 From Shapes to Garment.

ASSEMBLING SHAPES

One of the meanings of the term ‘construction’ is the arrangement and assemblage of separate units or shapes to fit together as a composition.

Central to this method of *Construction Knitting* is the development of knitted geometric shapes as modular¹⁰ units.

The feature of modular design is the production of shapes that can be adjusted, combined and interchanged to assemble a variety of garment designs. This modular step-by-step designing enables the easy adaptation and improvisation of patterns, for this method provides traces¹¹ of design steps. In this book, each design sequence is visualized, which shows how each stage informs the next.

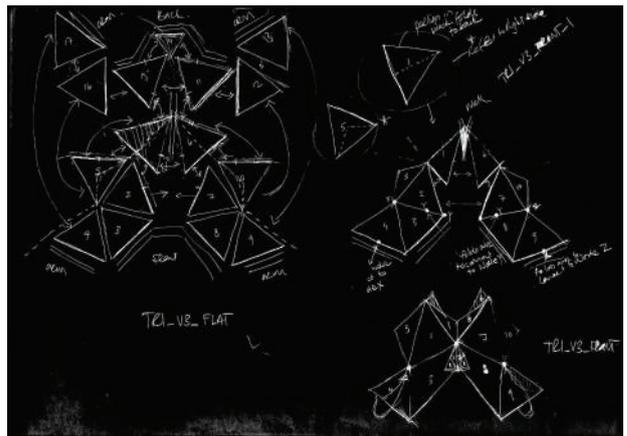
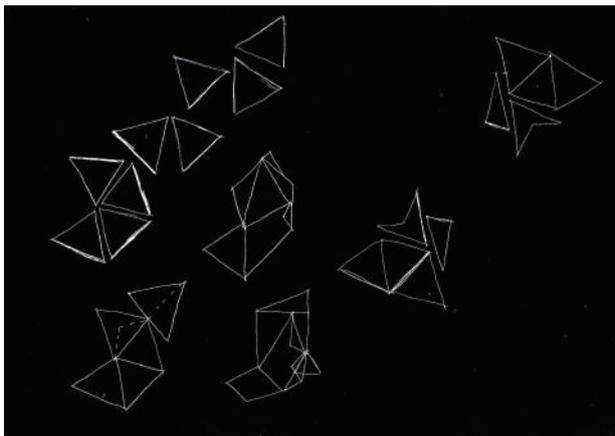
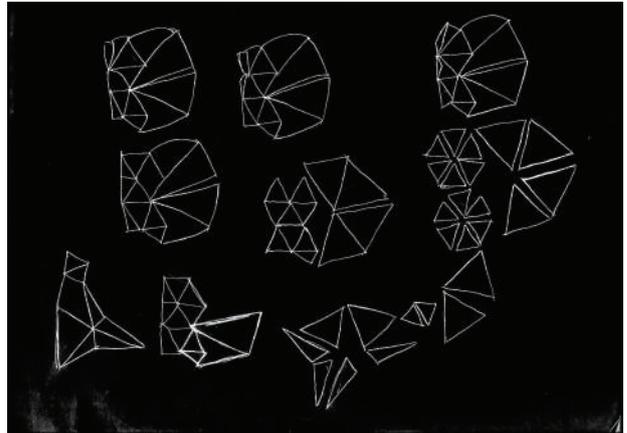
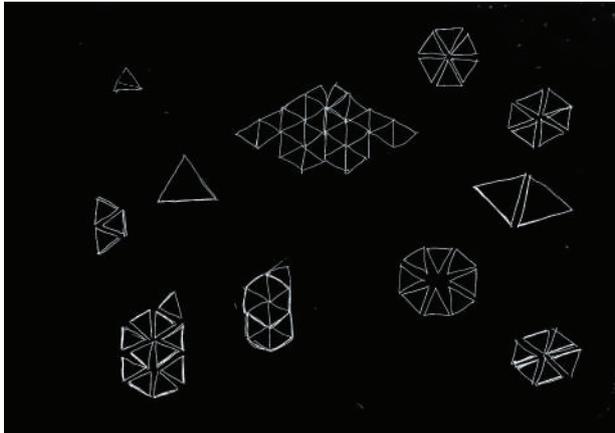
Making shapes and garment compositions in this manner is a simple and approachable way to start a knitting project. Indeed, design theorist Peter Dormer emphasizes the importance of simplifying process, in that ‘keeping things simple does not mean the objective is only to make simple things ... the objective is to make complicated things with procedures that are as simple as possible’ (1997). As Dormer suggests, compositions can grow in complexity. This stage-by-stage process builds confidence and an awareness of design process in the development of each design sequence.

By delving further into this process, a wide range of pattern compositions can be discovered in working with geometric shapes.

In the text *Pattern-Thinking*, based on Buckminster Fuller’s concepts on geometric patterns, there are two types of pattern organizations that are identified:¹²

- One generates an expected pattern outcome, where the whole is divided into parts, subject to rules of a proportion system.
- The other leads to an unexpected pattern outcome, where parts repeat to create a whole.
- A third possibility is also described as a method called ‘complex-repetition’, which creates flexible, adaptive patterns. The author explains this is an order ‘that emerges from the flexibility of parts’ to adapt and change during the process of repetition, and which has nothing to do with the systems of the part, or the whole (Lopez-Perez, 2020: 46). The author hypothesizes that this process can lead to outcomes that have not yet been discovered.

The third patterning phenomenon is often aligned with creation in nature, such as the subtle alterations that occur in the repetitive growth formations in shells, or in the petals of a flower. This ‘complex repetition’ theory is also conducive to the knitting process within simple applications of incremental alterations of stitches, adapting knitting’s form on a cellular level. The ‘Fabric Structure’ section in this book discusses the grid-like structure of the knitted form where a stitch represents a cell, and variations to patterns and shape are made by altering stitches. When this is applied, patterning for knitting can shift from prescribed and set variations, to design opportunity. As parts are changeable during the process of repetition, a wide scope of variety and finessed detail within each modification in the knitted form can be achieved.



2.37, 2.38, 2.39. 2.40 Design Iteration of Triangles from symmetrical pattern repeat to exploring unexpected pattern generation, and repetition that aligns with the theories of 'complex repetition' (Lopez-Perez, 2020: 46). A sketch design process demonstrating the parts undergoing adaptation and alteration during repetition.

FLAT AND DRAPE PATTERNS RELATIVE TO CONSTRUCTION KNITTING

Knitting usually involves making the fabric and the garment simultaneously, which is why hand-knitting patterns come as written step-by-step instructions. The pattern instructs the shaping of the fabric whilst knitting.

The purpose of a garment pattern is to record a prototype design so that it can be reproduced. However, it is also part of the process of designing as it establishes the technical parameters of a design, i.e., how a thing can be made. The educational website Fibre2Fashion supports this definition, describing pattern making as ‘a bridge function between design and production’ (Bhati, 2011: para. 2).

There are two arms to the generation of a pattern: design development and design recording.

In the development of a standard hand-knitting pattern, shapes typically adhere to conventional body block formats, e.g., bodice fronts, backs and sleeves as separate pieces. These fashion blocks follow the flat pattern garment construction technique – a technique derived from tailoring. With the exception of circular knitting patterns (which, in turn, resemble the three-dimensional industrial knitting machine process known as circular, seamless or wholegarment™ knitting¹³), hand-knitting patterns generally use flat shapes too.

The *Construction Knitting* approach differs in that it uses geometric shapes instead of conventional body blocks. This design development process resembles more of the drape pattern technique by not having to adhere to conventional blocks. Drape pattern cutting is traditionally a couture discipline, and involves wrapping fabric around a mannequin before creasing, splicing and pinning it into the desired form. The fabric is then marked up, removed from the mannequin and patterns, lines and measurements worked out. The *Construction Knitting* method is similar to this, as the design and fit is determined by draping and pinning shapes on a mannequin or body.

In the process of both flat and drape pattern systems, a type of deduction is applied which, following the premise of many patternmaking tutorials, is a type of ‘critical thinking’ similar to that used in solving geometric proofs. The online patternmaking blog Fair Fit Studio (n.d.) even says that this mathematical thinking is necessary and foundational for this particular skill.

Geometric proofs are a process of analysing a geometric shape and calculating angles and lengths of sides by working through a series of logical deduction in order to solve how that shape was made. Simply put, it is a method of looking at, and summing, the proportional relationships that exist between shapes. It is for this reason that geometrics are such an effective design tool, as they ‘reveal visual relationships’ and bring ‘visual coherence to design through visual structure’ (Elam, 2001: 5).

Respectively, a rudimentary method of proportioning can be applied here for calculating the measurements of knitting geometric shapes. Although it should be noted that these shapes are applied outside of their mathematical provenance here, as in knitting, these shapes can stretch and move beyond regular geometric forms. In the scope of applying mathematical thinking in the knitting process, in ‘Knitting for Fun’, Bernasconi, Bodei and Pagli (2007) propose that even ‘illiterate knitters practice mathematics during knitting ... without knowing it’. Bernasconi explains that knitting requires mathematical constructs to ‘realize symmetries, inversions, scalings and proportions; good abstraction capabilities are indeed needed to figure the final result out and to map the idea of a pattern into a knitted form’ (53). The point is that maths occurs generally in knitting without it necessarily being articulated.

Knitting is measured by gauge, meaning the amount of stitches and rows calculated in a given area. The size of the needles and yarn affects the knitting gauge ratio, which is based on an averaged range of measurements. Drawing from this data, the amount of stitches and rows within the area of a geometric shape can be calculated, and mapped into a knitting pattern.



2.41, 2.42, 2.43 Triangle Garments Design V.1,V.2 and V.3; sequences of change and adaptation. Beginning with a symmetrical pattern repeat of parts, followed by adaptation of the parts which changes how they assemble, and lead to change in the overall forms.

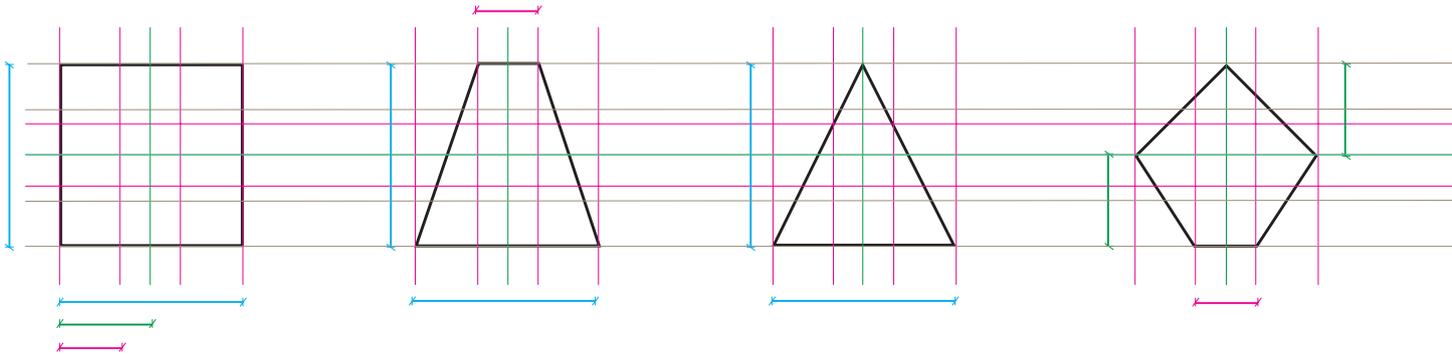
KEY

— WHOLE

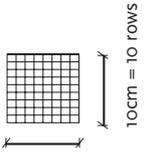
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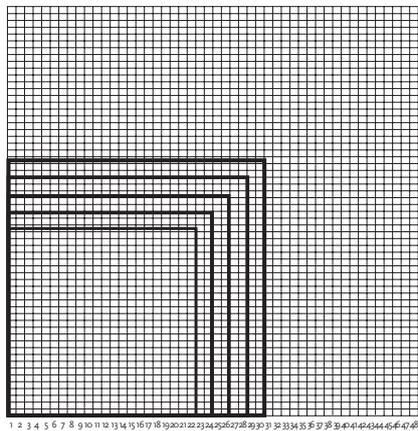
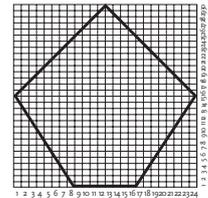
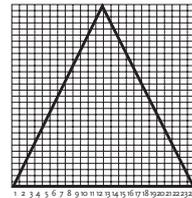
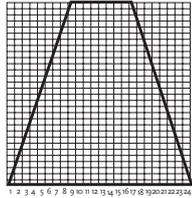
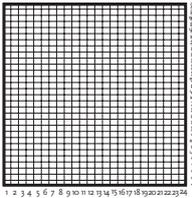
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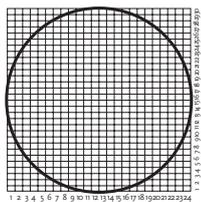
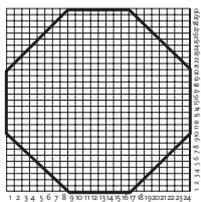
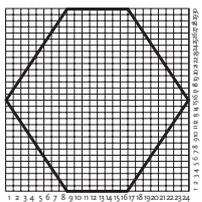
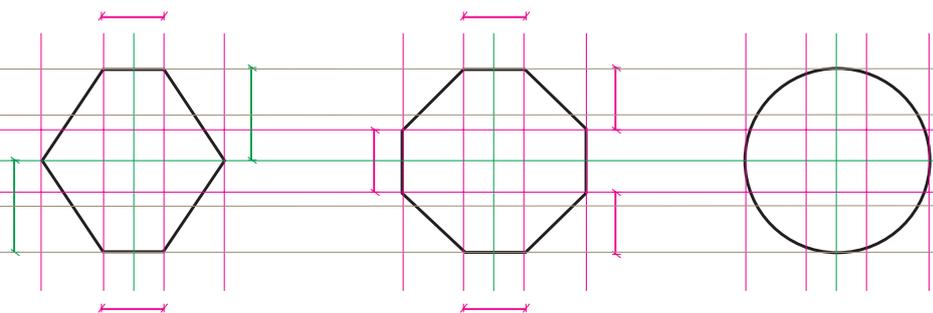
KNITTING GAUGE



10cm = 8 sts



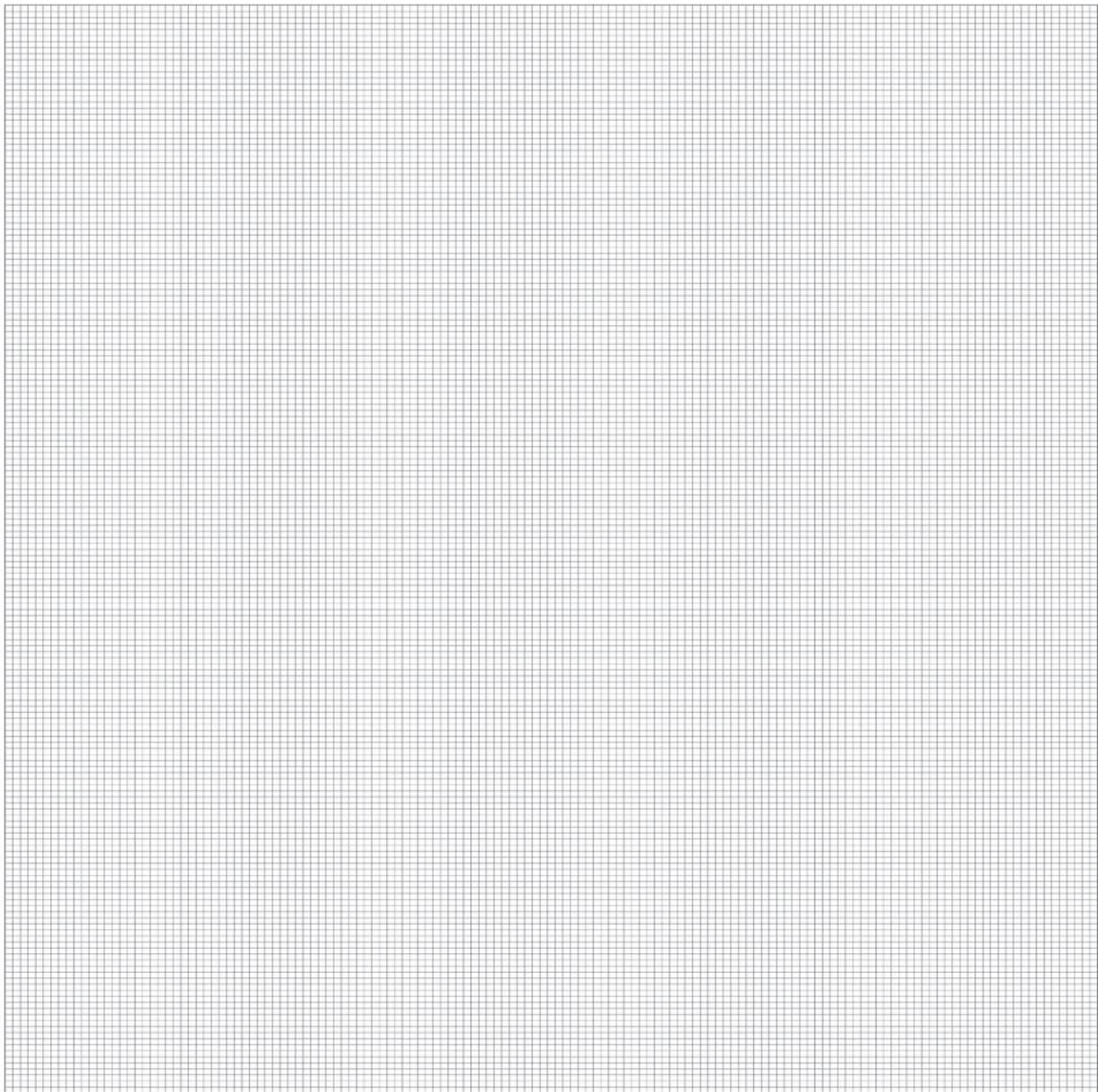
- S —————
- M —————
- L —————
- XL —————
- XXL —————



Top Row: 2.44 Proportional Relationships of Geometric Shapes.

Middle: 2.45 Geometric Shapes within the Knitting Grid and Knitting Gauge.

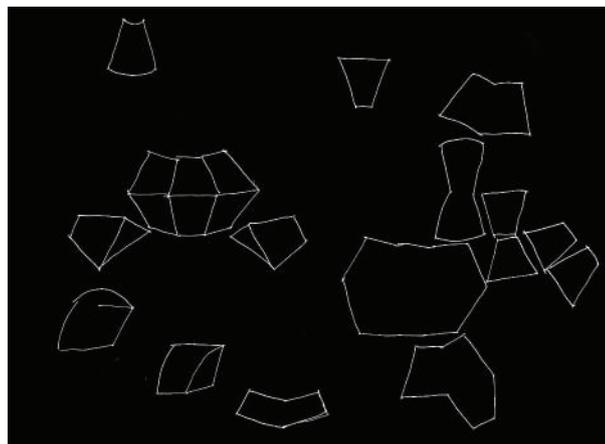
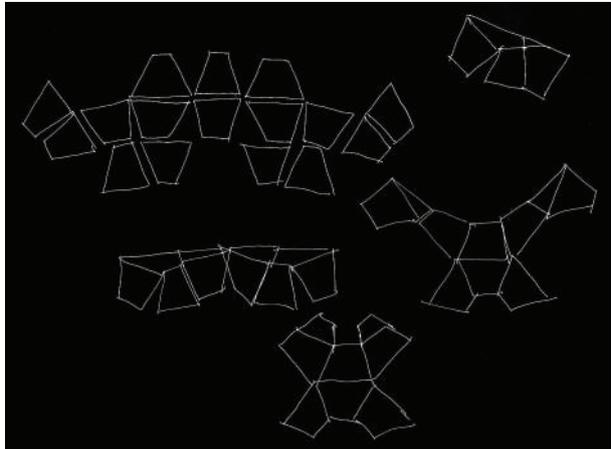
Bottom Row: 2.46 Grading Shape sizes within the Knitting Grid.



2.47 A 120cm knitting gauge grid template for readers to use. This grid can be copied, and shapes can be drawn in the grid, which shows how many stitches and rows to knit per cm, for the bulky yarn used in this book.

The design process of creating a garment for the *Construction Knitting* method entails an interplay of sequences between drawing and sketching shapes, to knitting and assembling these shapes into garment forms. The process is as follows:

1. Making the shapes and developing stitch structure of the knitting, alongside the calculation and sketching of knitted shapes, and;
2. experimenting with assembling knitted shapes into a garment form.
3. As a modular design process, there may be several adjustment steps where parts can be added or re-knitted, alongside recording and sketching to adapt the initial design into new formations.
4. Final joining of shapes and fitting of garment.
5. Final recording of knitting pattern and knitting notes, using grid graphs to measure stitches and rows.



2.48, 2.49, 2.50 Knitted shapes exploring shapes with angled and curved version, and other stitch configurations, alongside creative sketching to ‘think’ through design possibilities, in the joining and morphing of shapes.



2.51, 2.52 Starting the design process with simple joining of shapes, to developing more complex forms by morphing shapes and building in stitch structure.

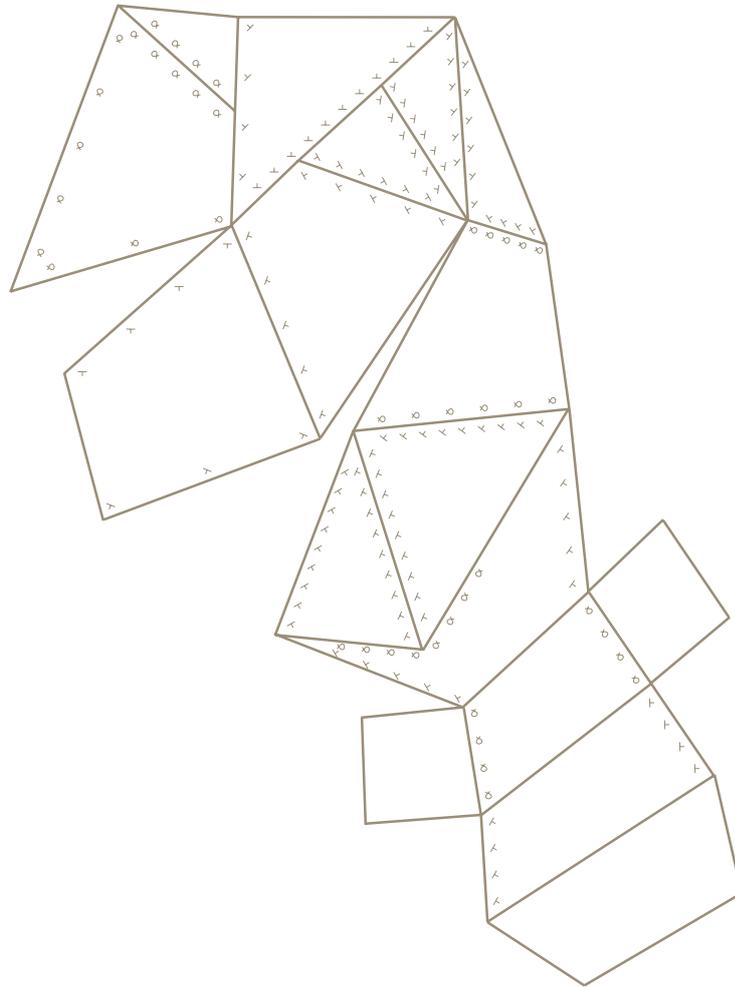


2.53a, 2.53b, 2.53c Three garment formations explored, demonstrating the modular design process, using the quadrilateral geometric shape from this book: Quad V.1,V.2,V.3.

Table 2.1 Construction Knitting

FLAT PATTERN CUTTING	DRAPE PATTERN CUTTING
<ol style="list-style-type: none"> 1. Two dimensional. 2. Standard blocks are easily available. 3. Conventional fit. 4. Balance and symmetry are easier to attain. 5. Accurate measurements. 6. Have to make a toile to test the design. 7. A reliable source pattern that is easily replicated. 	<ol style="list-style-type: none"> 1. Three dimensional. 2. You can see how a garment looks in three dimensions from the start. 3. Aids creativity and innovation. 4. Much easier to visualize the effect that you're trying to attain. 5. You can start draping without a design in mind. 6. You can drape a garment in the fabric you intend to use. 7. Harder to attain symmetry – great for asymmetric effects. 8. Good for bespoke, if working directly on the body. 9. More difficult for bespoke if working on a mannequin instead of body measurements. 10. Working with a non-straight grain can be challenging but can be exploited.

LINES, SHAPES, FORMS AND SILHOUETTES



2.54 Images from left to right: Lines as structural markings; shapes that show those markings within a surface area. Form shows the extent that the area covers. The body as a frame for shapes to envelop; silhouette.





2.55 Construction Cardigan, back view.

The previous chapters demonstrated that lines can be structural markings in a knitted fabric, and shapes show those markings within a surface area. Form shows the extent that the area covers. In fashion, the term ‘form’ delineates the body as a frame for shapes to envelop, and the term ‘silhouette’ adds context and meaning, as it adds function or purpose to a design.

A garment silhouette¹⁴ generally refers to the styling of dress that fits the ideals of the body shape of a current era. Naturally, the silhouette has undergone changes over time, altering the notion of what is the ideal and conventional fashion form. New generations of avant-garde designers have innovated the fashion form, working in ways to create space between the body and garment that defy established notions of conventional dress and functionality. One exhibition at MoMU in Antwerp, Belgium, entitled *Game Changers: Re-Inventing the 20th Century Silhouette*, looked at the work of designer Cristóbal Balenciaga, ‘whose innovations in the middle of the 20th century created a radically new silhouette, giving the body freedom of movement and building architectural volumes to create a space around it ... initiating a new relationship between body and garment’ (Van Godtsenhoven, Arzalluz and Debo, 2016: 37).

The phrase ‘form follows function’ is attributed to the architect Louis Sullivan, who designed the first skyscraper building. In principle, he meant that the external appearance of the building should reveal the interior function of the design but modernists adapted Sullivan’s dogma to propose an abandonment of excessive ornamentation in favour of sparsity and efficiency in design (Lambert, 1993). Today, deciding what comes first, form or function, is an ongoing and long-standing design debate, but it could be said that the ‘function-follows-form’ pertains to the aforementioned avant-garde type of innovative making. In fact, Professor Roger K. Lewis attributes this second adage to a branch of modern architecture that produces unconventionally shaped buildings that do not reveal their functional agendas. For Lewis, this reactionary approach is a rationalization that form should not solely be determined by function (2013). In fashion, ‘form-follows-function’ is usually understood in terms of making clothes wearable and the consideration of usefulness generated designs that were usually

linear, realist and free of complexity. The principles of functionalism have had a ripple effect throughout clothing design, applied from high-end couture to everyday basics. Coco Chanel is quoted as saying that ‘Luxury must be comfortable’ (Cvikl, 2021: 180) and her clothing offered hidden luxury rather than ostentation.

Design ergonomics spans a wide disciplinary area. It is the study of human interaction with other humans, the things they use, their work and environment. Its goal to optimize the ‘fit’ between the user, the thing being used and their work and environment means that it pays attention to recognized consistencies in comfort and use (Loschek, 2009). In a fashion context, ergonomics is mostly concerned with studying the needs of a user and the suitability of their clothing. It is prevalent in the development of knitted products, especially sportswear design. In fashion, templates are developed to systematize methods of fit, based on standardized garment construction. How this thinking is typically applied in knitting is seen in styles of jumpers. A jumper silhouette can be defined by how a garment hangs from the underarm to frame the body, such as straight, a-line, v-line or hourglass. Each prescribes different notions of ease or use for the wearer.

A jumper type is also identified by particular features such as its sleeve type, such as raglan, set-in, or drop-shoulder, that determine function and purpose in the garment.

The making of these jumper styles follows particular construction methods where the outcome is known and consistent, such as the sleeve cap and the armhole of the body block being designed to be shaped correspondingly so that they fit together when joined.

This is considered ergonomically sound design. But the problem with this approach is a sameness in the outcome of standardized silhouette styles. This standardization is challenged by other methods of garment construction, influenced by principles of deconstructed or non-functional design movements. Non-functional design is often associated with the deconstructionist art movement and this fashion typically looks incomplete, or has displaced components despite having benefited from great attention to detail in its construction. These design approaches aim to challenge existing and accepted notions of the look and purpose of a garment. They also

challenge traditional perceptions of beauty and might be termed ‘anti-fashion’.¹⁵

By using geometric shapes as a starting point for the design process, the technique in this book proposes a different logic for making a garment. Instead of

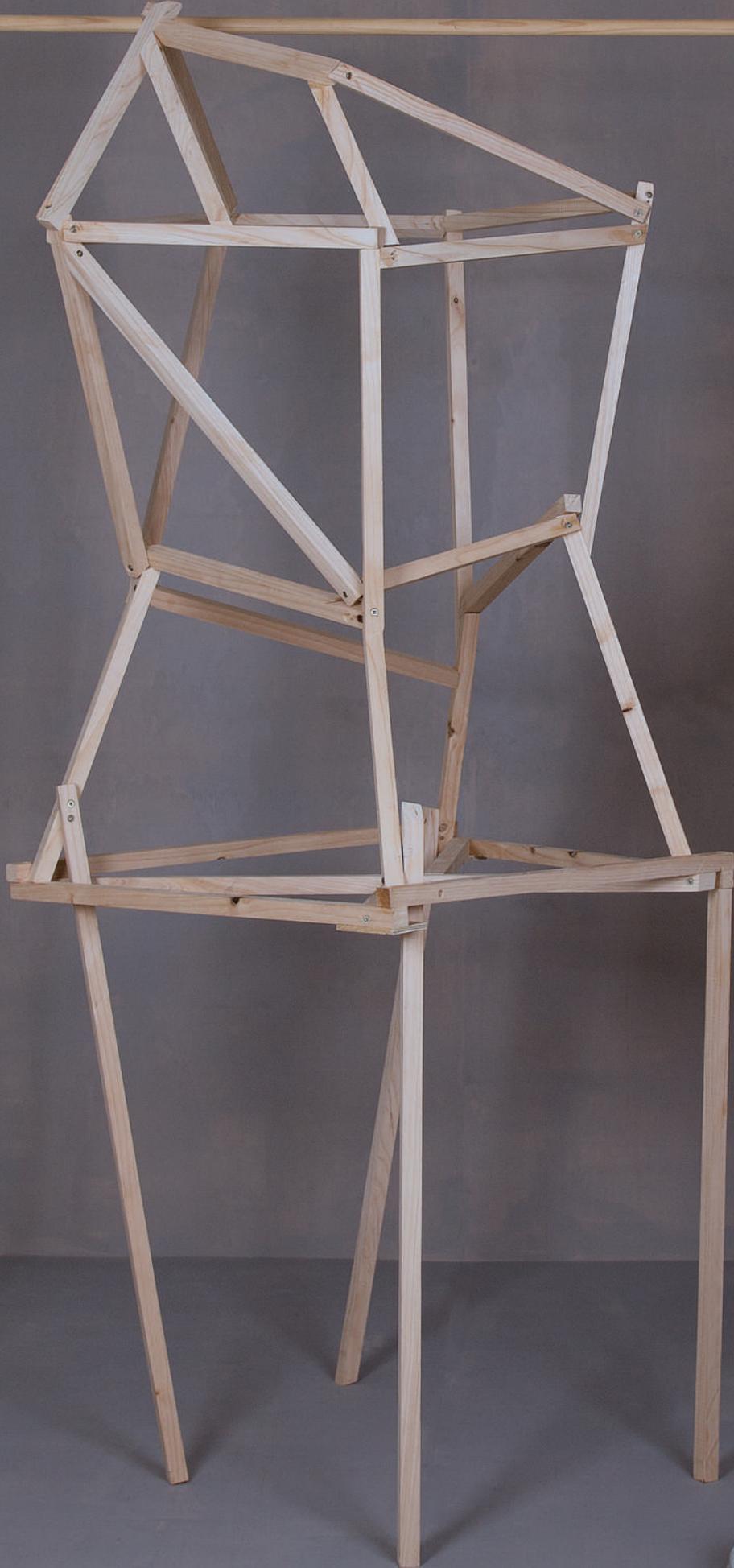
beginning with a standardized silhouette as the inherent design plan, these designs propose that a more unpredictable¹⁶ result can be aimed for, which can build a more experimental making process, and lead to more experimental garment forms and silhouettes.

NOTES

1. The dictionary definition of ‘structure’ is a mode of building, construction or organization, and the arrangement of parts, elements or constituents (‘Structure’, n.d.). It is the way a composition or form is held together.
2. The notion that a stitch can be regarded as a point, aligns with developments on digital and computational simulations of knitting, where the stitch is noted to have intermeshing points. These crossing points of intermeshed stitches are depicted as nodes, and the connecting nodes form a polygonal mesh as the knitted fabric.
Based on the hypothesis of academic research papers; *Flat knitting loop deformation simulation based on interlacing point model* by Jiang et al. (2017), *3-D Deformation Behaviour Simulation of Cable Stitch Based on Particle System in Weft Knitted Fabrics* by Sha et al. (2018), and *Yarn-Level Cloth Simulation with Sliding Persistent Contacts* by Cirio, Lopez-Moreno and Otaduy (2017), stitches contain connecting points that bend into three-dimensional loop deformations as a knitted fabric.
The most basic premise to this thinking is that knitting can be viewed as a vertical and horizontal grid line structure. The lines are formed by the connecting points (stitches). With relevance to occurrence of lines and shapes as discussed here, when there is a change made in the grid, such as when a stitch is decreased, that connecting line in the grid alters its course. When this action is repeated recurringly this affects the overall shape of the knitting. This contouring becomes the dominant visible line within the knitted shape, because it is the anomaly in the knitting grid. Therefore, for the sake of this book, the emphasis is placed on how these structural lines appear in knitted geometric shapes, to demonstrate design cause and effect as reasoned in this section.
3. In the book *Foundations of Art and Design*, educational design writer Alan Pipes defines ‘concept’, as a ‘scheme that brings diverse elements into a basic relationship’ (Pipes, 2003: 255).
4. Particulars (n.d.): n. specific points, details, circumstances.
5. Maurice de Sausmarez describes types of lines in *Basic Design: The Dynamics of Visual Form*, in which the descriptions embody the foundations of classic design principles (de Sausmarez, 2002: 21).
6. Wertheim (2015: 42) defines curved lines as expanding into positive space, for example, spherical shapes, while hyperbolic lines expand into negative and positive space, as in a ruffle.
7. For example, the conditions of an angled shape show the direction of vertical lines in a flat surface area. A curved shape occurs because the condition of the lines has changed to bend or curve, which expands the shape into positive space by raising the surface area up like a bubble. Hyperbolic shapes occur when the line distorts into both positive and negative space like a wave, turning the surface area into a ruffle.
8. The word Gestalt is used in modern German to mean the way a thing has been placed, or put together.
9. Tiling/Tessellation: the covering of a plane by closed shapes, without gaps or overlaps.
10. Modular: composed of standardized units or sections for easy construction or flexible arrangement.
11. According to the theory of Gestalt psychology, traces are created by processes. Founder of Gestalt theory, Kurt Koffka states that ‘process might be considered as a learning’ (547) and explains that to stimulate the learning, ‘first arousals of processes must be as inclusive as possible, as available traces can modify new processes’ (Koffka, 1955: 547). Making methods of knitting as inclusive – or as simple – as possible, is a theme of this book.
12. Professor Daniel Lopez-Perez (2020) contextualizes Buckminster Fuller’s process of translating pattern lines into structural lines. He defines ‘two parallel systems of order’ (46). The first results in ‘determined wholes’ which comes from ‘idealized geometrical frameworks’. This is where the whole determines the parts. The second approach is based on the systematic repetition of modules as a way to produce ‘undetermined wholes’. Here, the parts determine the whole. Lopez-Perez argues that these orders have ‘a lack of flexibility’, and therefore a limited range of patterning. But he also describes a third possibility, derived from a Deleuzian tradition (see *Difference and Repetition* by Deleuze, 1994), ‘which (is) not subject to a predetermined system derived either from the part or the whole but rather, based on changing parts that form a whole based on their own parameters of flexibility’ (Lopez-Perez, 2020: 47).

There are parallels with nature with this type of complex repetition. It could be said that knitting too can change within the patterning that aligns with this theory of complex repetition.

13. 'Wholegarment' is a trademark of the Japanese Shima Seiki company that produced the first seamless knitting machine. Academic and educator Sharon Evans-Mikelis describes seamless knitting as 'a garment manufacturing method whereby a series of interconnected tubes are knitted to create an entire garment. These garments come off the machine complete and they have no seams' (Evans-Mikelis, 2011: 11).
14. There are many connotations of what the fashion silhouette means. Literature on the topic generally concedes that the silhouette as a fashion form is a hybrid of past dress styles, where the main focus is on emphasizing the body shape: Fillmer (2010); Van Godtsenhoven, Arzalluz and Debo (2016); Geczy and Karaminas (2017).
15. This type of work has been seen since as early as the 1970s in the punk DIY movements which transferred into the knitted garments of Vivienne Westwood and later Alexander McQueen (Gill, 1998).
16. Fashion academic Sharon Evans-Mikelis writes on new design processes for knitwear, and the consequent aesthetics in the resulting garment form, asking: 'If a standard process, when applied to a conventional garment, creates a standard outcome; will a non-standard process, when applied to a conventional garment create a different outcome?' Mikelis further investigates the 'use of a different sequence of actions or calculations to achieve alternative outcomes' in experiments that lead to new and different garment forms (Evans-Mikelis, 2011: 14).



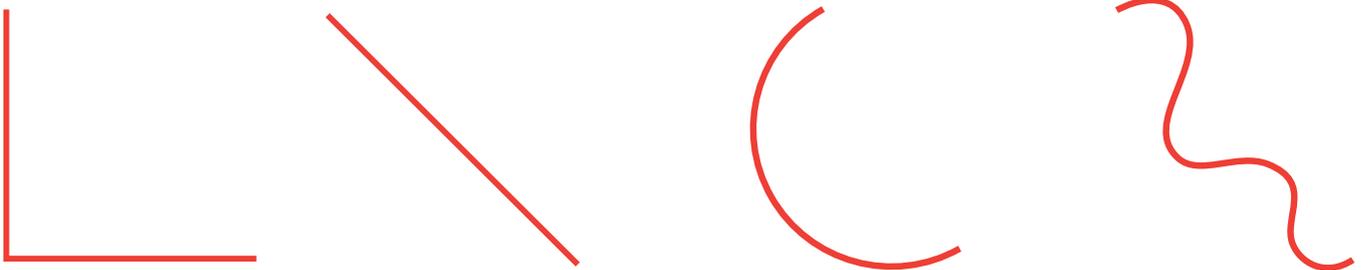
SECTION THREE

Construction Knitting Projects

In this section you will find details and photographs of various construction knitting projects. Patterns for these garments can be found online at <https://bloomsbury.pub/construction-knitting>

Left: 3.1 Construction Knitting Patterns.
Designing with Geometric Shapes.

LINES



3.2 Types of Lines.



STRAIGHT

DIAGONAL

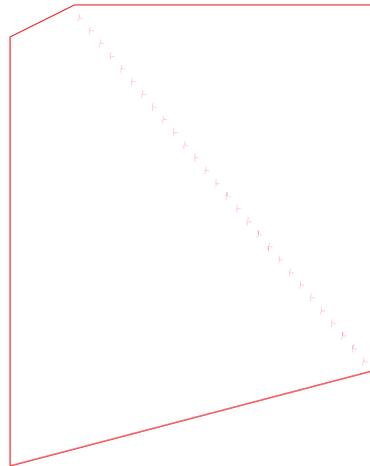
CURVED

HYPERBOLIC

3.3a, b, c, d Types of Lines.



STRAIGHT

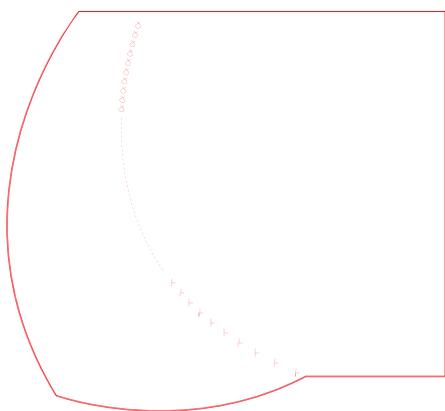


DIAGONAL

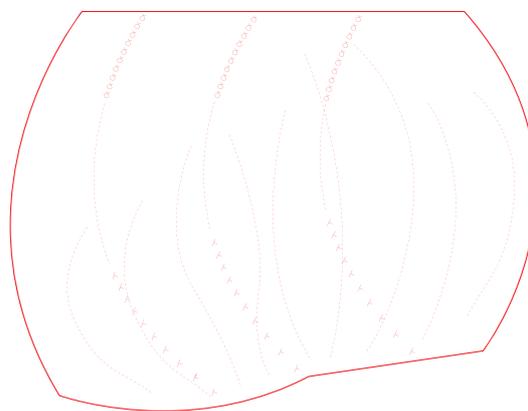
3.4 Types of Lines.

Lines within the knitted vest shapes, showing positioning of increasing/decreasing points. Straight, Diagonal, Curved, Hyperbolic.

In 'Design Elements' of Section Two of this book it is described that connecting points (stitches) run in a straight line within the vertical and horizontal knitting grid. When there is a change made in the grid, i.e., when stitches are increased or decreased, and depending on the frequency and ratio of the increasing/decreasing actions, the course of the line is altered to become either diagonal, curved or hyperbolic. This affects the overall shape of the knitting, and the directional, spatial and gravitational impulses in the knitted form, in the way it moves, envelops and drapes.

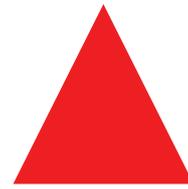
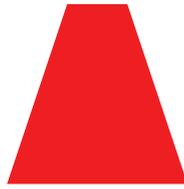


CURVED



HYPERBOLIC

SHAPES



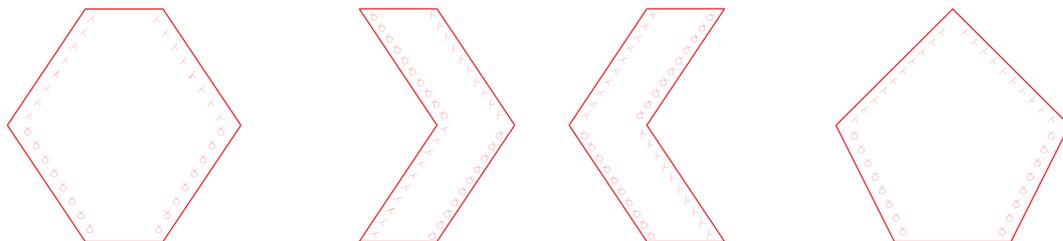
3.5 Shapes: Square, Quadrilateral, Triangle, Pentagon, Hexagon, Octagon, Circle.

Geometric shapes knitted for the Construction Knitting Projects:
Square, Quadrilateral, Triangle, Pentagon, Hexagon, Octagon and Circle.

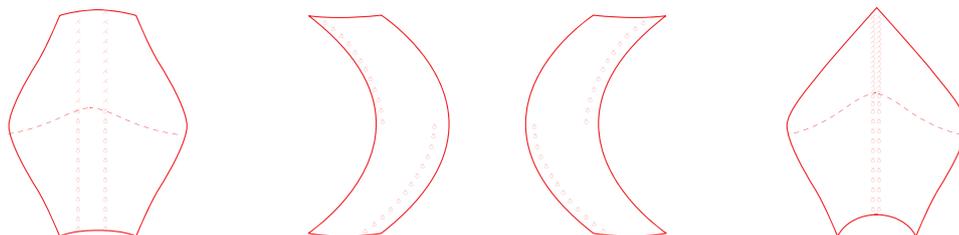


SHAPE TYPES

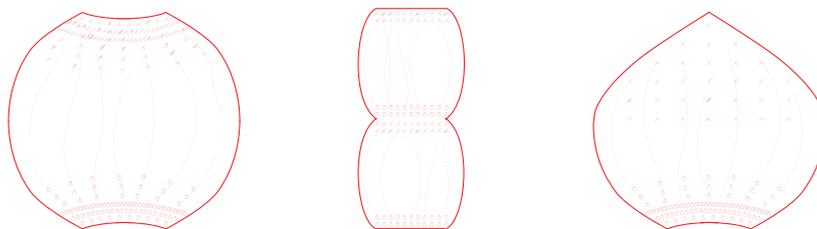
STRAIGHT, DIAGONAL



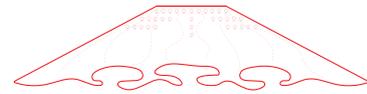
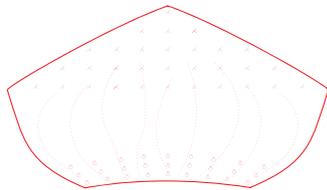
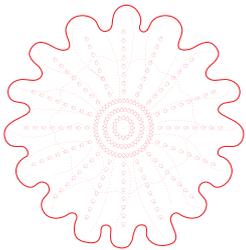
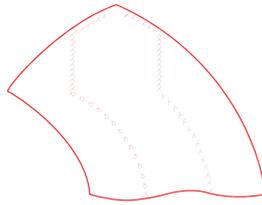
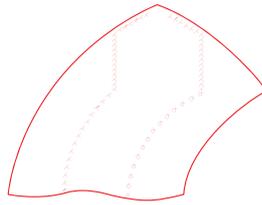
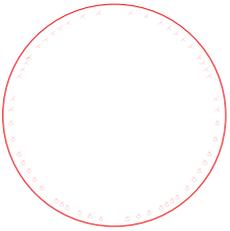
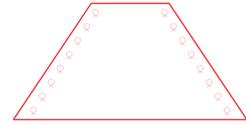
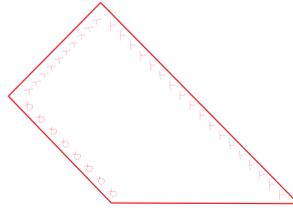
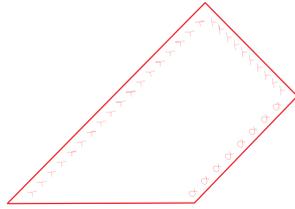
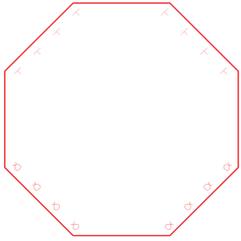
CURVED



HYPERBOLIC



3.6 Shapes with straight edges that make Angled shapes, with Curved and Hyperbolic versions of those shapes.



ANGLED



CURVED



3.7a Cardigan with Angled type shapes.

3.7b Cardigan with Curved versions of these shapes.

3.7c Cardigan with Hyperbolic versions of these shapes.

HYPERBOLIC



As defined in 'Knitting Geometric Shapes' in Section Two, by drawing on basic formal laws of design, and design language, geometric shapes can be grouped into three types of physical structures for the knitting projects in this book. Angled shapes show clear direction of the vertical or horizontal lines in a flat surface area. Curved shapes occur because the condition of the lines have changed to bend or curve which expand the shapes into positive space. Hyperbolic shapes develop when the lines distort into both positive and negative space like a wave, turning the surface area into a ruffle.

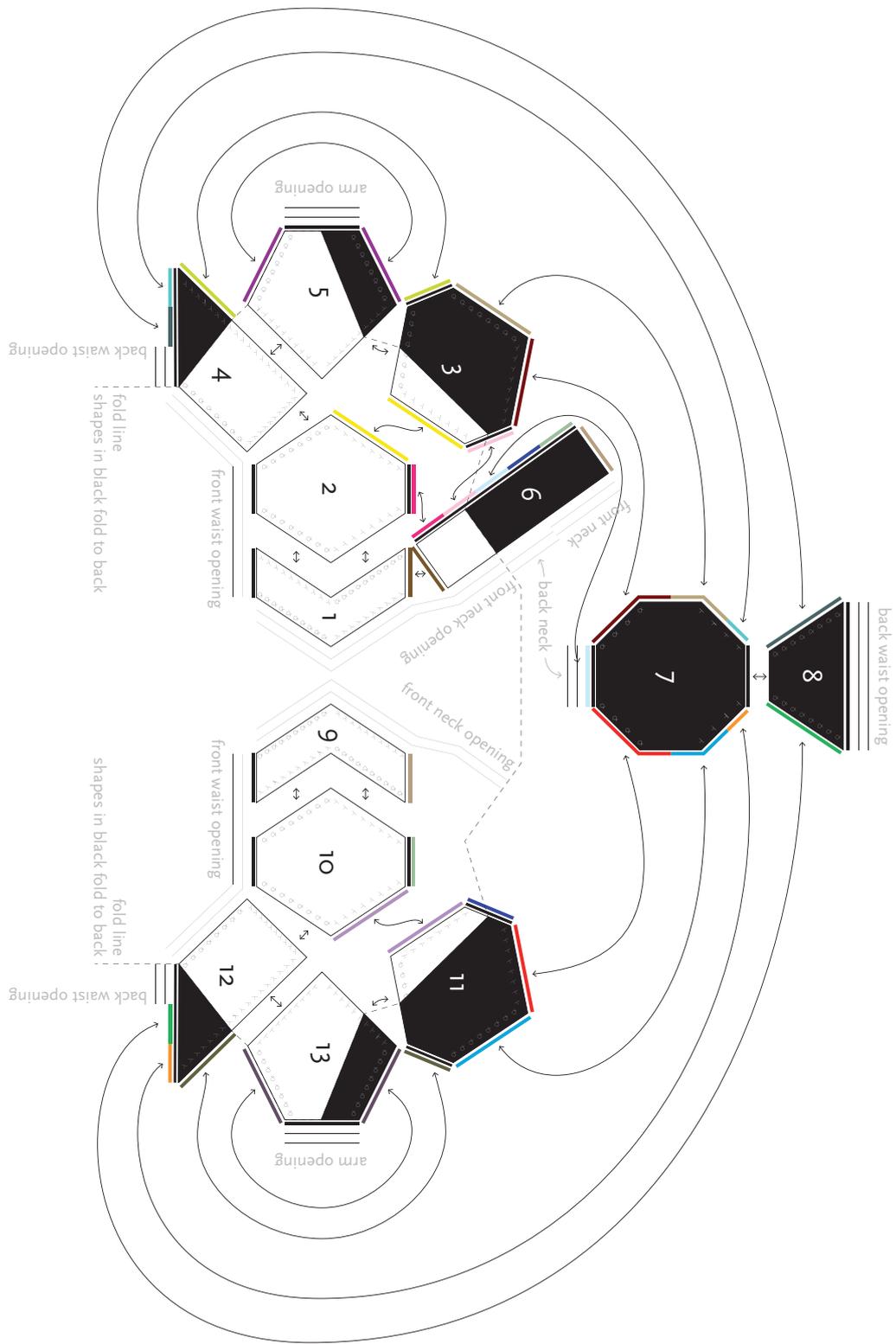
ANGLED



3.8a, 3.8b, 3.8c Angled Shapes Cardigan. $\frac{3}{4}$ Side view, Side view and $\frac{3}{4}$ Back view.

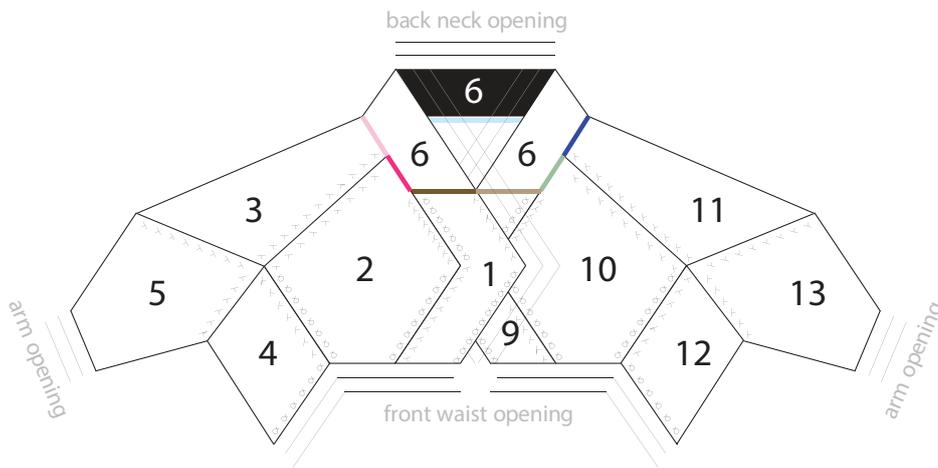
Angled Shapes.

These knitted angled geometric shapes have straight or diagonal edges. Straight edges are formed by no shaping, i.e. no increasing or decreasing, portrayed by square or rectangle shapes. Diagonally formed shapes are created by increasing or decreasing stitches at the edge of the knitting, represented by pentagon, hexagon, trapezoid, and zig-zag shapes.



3.9 Garment Pattern Assemblage of Angled Shapes Cardigan: Diagram showing how to join shapes.

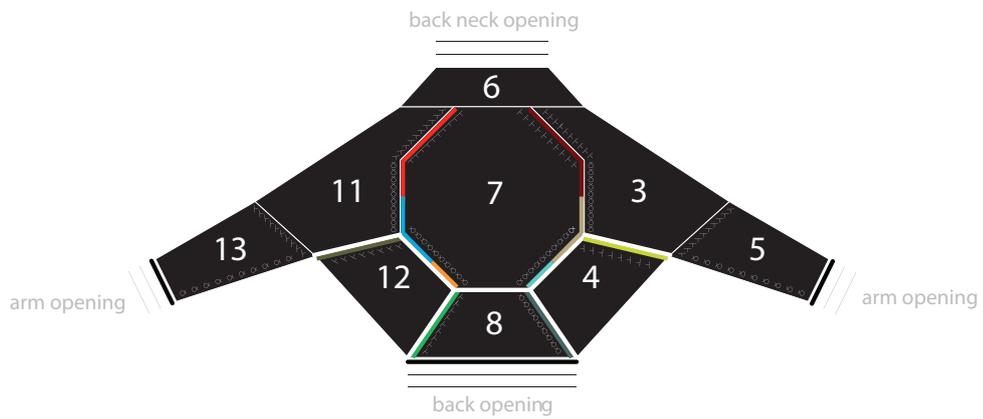
ANGLED – FRONT



Top: 3.10a Front view of Angled Shapes Cardigan.

Bottom: 3.11a Illustrated Front View of Angled Shapes Cardigan, shows shape joins.

ANGLED – BACK



Top: 3.10b Back view of Angled Shapes Cardigan.

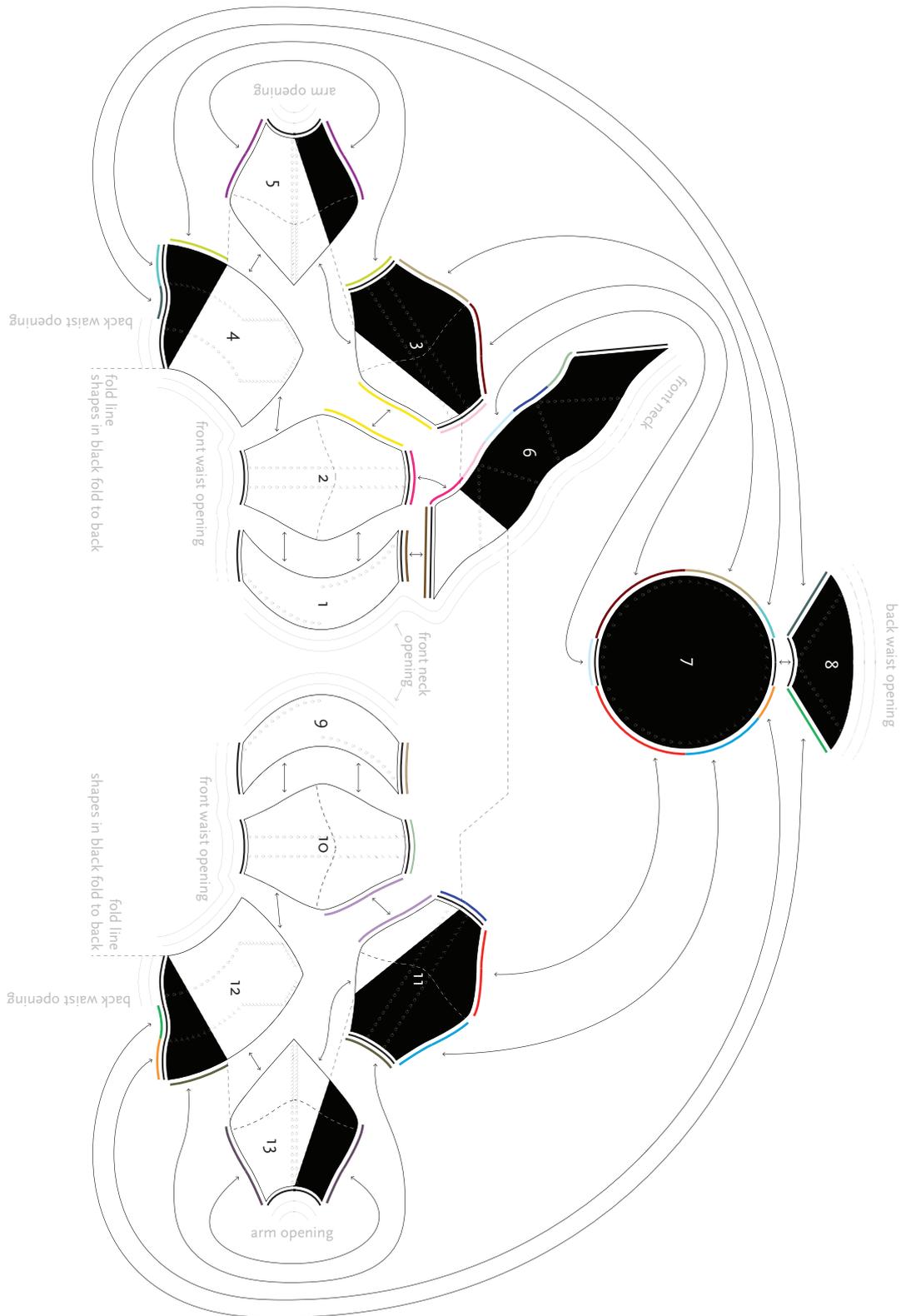
Bottom: 3.11b Illustrated view of Angled Shapes Cardigan, showing shape joins.

Curved Shapes.

Shifting the decreasing or increasing of stitches away from the edge of a knitted shape, to the internal face of the knitting, creates curves within the form. This contours the surface area of the shape as the direction of the knitting bends. When the shapes are joined, this highlights the additional volume and movement that occurs in the garment from the curving and warping of these shapes.

CURVED

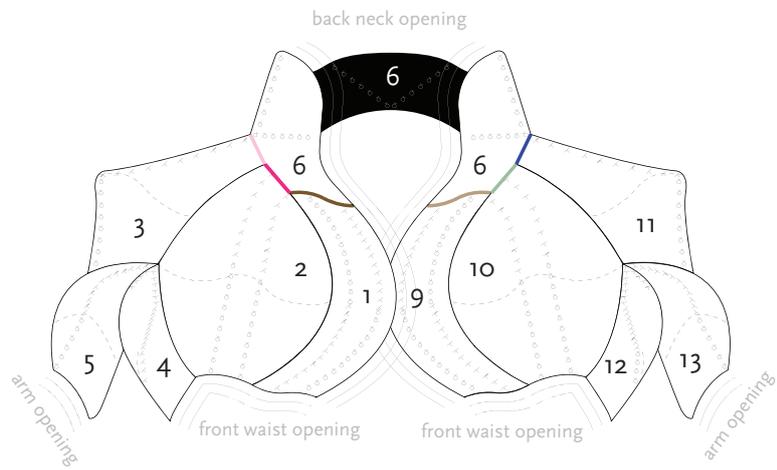




Left: 3.12 Curved Shapes Cardigan on model. Side View.

Right: 3.13 Garment Pattern Assemblage of Curved Shapes Cardigan: Diagram showing how to join shapes.

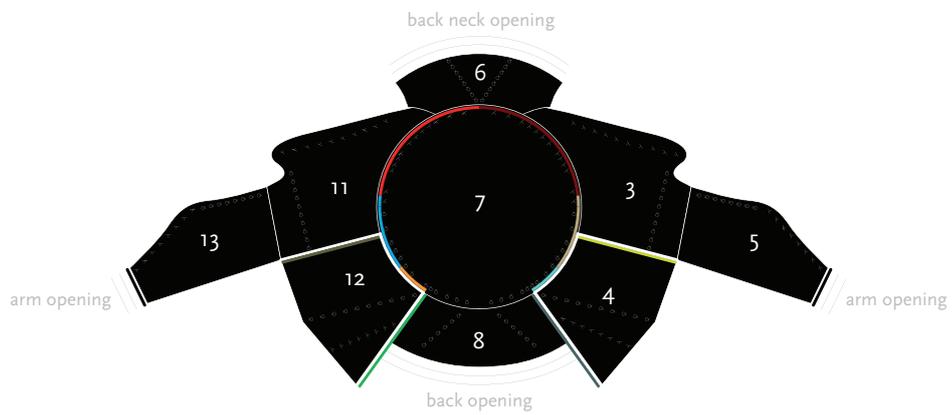
CURVED – FRONT



Top: 3.14a Front view of Curved Shapes Cardigan.

Bottom: 3.15a Illustrated front view of Curved Shapes Cardigan, showing shape joins.

CURVED – BACK



Top: 3.14b Back view of Curved Shapes Cardigan.

Bottom: 3.15b Illustrated back view of Curved Shapes Cardigan, showing shape joins.

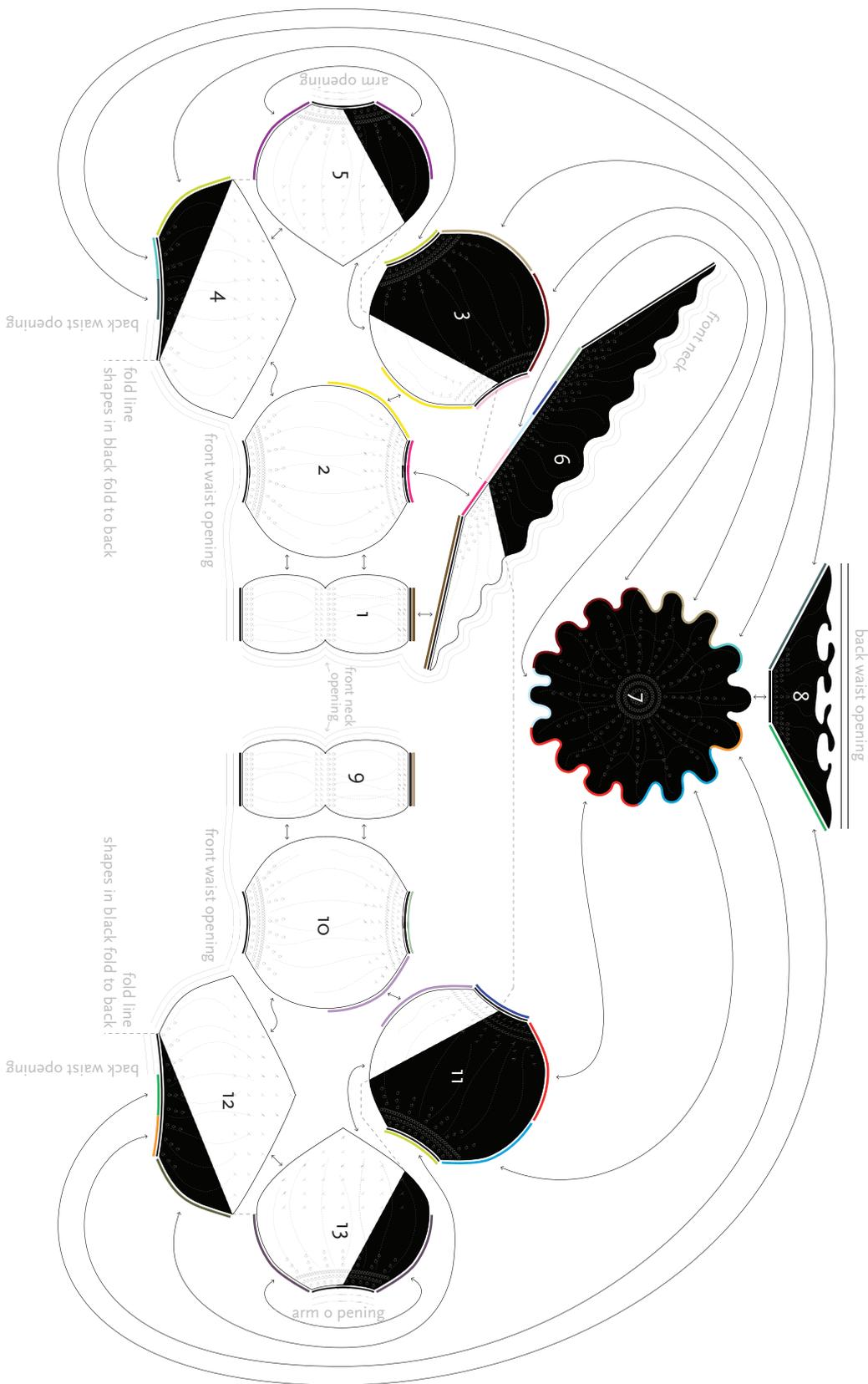
HYPERBOLIC



3.16a, b, c Hyperbolic Shapes Cardigan. $\frac{3}{4}$ Side view, Side view and $\frac{3}{4}$ Back view.

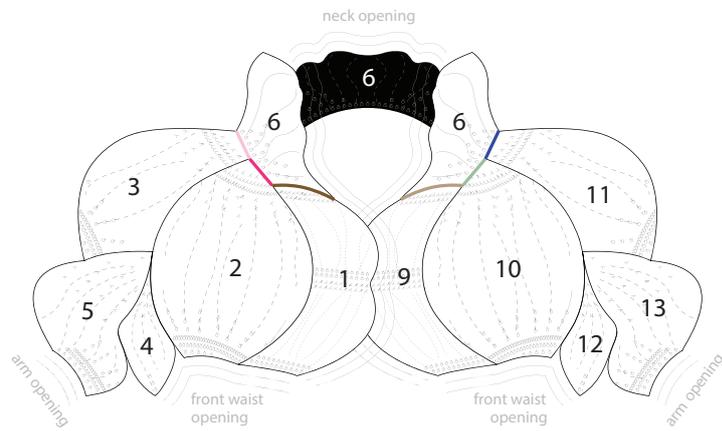
Hyperbolic shapes.

By adding rapid increasing and decreasing of stitches to these shapes, this causes them to ruffle and distort. Assembled as the same garment configuration as the two previous cardigans, this cardigan shows how the extra volume of these shapes, which contort into both negative and positive space, add further volume, depth and buoyancy to a garment overall.



3.17 Garment Pattern Assemblage of Hyperbolic Shapes Cardigan: Diagram showing how to join shapes.

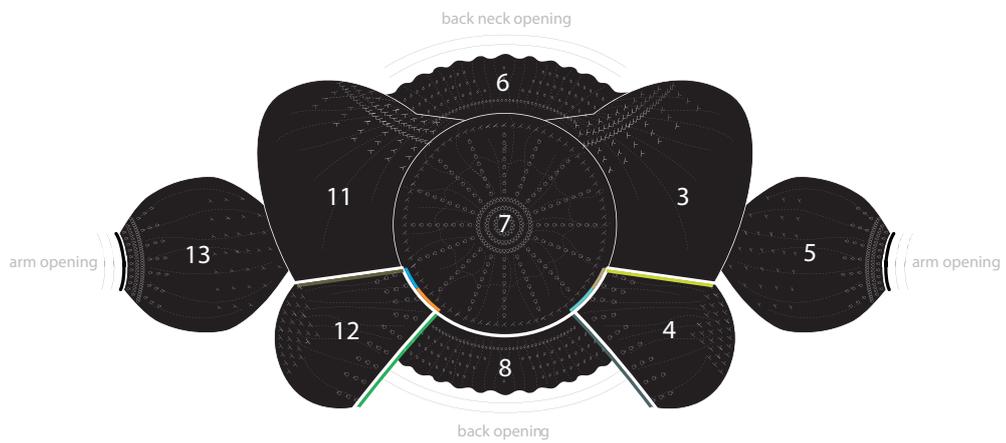
HYPERBOLIC – FRONT



Top: 3.18a Front view of Curved Shapes Cardigan.

Bottom: 3.19a Illustrated front view of Hyperbolic Shapes Cardigan, showing shape joins.

HYPERBOLIC – BACK



Top: 3.18b Back view of Hyperbolic Shapes Cardigan.

Bottom: 3.19b Illustrated view of back of Hyperbolic Shapes Cardigan, showing shape joins.

SILHOUETTES

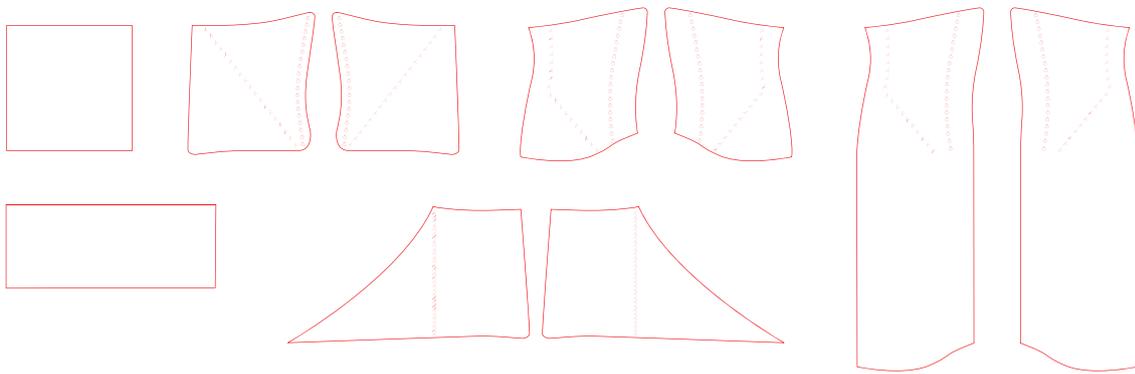


3.20 Collection of Garment Silhouette Patterns.

In Section Two ‘Assembling Shapes’, it is discussed that a modular design format to make garments is a feature of the Construction Knitting method. Modular Design is the production of shapes that can be adjusted, combined and interchanged to assemble a variety of garment designs. This step-by-step designing enables adaptation and improvisation of patterns, as design steps and design sequences are visualized, and shows how each stage informs the next. By using geometric shapes as a starting point for the design process, the technique in this book proposes a different logic from the standard method of pattern construction, to build a more experimental making process which leads to more experimental garment forms and silhouettes.



SQUARES



3.21a Knitted Square shape.



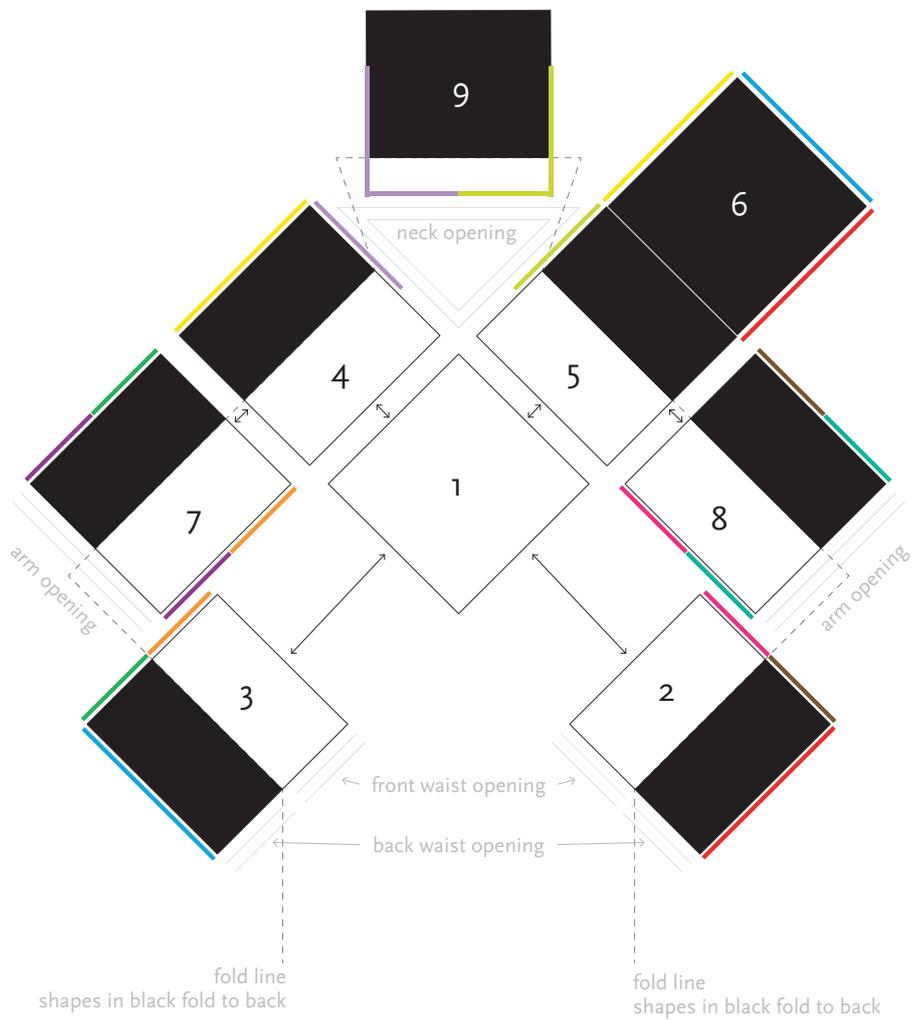
3.21b, c, d Square Shape garment patterns, Version 1, Version 2, Version 3.

Version 1.

This garment capsule begins with a simple knitted square, where Version 1 is made of joining the same size squares into a jumper.

SQ.V.1

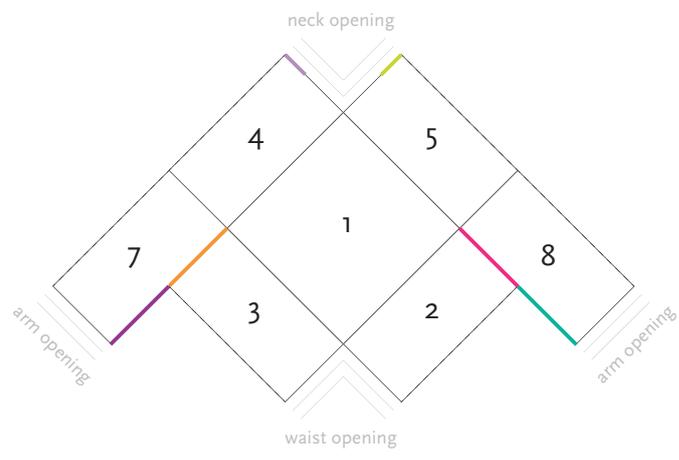




Left: 3.22 Square Garment V.1. Jumper. $\frac{1}{4}$ front view.

Right: 3.23 Shows shape joins.

SQ.V.1 FRONT



Top: 3.24a Front view of Square Garment V.1, Jumper.

Bottom: 3.25a Illustrated front view of Square Garment V.1, Jumper, showing shape joins.

SQ.V.2



3.26a, b, c Square Garment V.2. Cardigan. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

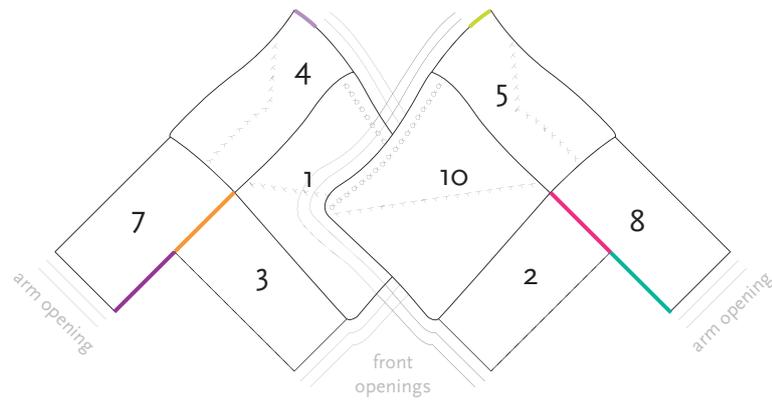
Version 2.

Some variation is made to the square in this capsule by adding slight curvature to the shape, deflecting from the uniformity of the previous 'square' assemblage in Version 1. The cardigan is a similar configuration to the jumper of V.1 in the way the shapes are put together, but the curvature slightly distorts and warps this cardigan form. The curved shapes create discrete contortion to the orientation and flow of lines in the knitting which adds some visual interest to the textile structure and the garment overall.



3.27 Garment Pattern Design, shows how to assemble shapes to make Cardigan.

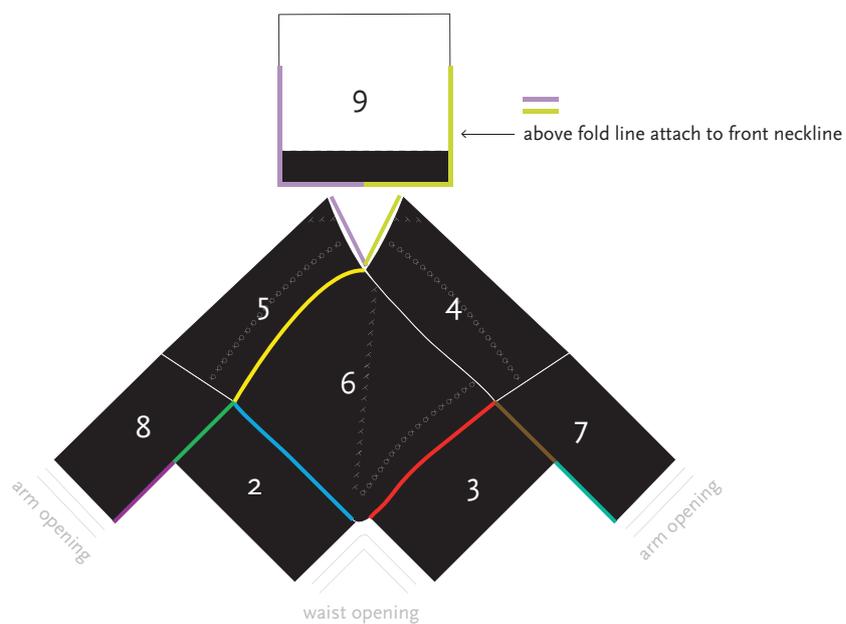
SQ.V.2 FRONT



Top: 3.28a Front view of Square Garment V.2, Cardigan.

Bottom: 3.29a Illustrated front view of Square Garment V.2, Cardigan, showing shape joins.

SQ.V.2 BACK



Top: 3.28b Back view of Square Garment V.2, Cardigan.

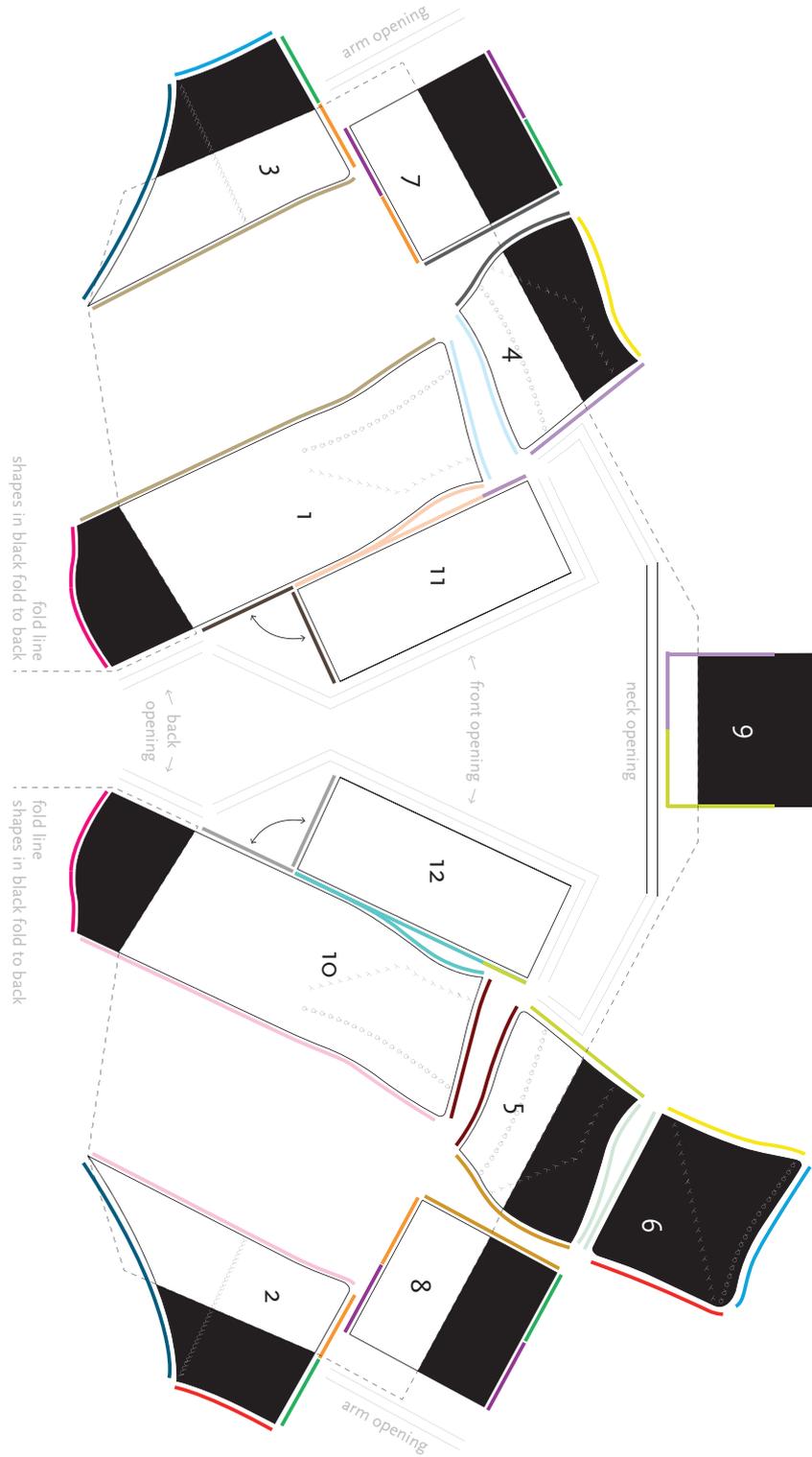
Bottom: 3.29b Illustration of back of Square Garment V.2, showing where shapes join to make cardigan.

Version 3.

Following on from Version 2 as a precedent, this project is a manageable step towards further building of complexity in the knitting and assemblage of square-ish shapes. By widening and lengthening the knitting of curved squares, these shapes transform into rectangles that add length to the garment. A knit and purl rib stitch pattern is used in some of these shapes which adds depth and contrast, building a cocoon-like silhouette in the garment form.

SQ.V.3

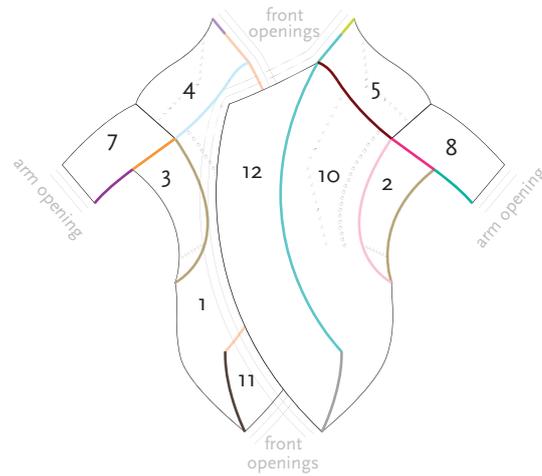




Left: 3.30 Square Garment V.3, Coat. $\frac{3}{4}$ Front view.

Right: 3.31 Garment Pattern Design, Shows how to assemble shapes to make Coat.

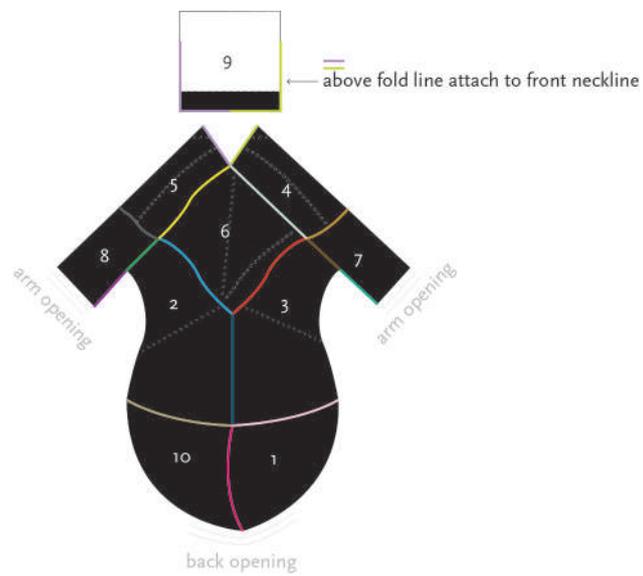
SQ.V.3 FRONT



Top: 3.32a Front view of Square Garment V.3, Coat.

Bottom: 3.33a Illustrated front view of Square Garment V.3, Coat, showing shape joins.

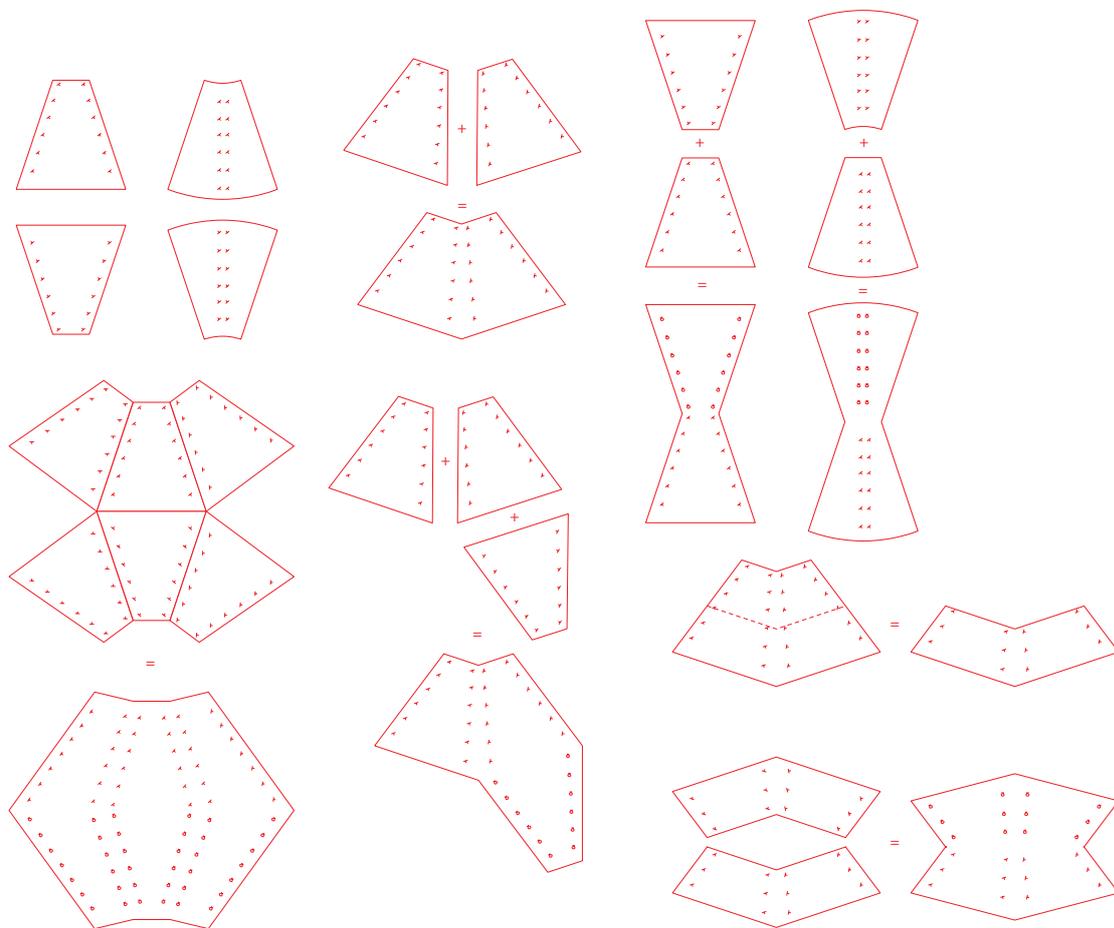
SQ.V.3 BACK



Top: 3.32b Back view of Square Garment V.3, Coat.

Bottom: 3.33b Illustration of back of Square Garment V.3, Coat, showing where shapes join to make cardigan.

QUADRILATERALS



3.34 Quadrilateral shapes made for these Garment Capsules.



3.35a, b, c Quadrilateral Garment Collection, Version 1, Version 2, Version 3.

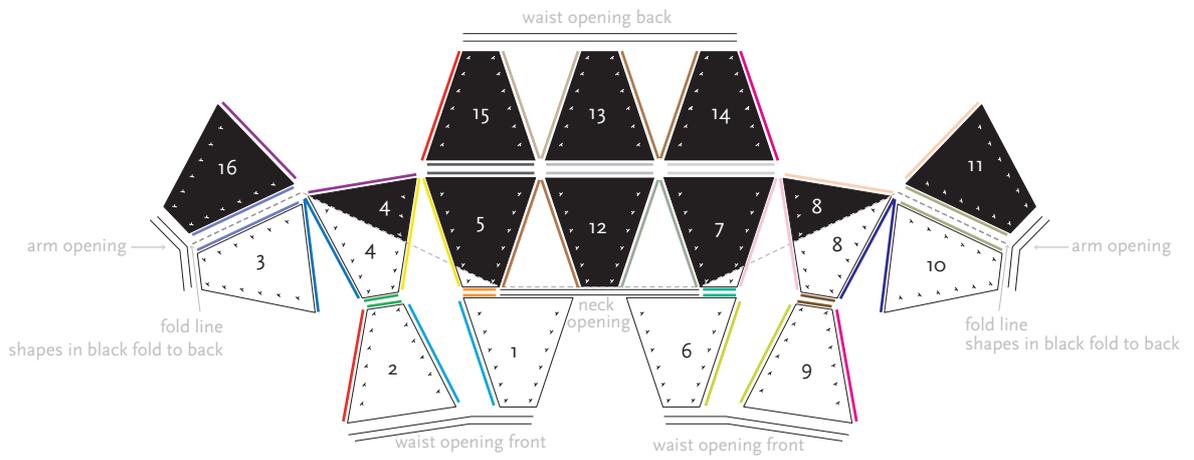
QU.V.1



3.36a, b, c Quad Garment V.1. Jumper. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

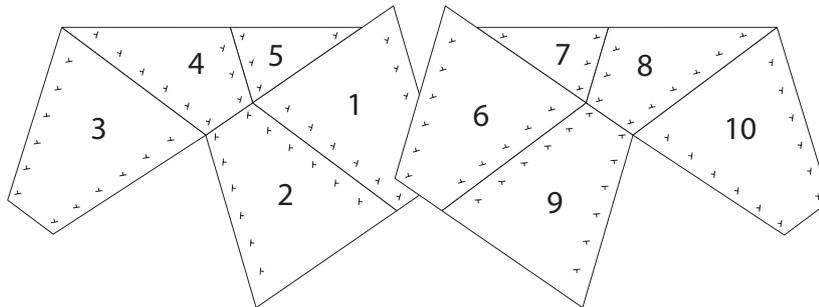
Version 1.

This garment capsule begins with joining the same size quadrilateral shapes into a bolero-style garment.



3.37 Quad Garment V.1. Design, shows how to assemble shapes to make Bolero.

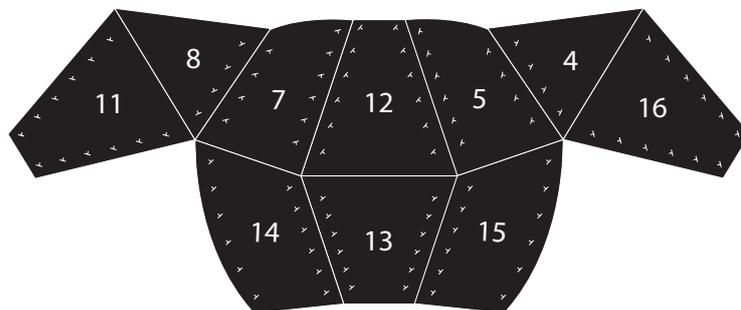
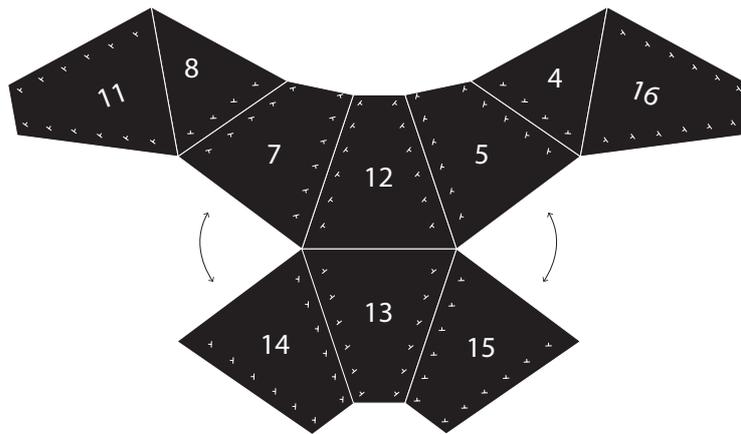
QU.V.1 FRONT



Top: 3.38a Front view of Quad Garment V.1. Bolero.

Bottom: 3.39a Illustrated front view of Quad Garment V.1, Bolero, showing shape joins.

QU.V.1 BACK



Top: 3.38b Back view of Quad Garment V.1. Bolero.

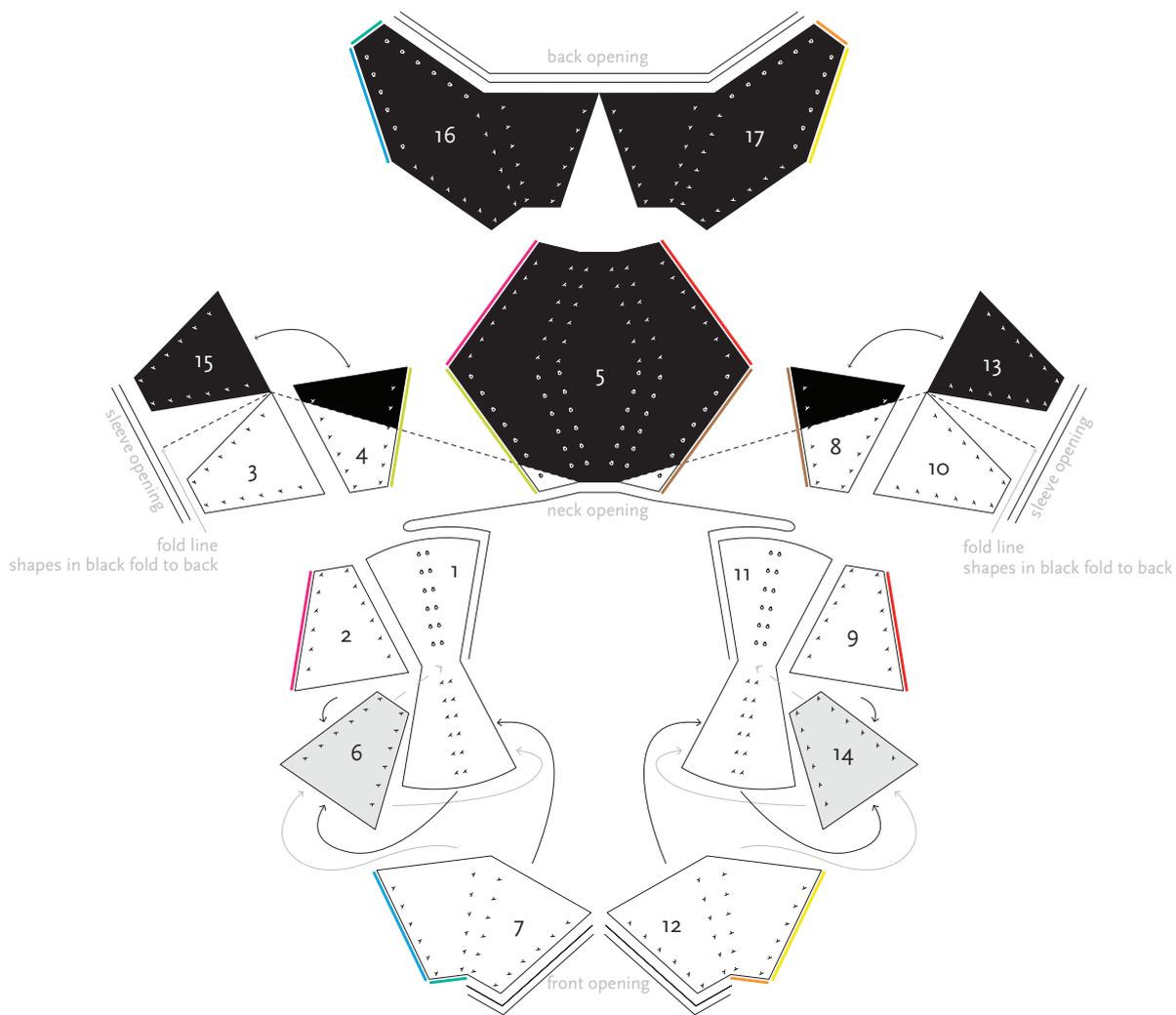
Middle 3.39b and Bottom 3.40 Illustrated back views of Quad Garment, V.1. Bolero, shows shape joins.

Version 2.

Following a similar configuration to Version 1 in the way the shapes are assembled, here additional shapes are added to transform the garment into a long cardigan. Some shapes are merged, such as the back, where the equivalent of six shapes are knitted together. Here the increasing and decreasing of stitches is performed in the same position where the joins of the separate shapes would otherwise be, so that the shaping marks form shaping lines or structural lines within the internal face of the knitted fabric. Quad shapes are merged with inverted and mirrored shapes, and layered over the top of each other which when assembled will create pockets in the garments. Shapes in the back are joined at right angles, which emulate the protruded effect in the sleeves.

QU.V.2



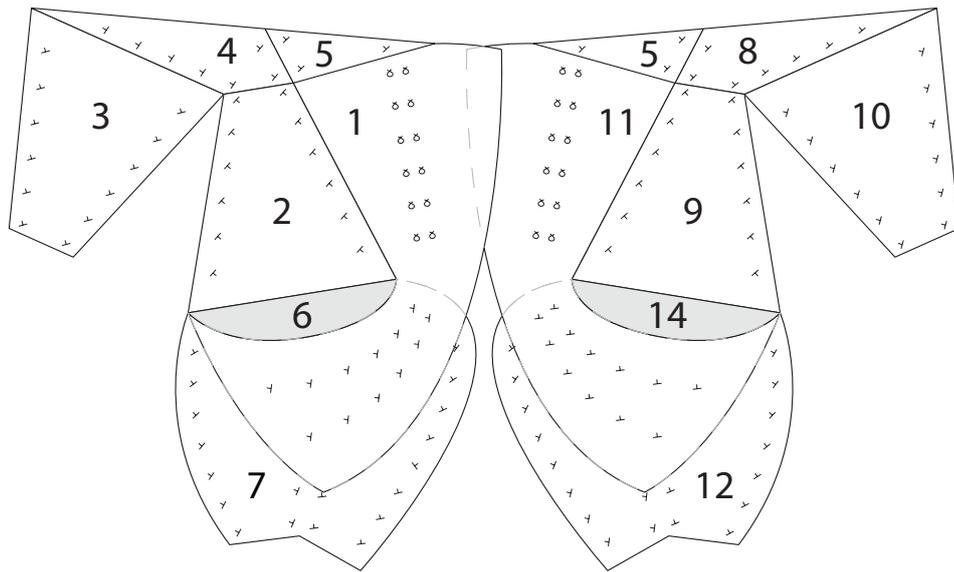
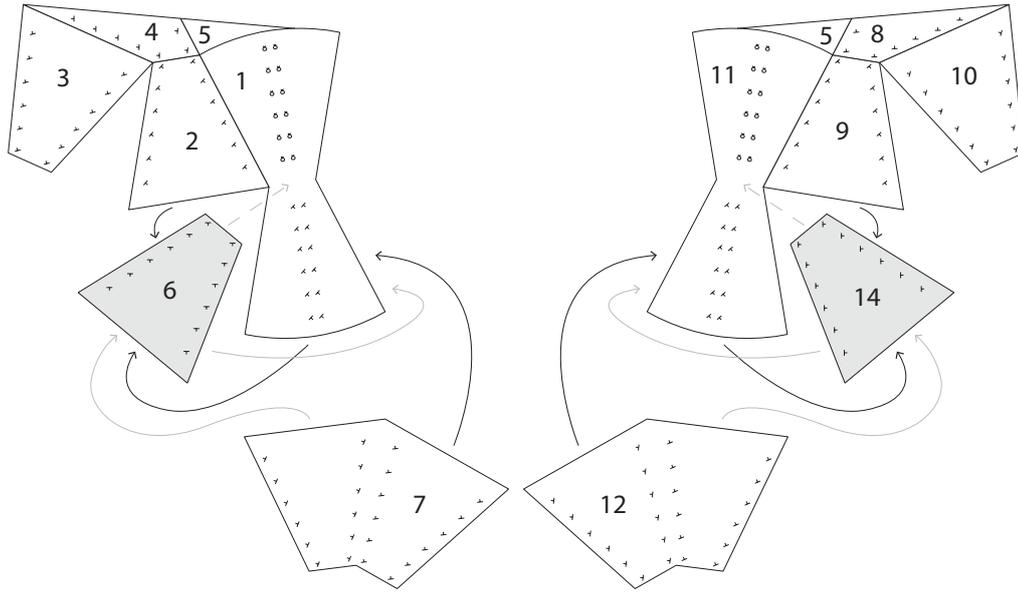


Left: 3.41 Square Garment V.2. Cardigan. $\frac{3}{4}$ Front view.
Right: 3.42 Shows shape joins.

QU.V.2 FRONT



3.43a Front view of Quad Garment V.2. Cardigan.

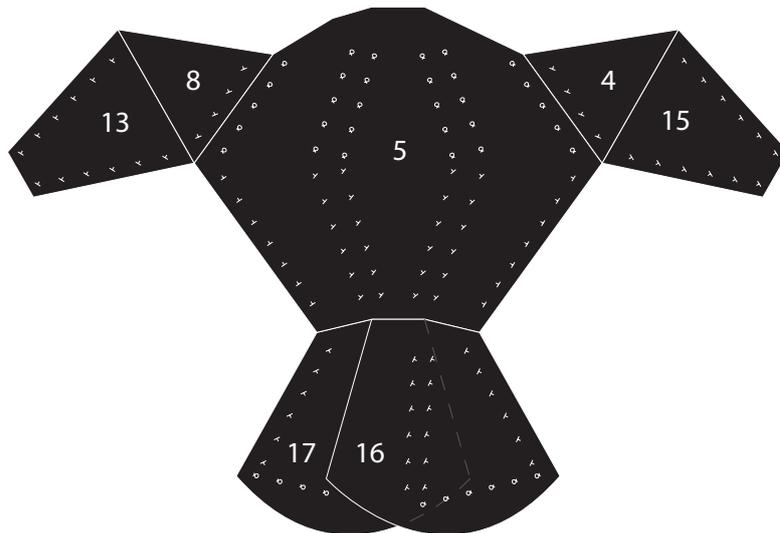
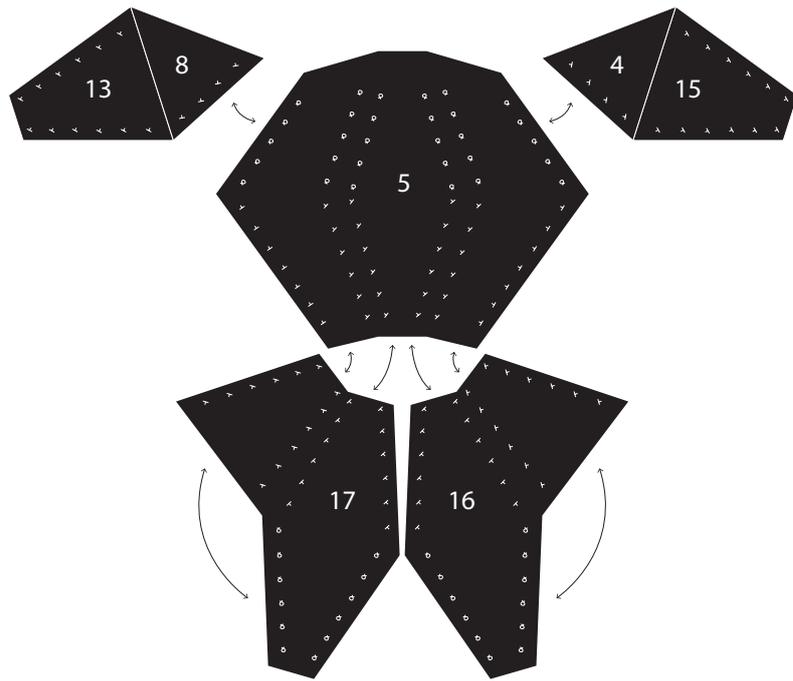


Top 3.44 and Bottom 3.45 Illustrated front views of Quad Garment, V.2. Cardigan, shows shape joins.

QU.V.2 BACK



3.43b Back view of Quad Garment
V.2. Cardigan.



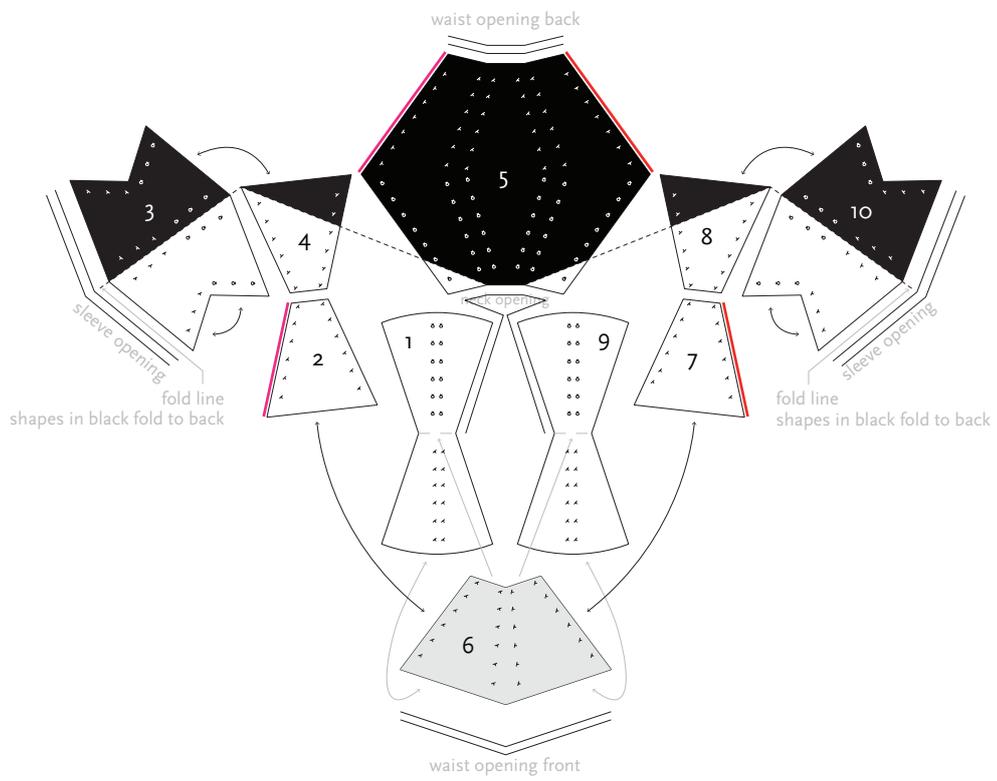
Top 3.46a and Bottom 3.46b Illustrated back views of Quad Garment, V.2. Cardigan, shows shape joins.

Version 3.

These shapes assemble into a tunic top, and there is a variation to the stitch structure in the form of a slip stitch configuration which creates a lace effect in the fabric. The slip stitch pattern together with the increasing and decreasing of stitches makes the knitting process a bit more complex; but this creates striking structural lines in the textile. The lace opens up and lightens the fabric to contrast the chunky weight of the garment which balances the overall garment form. Like the previous garment version, shapes when layered over each other function as pockets, exploiting the profile of this shape.

QU.V.3





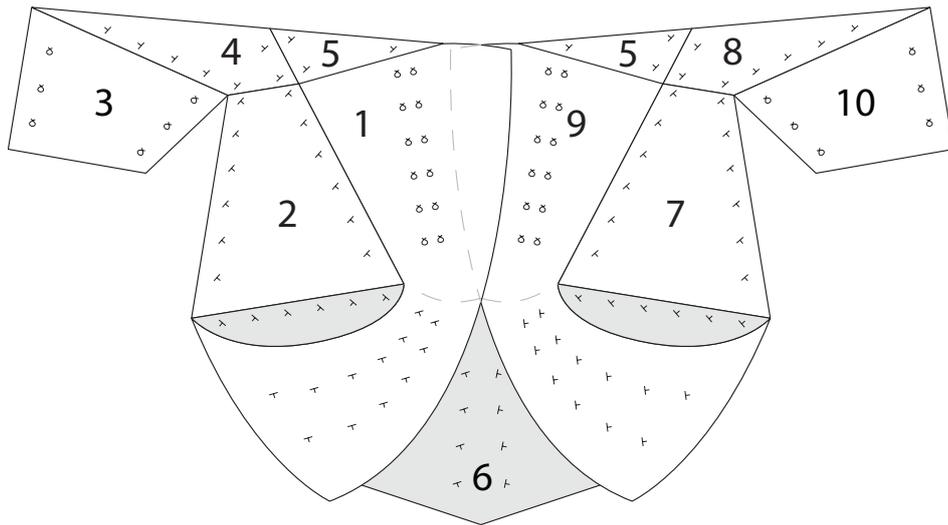
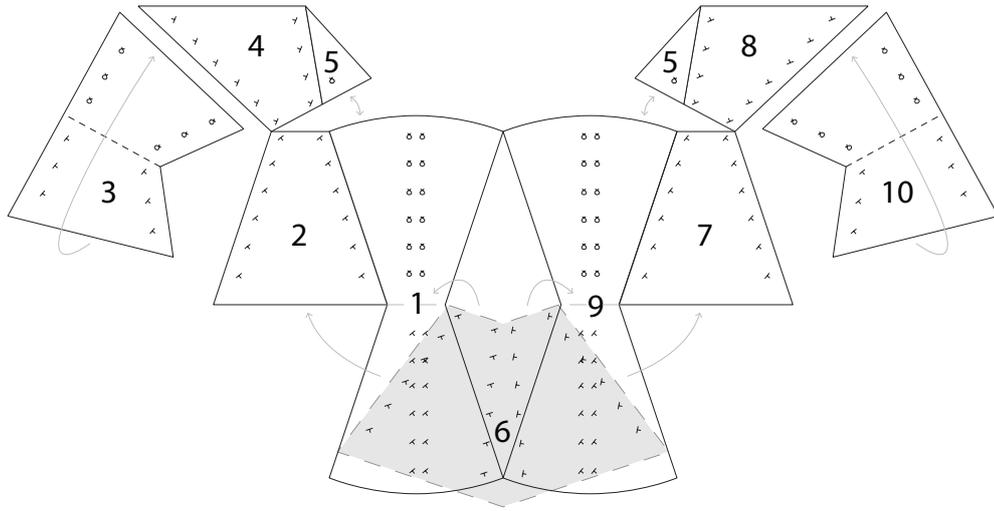
Left: 3.47 Quad Garment V.3. Tunic Top. $\frac{3}{4}$ Front view.

Right: 3.48 Shows shape joins.

QU.V.3 FRONT



3.49a Front view of Quad Garment V.3. Tunic Top.

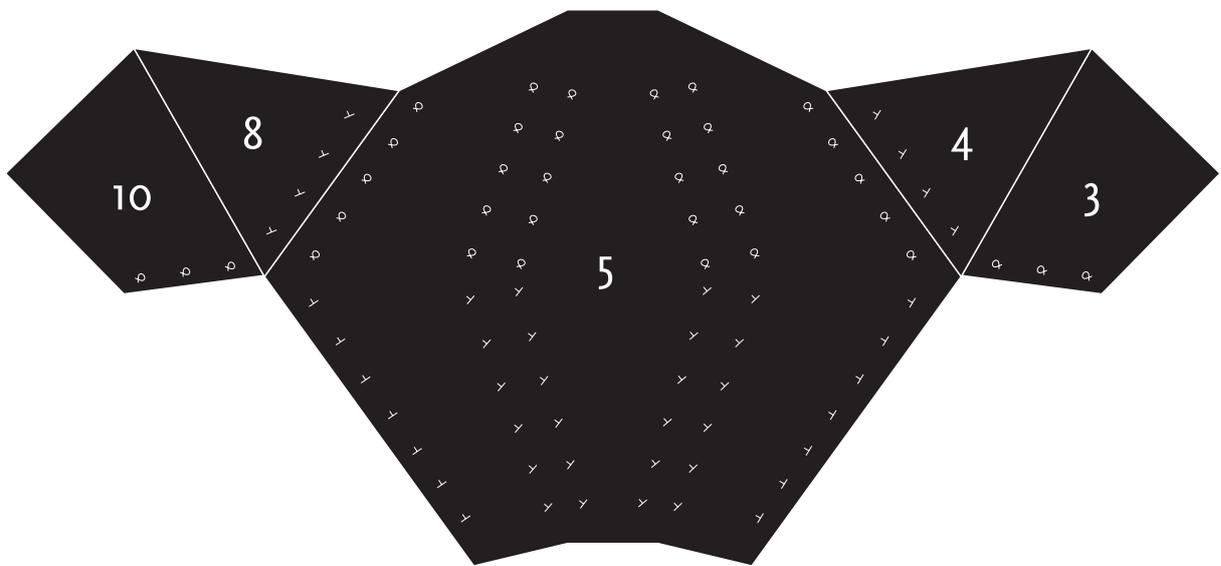


Top 3.50a and Bottom 3.50b Illustrated front views of Quad Garment, V.3. Tunic Top, shows shape joins.

QU.V.3 BACK

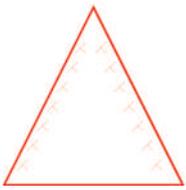


3.49b Back view of Quad Garment V.3. Tunic Top.

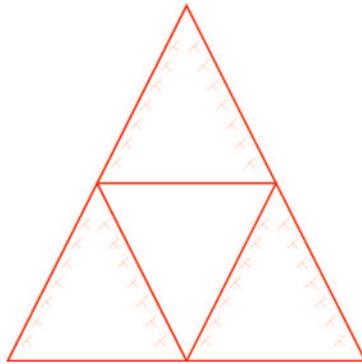


3.51 Illustrated back view of Quad Garment V.3, Tunic Top, showing shape joins.

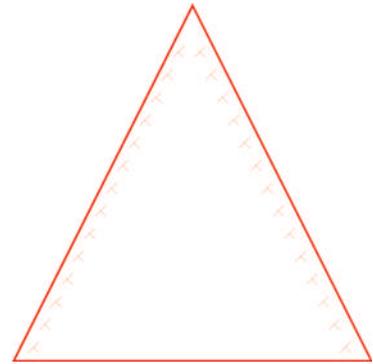
TRIANGLES



3.52 Triangle shapes.



=





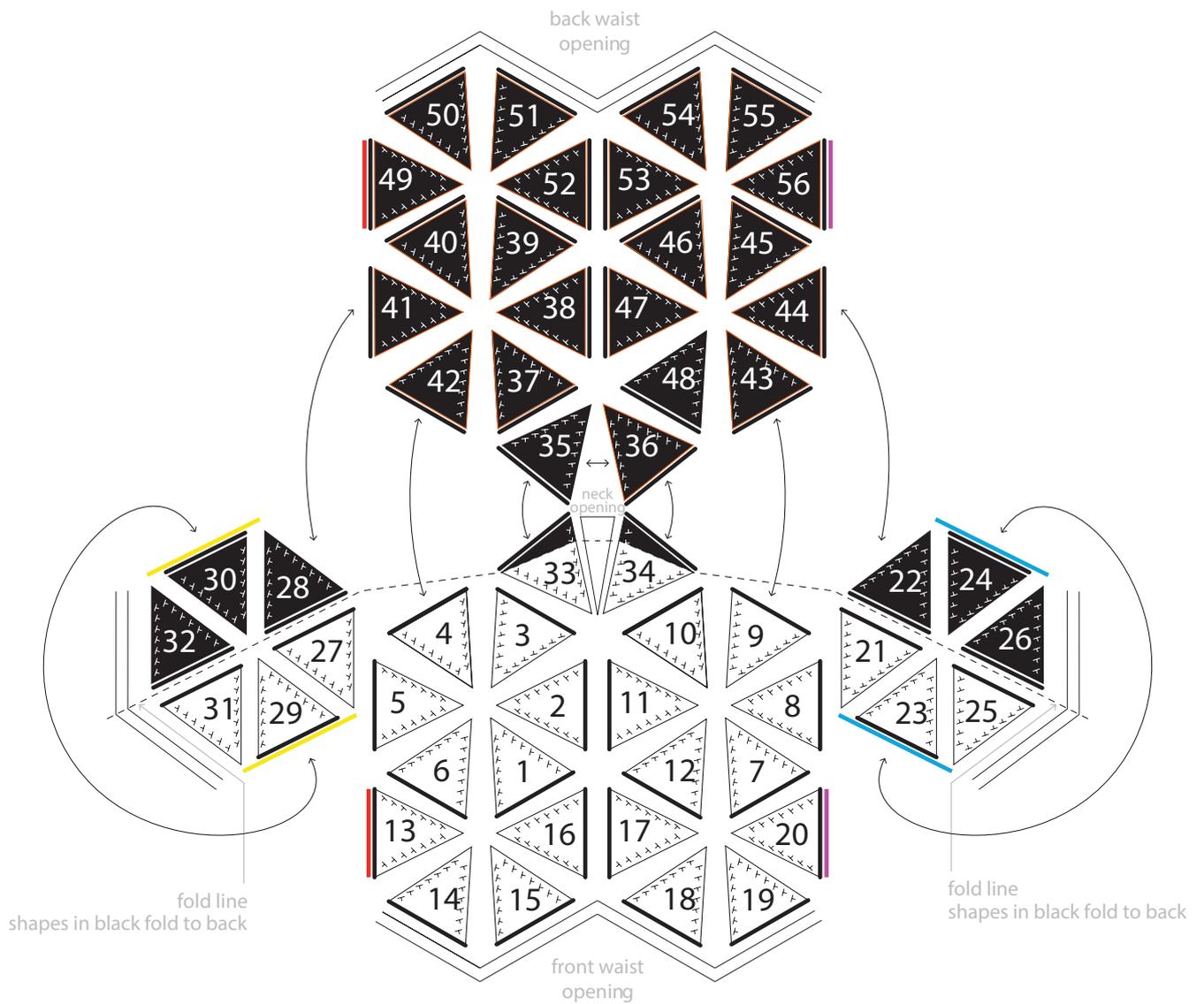
3.53a, b, c Triangle Garment Collection, Version 1, Version 2, Version 3.

Version 1.

This garment capsule begins with joining the same size triangle shape into a sweater, through a tessellation style of patterning, which is a rhythmic method of assembling shapes together by matching proportional sides.

TR.V.1

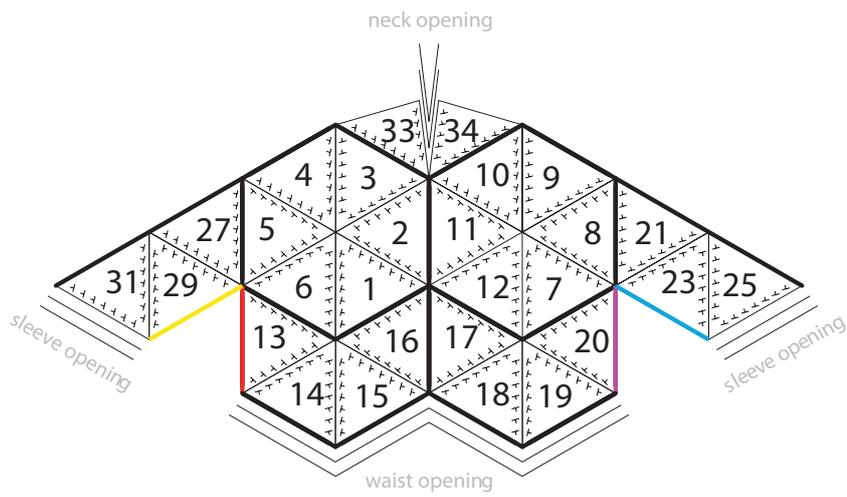




Left: 3.54 Triangle Garment V.1. Sweater. $\frac{3}{4}$ Front view.

Right: 3.55 Shows shape joins.

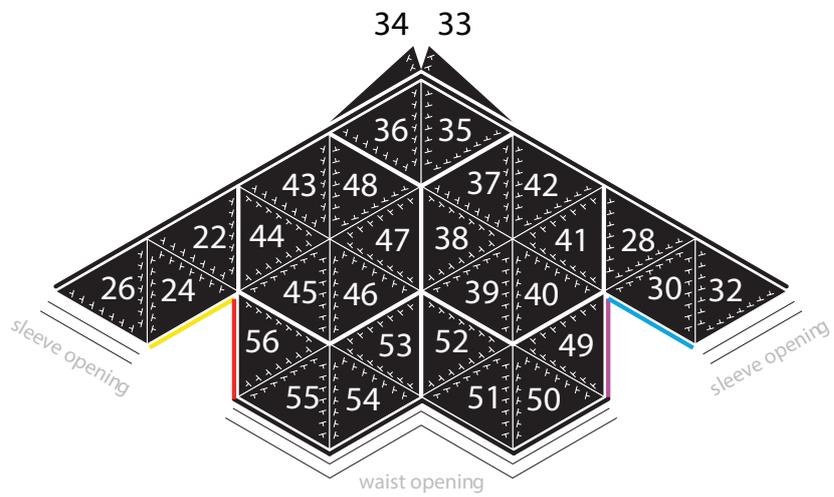
TR.V.1 FRONT



Top: 3.56a Front view of Triangle Garment V.1. Sweater.

Bottom: 3.57a Illustrated front view of Triangle Garment V.1, Sweater, showing shape joins.

TR.V.1 BACK



Top: 3.56b Back view of Triangle Garment V.1. Sweater.

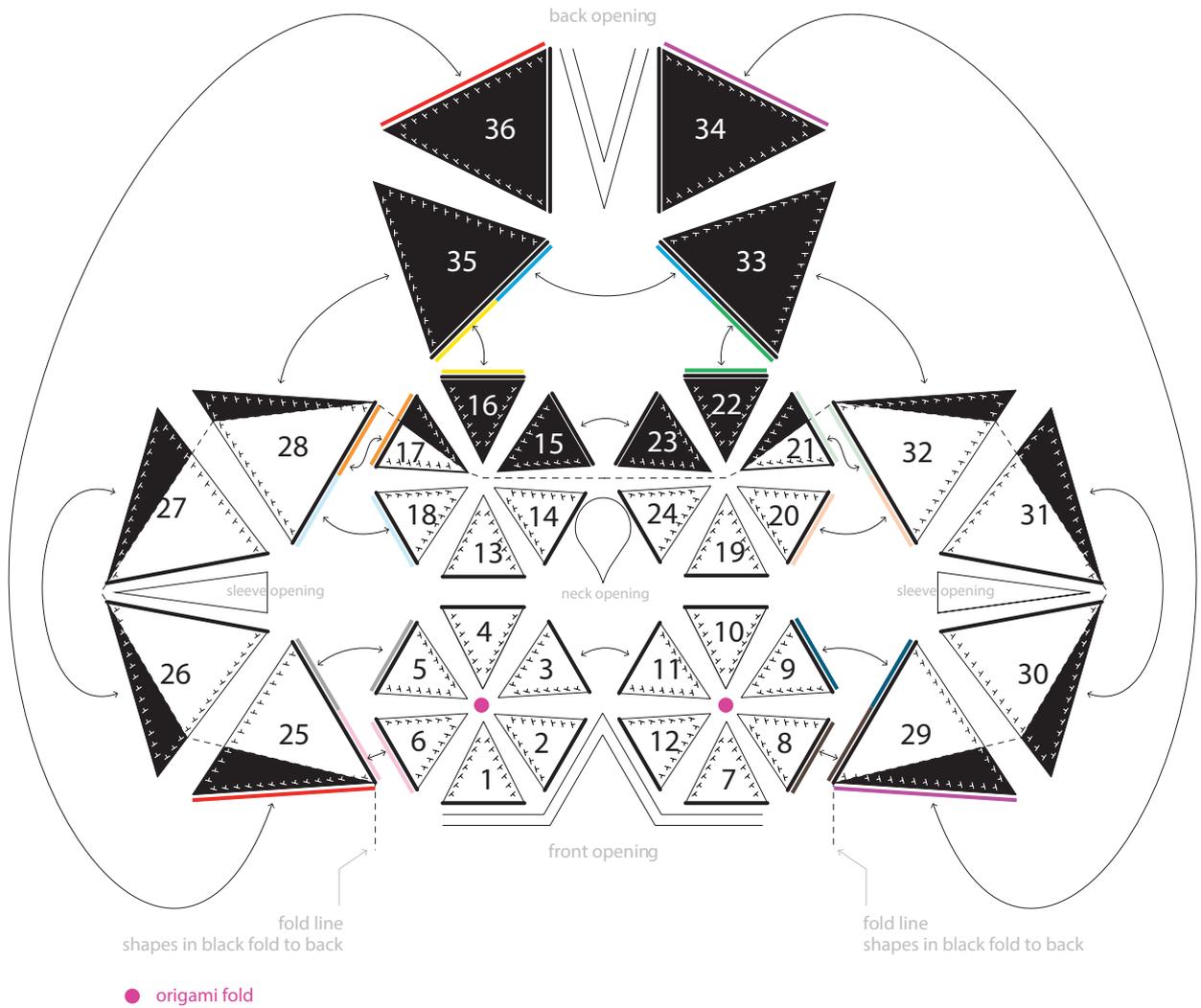
Bottom: 3.57b Illustration of back of Triangle Garment V.1 Sweater, showing where shapes join.

Version 2.

A proportionately larger triangle is added to Version 2. The patterning breaks away from the previous garment layout but a rhythm is still maintained through proportional symmetry, as the shapes are assembled into a kimono-style cape. Folding and origami are a trait of designing with geometric shapes, and so origami folds are introduced in this capsule. Two triangle points on either side of the garment origami-fold to connect in the middle, which creates pleats into smaller triangle fractions underneath to create a tiered and dimensional look to the garment.

TR.V.2



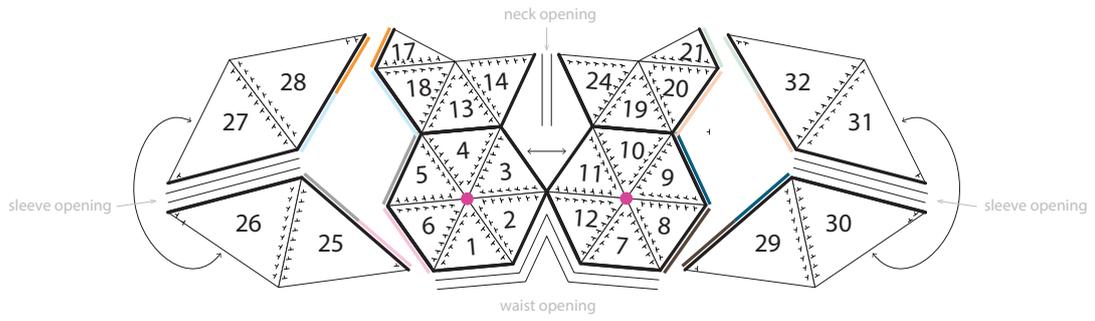


Left: 3.58 Triangle Garment V.2. Cape. $\frac{3}{4}$ Front view.
Right: 3.59 Shows shape joins.

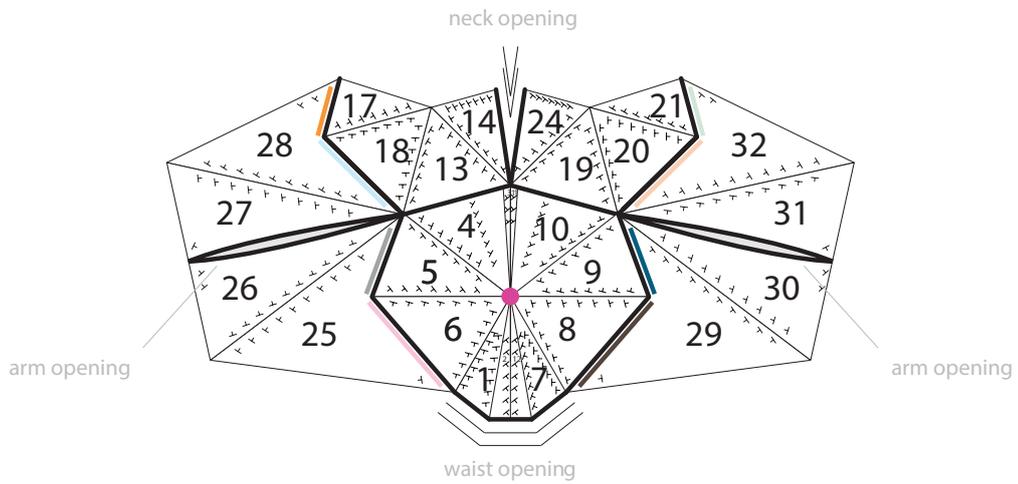
TR.V.2 FRONT



3.60a Front view of Triangle Garment V.2. Cape.



● join dots for origami fold



● origami fold

Top: 3.61a Front of Triangle Garment V.2. Cape, showing where shape joins.

Bottom: 3.61b Illustrations of back of Triangle Garment V.2. Cape, showing where shape joins.

TR.V.2 BACK



3.60b Back view of Triangle garment V.2 Cape.

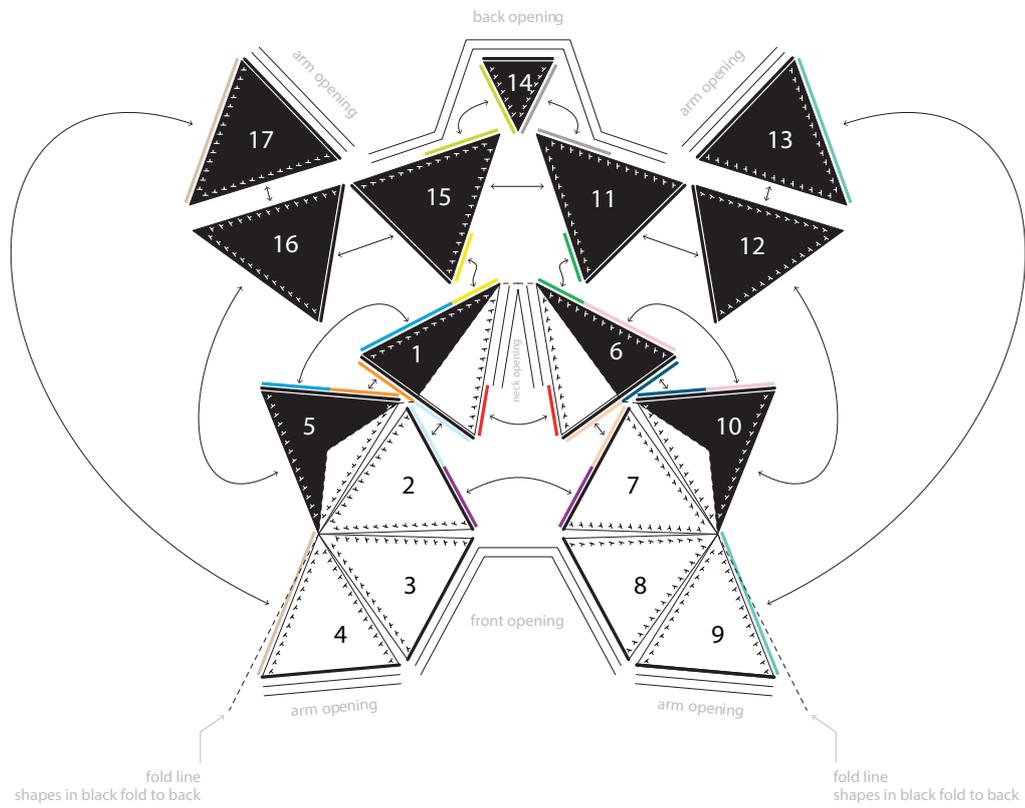
TR.V.3



3.63a, b, c Triangle Garment V.3. Lace Cape. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

Version 3.

These shapes are made from the large triangles, which are all knitted in a slip stitch configuration that generates a slight skew in each triangle shape. This disturbs the symmetry of the triangle assemblages as devised in the previous garments for this stitch structure changes the kinetic impulses of the textile. When these shapes are assembled, they tilt and bulge in different directions from the seams. In the makeup of the garment there are several origami pleats with connecting points at the shoulders, sleeves and the middle, which create layers and folds of coiling triangles underneath; highlighting a sense of movement in the overall form.

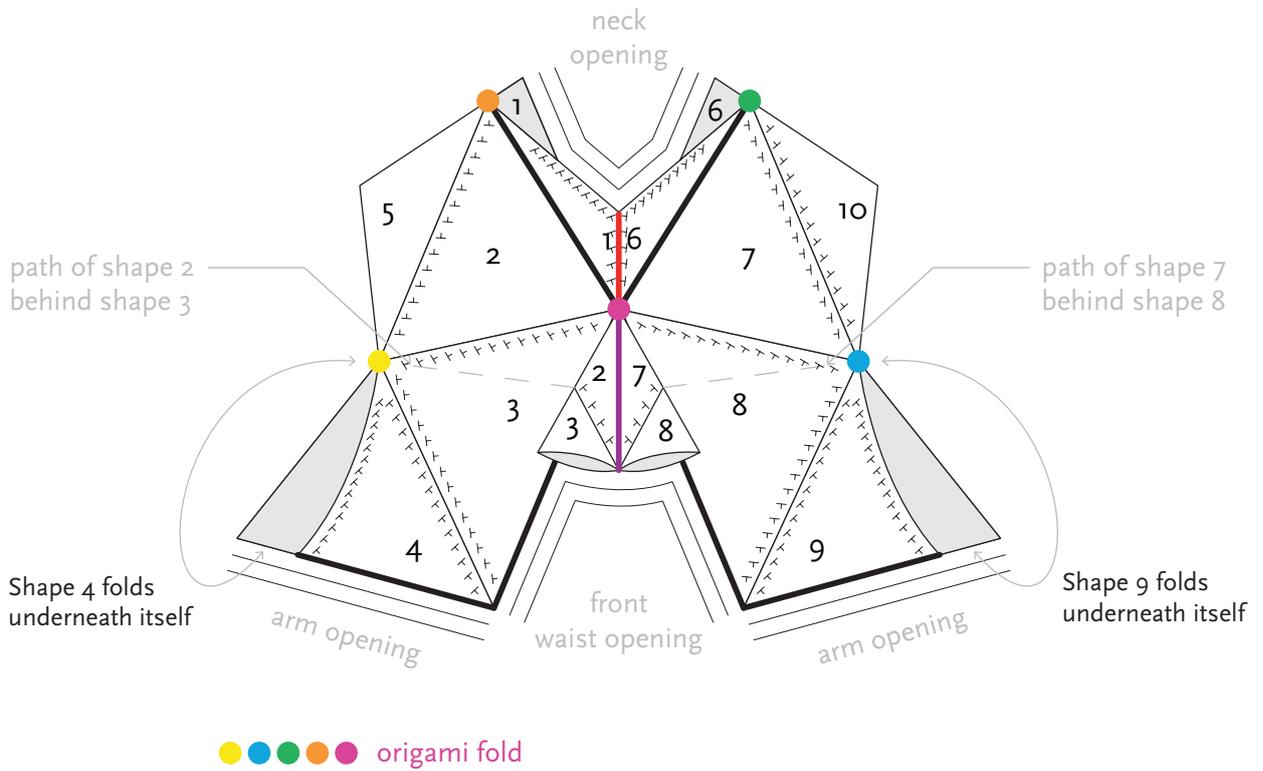
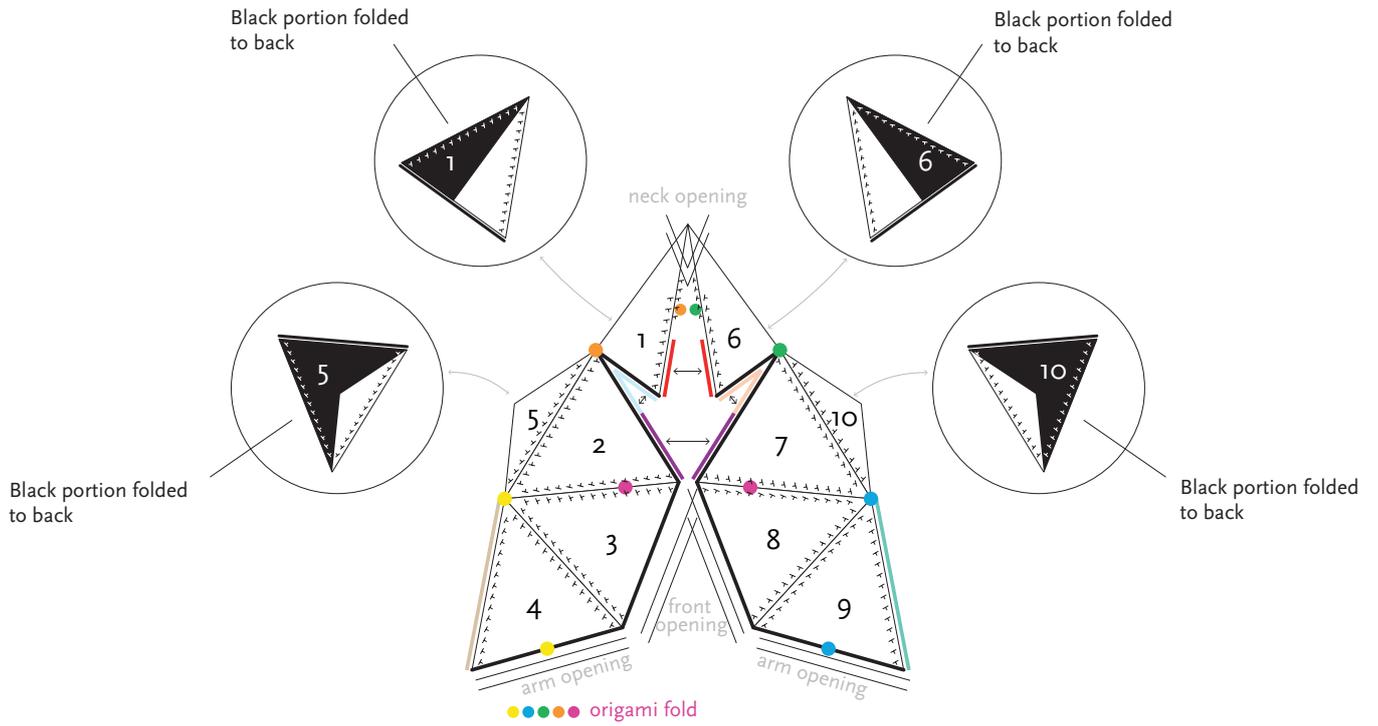


3.64 Triangle Garment V3. Design, shows how to assemble shapes to make Cape.

TR.V.3.FRONT



3.65a Front view of Triangle Garment V.3. Lace Cape.

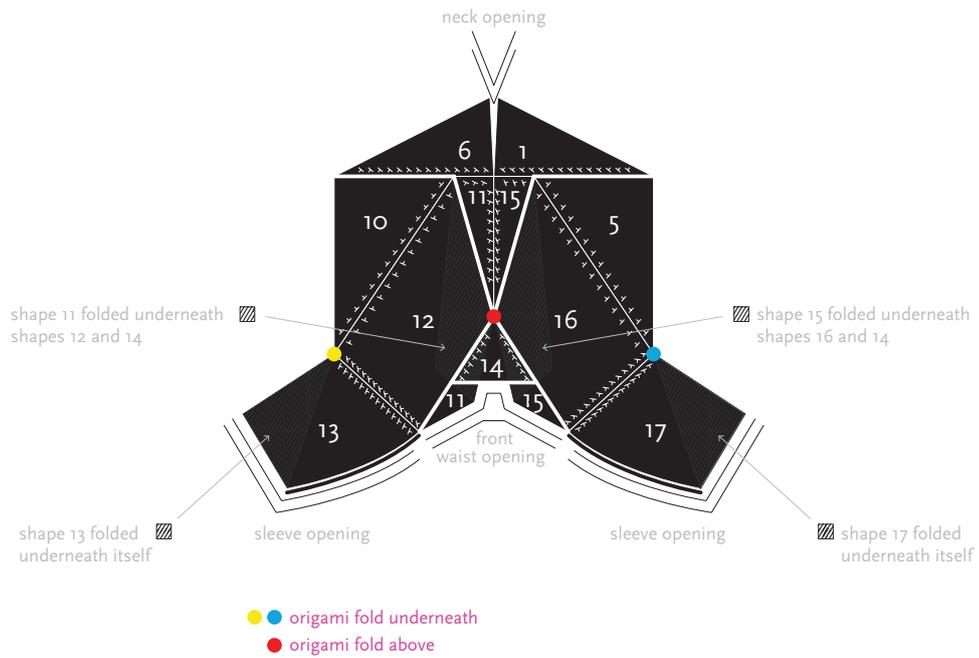
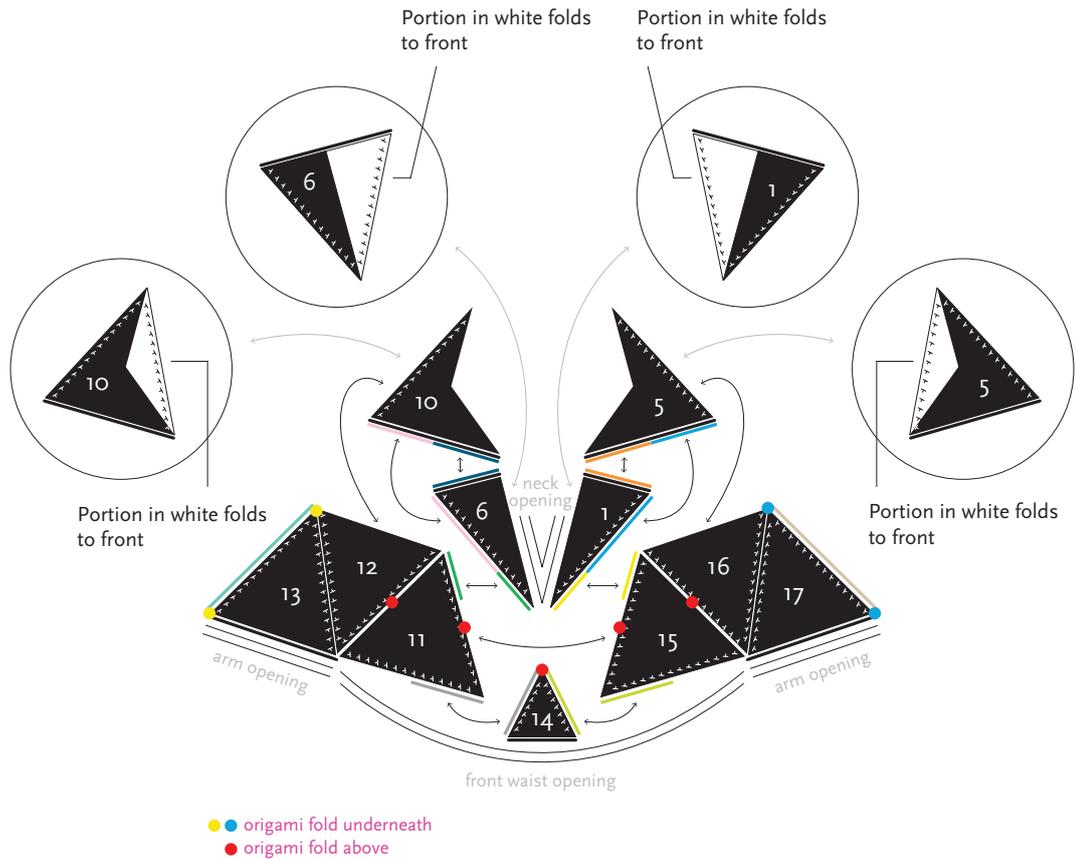


Top 3.66a and Bottom 3.66b Illustrated front views of Triangle Garment, V.3 Lace Cape, shows shape joins.

TR.V.2 BACK

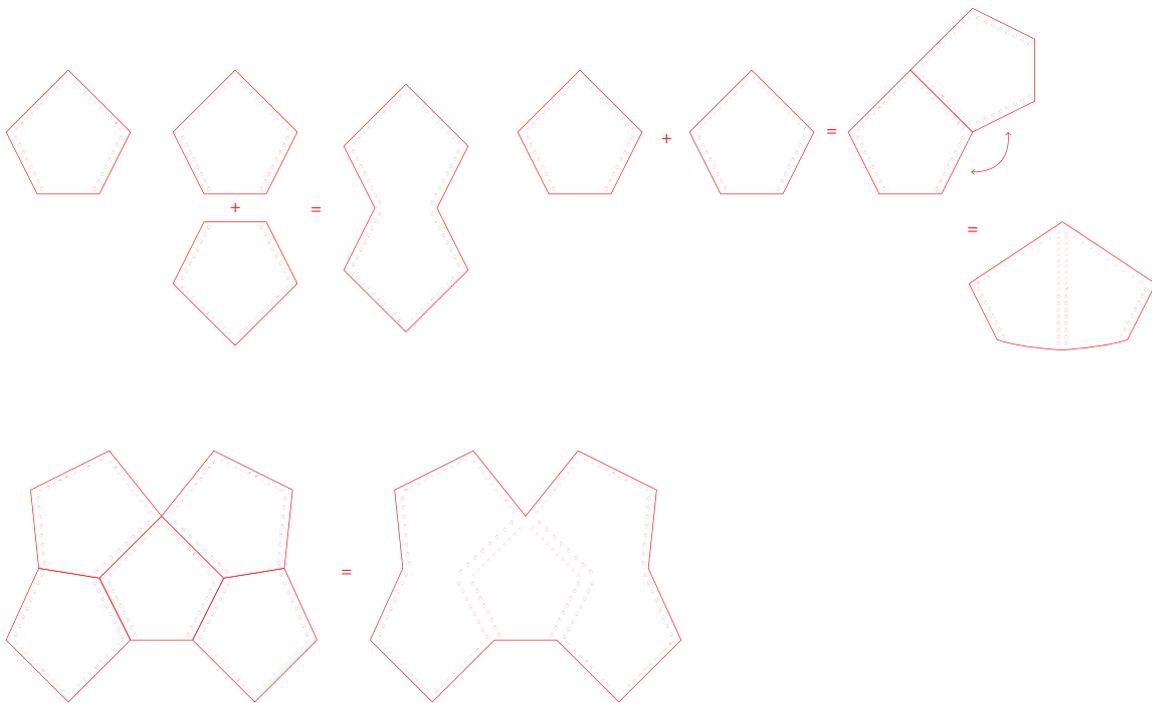


3.65b Back view of Triangle Garment V.3.



Top 3.67a and Bottom 3.67b Illustrated back views of Triangle Garment V.3, Lace Cape, showing shape joins.

PENTAGONS



3.68 Pentagon shapes.



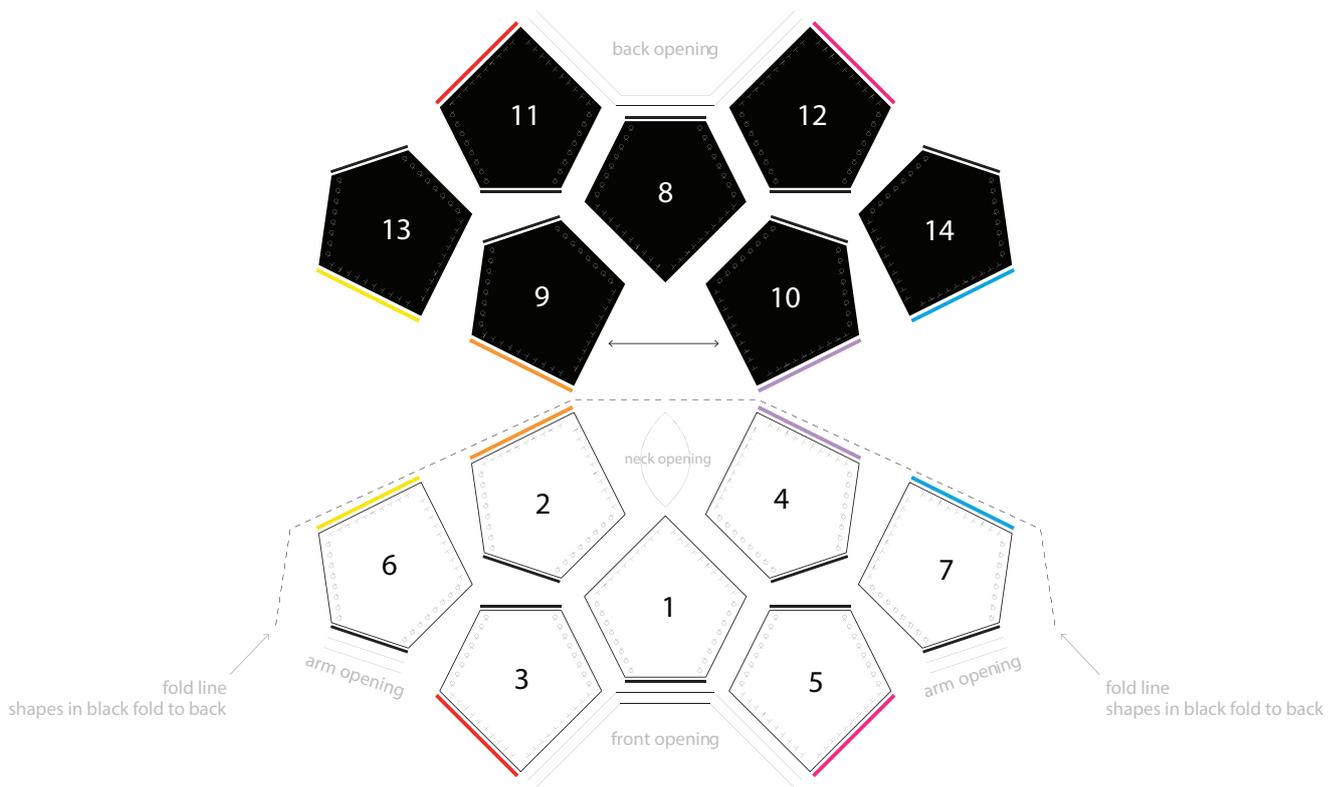
3.69a, b, c Pentagon Garment Collection, Version 1, Version 2, Version 3.

Version 1.

This garment capsule begins with joining the same size pentagon shape into a half-sleeve sweater, in a symmetrical layout, turning shapes upside down so the proportional sides match when joining together.

PN.V.1

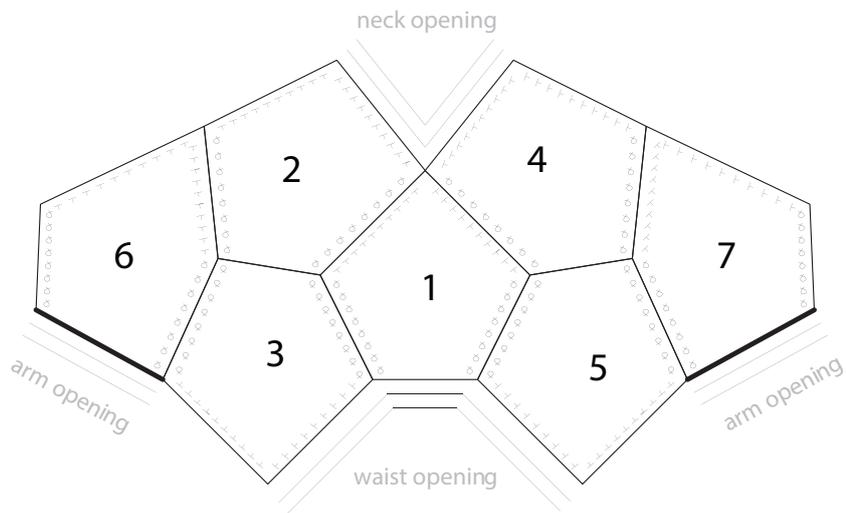




Left: 3.70 Pentagon Garment V.1. Top. $\frac{3}{4}$ Front view.

Right: 3.71 Illustration of Pentagon Garment V.1. Sweater, showing where shapes join.

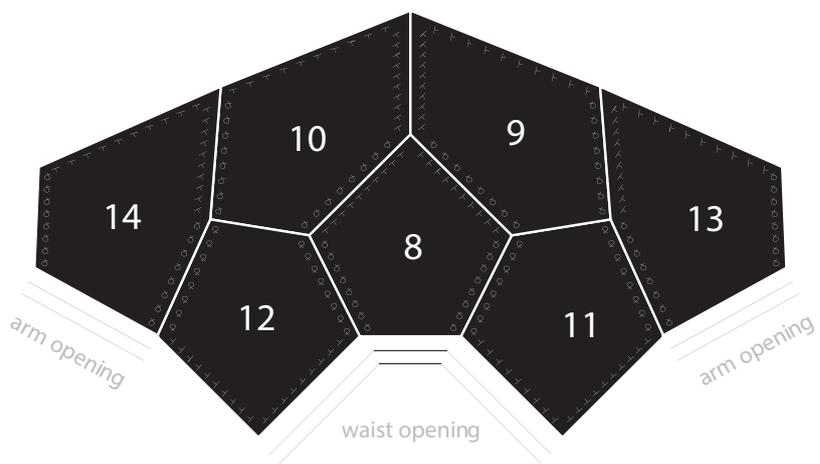
PN.V.1 FRONT



Top: 3.72a Front view of Pentagon V.1.Top.

Bottom: 3.73a Illustrations of front of Pentagon Garment V.1.Top, showing shape joins.

PN.V.1 BACK



Top: 3.72b Back of Pentagon Garment V.1. Top.

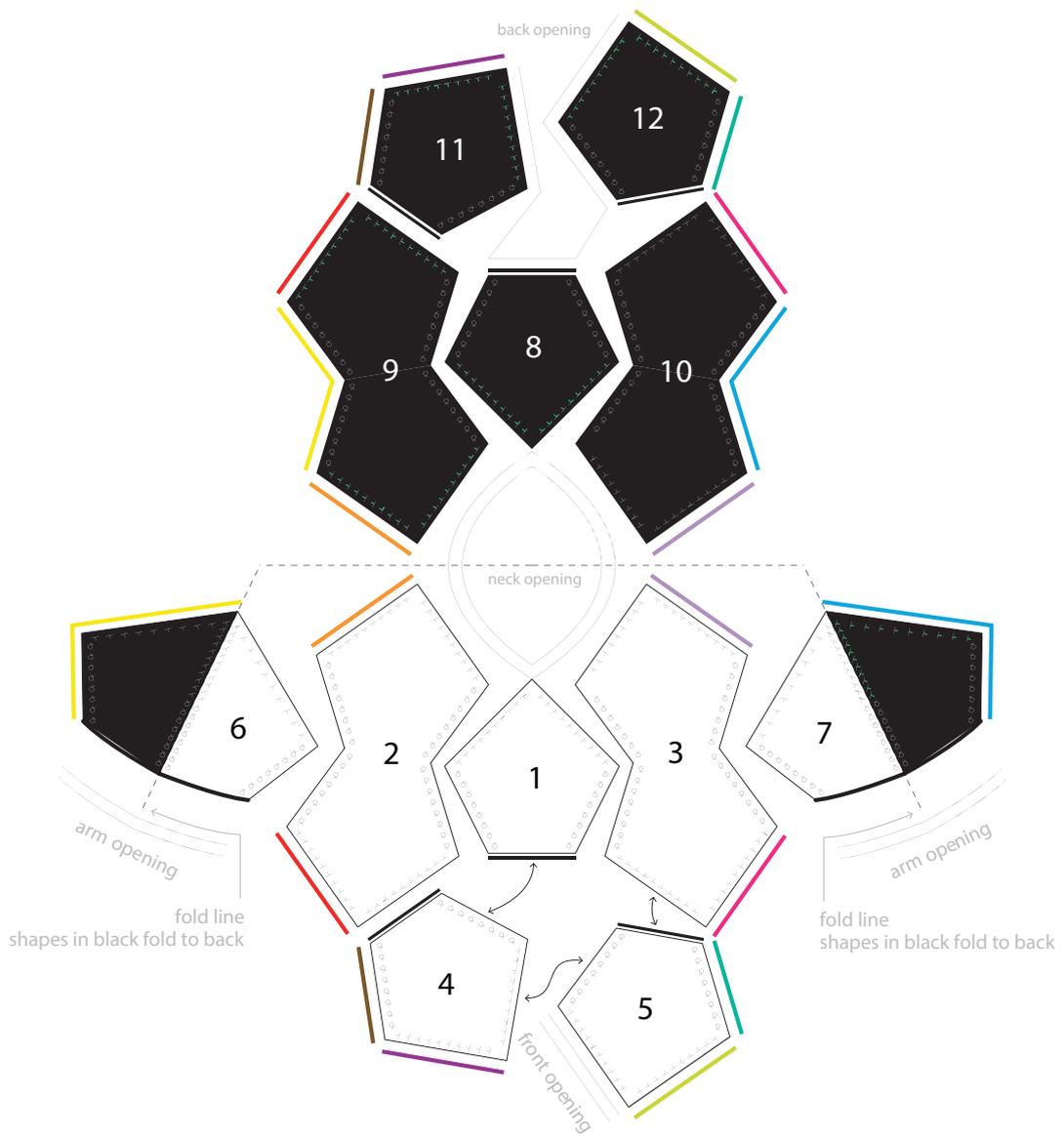
Bottom: 3.73b Illustration of back of Pentagon Garment V.1. Top, showing shape joins.

Version 2.

This is a lengthened version of the Version 1 sweater that becomes a tunic. A slip stitch structure is created for these shapes, where the knitting pattern mixes a fine yarn gauge with a chunky yarn gauge. This generates an uneven surface texture, and structurally opens up the fabric. Some shapes are merged by being knitted together with the inverted shape, and are assembled in the bodice of the garment at the front, and at the back; while additional shapes are joined to the bottom of the bodice in an asymmetric configuration. These shapes, which are knitted in a knit stitch, when joined generate raised contours in the garment, which is also seen in the sleeves of Version 1 of this garment. This feature, which is also highlighted here by the contrast between the two knitted structures, shows the extra spatial dimension that this shape brings to the garment form.

PN.V.2

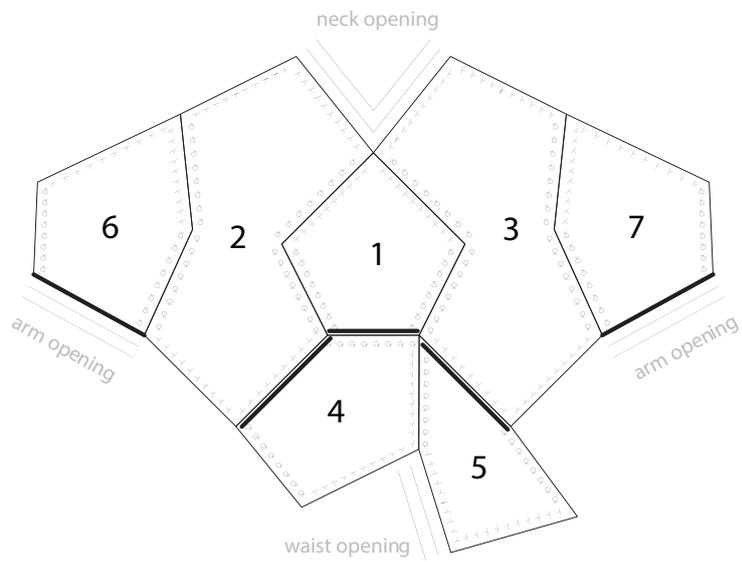




Left: 3.74 Pentagon Garment V.2. Tunic. $\frac{3}{4}$ Front view.

Right: 3.75 Illustration of Pentagon Garment V.1. Sweater, showing where shapes join.

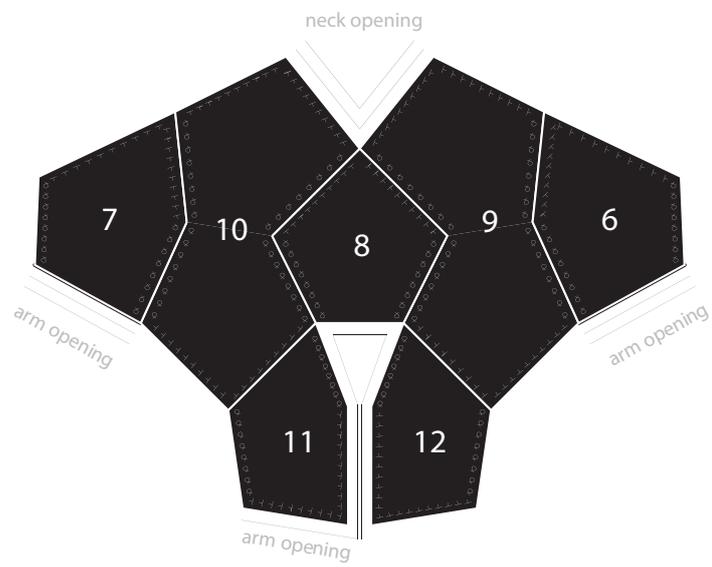
PN.V.2 FRONT



Top: 3.76a Front view of Pentagon V.2. Tunic.

Bottom: 3.77a Illustrated front view of Pentagon Garment V.2, Tunic, showing shape joins.

PN.V.2 BACK



Top: 3.76b Back view of Pentagon V.2. Tunic.

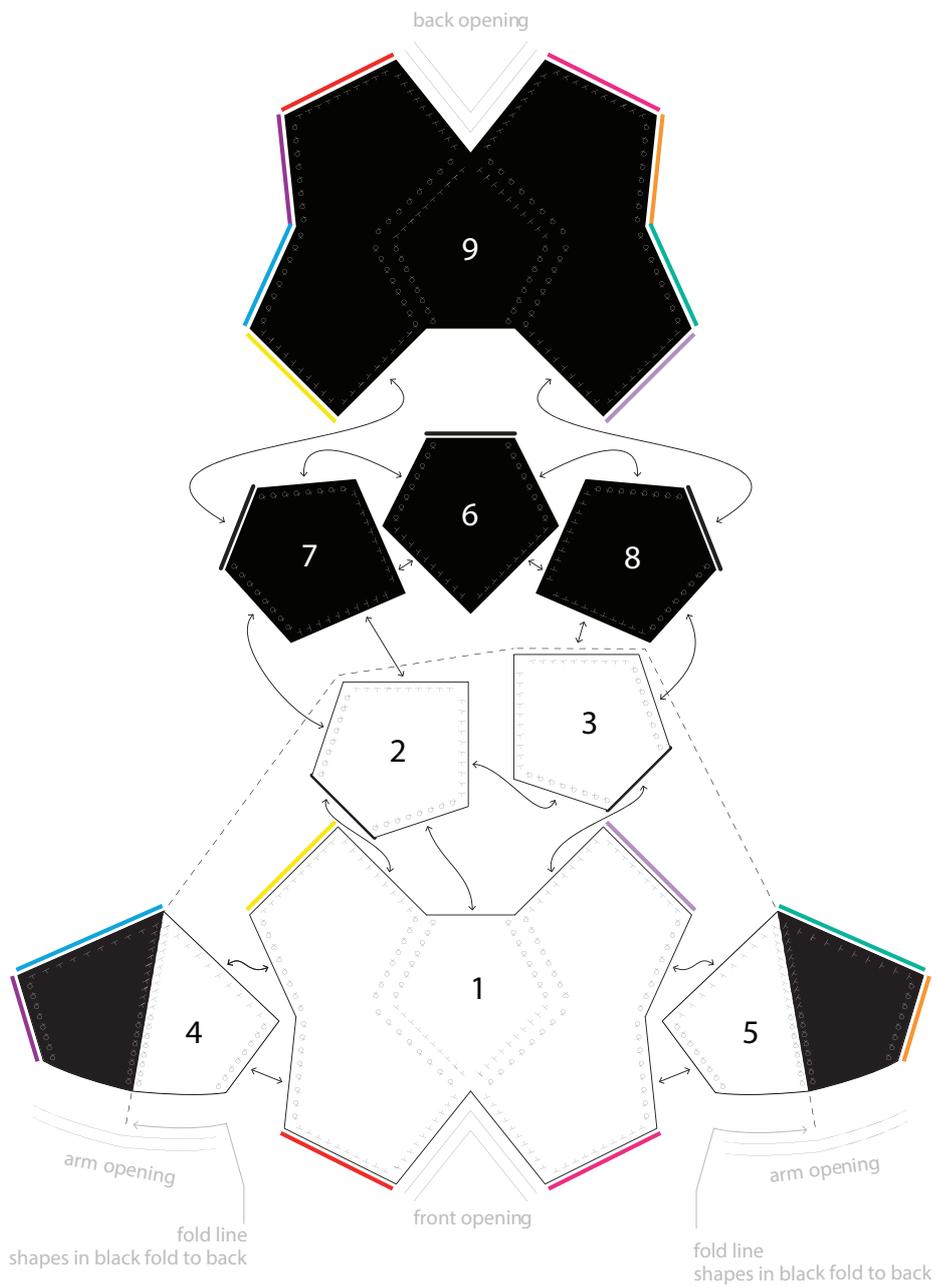
Bottom: 3.77b Illustration of back of Pentagon Garment V.2 Tunic, showing shape joins.

Version 3.

This is a similar composition to the previous two garments, where these shapes assemble into a jumper version. This garment merges all the body pentagon shapes into one knitted piece, which is made in the mixed gauge, slip stitch pattern. Additional shapes are added to the top portion of this garment, creating an asymmetrical raised neck collar, which shifts the entire garment form into dissymmetry. The addition of the neck pieces lowers the sleeve line, and alters the sleeve length to appear to be full length, as opposed to the half-length sleeve positioning of the previous garments.

PN.V.3

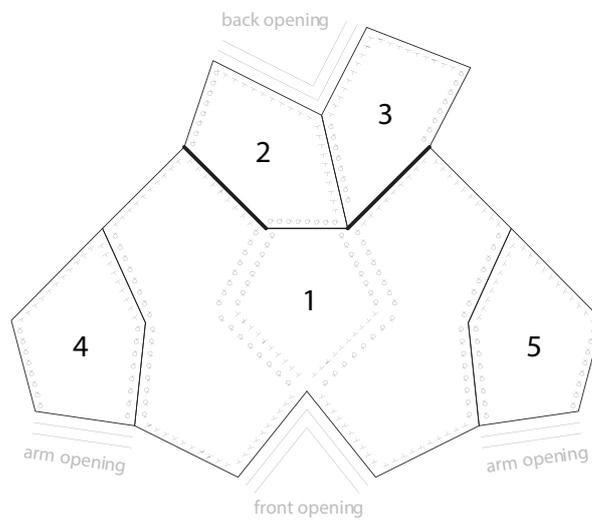




Left: 3.78 Pentagon Garment V.3. Jumper. $\frac{3}{4}$ Front view.

Right: 3.79 Illustration of Pentagon Garment V.3. Jumper, showing where shapes join.

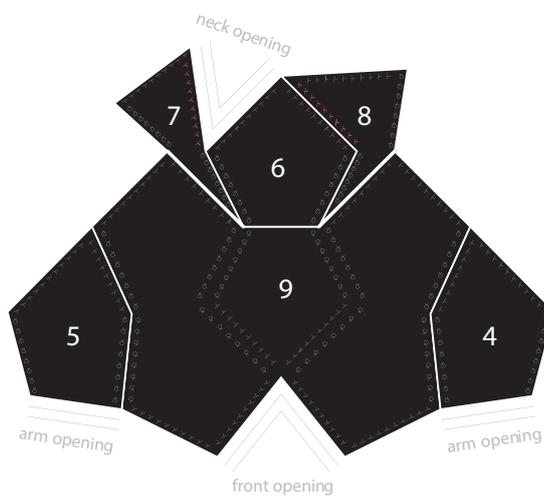
PN.V.3 FRONT



Top: 3.80a Front view of Pentagon V.3. Jumper.

Bottom: 3.81a Illustration of front of Pentagon Garment V.3.Jumper. Shows shape joins.

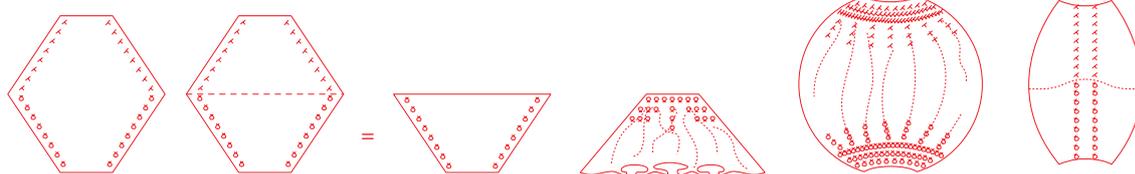
PN.V.3 BACK



Top: 3.80b Back view of Pentagon V.3. Jumper.

Bottom: 3.81b Illustration of back of Pentagon Garment V.3. Jumper, showing shape joins.

HEXAGONS



3.82 Hexagon shapes.



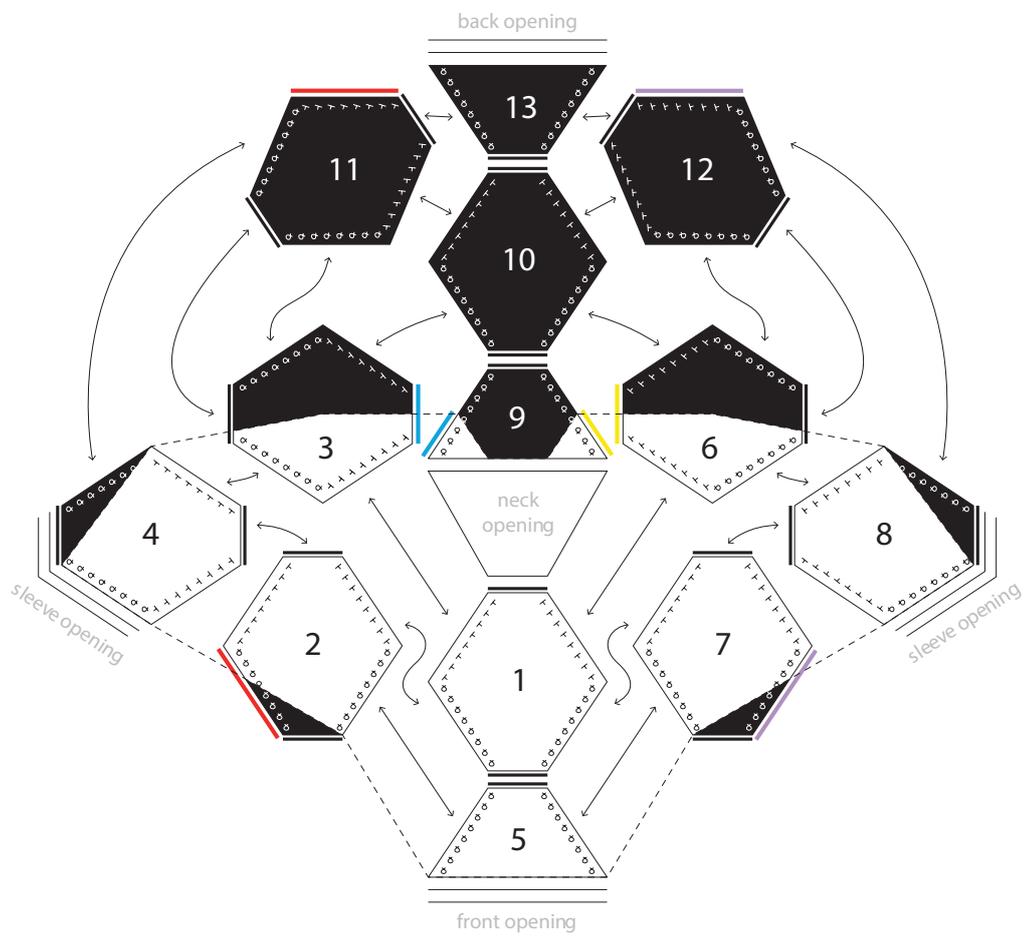
3.83a, b, c Hexagon Garment Collection, Version 1, Version 2, Version 3.

Version 1.

This garment capsule begins with joining the same size hexagon shape into a sweater, with the addition of a half hexagon to create enclosure in the bodice and neckline to make this garment sit better on the body.

HX.V.1





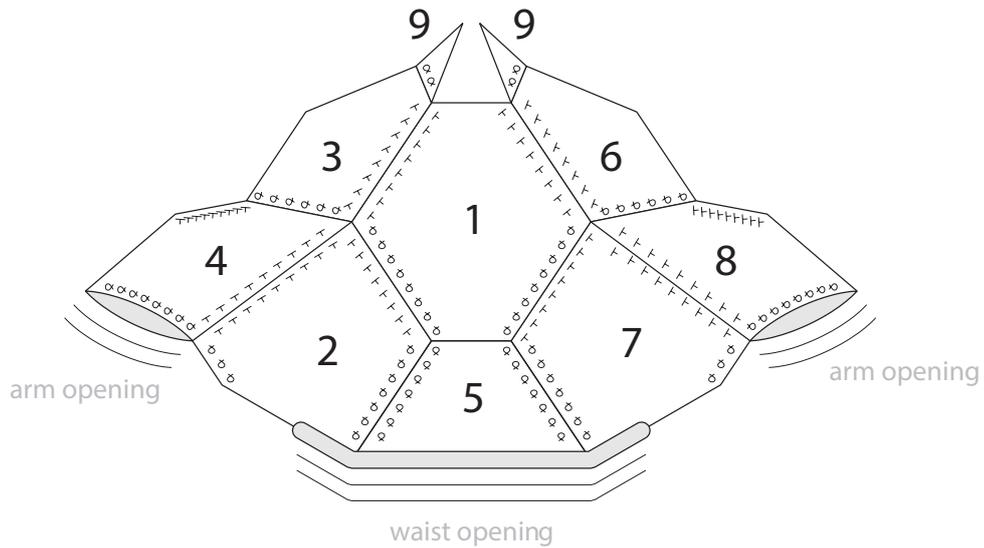
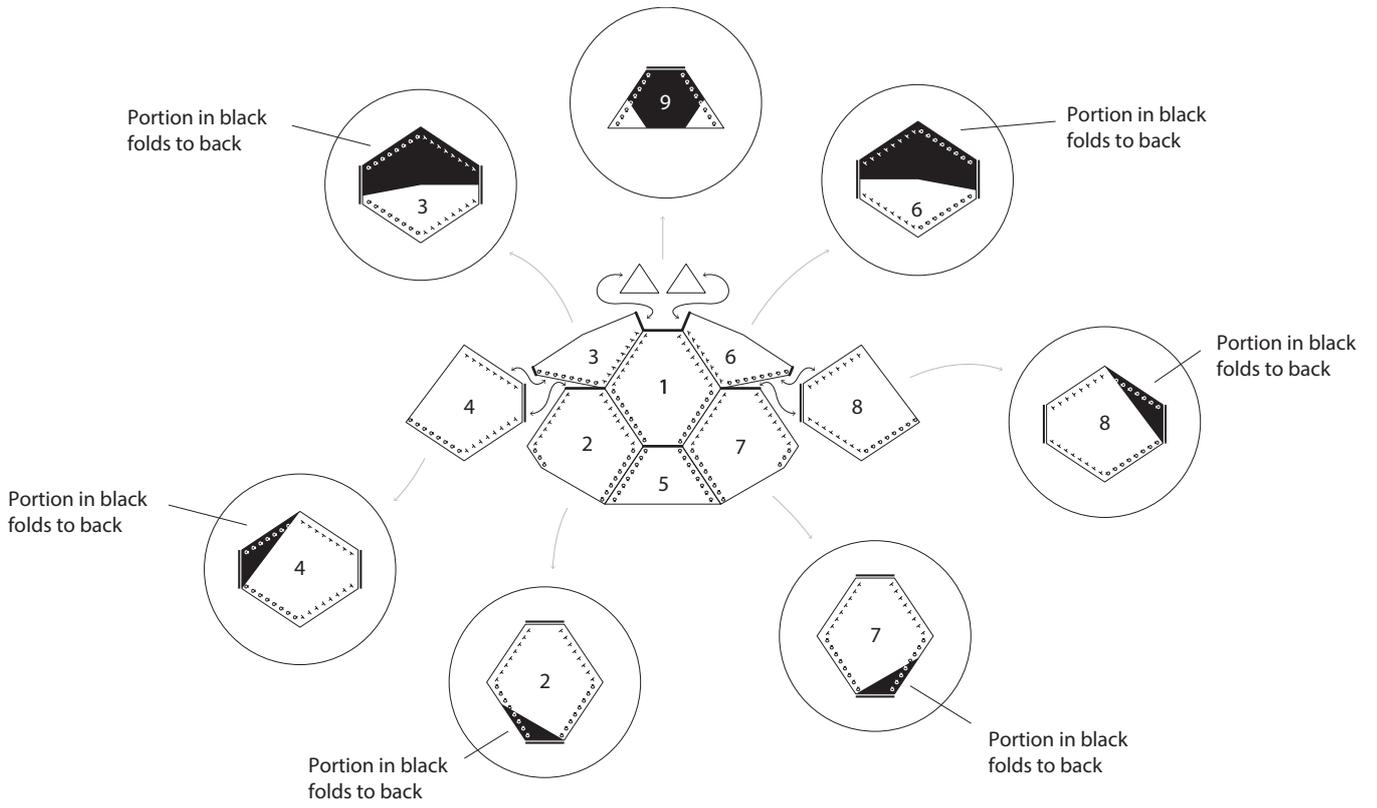
Left: 3.84 Hexagon Garment V.1. Sweater. $\frac{3}{4}$ Front view.

Right: 3.85 Illustration of Hexagon Garment V.1. Sweater, showing where shapes join.

HX.V.1 FRONT



3.86a Front view of Hexagon V.1. Sweater.

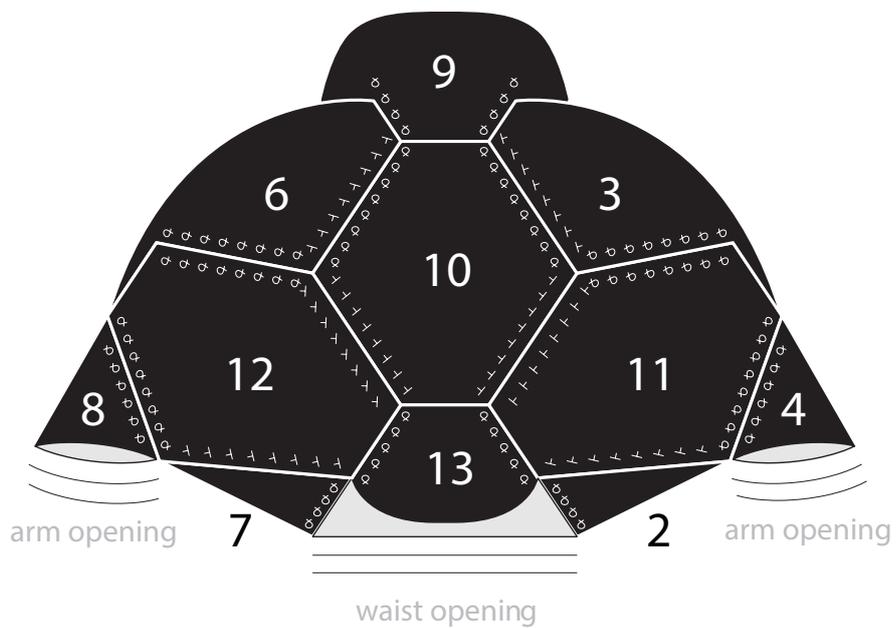
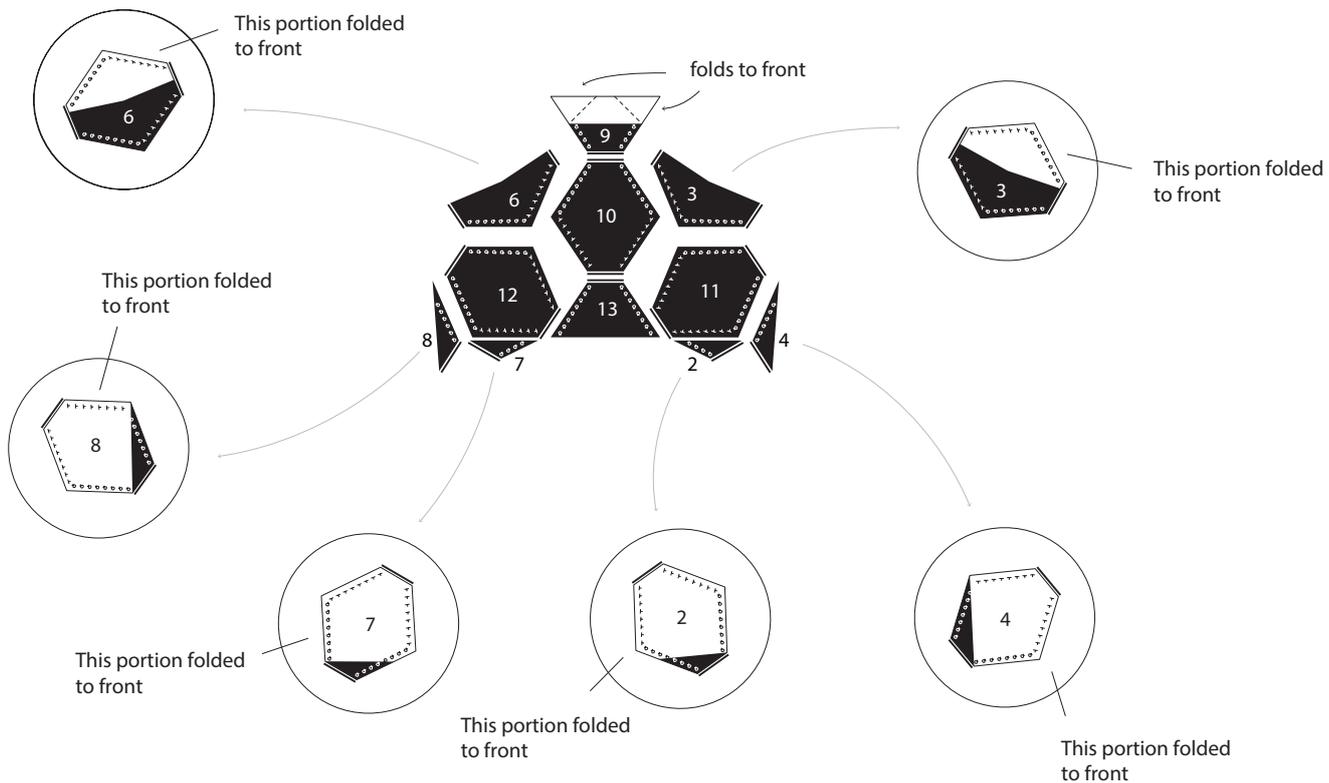


Top 3.87a and Bottom 3.87b Illustrated front views of Hexagon Garment, V.1. Sweater, shows shape joins.

HX.V.1 BACK



3.86b Back view of Hexagon V.1. Sweater.



Top 3.88a and Bottom 3.88b Illustrated back views of Hexagon Garment, V.1. Sweater, shows shape joins.

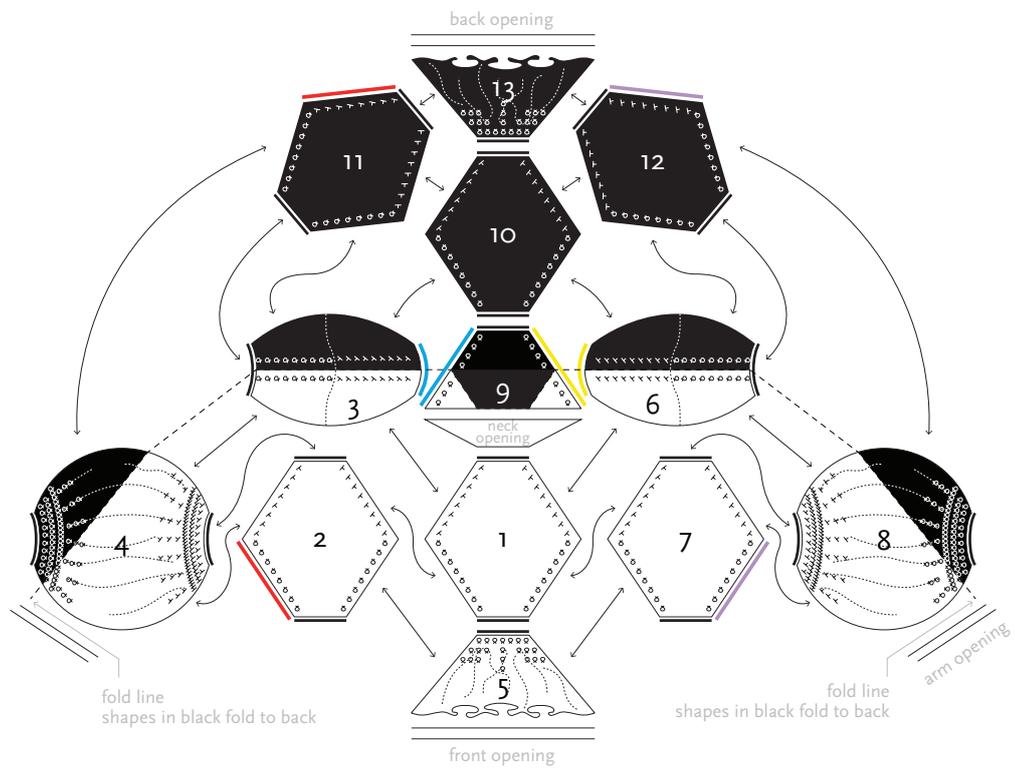
HX.V.2



3.89a, b, c Hexagon Garment V.2. Curved/Hyperbolic Sweater. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

Version 2.

This pattern has an identical layout to Hexagon Version 1, but this sweater has some shapes made as curved and hyperbolic hexagons. These shapes bring volume and a new spatial dimension to the garment form. The extra volume emphasizes certain parts of the garment like the shoulders and sleeves, and the waist openings in the front and back. Balance in the form is maintained overall by the straight angled hexagon shape centre to the garment.

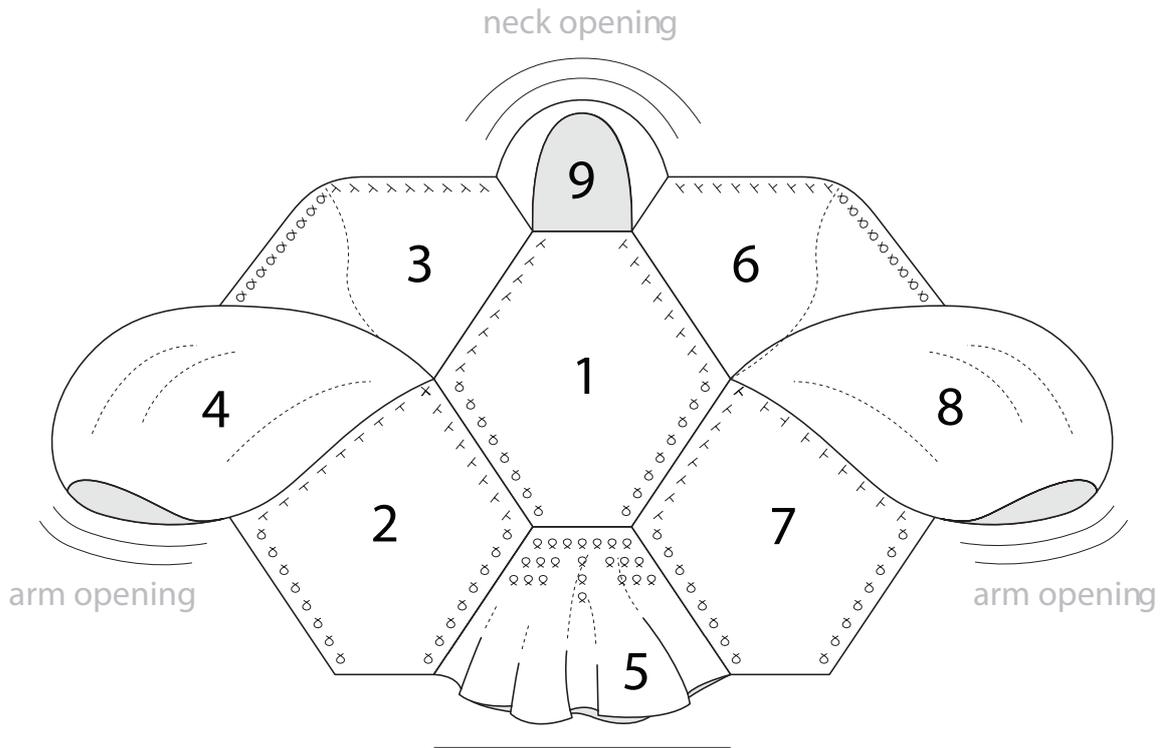
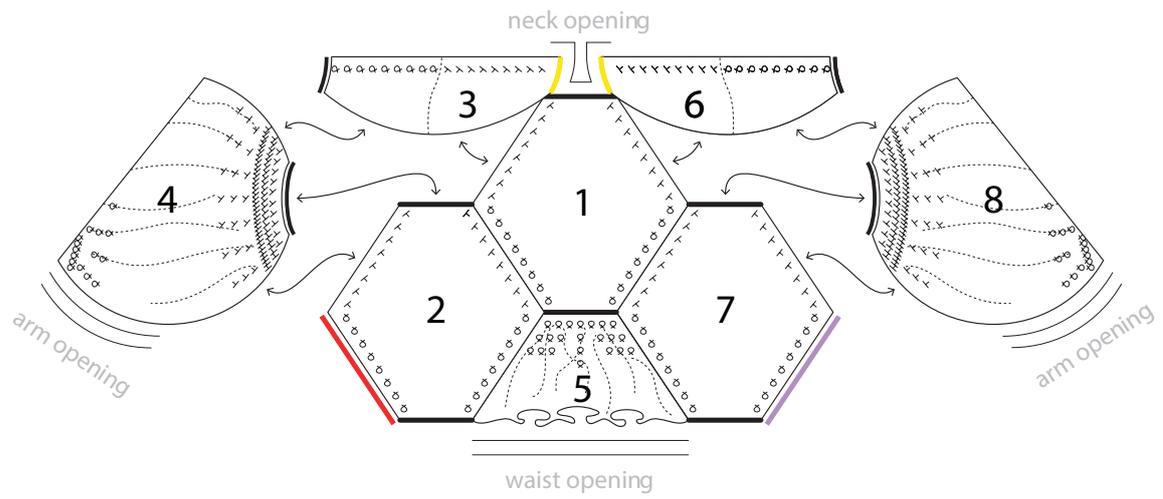


3.90 Hexagon Garment V.2. Design, shows how to assemble shapes to make Curved/Hyperbolic Sweater.

HX.V.2 FRONT



3.91a Front and Back view of Hexagon V.2. Curved/Hyperbolic Sweater.



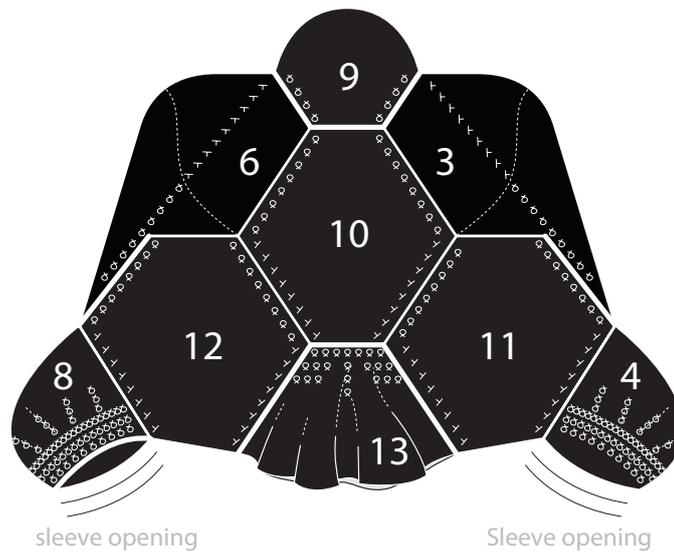
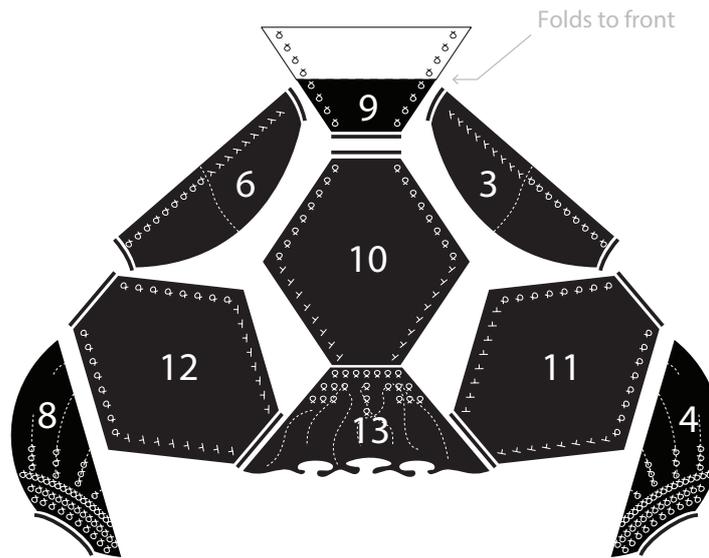
Top: 3.92a Front of Hexagon Garment V.2. Curved/Hyperbolic Sweater, showing shape joins.

Bottom: 3.92b Illustration of back of Hexagon Garment V.2. Curved/Hyperbolic Sweater, showing shape joins.

HX.V.2 BACK



3.91b Back view of Hexagon V.2.
Curved/Hyperbolic Sweater.



Top: 3.93a Back of Hexagon Garment V.2. Curved/Hyperbolic Sweater.

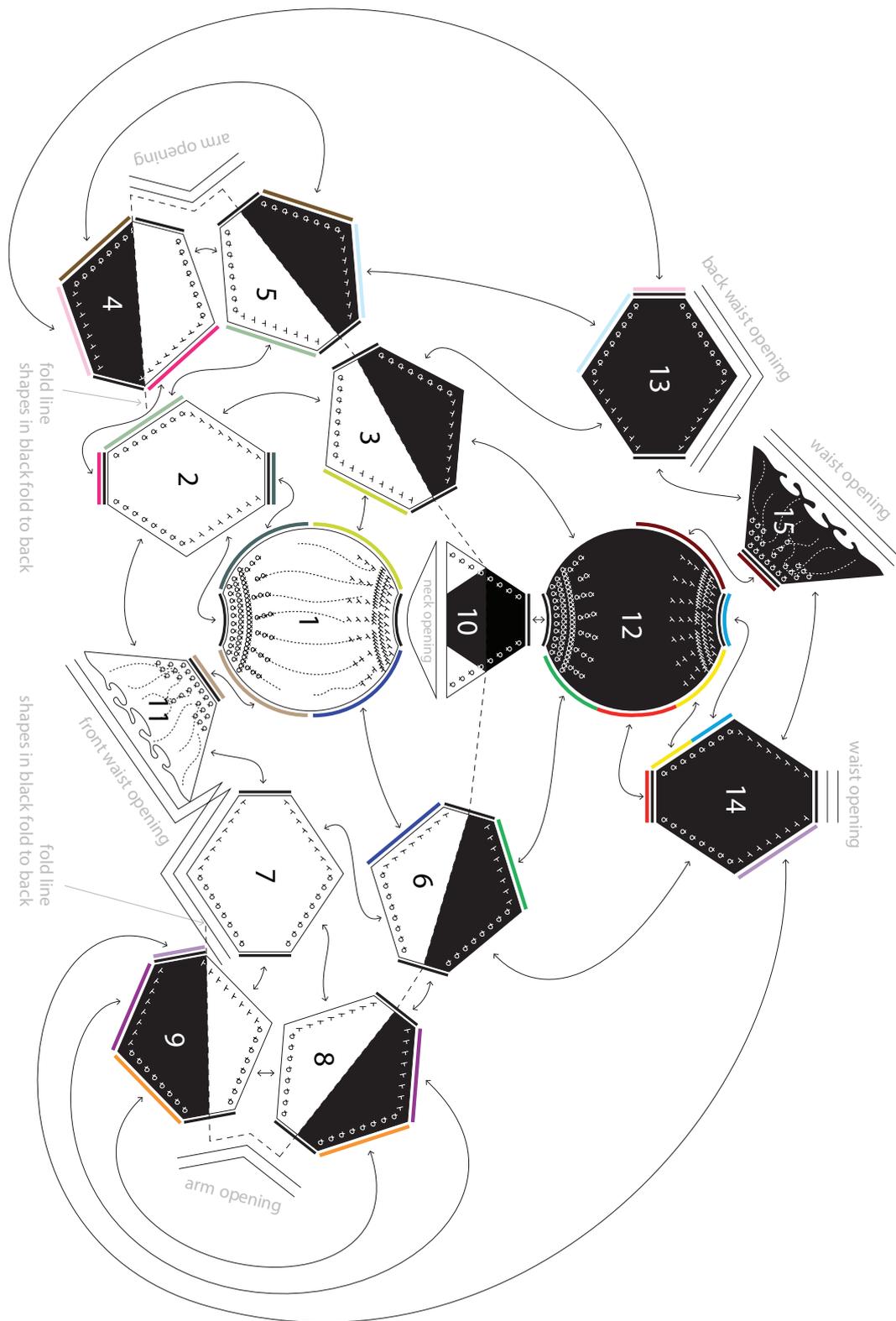
Bottom: 3.93b Illustrated back view of Hexagon Garment V.2, Curved/Hyperbolic Sweater, showing shapes joined.

Version 3.

This garment is a similar jumper configuration to the previous version, where this version is tilted off-balance by changing the central hexagon shapes to hyperbolic shapes. These shapes distort the form with the additional volume, which delivers visual prominence to some areas of the garment, and recession to others. The knitted stitch structure is altered in the shapes on the sleeves and some body portions, where a transfer stitch configuration in the form of a cable pattern is knitted in the shape. This cable pattern has a three-dimensional effect which emphasizes the fluctuation of depth and surface in the textile structure, which is a characteristic of this garment form overall.

HX.V.3





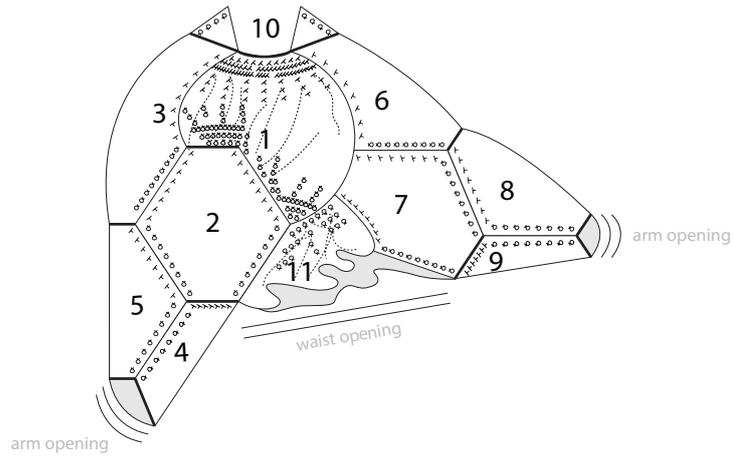
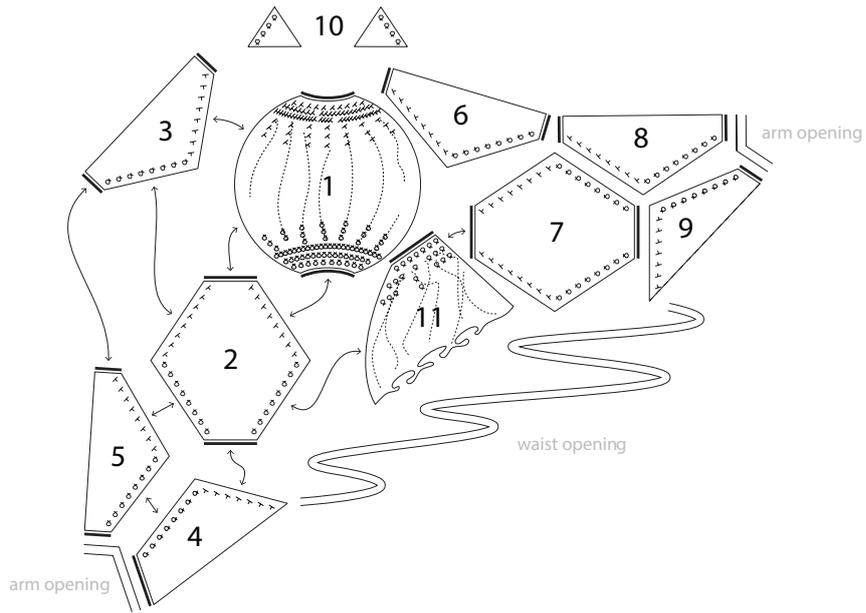
Left: 3.94 Hexagon Garment V.3. Asymmetrical Curved/Hyperbolic Sweater. $\frac{3}{4}$ Front view.

Right: 3.95 Illustration of Garment V.3. Asymmetrical Curved/Hyperbolic Sweater, showing where shapes join.

HX.V.3 FRONT



3.96a Front view of Hexagon V.3. Asymmetrical Curved/Hyperbolic Sweater.



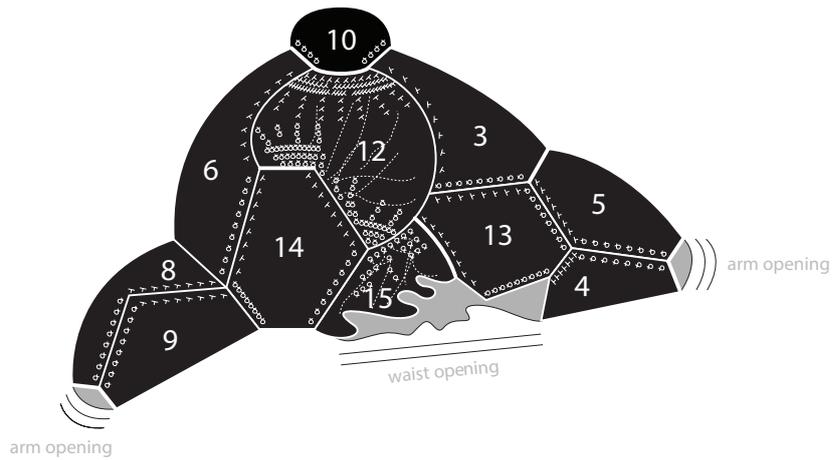
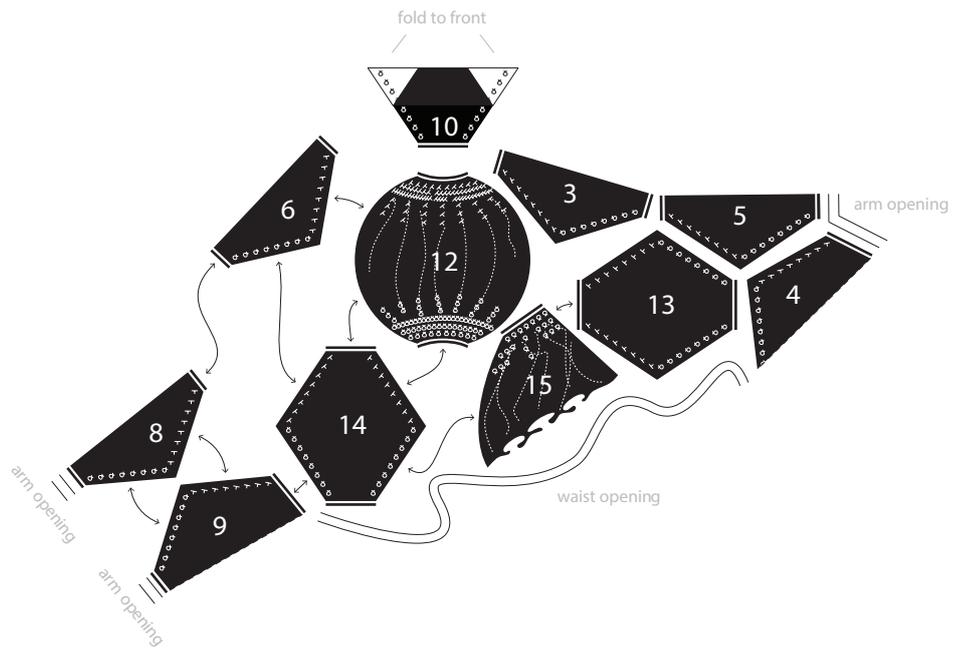
Top: 3.97 Front of Hexagon Garment V.3. Asymmetrical Curved/Hyperbolic sweater, showing shape joins.

Bottom: 3.98 Illustrated front view of Hexagon Garment V.3, Asymmetrical Curved/Hyperbolic Sweater, showing shapes joined.

HX.V.3 BACK

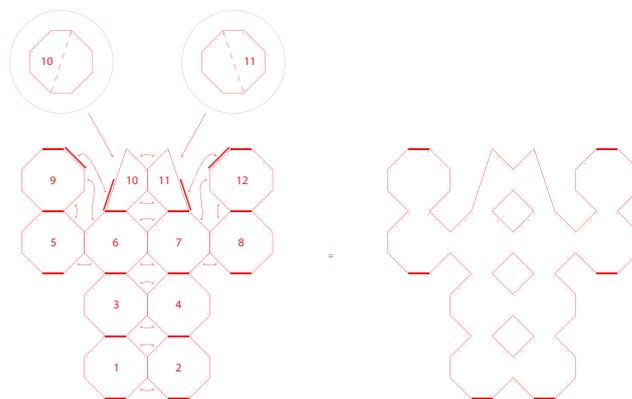
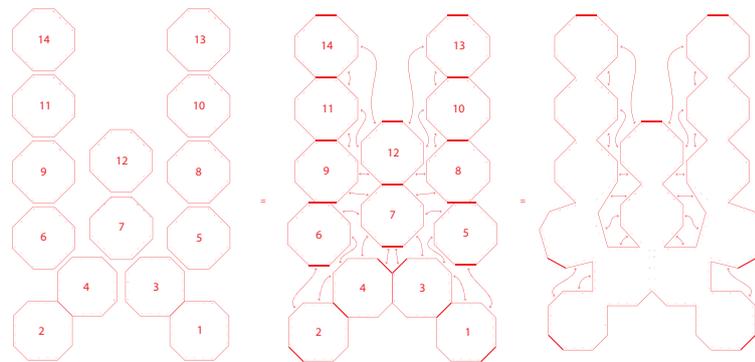
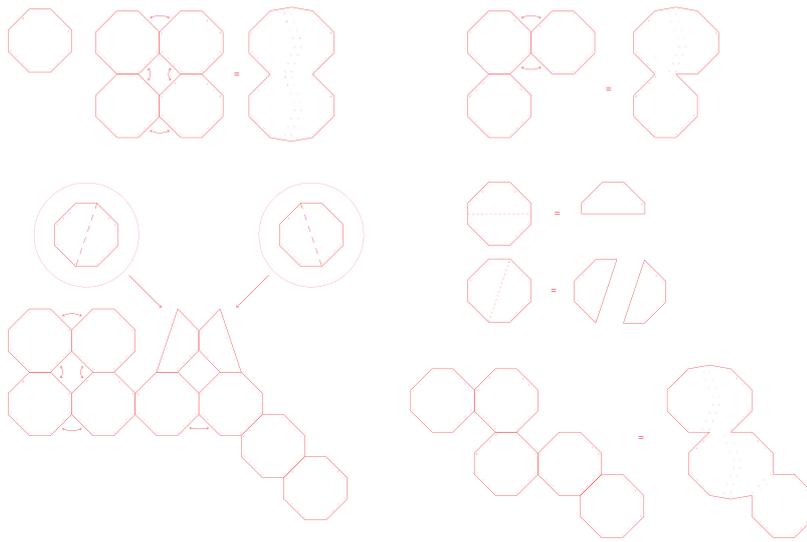


3.96b Back view of Hexagon V.3. Asymmetrical Curved/Hyperbolic Sweater.



Top 3.99 and Bottom 3.100 Illustrated back views of Hexagon Garment, V.3. Asymmetrical Curved/Hyperbolic Sweater, shows shape joins.

OCTAGONS



3.101, 3.102, 3.103 Octagon shapes.



3.104a, b, c Hexagon Garment Collection, Version 1, Version 2, Version 3.

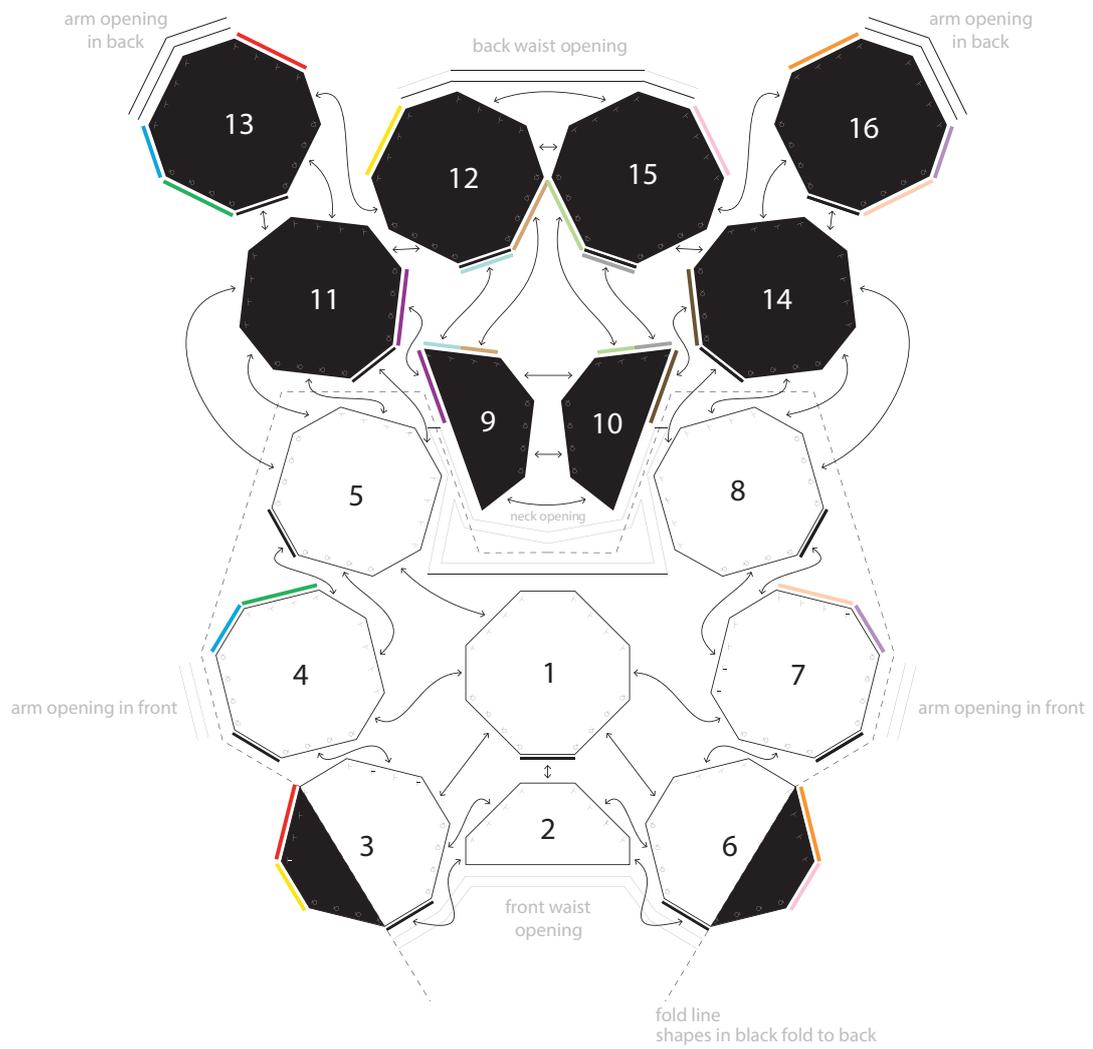
OCT.V.1



3.105a, b, c Octagon Garment V.1. Sweater. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

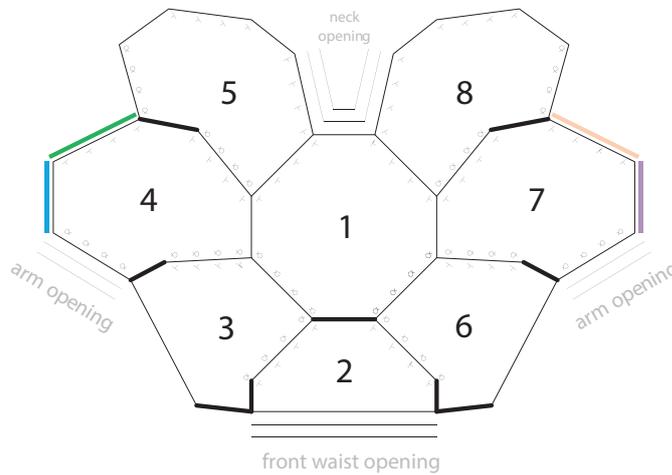
Version 1.

This garment capsule begins with joining the same size octagon shape into a sweater. This shape being eight-sided creates a roundedness at the seams which brings volume and dimension to the garment form seen particularly at the sleeves. Two shapes in the centre back have been half partitioned to reduce some of this volume where it is not needed in the garment.



3.106 Octagon Garment V.1. Design, shows how to assemble shapes to make Sweater.

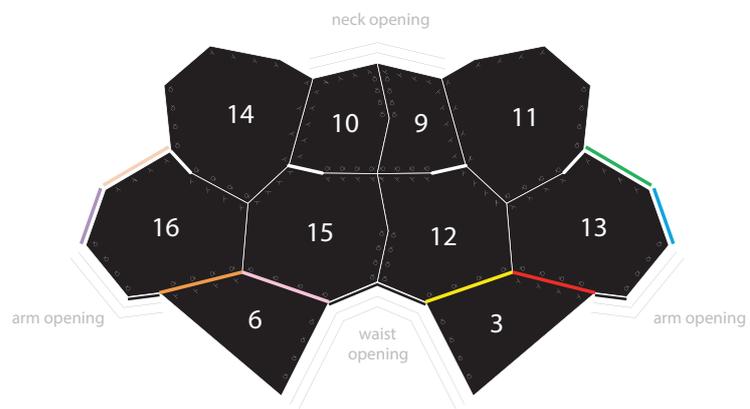
OCT.V.1 FRONT



Top: 3.107a Front view of Octagon V.1. Sweater.

Bottom: 3.108a Illustrated front view of Octagon Garment V.1, Sweater, showing shape joins.

OCT.V.1 BACK



Top: 3.107b Back view of Octagon V.1. Sweater.

Bottom: 3.108b Illustration of back of Octagon Garment V.1. Sweater, showing shape joins.

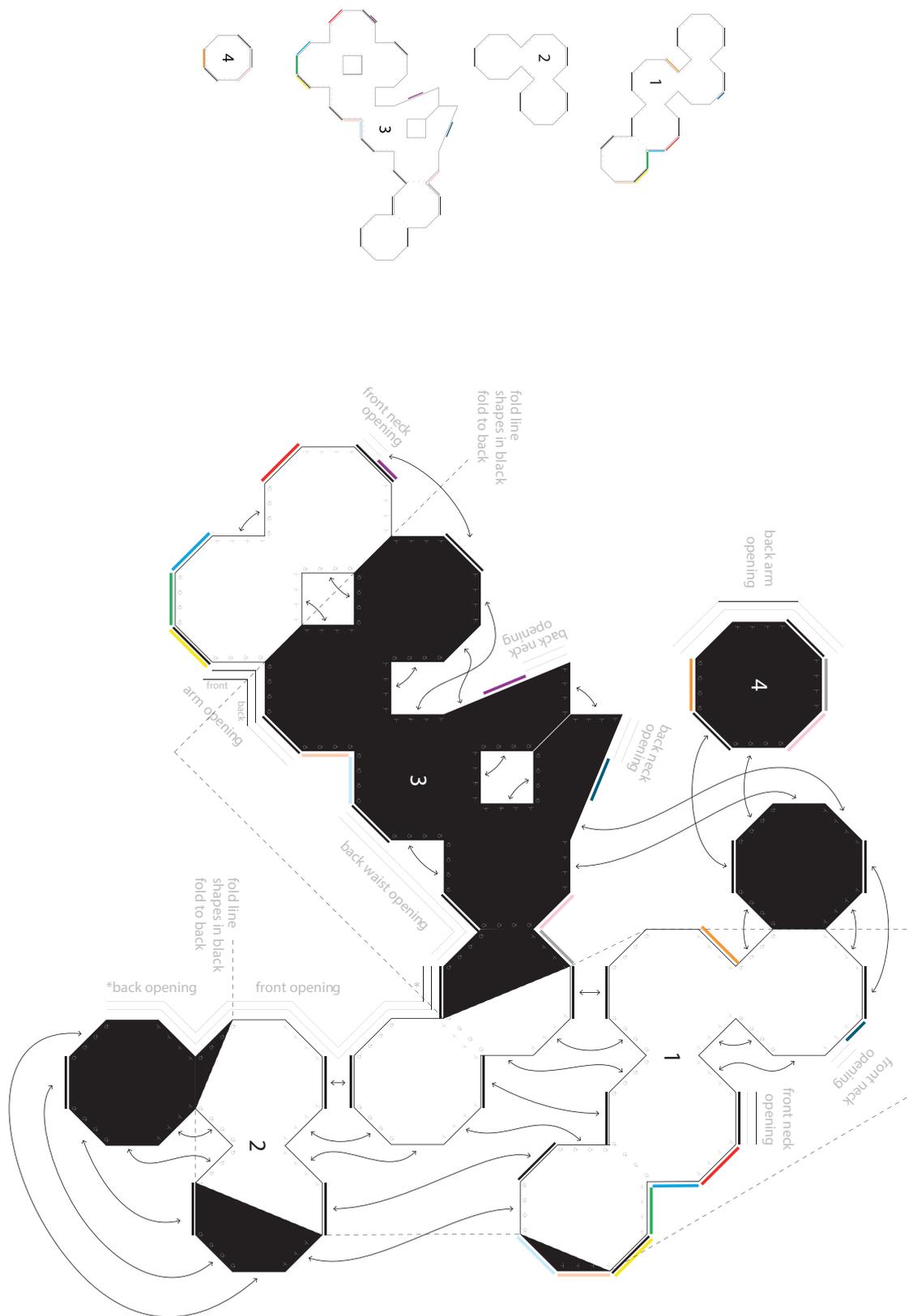
OCT.V.2



3.109a, b, c Octagon Garment V.2. Tunic. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

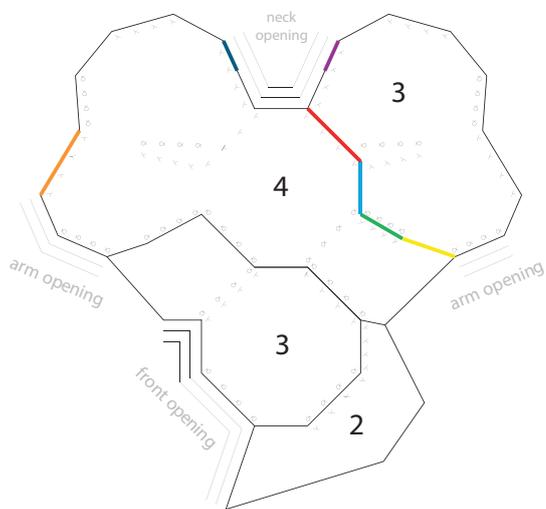
Version 2.

This pattern is a similar configuration to Version 1, but shapes merge together and are knitted into larger pieces, with additional shapes that extend this garment into an asymmetrical tunic. The shapes are made in different knitting gauges, where some shapes are made in a fine yarn, and some in a chunky yarn. The shape made in the finer yarn has five shapes knitted together as one shape, while the chunky yarn shapes have three shapes merged, and eight and two half octagons knitted all together as one piece. Shape 1, which comprises five shapes knitted together and which is made in a finer yarn gauge, is positioned at the hip of one side of the garment, which then drapes up the body to pivot centre, and thereafter wraps across the shoulder to the other side of the garment, to become the front part of the sleeve. The heavier gauge shapes flank this fine gauge shape, below it, and at the back. A symbiosis between knitting shapes into a physical structure, and the dimensional reasoning required in assembling these shapes together, provides a stimulating design exercise in the making of this garment.



3.110 Octagon Garment V.2. Design, shows how to assemble shapes to make Tunic.

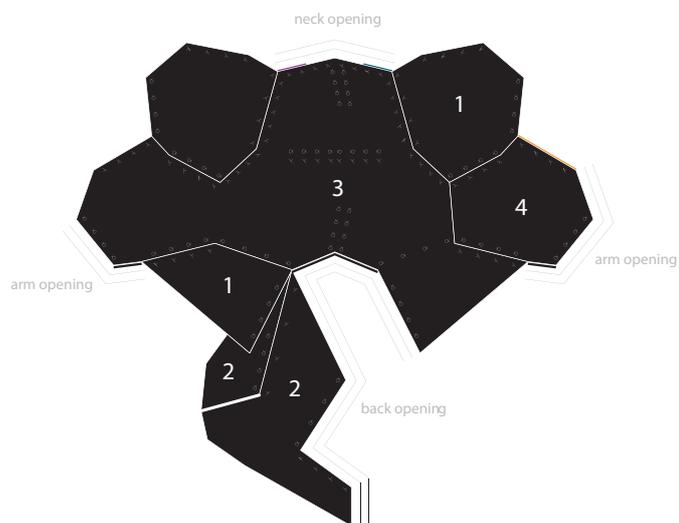
OCT.V.2 FRONT



Top: 3.111a Front view of Octagon V.2. Tunic.

Bottom: 3.112a Illustrated front view of Octagon Garment V.2, Tunic, showing shape joins.

OCT.V.2 BACK



Top: 3.111b Back of Octagon V.2. Tunic.

Bottom: 3.112b Illustration of back of Octagon Garment V.2. Tunic, showing shape joins.

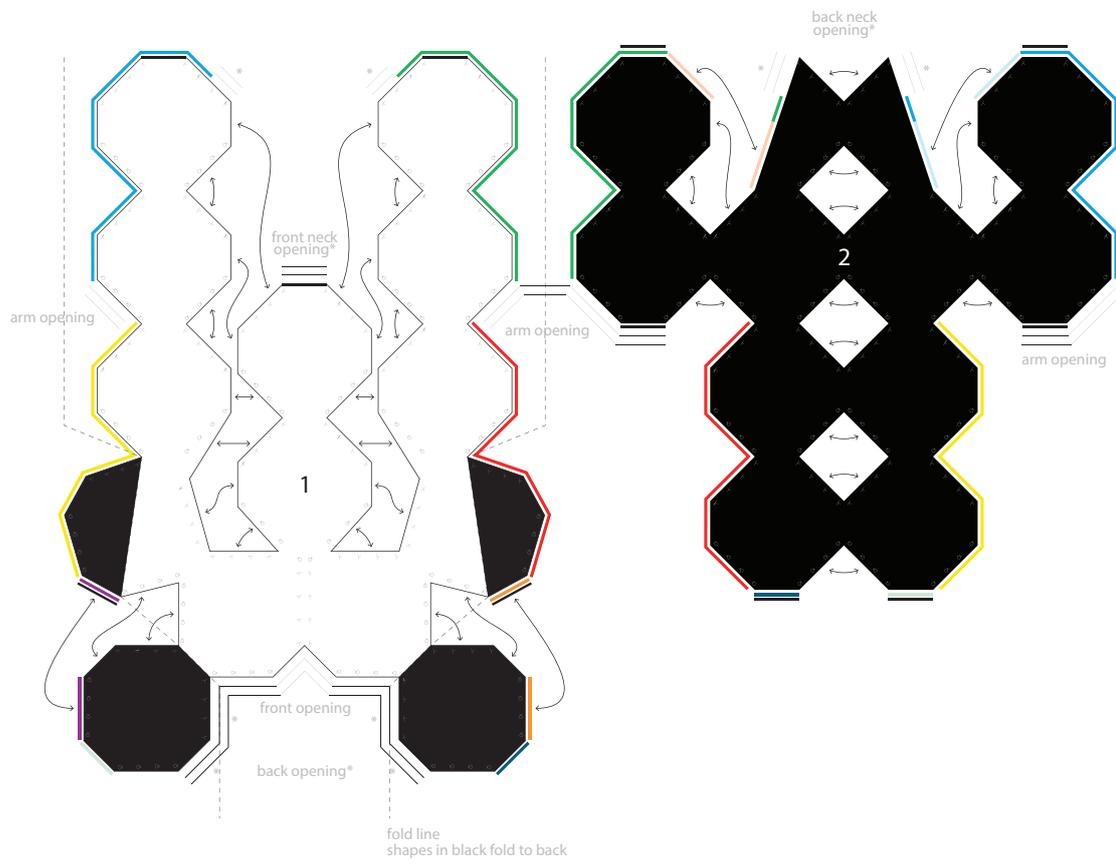
OCT.V.3



3.113a, b, c Octagon Garment V.3. Dress. $\frac{3}{4}$ Front, Side and $\frac{3}{4}$ Back view.

Version 3.

As a final stage to the dimensional reasoning that geometric shapes bring to this design process, this garment entails merging all fourteen octagon shapes in the front of the garment as one single knitted shape, and all ten and the two half shapes together in the back. It is knitted in a fine yarn gauge, joined together at the side seams to make a dress. The shaping lines of increasing and decreasing stitches are positioned where the joins would otherwise be, which become structural lines in the knitted fabric. This knitting sculpts the octagon shapes into this seamless fabric, where these structural lines form contours and folds as it drapes over the body.

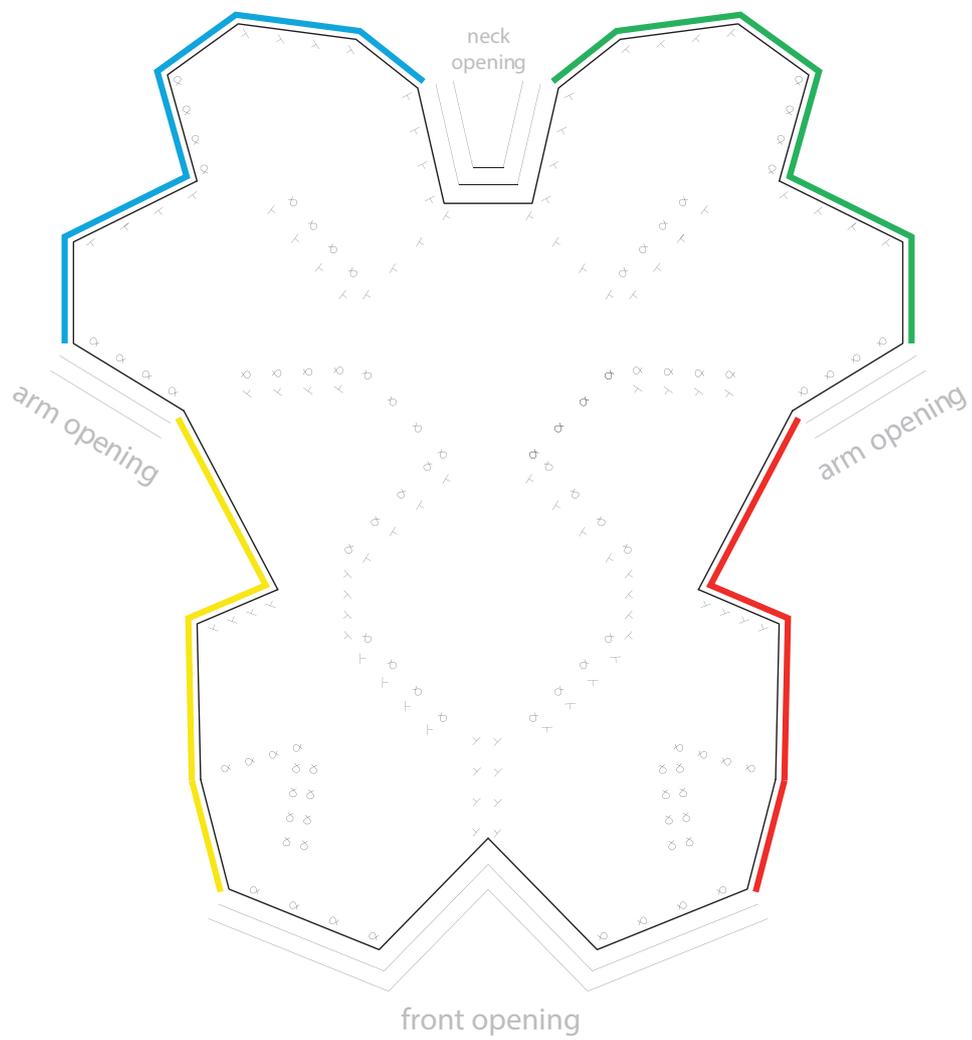


3.114a, b Octagon Garment V.3. Design, shows how to assemble shapes to make Dress.

OCT. V.3 FRONT



3.115a Front view of Octagon V.3. Dress.

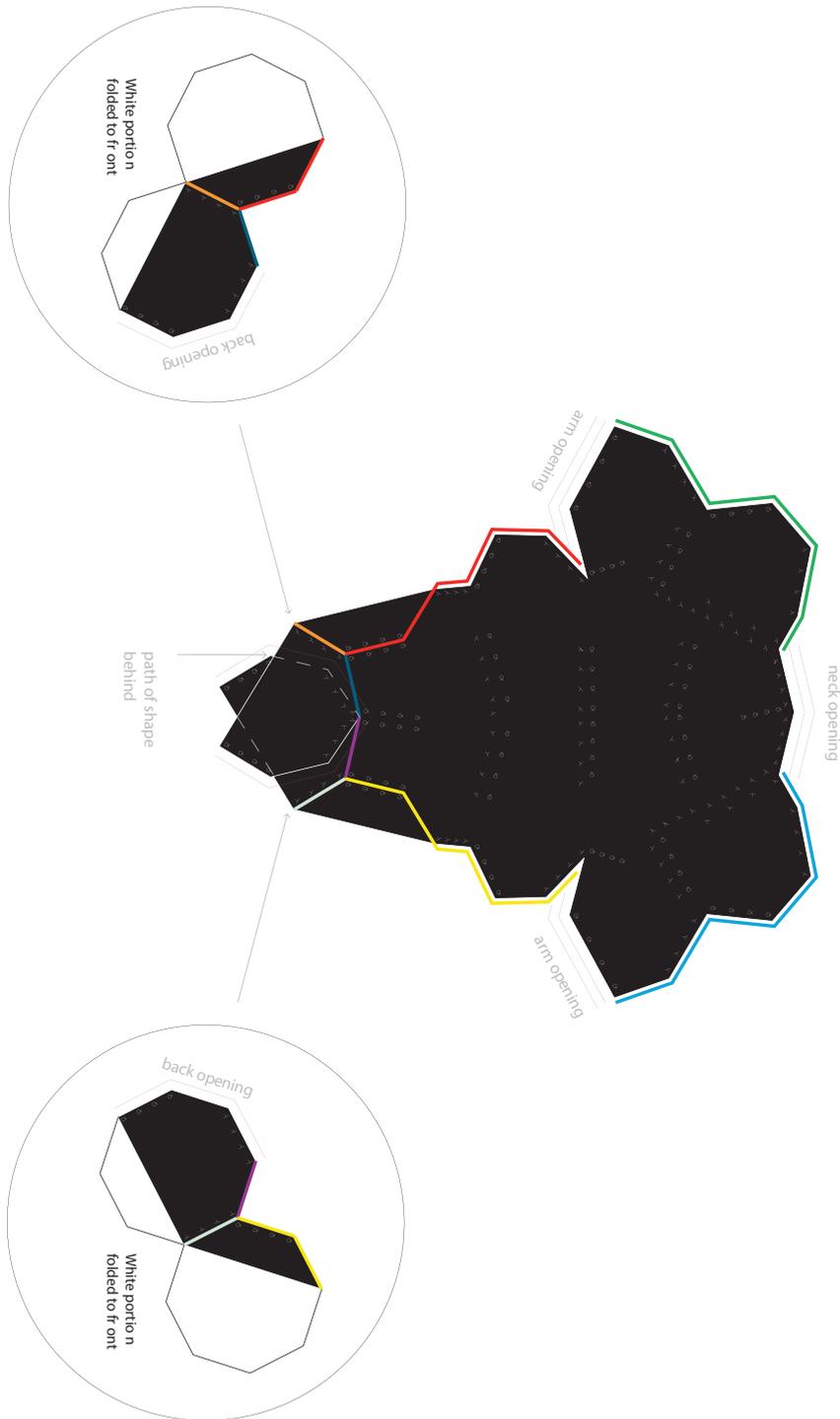


3.116a Front of Octagon Garment V.3. dress, showing shape joins.

OCT. V.3 FRONT



3.115b Back view of Octagon V.3. Dress.



3.116b Back of Octagon Garment V.3. Dress. Shows shape joins.

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