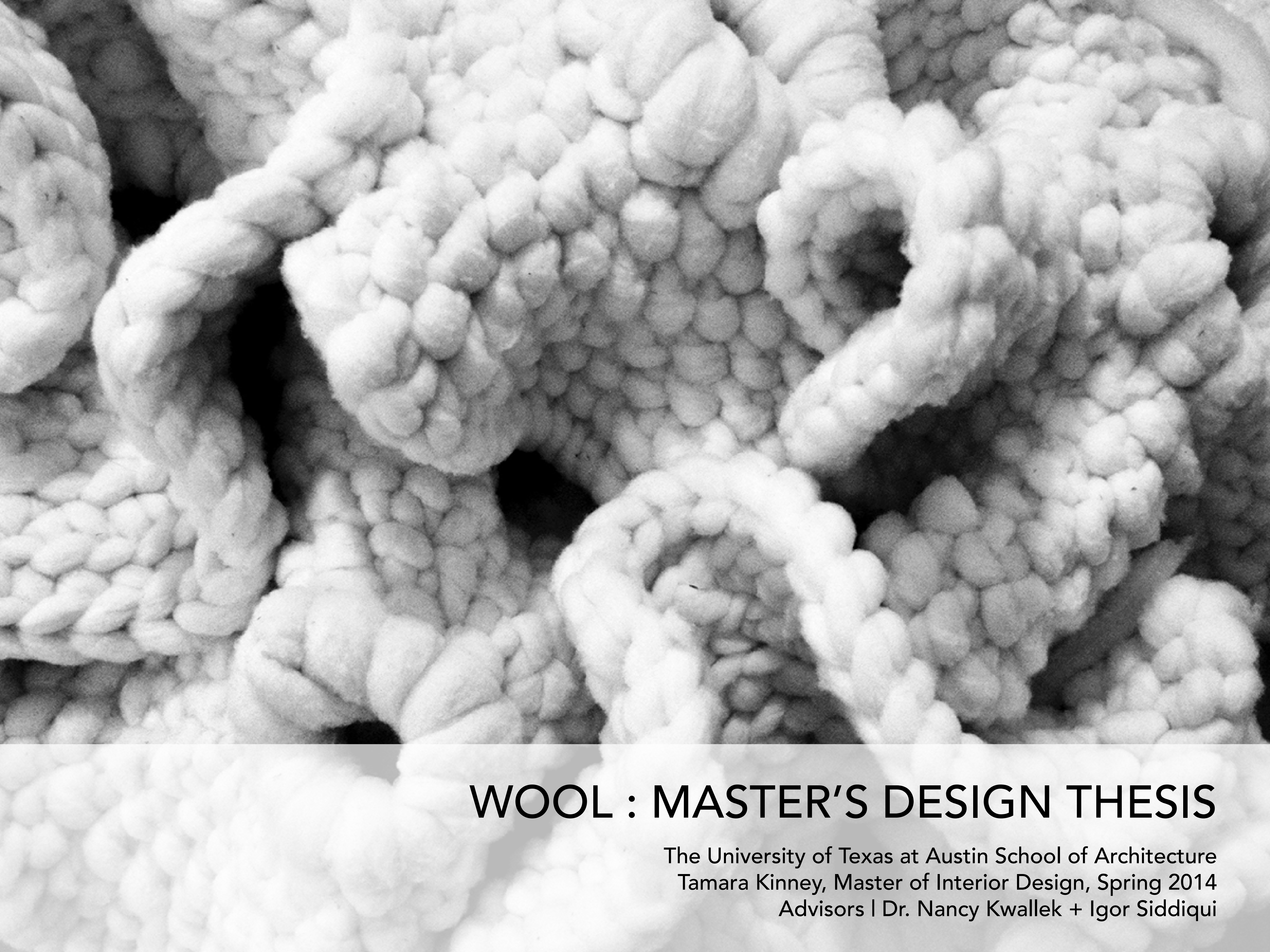


WOOL : MASTER'S DESIGN THESIS

The University of Texas at Austin School of Architecture
Tamara Kinney, Master of Interior Design, Spring 2014
Advisors | Dr. Nancy Kwallek + Igor Siddiqui

Figure A.1

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation and thanks to my advisors Dr. Nancy Kwallek and Igor Siddiqui of the School of Architecture at the University of Texas at Austin for encouraging my research and allowing me to grow as a designer. Your advice on both my research and design process has been instrumental to the completion and quality of my Masters Design Study. In addition I would like to thank Lois Weinthal, who first introduced me to the possibilities of felt and wool fiber.

I would like to extend my gratitude to Dr. Richard Corsi and Daniel Lu from the Civil Architectural and Environmental Engineering Department for sharing their research and test studies. A special thanks to Anais and Jane McBride from the McRanch in Dripping Springs, TX for allowing me to experience small-scale fiber processing with a hands-on approach and providing local Texas wool roving. Additionally, I would like to express appreciation to my fellow Materials Co-op colleagues for their helpful feedback and assistance throughout this process and particularly the Director, Jennifer Wong for supporting my thesis research and exhibiting my final installations. My sincerest thanks to the University of Texas at Austin School of Architecture and the Materials Co-op for their financial assistance.

A special thank you to my family for their unconditional support and encouragement throughout all of my endeavors. Words cannot express how grateful I am for all of the sacrifices you have made on my behalf. I would also like to thank all of my friends who supported me in this journey, and incited me to strive towards my goals. Graduate school has been the most invaluable and intellectually inspiring two years of my life and I thank everyone who helped me along the way.

ABSTRACT

Given the increasing awareness of indoor air quality (IAQ) and the direct correlation to human health, passive removal materials (PRM) have become known as a potential strategy for reducing occupant exposure to indoor air pollutants (Lu 2013). In recent studies, untreated natural wool fiber has been recognized as a PRM for removing formaldehyde, sulfur dioxide and nitrogen dioxide. These are common volatile organic compounds (VOCs) emitted from sources, such as building materials, fixtures, furnishings and cleaning supplies (Darling et al. 2012). Test chamber studies have shown that wool fiber can irreversibly remove up to 67% of these VOC's in an interior environment (Curling et al 2012). When the toxins come in physical contact with the fiber, a chemical reaction occurs due to the amino-acid side chains within the keratin molecule. Increase in air-tight buildings has recently become a concern with the rising popularity of sustainable building practices, causing occupant exposure to these indoor air pollutants to rise (Weschler 2009). Beyond known adverse health effects, such as eye irritation and respiratory issues, formaldehyde has been designated by the International Agency for Research on Cancer (IARC) as a human carcinogen and is the leading cause for Sick Building Syndrome (SBS) (World Health Organization 2010).

The interior cortex of a wool fiber is hydrophilic – highly water absorbent, and can absorb 1/3 its weight in moisture. Wool fiber has a unique wicking property that allows the fiber to absorb water vapor from the air in a regulating sense; absorbing when there is an excess moisture level and releasing the gained moisture when the surrounding atmosphere is less humid. This provides passive humidity regulation in an indoor environment, stabilizing the comfort level of 20-50% relative humidity (RH) without requiring higher air-conditioning or ventilation rates (Bingelli 2010). Wool also has excellent properties for optimizing indoor acoustics, as it absorbs acoustic energy via the friction of air being moved through the tiny spaces between fibers and reduces traveling noise and reverberation (Bingelli 2010). In an untreated, natural roving state the density of wool is ideal for acoustic control in conversational speech situations where 70dB or lower is present, such as meeting rooms, lobbies and restaurants.

With the consideration of these properties, wool has the capability to improve the indoor environment quality (IEQ) and the health of occupants through the absorption of indoor air pollutants, humidity regulation and acoustic control. As Australia and the USA are among the top 3 wool producing countries, I will be working specifically with locally sourced wool from New South Wales and Texas as a basis for a sustainable IEQ intervention installation model that may be applied to future projects. The wool was obtained from local, small-scale fiber farms that implement hand processing in an effort to reduce toxins, in addition to lowering the manufacturing energy and transportation emission requirements. The local supply chain model provides increased environmental, social, economic and human health benefits to the design. Individual installations based on the vernacular wool fiber atrributes and interior climate needs will greatly increase the overall spatial environment, while also serving as an aesthetically pleasing piece of art.

Figure A.2

TABLE OF CONTENTS


Figure A.3

Figure A.4

LIST OF FIGURES

LIST OF ACRONYMS

ACH - Air Changes per Hour

ASTM – American Society for Testing Materials

CDC - Center for Disease Control + Prevention

CH_2O or HCHO - Formaldehyde

cN/tex - centiNewton/tex

CO_2 – Carbon Dioxide

dB - Decibel

EPA – Environmental Protection Agency

Hz - Hertz

IARC - International Agency for Research on Cancer

IAQ – Indoor Air Quality

IEQ – Indoor Environment Quality

ISO – International Organization for Standardization

MDF – Medium density fiberboard

NRC – Noise-reduction coefficient

PRM - Passive Removal Material

RH – Relative humidity

SBS - Sick Building Syndrom

SO_2 - Sulfur Dioxide

UF – Urea-formaldehyde

USDA – United States Department of Agriculture

USGBC – Unites States Green Building Council

VOC – Volatile Organic Compound

WHO - World Health Organization

WRONZ – Wool Research Organization of New Zealand

Figure A.5

WOOL

Figure 1.1

WOOL : AN ANIMAL FIBER

- A NATURAL FIBER FROM THE COAT OF A SHEEP.
- ONE OF THE OLDEST TEXTILE MATERIALS, DATING BACK TO 8000 BC.
- RAPIDLY RENEWABLE RESOURCE - SHEEP ARE SHEARED ONCE A YEAR.
- WOOL FIBER THICKNESS AND FINENESS RANGES FROM COARSE TO MERINO.
- ENDLESS APPLICATIONS: FROM INDUSTRIAL TO BUILDING MATERIALS, APPAREL AND HOME FURNISHINGS.
- WOOL CAN BE PROCESSED AS A WOVEN OR NONWOVEN TEXTILE.
- WOOL REQUIRES VERY LITTLE TO ZERO MECHANICAL PROCESSING.
- WOOL FIBER CAN BE PRODUCED INTO ROVING OR YARN USING NO TOXINS.
- U.S. IS THE LARGEST CONSUMER OF WOOL AS A TEXTILE.
- AUSTRALIA IS THE LARGEST PRODUCER OF WOOL, WITH THE U.S. FOLLOWING AS 3RD, AFTER CHINA.
- WOOL HAS VERY STRONG THERMAL, MOISTURE, ACOUSTIC AND TOXIN ABSORBING QUALITIES.

KEY HISTORICAL DATES

Figure 1.2

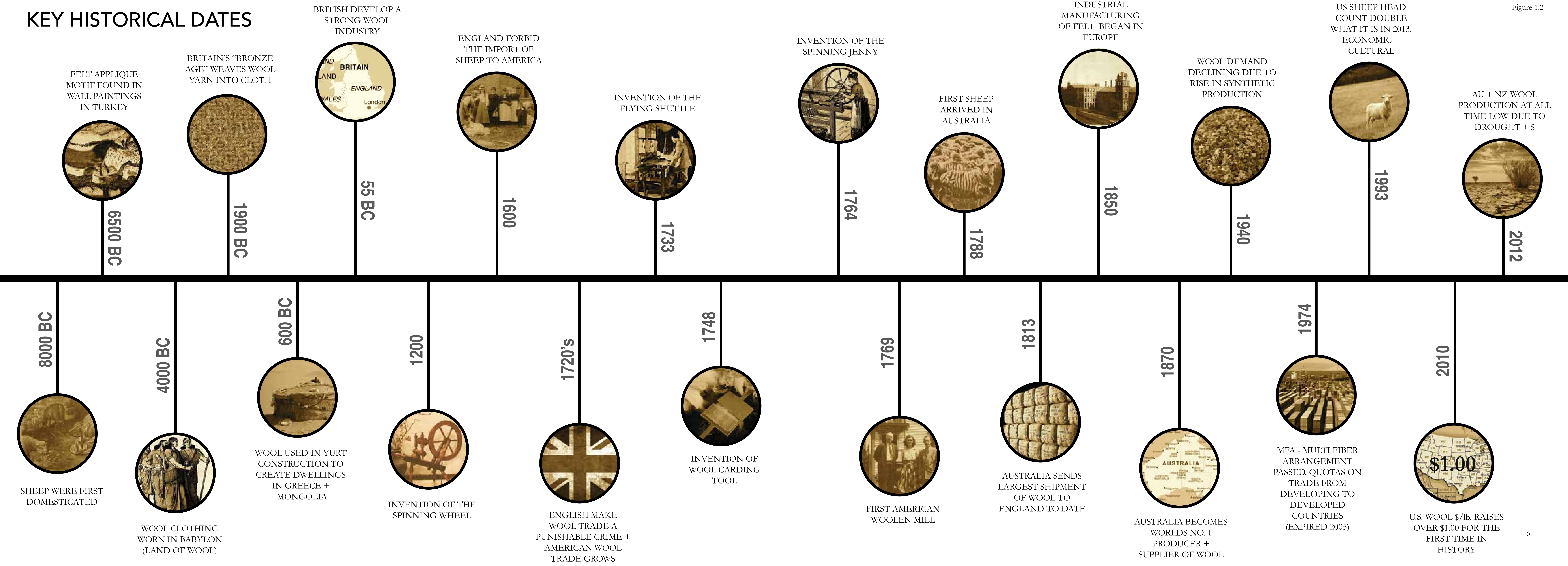


Figure 1.3

GLOBAL WOOL PRODUCTION

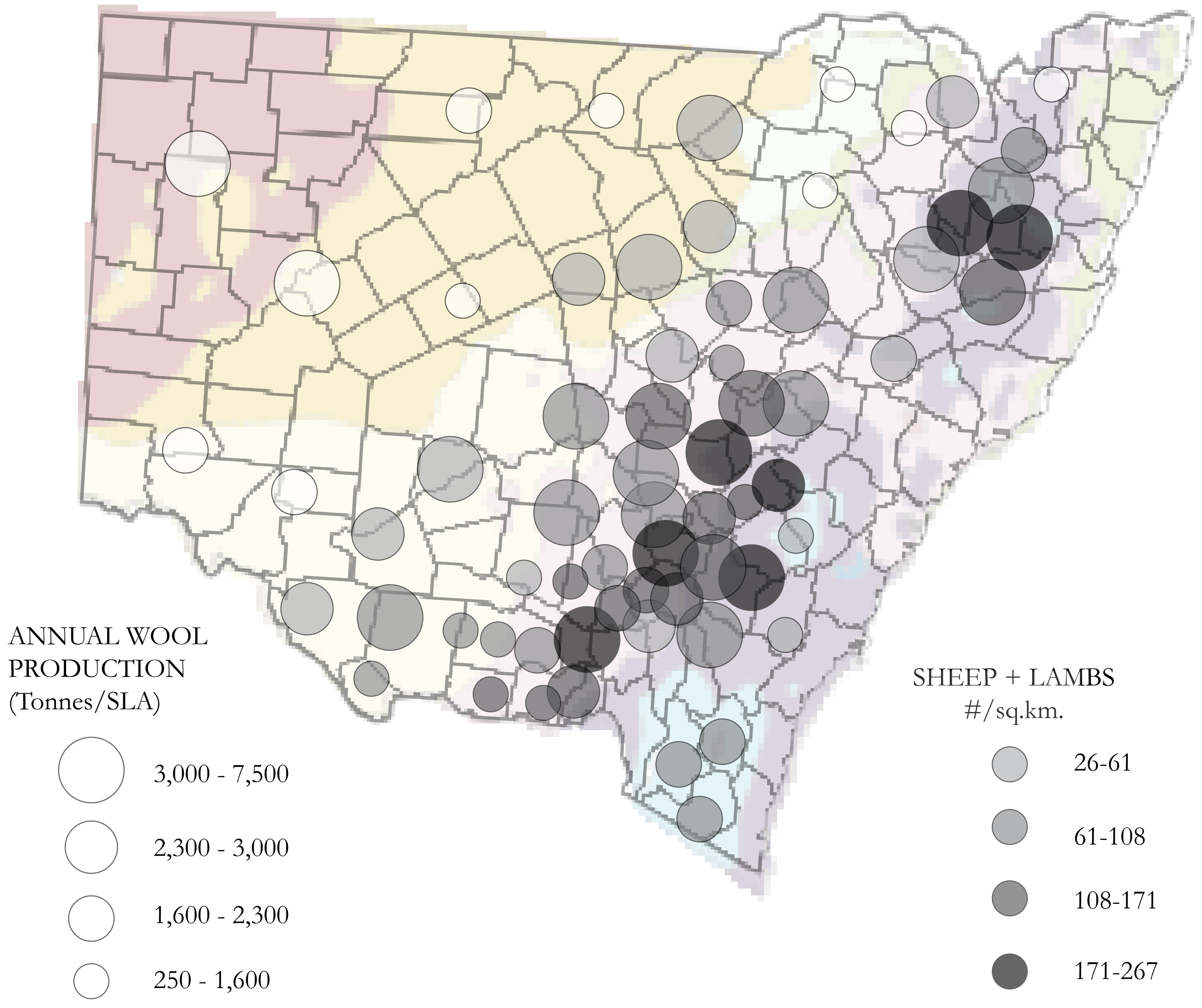
1. AUSTRALIA - 25%
2. CHINA - 18%
3. UNITED STATES 17%
4. NEW ZEALAND 11%
5. ARGENTINA 3%
6. UNITED KINGDOM 2%
7. IRAN 2%
8. AFGHANISTAN 2%
9. INDIA 2%
10. SUDAN 2%
11. SOUTH AFRICA 1%

Figure 1.4

NSW SHEEP + WOOL PRODUCTION

SHEEP HEAD COUNT + ANNUAL WOOL PRODUCTION (IN TONNES)

Climate Zone Map. Australian Government 2009.



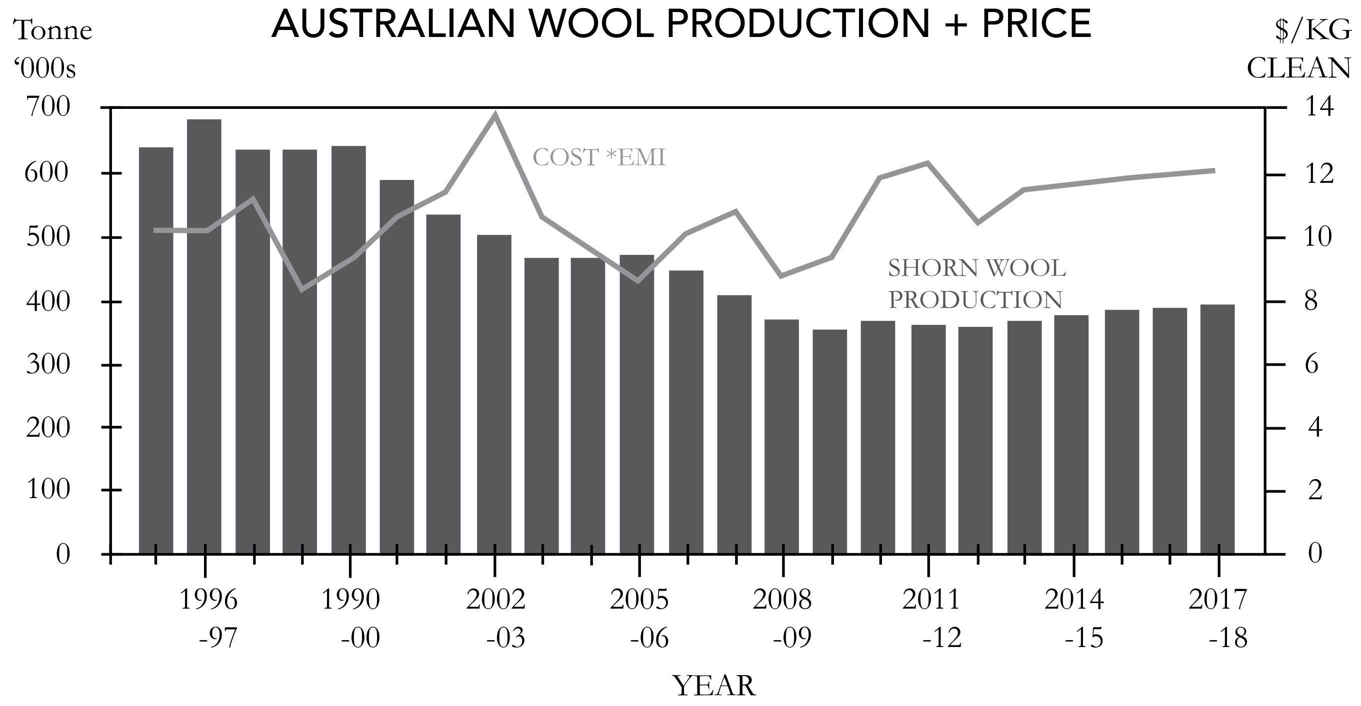


Figure 1.5

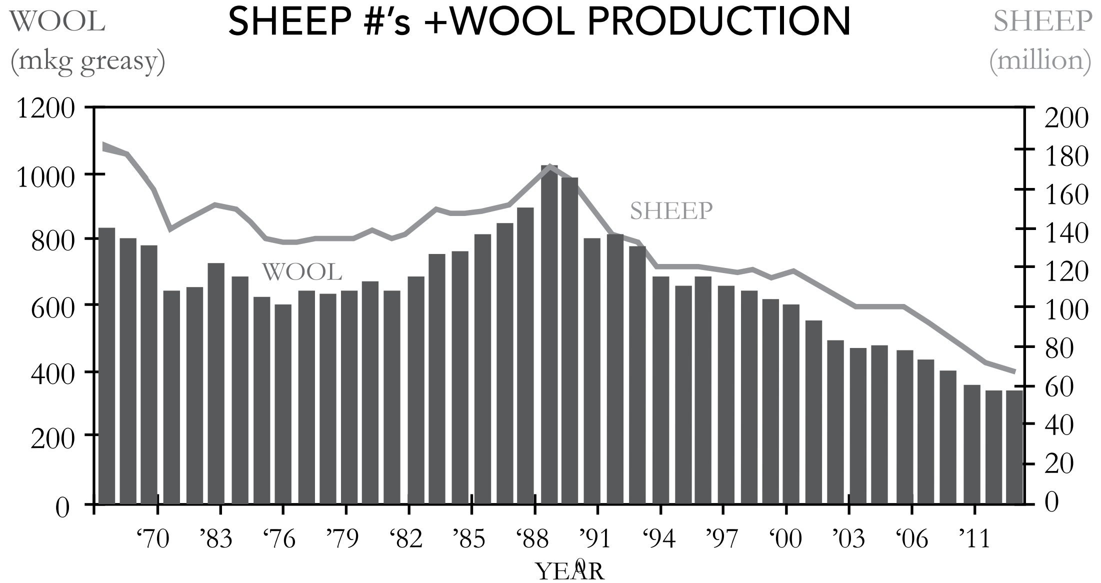


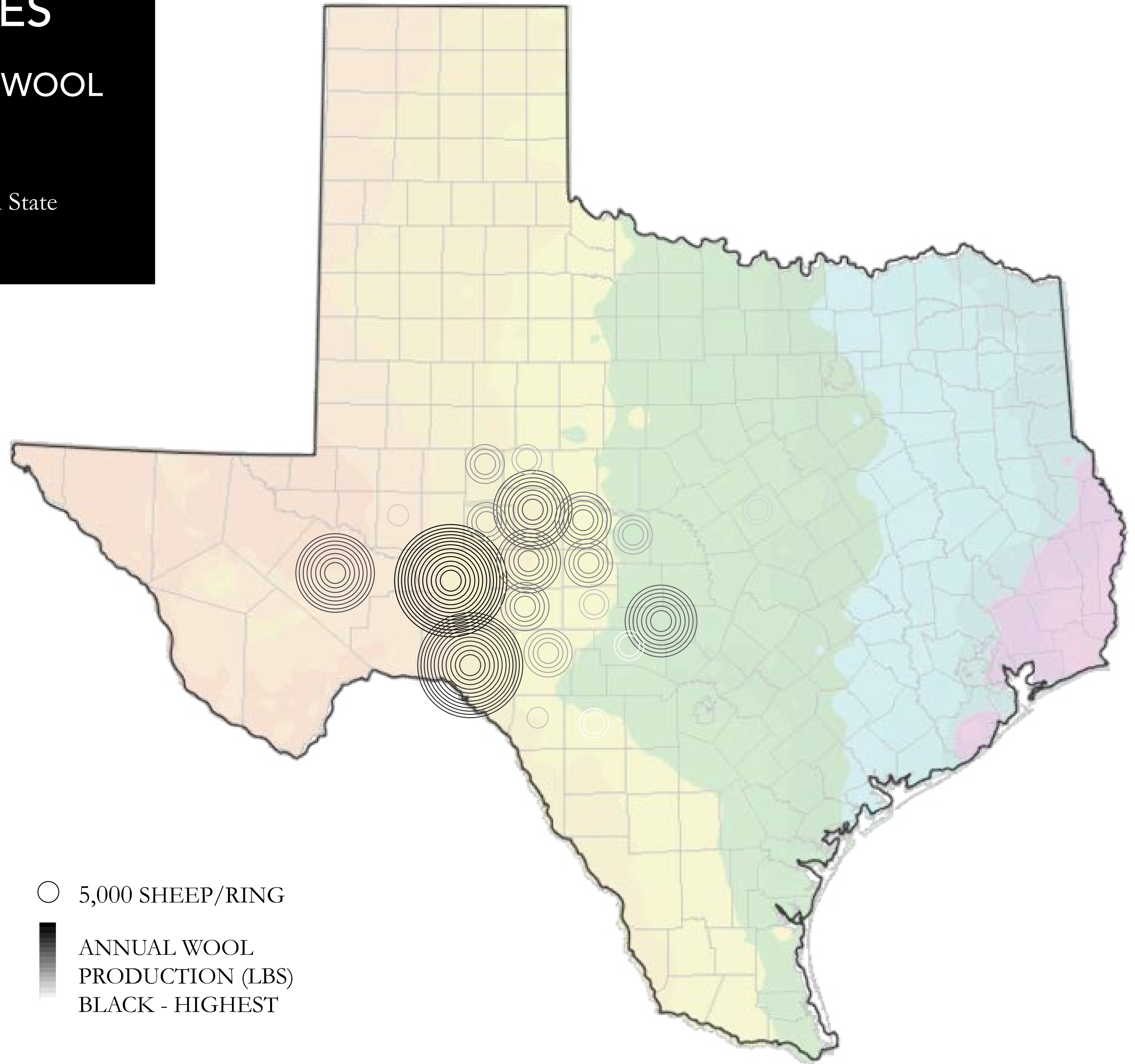
Figure 1.6

Figure 1.7

TOP 20 TEXAS COUNTIES

SHEEP HEAD COUNT + ANNUAL WOOL PRODUCTION (IN LBS)

Climate Zone Map. PRISM Climate Group, Oregon State University. Created 2 June 2013.



U.S. SHEEP COUNT + WOOL PRODUCTION

YEAR	SHEEP HEAD COUNT [MILLION]	SHORN WOOL [MILLION LBS]	AVG. $/LB	TOTAL $ [MILLION]
2013	5.34	---	---	---
2012	5.35	28.5	$1.53	43.6
2011	5.53	29.3	$1.67	48.9
2010	5.63	30.6	$1.15	35.3
2009	5.75	30.9	$0.79	24.4
2008	6.06	33.0	$0.99	32.5
2007	6.19	34.5	$0.88	30.3
2006	6.23	36.0	$0.68	24.4
2005	6.14	37.2	$0.71	26.3
2004	6.09	37.6	$0.80	29.9
2003	6.35	38.1	$0.72	27.4
2002	6.69	41.2	$0.53	21.8
2001	6.93	43.0	$0.36	15.3
2000	7.24	46.4	$0.33	15.5

Figure 1.8

GLOBAL FIBER MARKET SHARE

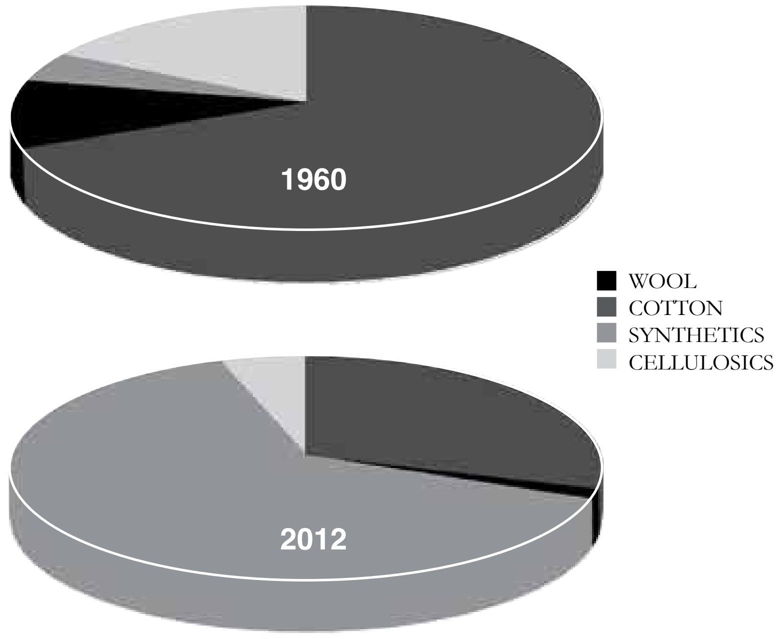


Figure 1.9

U.S. SHEEP + LAMB INVENTORY

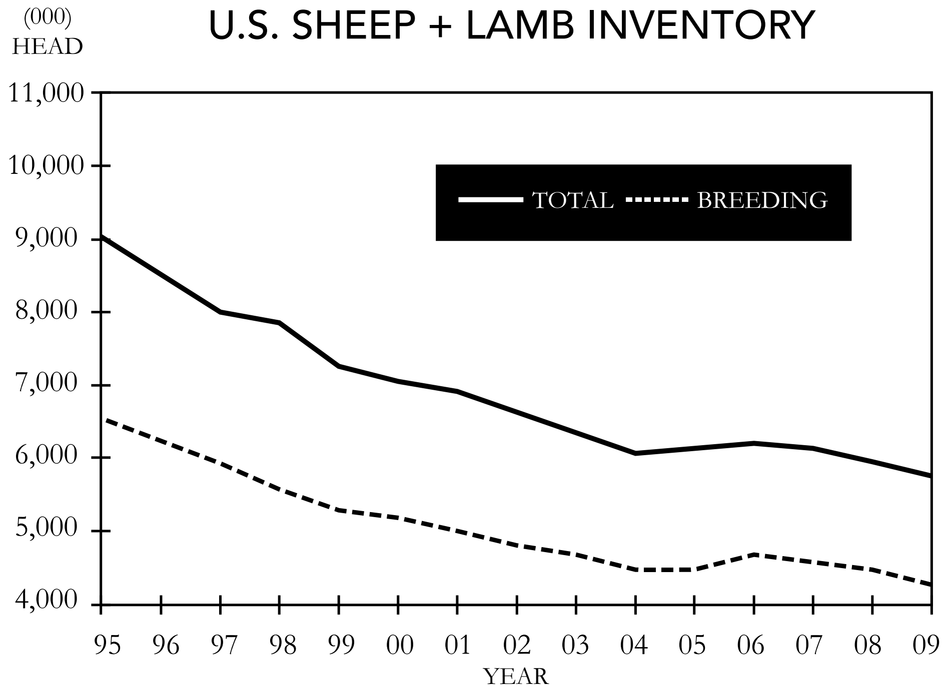


Figure 1.10

LOCAL SUPPLY CHAIN MODEL

Figure 1.11

1. LOCALLY SOURCED

- CHOOSE IN SEASON IF SEASONAL
- EASY ACCESS TO MATERIAL SUPPLY
- SUPPORT THE LOCAL ECONOMY
- ELIMINATE TRANSPORTATION EMISSIONS + FUEL REQUIREMENTS

2. LOCAL + SMALL-SCALE PROCESSING

- EASY ACCESS TO THE SUPPLY CHAIN
- EASE TO INTENSIVE QUALITY CONTROL
- SUITED TO SMALL-BATCH + CUSTOM PRODUCTS VS. MASS PRODUCTION
- SMALL-SCALE, SUSTAINABLY RUN MANUFACTURING PROCESSES.

3. REGIONAL + HISTORIC MAKING

- HAND-MADE WITH CARE
- INCREASE AVAILABLE JOBS IN THE LOCAL COMMUNITY
- HISTORIC + EMOTIONAL ATTACHMENT TO VERNACULAR DESIGNED PRODUCTS
- UTILIZE SKILLED LOCAL CRAFTSPEOPLE, TECHNICIANS + PRODUCT DESIGNERS

4. SELL LOCALLY

- DEVELOP ETHICAL CONSUMPTION BUYING PATTERNS IN CONSUMERS
- SELL IN LOCAL SHIPS THAT SUPPORT LOCAL ECONOMY + LOCAL PRODUCTS
- ECUATE THE CONSUMER ON THE WHOLE LIFE-CYCLE OF THE PRODUCT
- ‘PRIDE OF PLACE’ - GEOGRAPHIC INGREDIENT BRANDING

Figure 1.12

NEW SOUTH WALES, AUSTRALIA

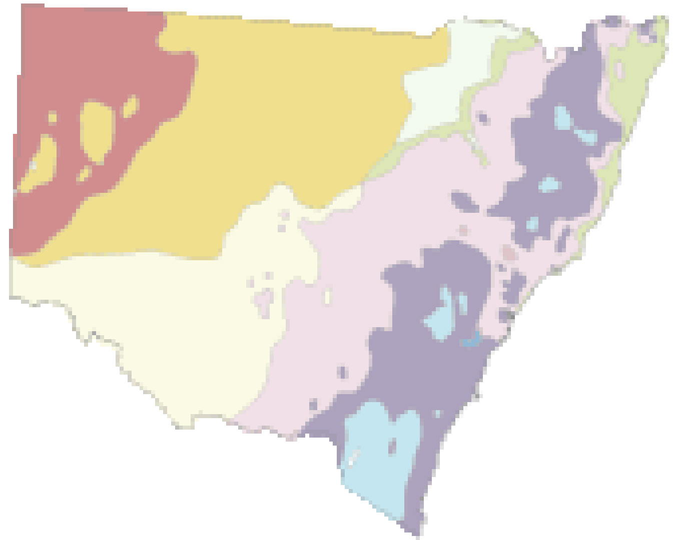


Figure 1.13

Figure 1.15

WOOL USED

SHETLAND SHEEP

- Medium - Coarse grade
- 30 Micron count
- Optimal for absorption of toxins, humidity and acoustic control as the fibers are more dense and have a rough texture.

Figure 1.14

NEW SOUTH WALES CLIMATE

Over half of NSW is arid to semi-arid and becomes more temperate as you move East towards the coast. The sheep population is mostly located inland NSW, where the climate is arid; a severe lack of available water that prevents the growth and development of plant and animal life.

HOW THIS EFFECTS THE BUILT ENVIRONMENT

The arid climate in NSW causes a lack of humidity needed for occupant comfort in interior environments; humans are most comfortable at 20-50% relative humidity. A coarse wool fiber installation that can be touched and wrapped around the body would allow the fiber to wick moisture and cool the temperature of the body, without having to increase air conditioning or ventilation rates.

TEXAS, USA

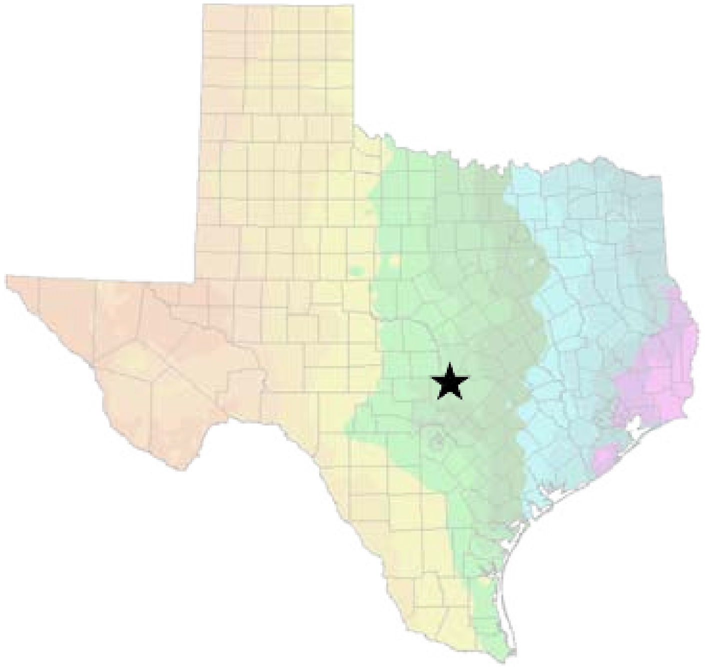


Figure 1.16

Figure 1.18

WOOL USED

AMERICAN CORMO SHEEP

- Medium - Coarse grade
- 26 Micron count
- Optimal for absorption of toxins, humidity and acoustic control as the fibers are more dense and have a rough texture.

Figure 1.17

TEXAS CLIMATE

As the climate varies throughout the state of TX, this installation will focus on the Hill Country where the McRanch is located in Dripping Springs. The climate in Central Texas is humid subtropic, characterized by hot, humid summers and mild winters.

HOW THIS EFFECTS THE BUILT ENVIRONMENT

The humid subtropic climate in Central Texas affects the interior environment with a high level of humidity, causing the relative humidity to often rise much higher than occupant comfort level. To alleviate the high humidity air conditioning and ventilation rates are increased. As humidity and hot air rise, a ceiling installation is the most appropriate design solution for a Central Texas wool.

Figure 1.19

★ THE McRANCH | DRIPPING SPRINGS, TX

The McRanch is a small, family owned ranch located West of Dripping Springs, TX. They have a range of natural fiber animals including sheep, angora goats, llama's and angora rabbits. The small-scale of their fiber production allows for completely natural processing using traditional methods rather than mechanical. This provides the most toxin-free fibers possible, creating the cleanest wool available and reduces the energy and transportation emission requirements. These are important quality as the wool is being used to absorb indoor air toxins.

DESIGN

MASTER'S DESIGN THESIS

Indoor wool installations made from locally sourced fiber that improve the interior environment quality (IEQ) through the absorption of harmful indoor air pollutants, acoustic control and humidity regulation. Recent studies have recognized natural wool fiber as a passive removal material (PRM) that can irreversibly absorb three of the EPA's top 9 most harmful indoor air toxins: formaldehyde, nitrogen dioxide and sulfur dioxide. All of which have adverse effects on human health, such as eye irritation, respiratory issues and formaldehyde is both carcinogenic and the leading cause of Sick Building Syndrome (SBS). These are common volatile organic compounds (VOCs) emitted from building materials, fixtures, furnishings and cleaning supplies among others and are present in most interiors.

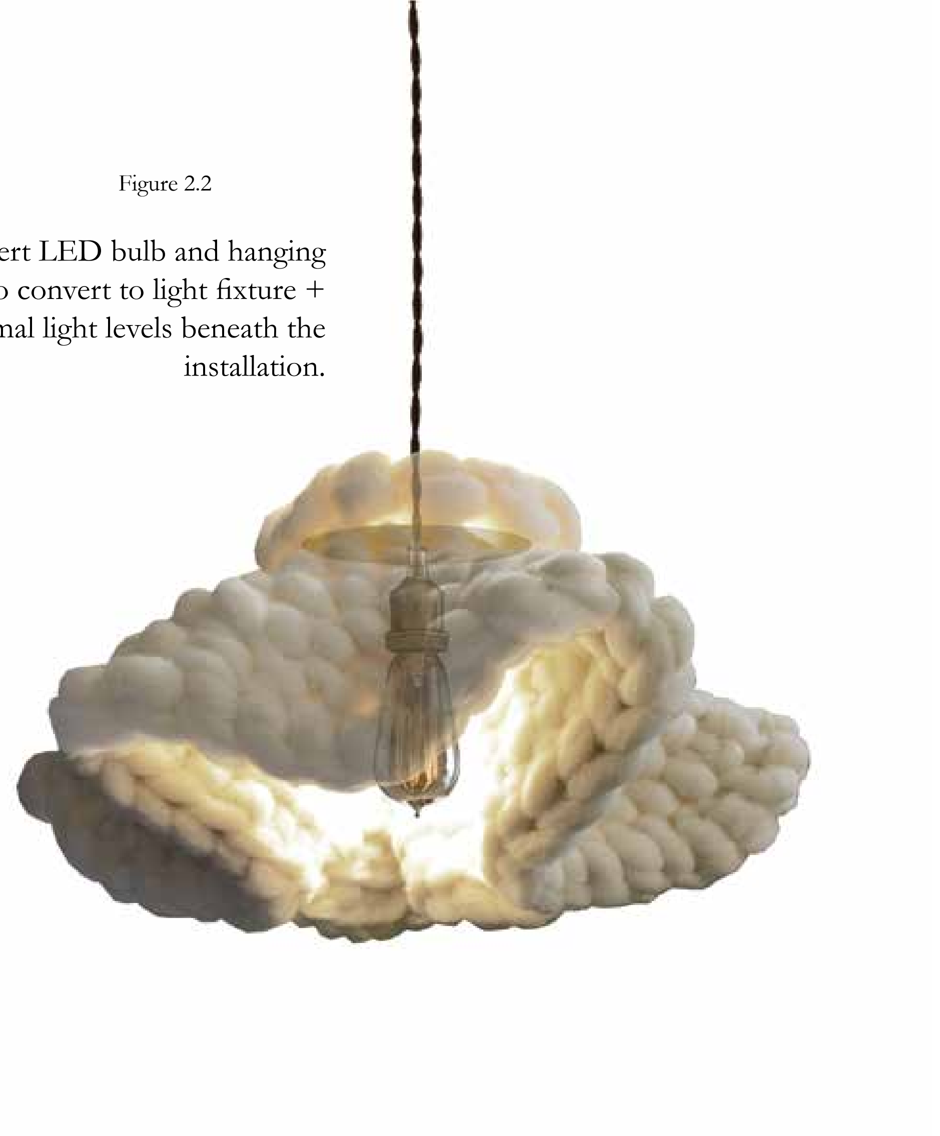
Wool has excellent acoustic control properties, as it absorbs traveling noise and reverberation, providing an optimal space for conversation speech settings where 70dB or lower is present. The wool fiber also regulates the humidity in an interior environment, as the hydrophilic interior cortex retains water vapor from the air and releases the excess when the atmosphere becomes less humid. This is a form of passive humidity regulation with no increase in air conditioning or ventilation rates. Additional sustainability features are present in the development of a local supply chain model that focuses on vernacular wool fiber and the interior comfort needs of each specific design. The wool was sourced from the local family run fiber farm in Dripping Springs, TX where they hand-process their wool, which eliminates toxins, energy requirements from mechanical processing and transportation emissions. This local supply chain model has been designed for implementation on future projects, as it increases the environmental, social, economic and human health benefits of the design.


Figure 2.1

TX CAMPANULA

Figure 2.2

Option to insert LED bulb and hanging metal fixture to convert to light fixture + add optimal light levels beneath the installation.



Master's Design Thesis | A sustainable ceiling installation fabricated from regional wool that will improve the interior environment through humidity regulation, acoustic control and VOC absorption, while also serving as an aesthetically pleasing piece of art. The use of vernacular, locally-sourced materials from a small-scale ranch in Dripping Springs, TX greatly decreases transportation and manufacturing emissions. The local supply chain model provides increased environmental, social, economic and human health benefits to the design.

The design solution provides an intimate space while seated beneath, both visually and spatially. Optimal acoustic control is created for conversation spaces [70 dB or lower], such as meeting rooms, restaurants and lobbies. The hydrophillic interior cortex of a wool fiber allows for 1/3 its weight in moisture absorption, as well as its unique wicking property, providing humidity regulation in an interior [stabilizing the optimal level of 20-50% relative humidity]. Recent research has proven that the wool fiber can irreversibly absorb 3 of the EPA's top 9 most harmful indoor air toxins [formaldehyde, sulfur dioxide + nitrogen dioxide], the ability to purify the air quality will improve human health and reduce SBS - Sick Building Syndrom. Along with the inherent wool properties and those designed for, the wool installation has the versatile option to easily become a light fixture by stringing a single bulb through the circular steel plate that has been designed to accomodate both options.

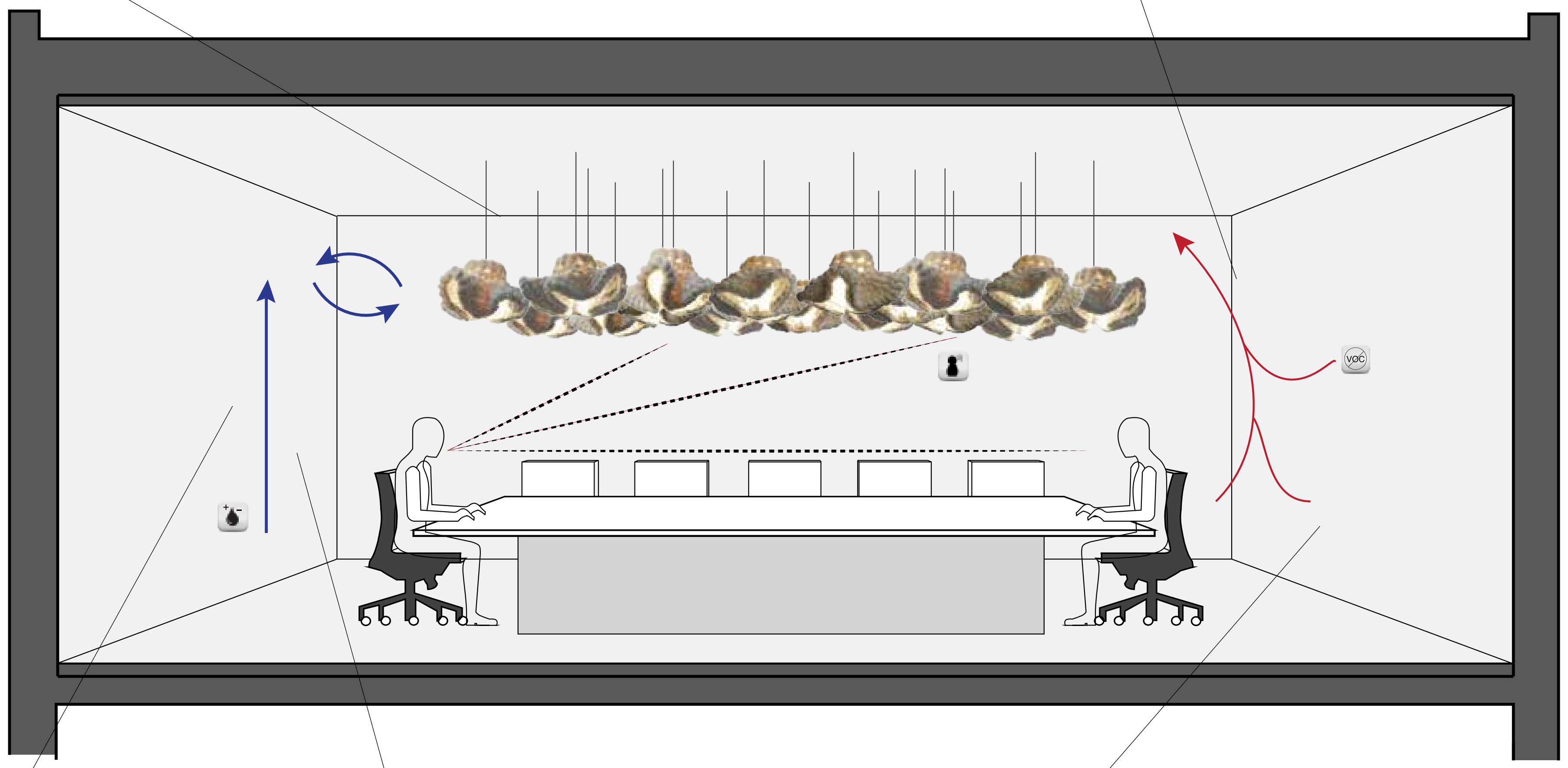
Figure 2.3

INTERIOR ENVIRONMENT IMPROVEMENTS

Wool fiber in this form provides optimal acoustic control in conversational speech situations, [70dB or lower]. The wool absorbs and reduces traveling noise and reverberation to create strong direct conversation while reducing exterior noises.

Wool has been tested and proven to irreversibly absorb 3 of the EPA's top 9 most harmful indoor air toxins - formaldehyde, sulfur dioxide and nitrogen dioxide.The keratin molecule located on the inside of the wool fiber reacts and binds to these specific chemical compounds.

Figure 2.4



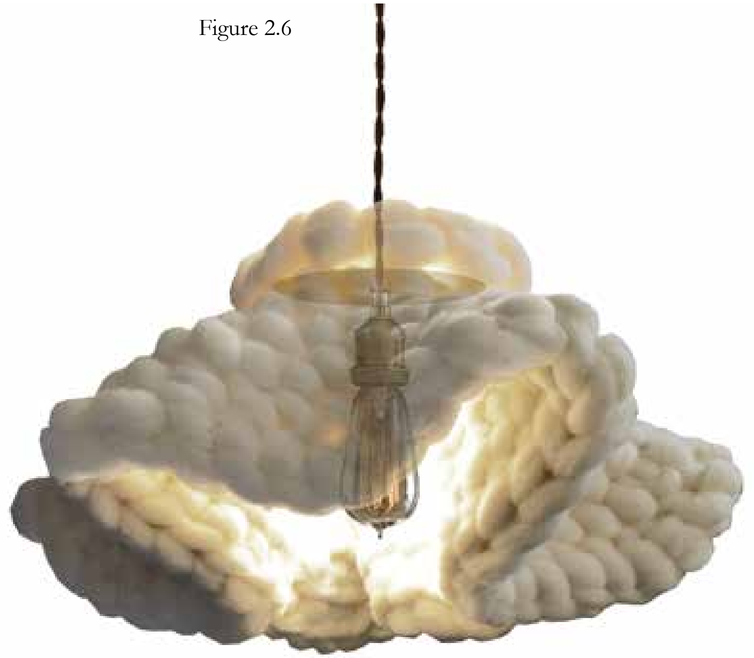
Wool absorbs acoustic energy via the friction of air being moved through the tiny spaces between fibers. Increased thickness, density and porosity improve this ability. Wool can provide up to 0.90 NRC [Noise-Reduction Coefficient].

Wool fiber's interior cortex is hydrophillic and can absorb 1/3 its weight in moisture. Wool has a unique *wicking* technique which allows the fiber to absorb moisture from the air, therefore it can reduce excess humidity in an interior environment. The fibers will regulate the moisture level in a space,releasing the gained humidity when the surrounding atmosphere is less humid. Humans are most comfortable in 20-50% relative humidity.

Formaldehyde, sulfure dioxide and nitrogen dioxide are common VOC's offgased from many popular building materials, systems, furnishings, cleaning products etc. These chemical compounds tend to evaporate at room temperature and are released into the air we breathe. Indoor air toxins cause SBS - Sick Building Sydrome (formaldehyde is the largest contributor to SBS), respiratory issues, eye irritation and some are carcinogenic.

Figure 2.5

Figure 2.6



Designed to accomodate a hanging light fixture or to remain a ceiling piece.

Figure 2.7

Figure 2.8

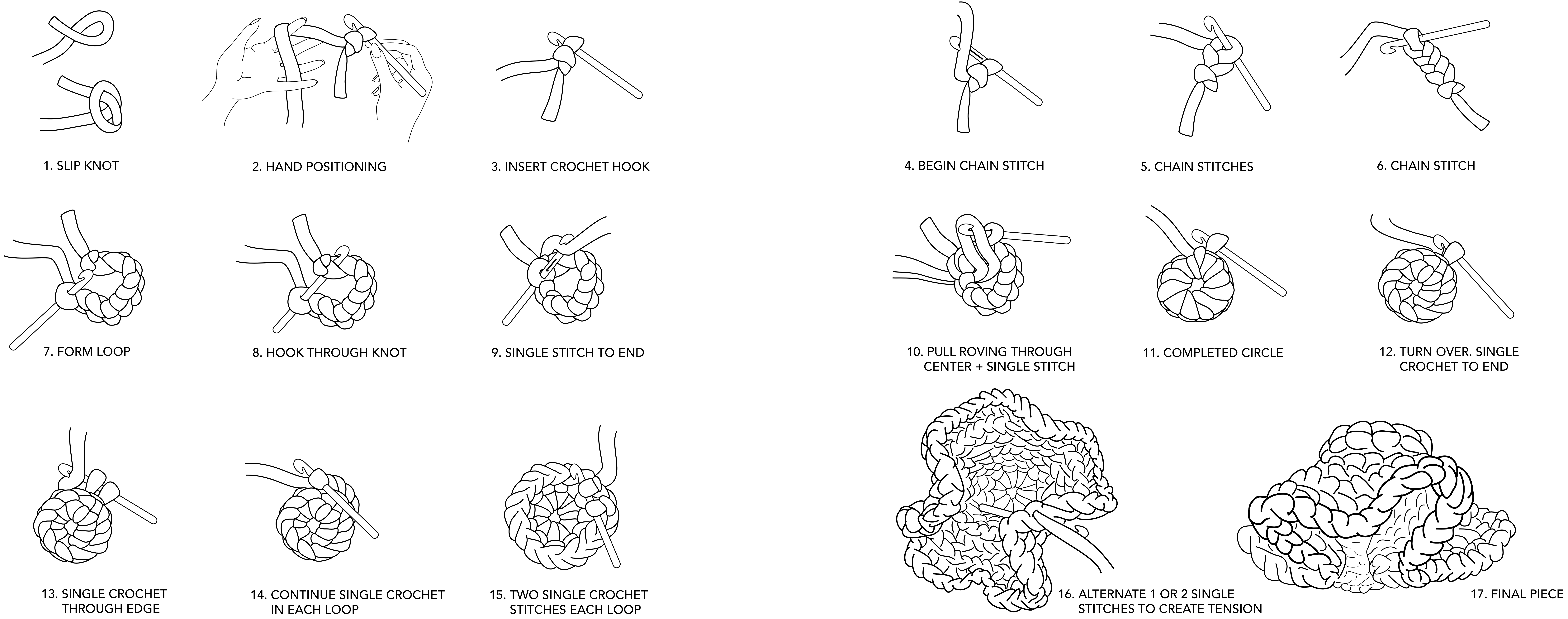

1. SLIP KNOT
2. HAND POSITIONING
3. INSERT CROCHET HOOK
4. BEGIN CHAIN STITCH
5. CHAIN STITCHES
6. CHAIN STITCH
7. FORM LOOP
8. HOOK THROUGH KNOT
9. SINGLE STITCH TO END
10. PULL ROVING THROUGH CENTER + SINGLE STITCH
11. COMPLETED CIRCLE
12. TURN OVER. SINGLE CROCHET TO END
13. SINGLE CROCHET THROUGH EDGE
14. CONTINUE SINGLE CROCHET IN EACH LOOP
15. TWO SINGLE CROCHET STITCHES EACH LOOP
16. ALTERNATE 1 OR 2 SINGLE STITCHES TO CREATE TENSION
17. FINAL PIECE

Figure 2.9

Figure 2.10

Master's Design Thesis | A sustainable lounging knot fabricated from regional wool that will imrpove the interior environment through humidity regulation, VOC absorption, occupant comfort and acoustic control. The A.Knot has been designed based on the regional climate conditions and wool fiber characteristics of the province of New South Wales, Australia. NSW is the highest producing province in Australia, which is the highest wool producing country in the world. Implementing the local supply chain model, this is a project based out of Australia and the use of vernacular, locally-sourced materials from a small-scale farm in New South Wales greatly decreases manufacturing energy requirements and reduces the use of processing toxins. The local supply chain model provides increased environmental, social, economic and human health benefits to the design.

The design solution provides an indivual lounging space or a group resting form. The A.Knot was designed to accompany the TX Campanula as an engaging sensory installation. Viewers may lounge on the A.Knot while viewing the TX Campanula above, or a group of people may experience the installation together by resting their heads along the edge of the knot. The hydrophilic interior cortex of a wool fiber allows for 1/3 its weight in moisture absorption, working with its unique wicking property, providing passive humidity regulation to an interior and working to cool or warm the occupant laying within the knot. The wool fiber is also working as a passive removal material (PRM), irreversibly removing 3 of the EPA's top 9 more harmful indoor air pollutants: formaldehyde, nitrogen dioxide and sulfur dioxide. The ability to purify the air will improve occupant human health and reduce Sick Building Syndrome (SBS). The A.Knot is a versatile design that may be reconfigured to suit the needs and desires of the users, engaging the visitors with the material and the installation.

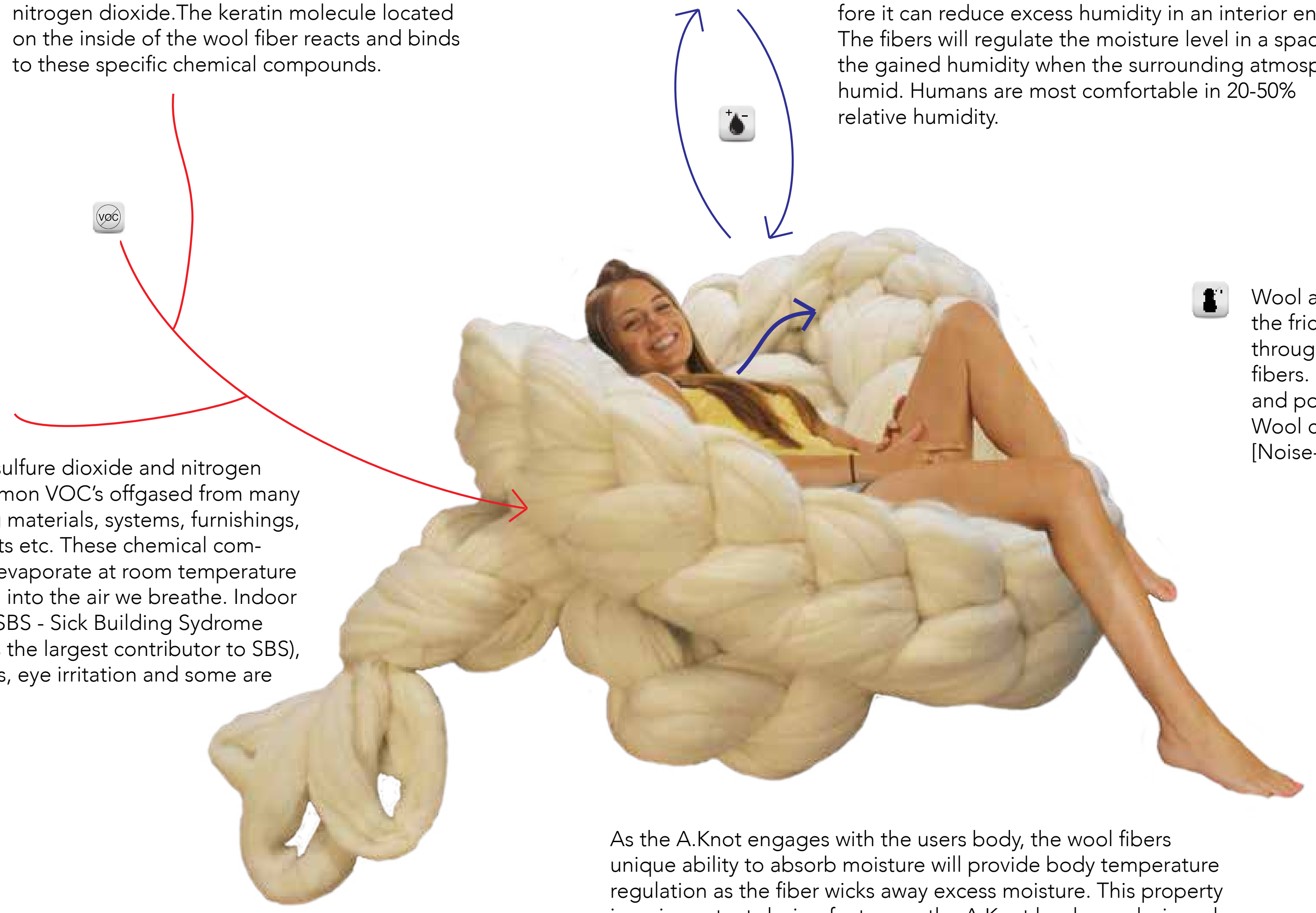
Figure 2.11

A.KNOT I INTERIOR + OCCUPANT IMPROVEMENTS

Wool has been tested and proven to irreversibly absorb 3 of the EPA's top 9 most harmful indoor air toxins - formaldehyde, sulfur dioxide and nitrogen dioxide.The keratin molecule located on the inside of the wool fiber reacts and binds to these specific chemical compounds.

Wool fiber's interior cortex is hydrophillic and can absorb 1/3 its weight in moisture. Wool has a unique *wicking* technique which allows the fiber to absorb moisture from the air, therefore it can reduce excess humidity in an interior environment. The fibers will regulate the moisture level in a space,releasing the gained humidity when the surrounding atmosphere is less humid. Humans are most comfortable in 20-50% relative humidity.

Formaldehyde, sulfure dioxide and nitrogen dioxide are common VOC's offgased from many popular building materials, systems, furnishings, cleaning products etc. These chemical compounds tend to evaporate at room temperature and are released into the air we breathe. Indoor air toxins cause SBS - Sick Building Sydrome (formaldehyde is the largest contributor to SBS), respiratory issues, eye irritation and some are carcinogenic.

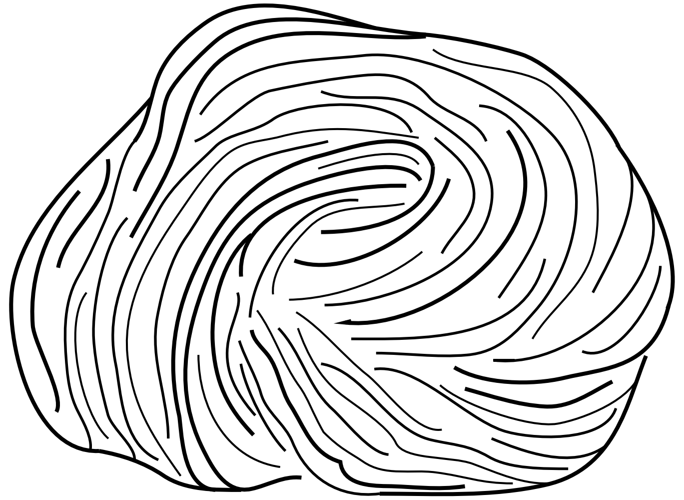


Wool absorbs acoustic energy via the friction of air being moved through the tiny spaces between fibers. Increased thickness, density and porosity improve this ability. Wool can provide up to 0.90 NRC [Noise-Reduction Coefficient].

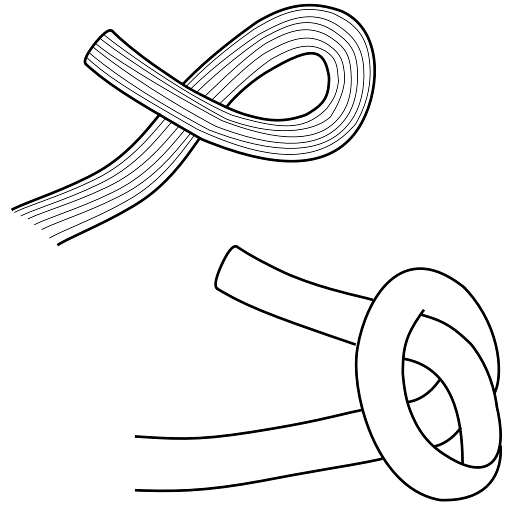
As the A.Knot engages with the users body, the wool fibers unique ability to absorb moisture will provide body temperature regulation as the fiber wicks away excess moisture. This property is an important design feature as the A.Knot has been designed based on the arid climate of NSW, where interiors have an extreme lack of humidity which causes occupant discomfort.

Figure 2.12

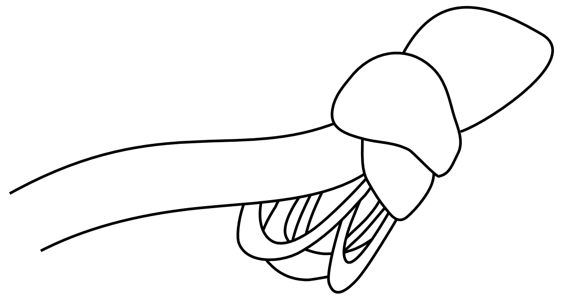
Figure 2.13



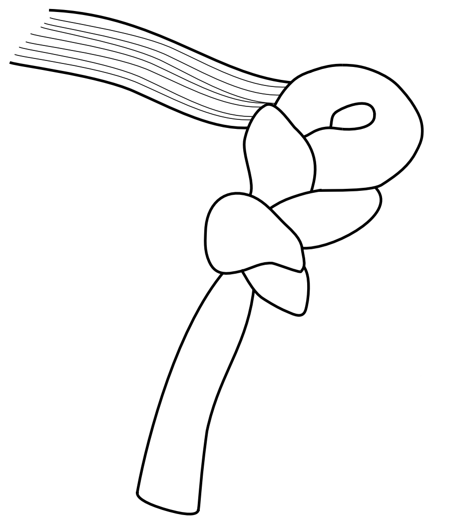
1. 250 oz. NATURAL WOOL ROVING



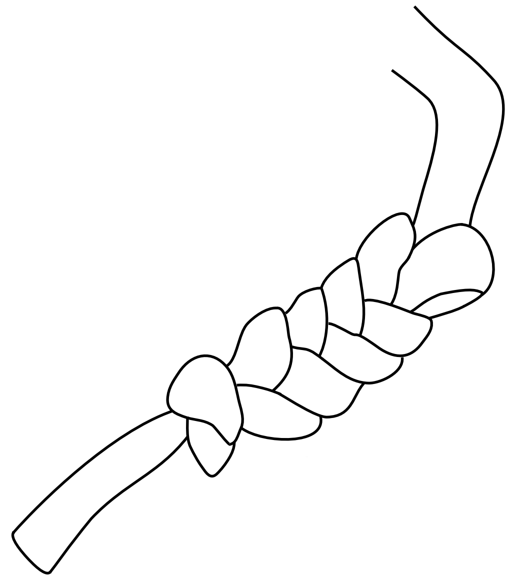
2. SLIP KNOT 8 LENGTHS OF ROVING THICK



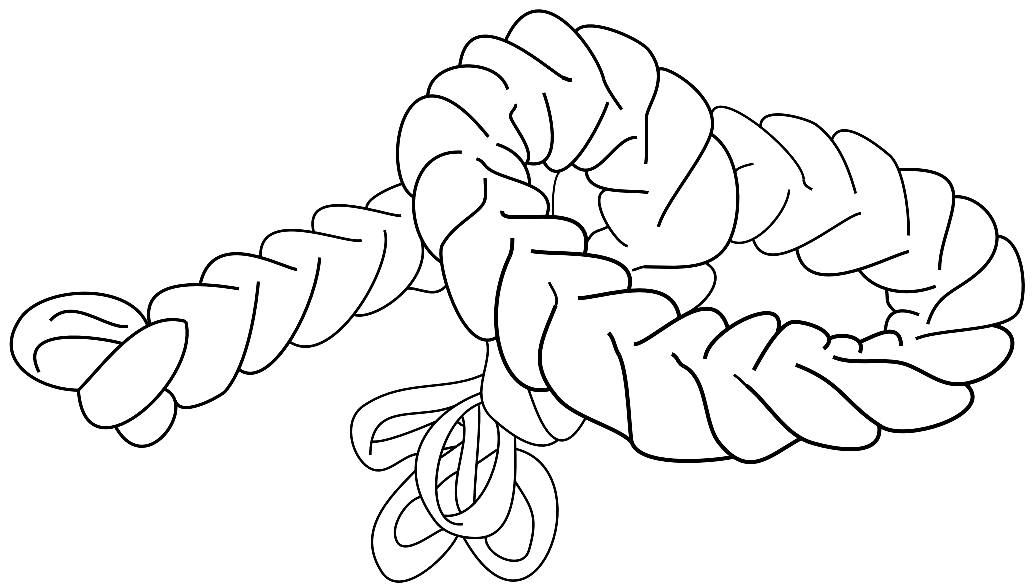
3. TIGHT SLIP KNOT END



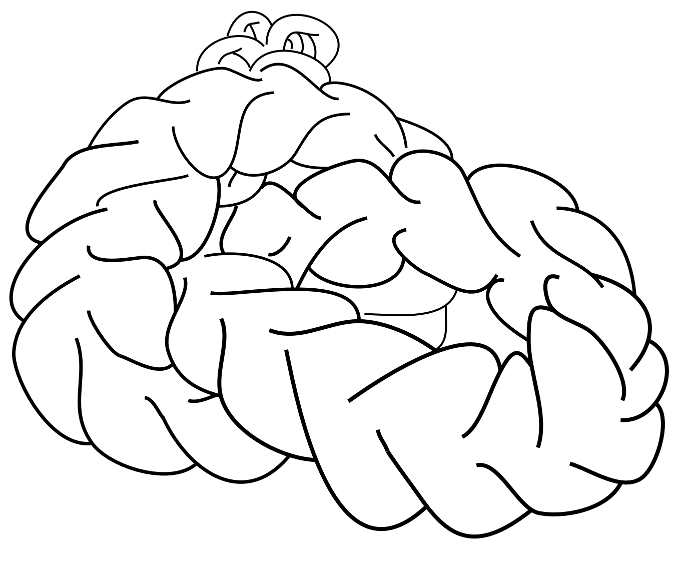
4. BEGIN CHAIN STITCH



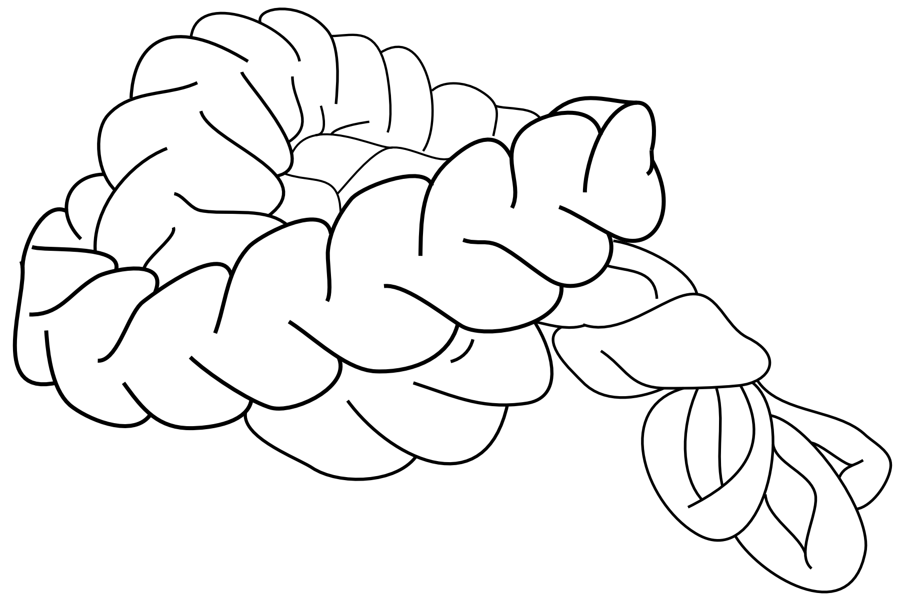
5. CONTINUE CHAIN STITCHING



7. 16′ LONG CHAIN STITCH FORM



8. OVER-SIZED SLIP KNOT OPTION



9. OVER-SIZE SOFT KNOT OPTION

UTSoA MATERIALS CO-OP | WEST AUSTIN STUDIO TOUR

Figure 2.14

Figure 2.15

Figure 2.16

WOOL : A NATURAL FIBER

Figure 3.1

WOOL FIBER ATTRIBUTES

NATURAL FIBER
Wool is a natural animal fiber that grows naturally as a coat on sheep and does not require any sort of chemicals or manufacturing to produce.

RAPIDLY RENEWABLE RESOURCE
According to the USGB a 'Rapidly Renewable Resource' must be planted and harvested in less than a ten year cycle. Wool is sheared from sheep once every year.

NONWOVEN OR WOVEN APPLICATION
Wool fibers are suitable for both woven/knitted and nonwoven applications. Woven/knitted wool is processed into yarn and has great spinnability due to its scaling and crimp. Wool is the best natural fiber for nonwoven applications due to its ease of felting ability.

FELTING ABILITY
The scaly and coarse nature of a wool fiber allows it to felt together and join to other wool or natural fibers with agitation, water and soap.

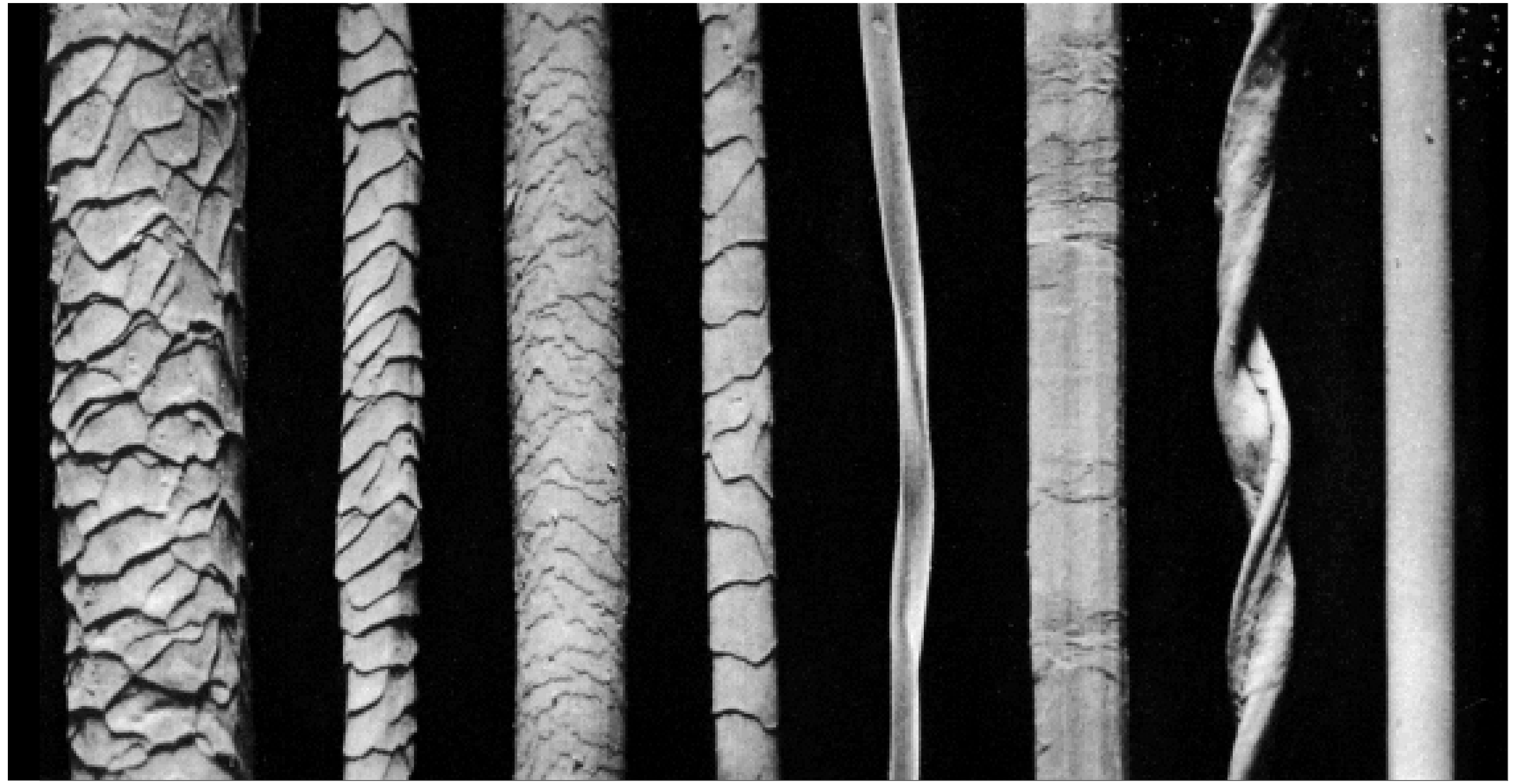
ELASTICITY
Wool fibers can be bent over 30,000 times without danger of breaking or damage. It is the natural elasticity and wave or crimp that allows this fiber to be stretched as much as 130% and spring back into place when dry; a wet fiber can stretch up to 1/2.

MOISTURE ABSORPTION
Wool fibers can absorb up to 30% of its weight in moisture, with a moisture regain of 16-18%. Wool fibers absorb and release moisture from surrounding air without compromising its thermal efficiency.

THERMAL INSULATION
As a building insulation material, wool has an R-value of 3.5/inch of thickness.

FLAME RESISTANT
Wool is naturally flame resistant and self extinguishes. The fiber will smolder and char, but will not burst into flames. It has a very low flame spread, heat of combustion and does not melt or drip when heated.

FIBER COMPARISON + DEFINING WOOL TERMINOLOGY



COARSE WOOL FINE WOOL ALPACA CASHMERE SILK LINEN COTTON POLYESTER

Figure 3.2

FIBER
A unit of of matter; long, thin and flexible structure, either natural or manufactured that forms the basic element of a textile structure.

DIAMETER
The thickness or fineness of a fiber, in wool this defines the grade which is often measured by micron. Diameter ranges from 16 microns (finest merino wool) to over 40 microns (coarsest long wool types). The diameter affects the fiber flexibility and spinnability.

LENGTH
All natural fibers are staple fibers (excluding silk). Staple fibers range in length from 3/4" to 18" and are highly variable in length. The fiber length usually increases with the diameter increasing.

CRIMP
The number of bends per unit length along the wool fiber, this generally indicated the spinnability of the wool. Fibers with a fine crimp have many bends and usually have a small diameter; these can be spun into fine yarns with great lengths. Crimp is measured in crimps per inch or crimps per centimeter.

LUSTER
The light reflection or sheen of the wool fiber. The finer wools (lower micron count) generally have a higher luster than the coarse wool.

TENACITY
The tensile strength of the wool fiber. Wool is much stronger dry than wet and the fiber is hydrophillic, absorbing water into its core. Wool has a dry strength of 11.5-13 cN/tex and a moisture regain of 16-18%. The dimensional stability of a wool fiber is strong in elastic recovery, but very weak when considering shrinkage.

ELONGATION
A wool fiber has the ability to stretch, or elongate and return back to its shape when dry due to its elasticity. Dry wool has a breaking elongation of 30-40%.

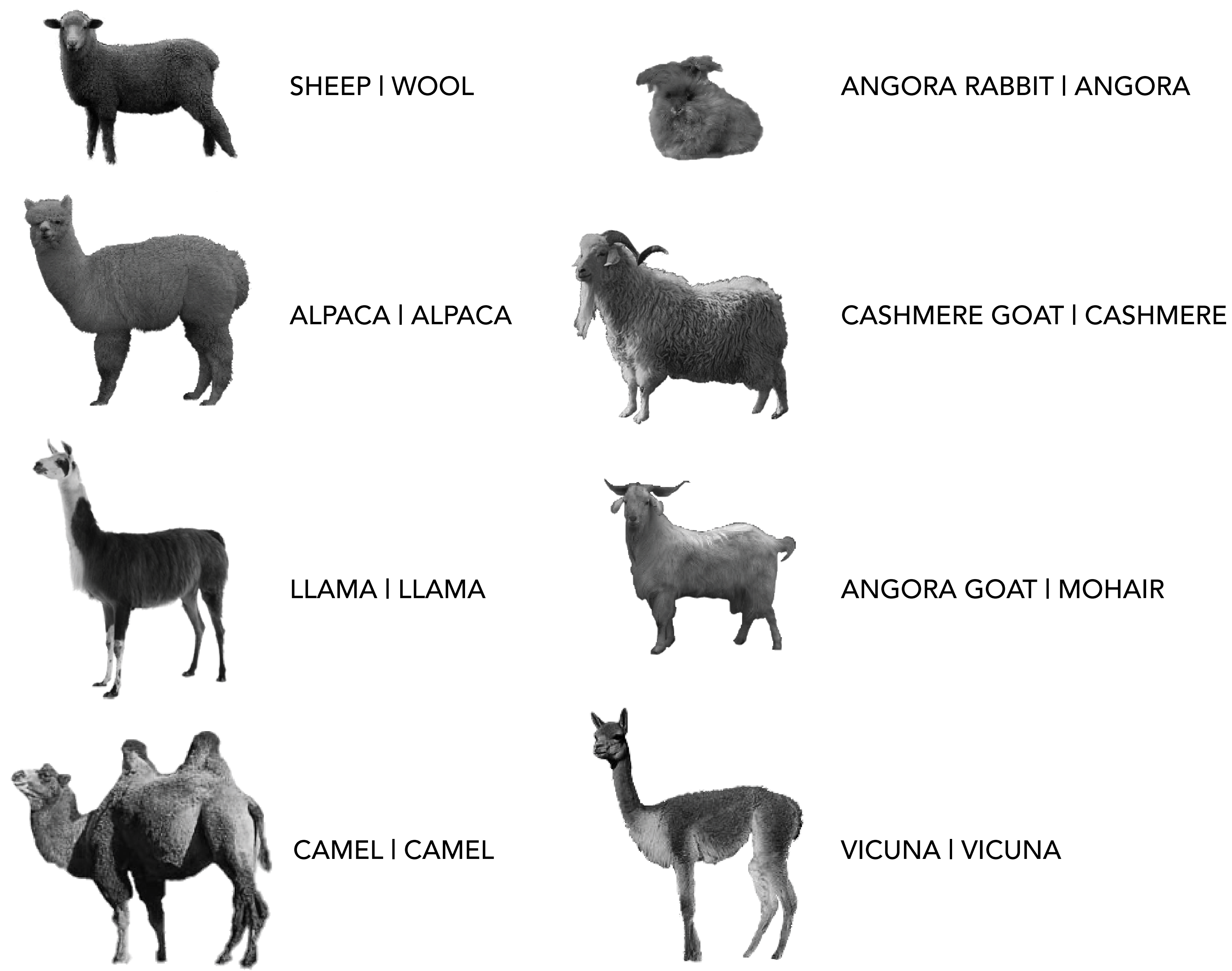


Figure 3.3

NATURAL ANIMAL FIBERS

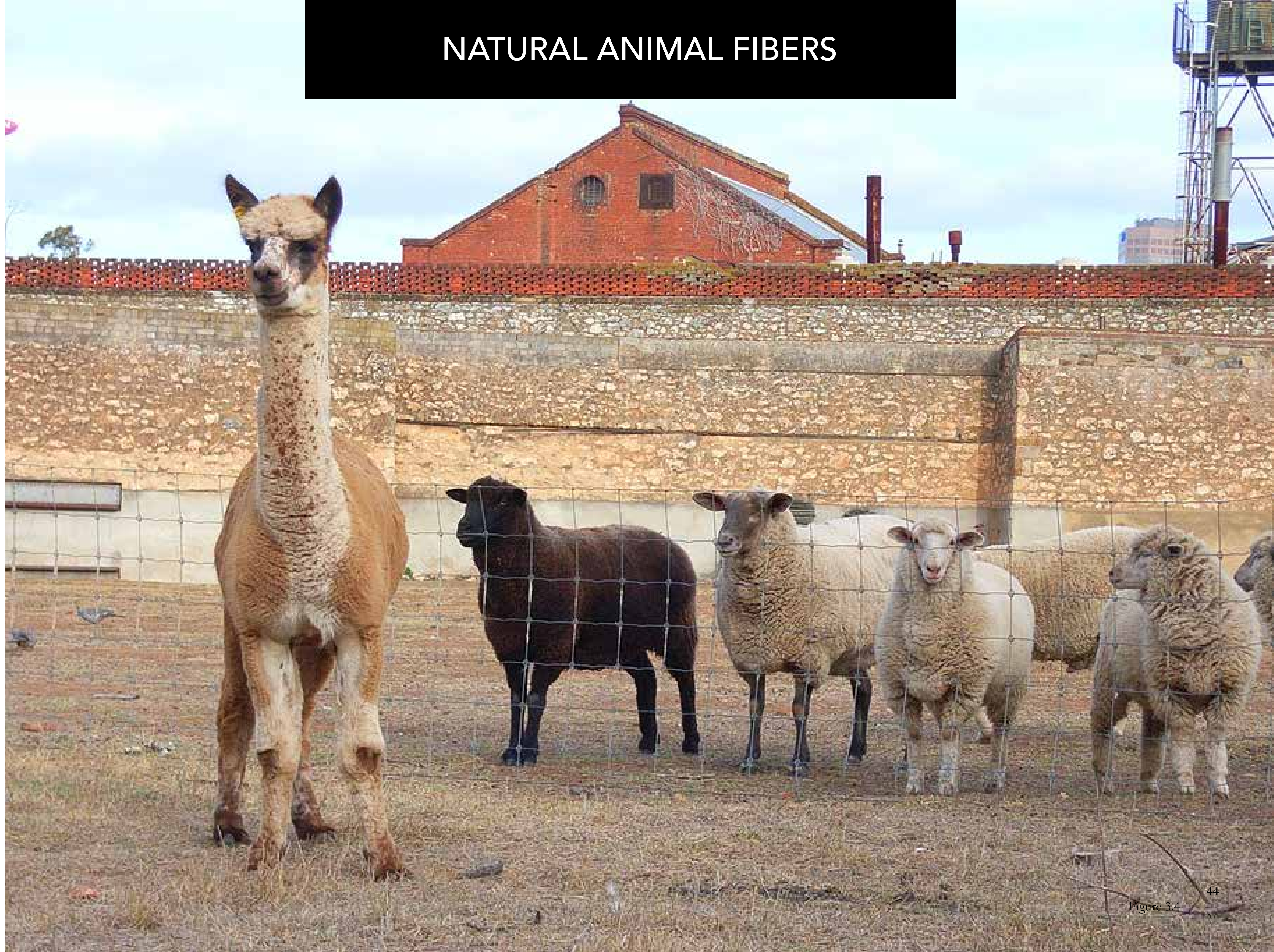


Figure 3.4

SHEEP WOOL GRADES + STANDARDIZING SYSTEMS

TYPE OF WOOL	OLD BLOOD GRADE	STANDARD SPECIFICATIONS: USDA GRADE	STANDARD SPECIFICATIONS: AVG. FIBER DIAMETER (microns)
Fine	Fine	- 80's	Under 17.70
Fine	Fine	80's	17.70-19.14
Fine	Fine	70's	19.15-20.59
Fine	Fine	64's	20.60-22.04
Medium	1/2 Blood	62's	22.05-23.49
Medium	1/2 Blood	60's	23.50-24.94
Medium	3/8 Blood	58's	24.95-26.39
Medium	3/8 Blood	56's	26.40-27.84
Medium	1/4 Blood	54's	27.85-29.29
Medium	1/4 Blood	50's	29.30-30.99
Coarse	Low 1/4	48's	31.00-32.69
Coarse	Low 1/4	46's	32.70-34.39
Coarse	Common	44's	34.40-36.19
Very Coarse	Braid	40's	36.20-38.09
Very Coarse	Braid	36's	38.10-40.20
Very Coarse	Braid	+ 36's	Over 40.20

*American Society for Testing Materials (ASTM) Designation D3991

Figure 3.5

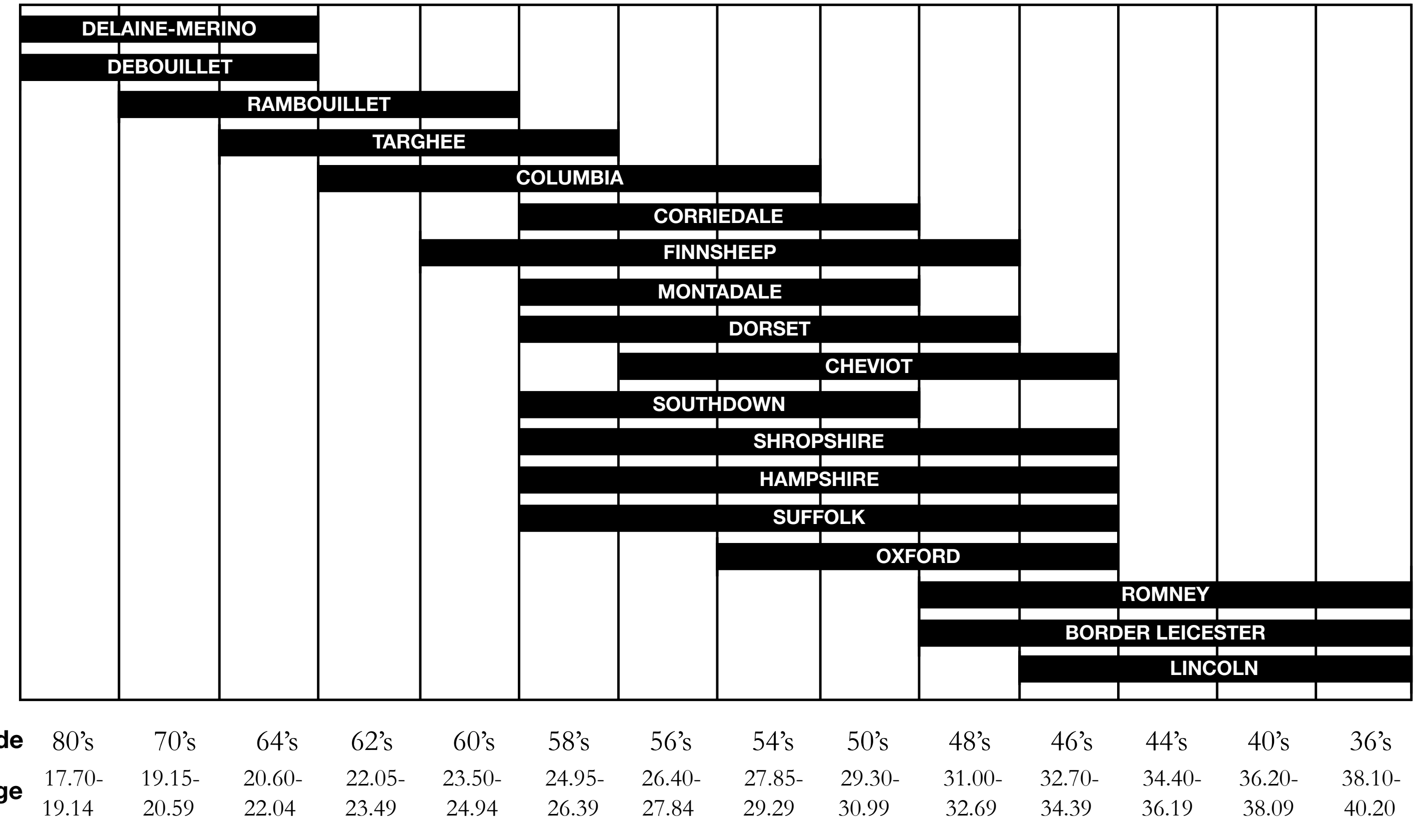


Figure 3.6

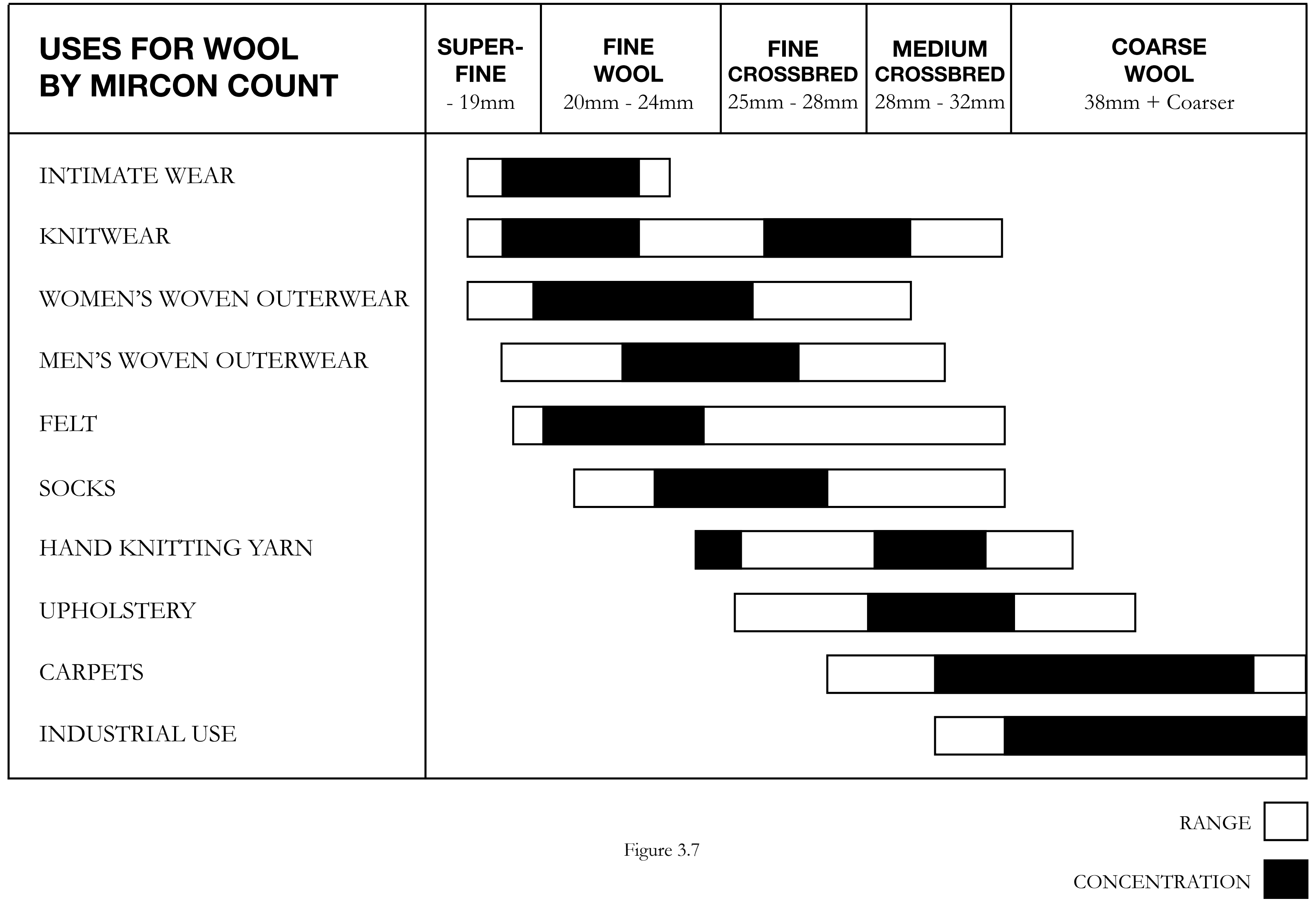
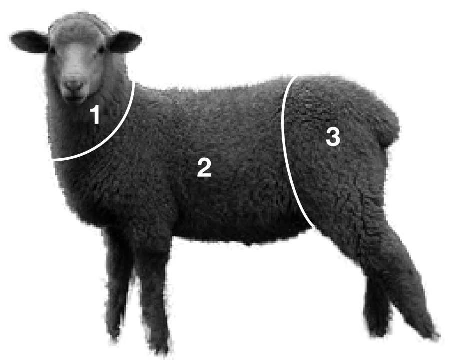


Figure 3.7

SHEEP FIBER QUALITY

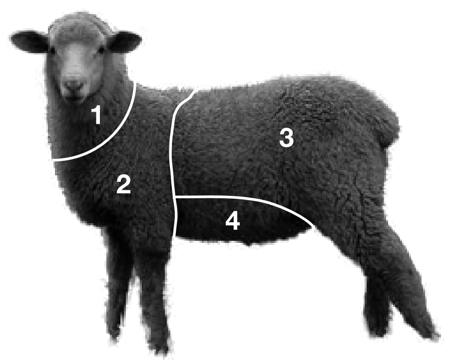
Figure 3.8

FINENESS



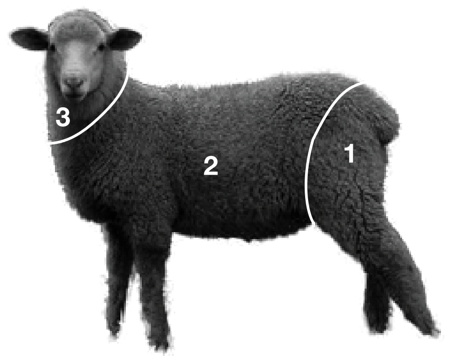
FINEST TO COARSEST
1. Head wool.
2. Dominant wool over the body.
3. Rump and britch wool.

DENSITY



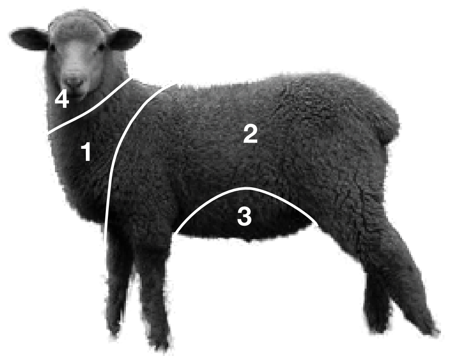
MOST DENSE TO LEAST DENSE
1. Head wool.
2. Neck and shoulder wool.
3. Dominant wool.
4. Belly wool.

LENGTH



LONGEST TO SHORTEST
1. Lower britch wool.
2. Dominant wool over the body.
3. Head wool.

CLEAN WOOL YIELD



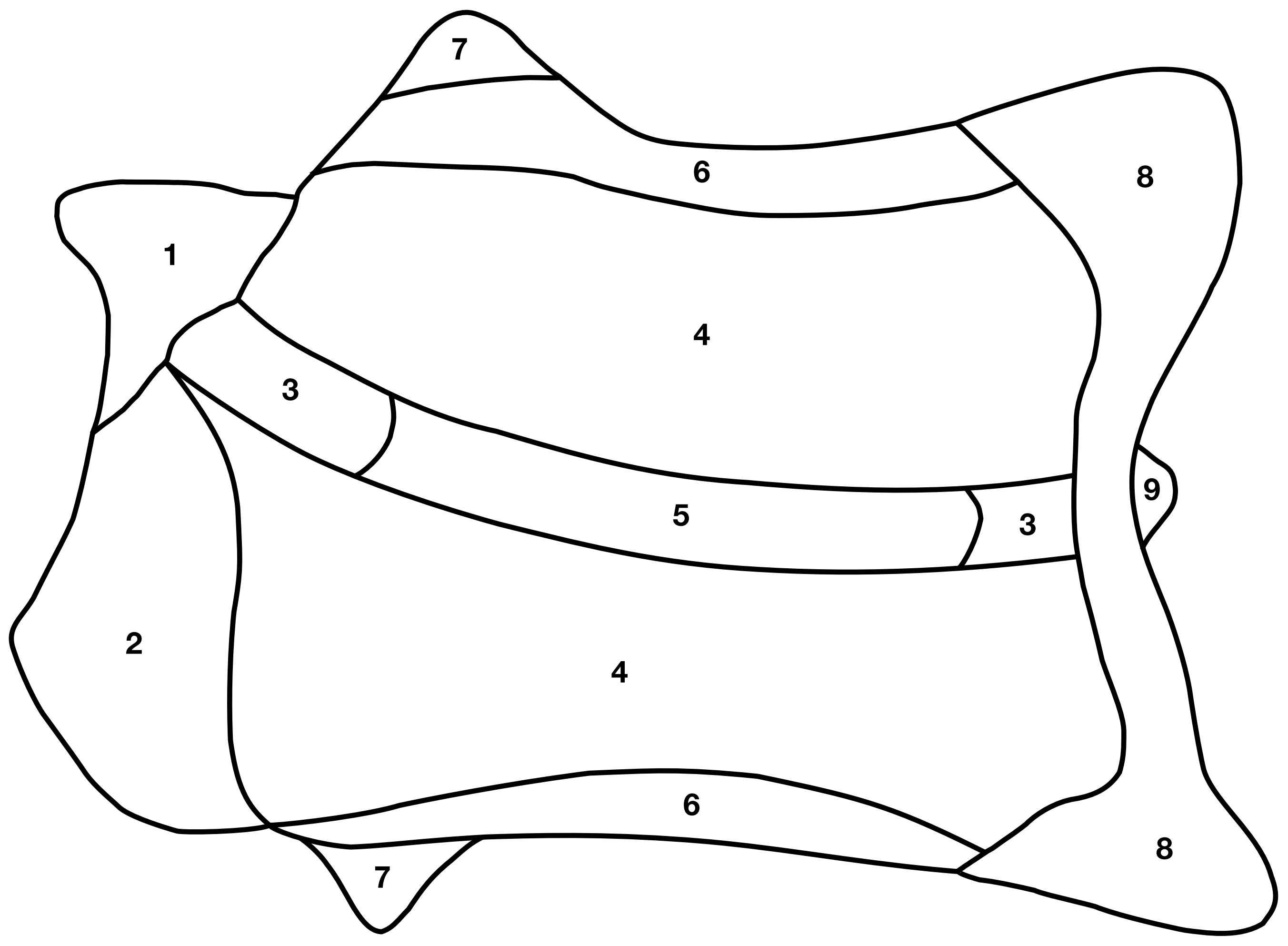
HIGHEST % YIELD TO LOWEST
1. Neck wool.
2. Dominant wool over the body.
3. Belly wool.
4. Head wool.

Figure 3.9

Figure 3.10.

SHEEP FLEECE DIAGRAM

Figure 3.11



1 TOP KNOT
2 NECK
3 BKS2
4 DOMINANT FLEECE
5 BKS
6 SKIRTINGS
7 LEGS
8 BRITCH
9 TAIL

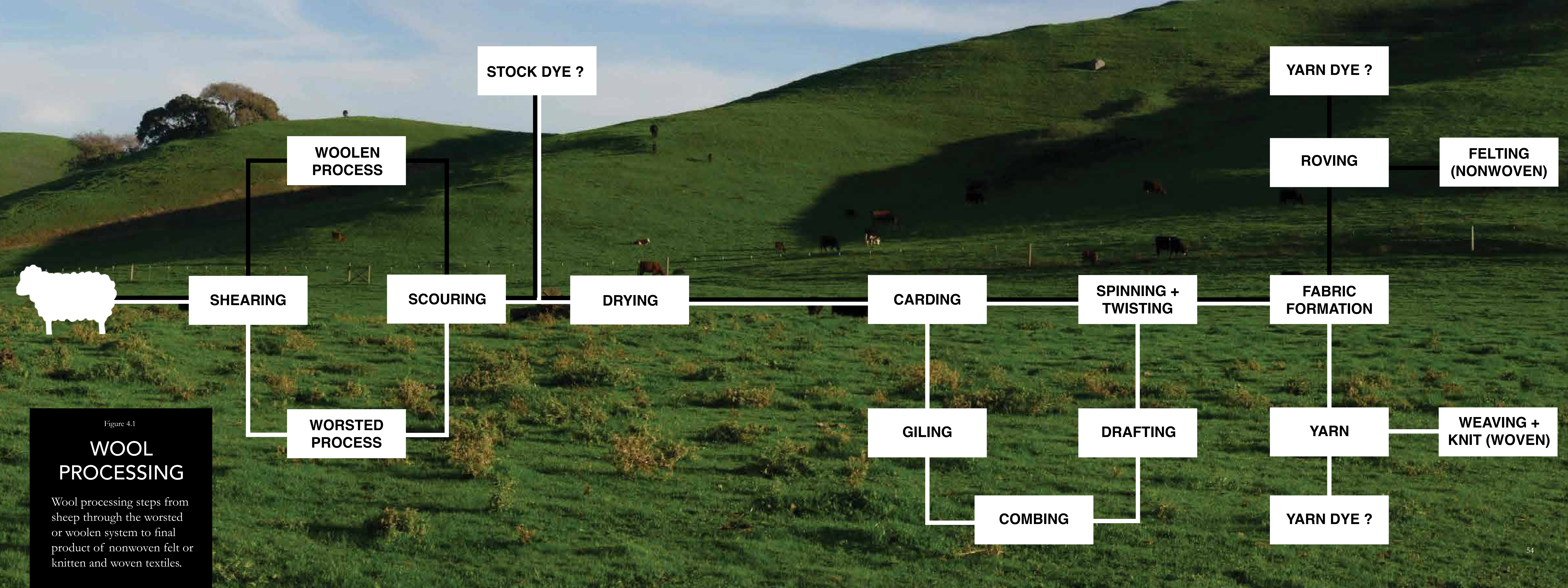


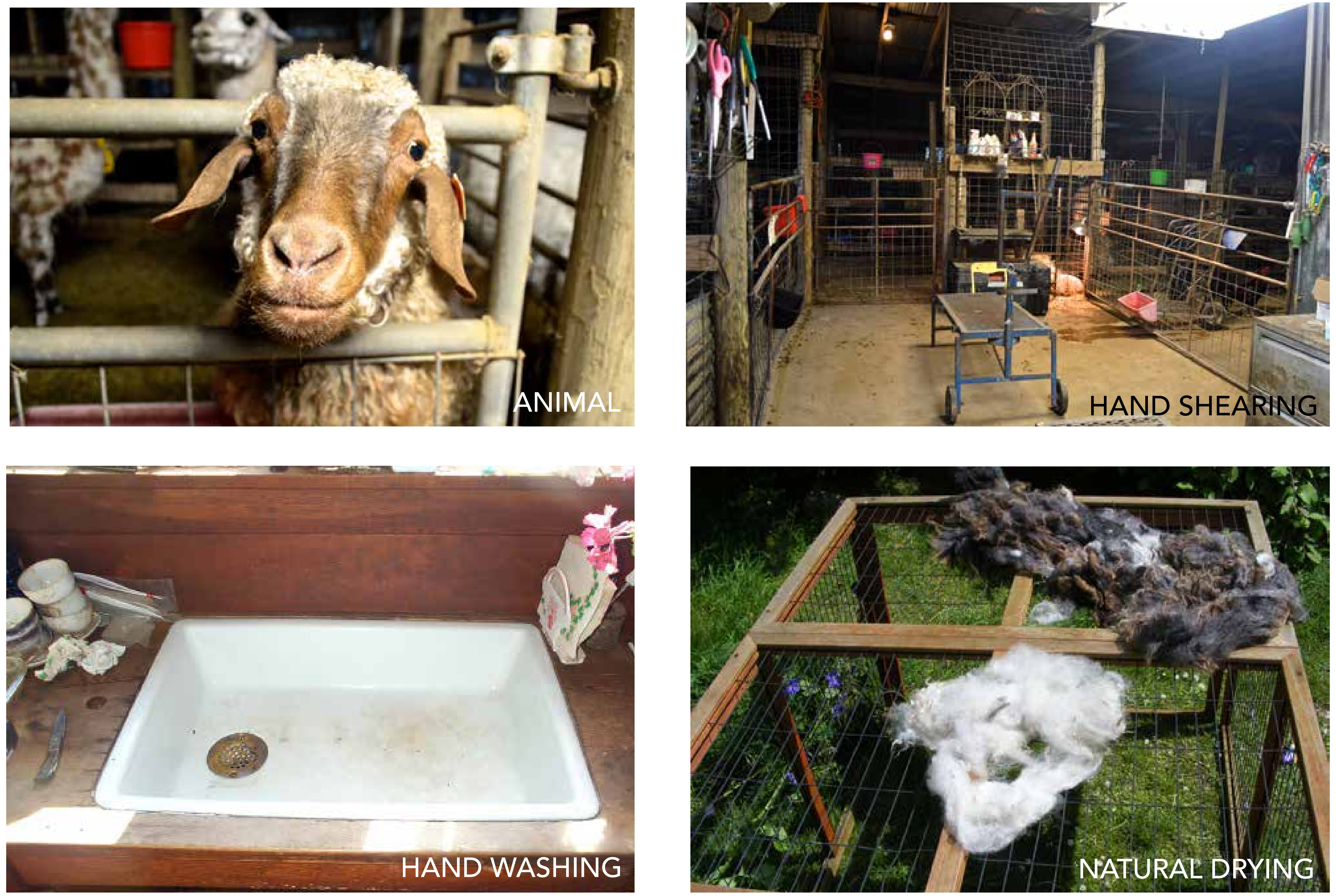
Figure 4.1

WOOL PROCESSING

Wool processing steps from sheep through the worsted or woolen system to final product of nonwoven felt or knitten and woven textiles.

Figure 4.2

Figure 4.3



WOOL LIFE CYCLE

Figure 4.4

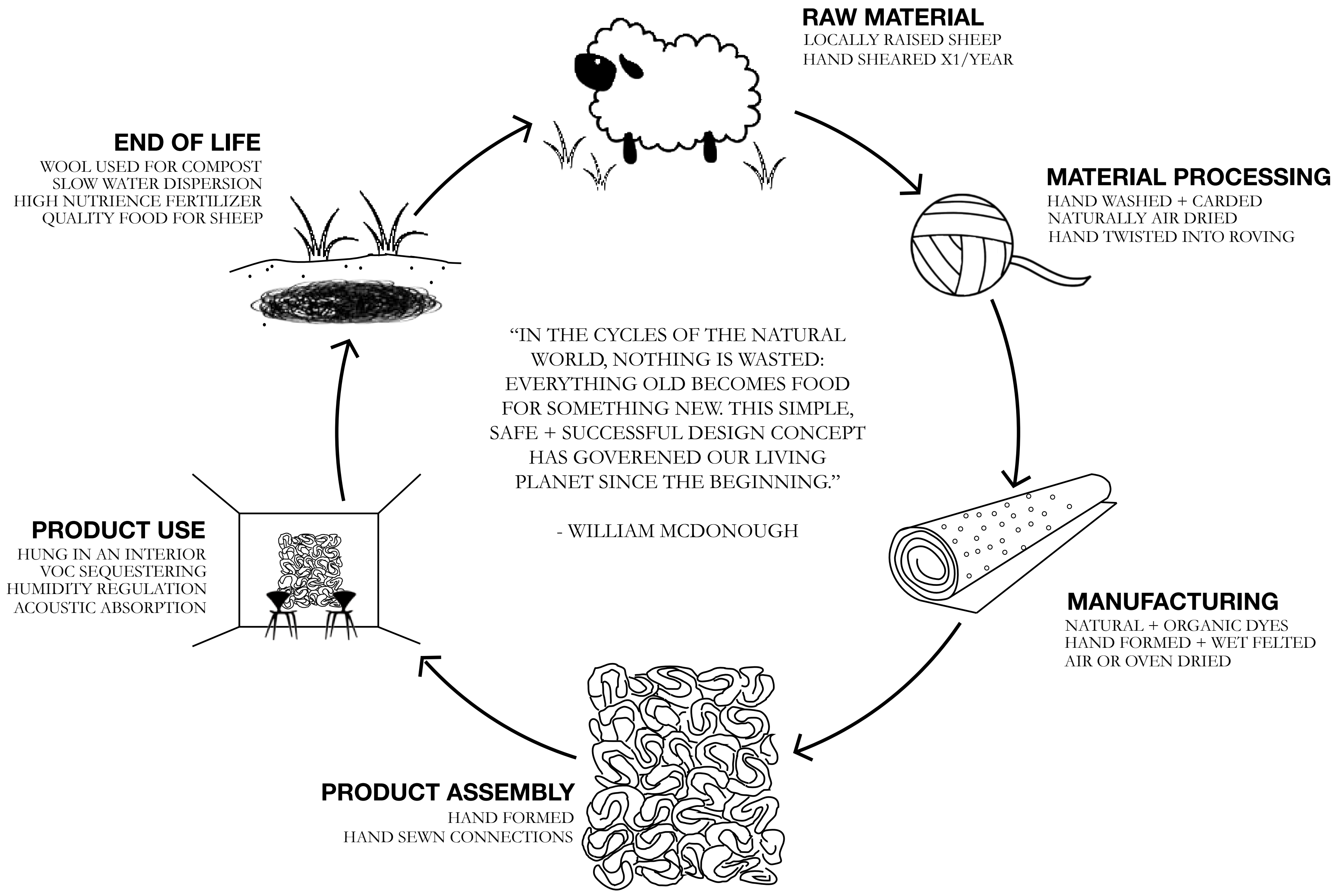
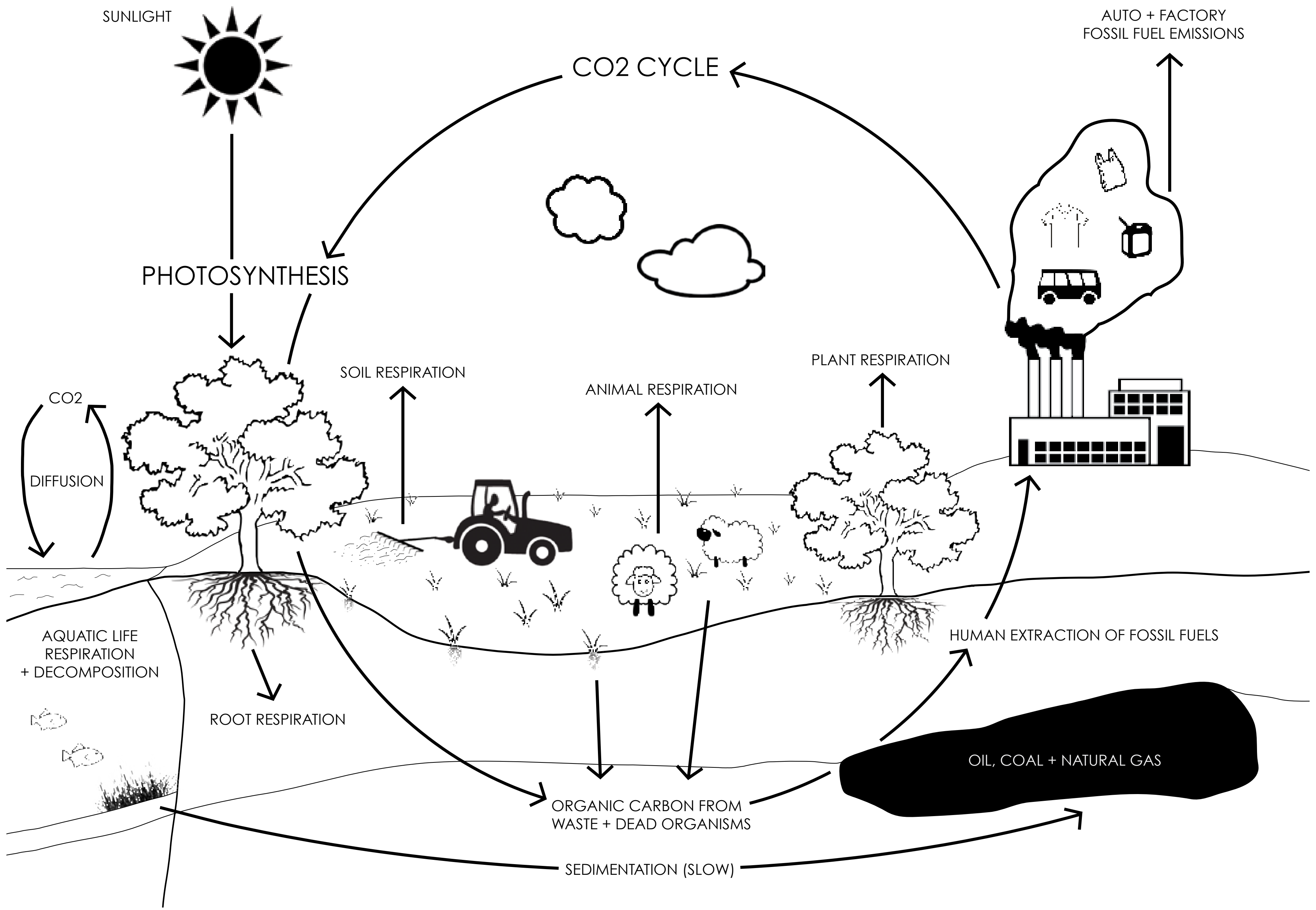


Figure 4.5

Figure 4.6

CO2 + PHOTOSYNTHESIS PROCESS DIAGRAM

Figure 4.7



AS A *COMPETITIVE* NATURAL FIBER
- MUST MEET 3 BASIC REQUIREMENTS:

1. BE AVAILABLE IN SUFFICIENT QUANTITIES
2. BE ECONOMICALLY COMPETITIVE
3. HAVE SUFFICIENTLY LONG, STRONG AND FINE FIBERS

IMPORT/EXPORTS

- U.S. IMPORTS 40% OF ITS WOOL FROM NEW ZEALAND + 30% FROM AUSTRALIA

- CHINA BUYS 70% OF ALL U.S. WOOL EXPORTS

- GLOBAL WOOL PRODUCTION IN 2013 2.8 MILLION LBS

- U.S. WOOL PRODUCTION IN 2013 28.5 MILLION LBS

SUPPLY + DEMAND

- DEMAND FOR WOOL HAS DECLINED SINCE THE MID 1940'S WITH THE ADVENT OF SYNTHETIC FIBER PRODUCTION

- SUPPLY IS LIMITED BY FARMLAND, ANIMAL POPULATION, WEATHER, NATURAL DISASTERS, DISEASE, INSECTS ETC. THEREFORE SUPPLY CAN BE UNPREDICTABLE AND CANNOT BE INCREASED AT WILL TO RESPOND TO DEMAND

AS A NATURAL FIBER

- NATURAL FIBERS ARE HIGHLY VARIABLE

- 41% OF GLOBAL WOOL IS 'COARSE'

WOOL CHALLENGES + OPPORTUNITIES

Figure 4.8

ACOUSTIC ABSORPTION

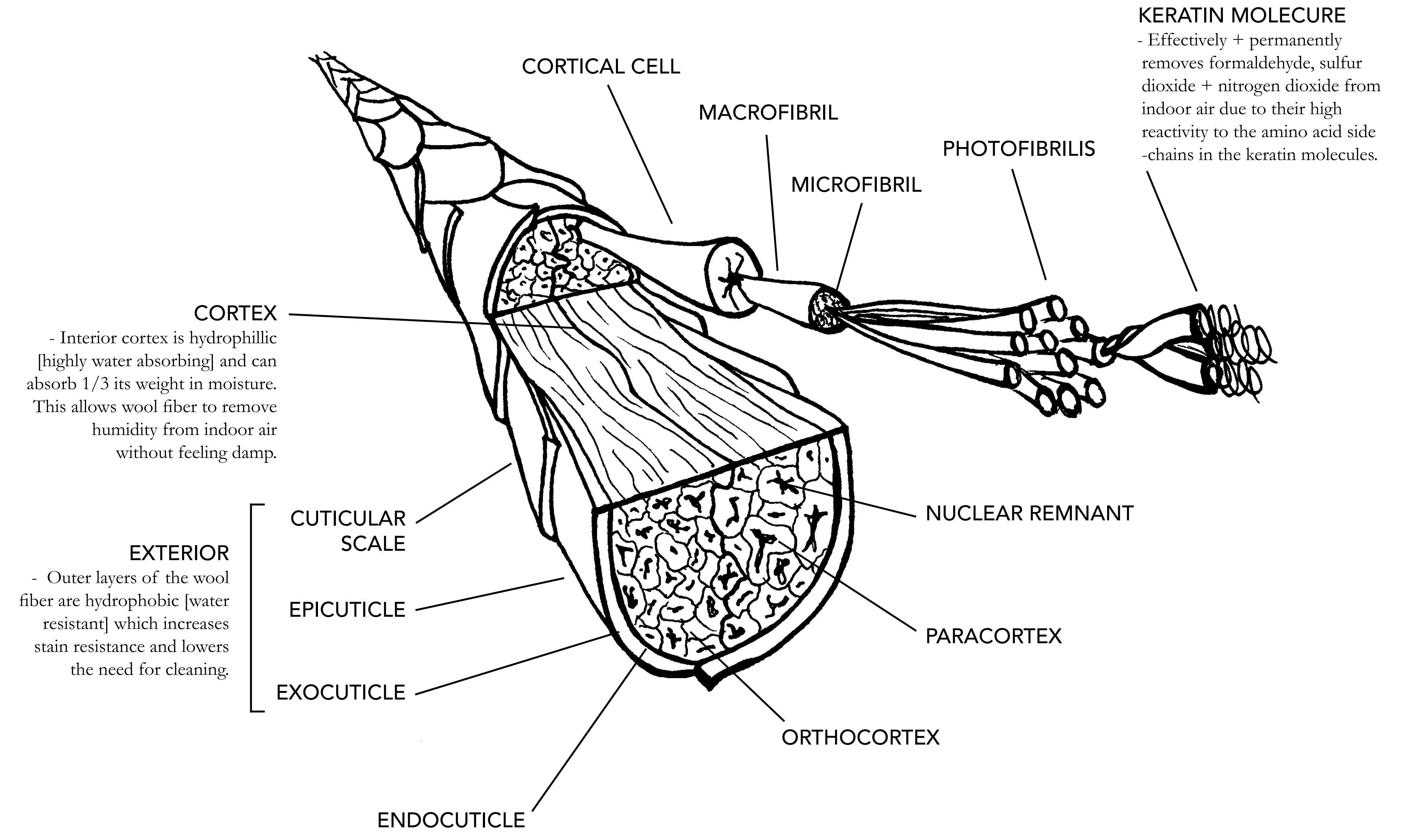
INDOOR AIR QUALITY - VOC'S

HUMIDITY REGULATION

UNIQUE WOOL PROPERTIES FOR INTERIOR APPLICATIONS

WOOL FIBER COMPOSITION

Figure 5.1



CUTICLE
On the outside of the wool fiber is a protective layer of scales callec cuticle cells. They overlap like scales and the exposed edges of the cells face away from the root end, so there's more friction when you rub the fiber in one direction than the other. This helps wool expel dirt and gives it the ability to felt. Wool felts when fibers are aligned in opposite directions and they become tangled. The scales have a waxy coating chemically bound to the surface, that stops water from penetrating the fiber but allows absorptions of water vapour. This makes wool water-repellant and resistant.

CORTEX
The cortex - the internal cells - make up 90% of the fiber. There are two main types of cortical cells - ortho-cortical and para-cortical. Each has a different chemical composition. In finer fibers, these two types of cells form in two distinctive halves. The cells expand differently when they absorb moisture, making the fiber bend - this creates the crimp in wool. In coarser fibers, the para-cortical and orth-cortical cells form more randomly, so there is less crimp.

CORTICAL CELL
The cortical cells are surrounded and help together by a cell membrane complex, acting similarly to mortar holding bricks together in a wall. The cell membrance complex contains proteins and waxy lipids and runs through the entire fiber. The molecules in this region have fairly weak intermolecular bonds, which can break down when exposed to continued abrasion and strong chemicals. The cell membrane complex allows easy uptake of dye molecules.

MACROFIBRIL
Inside the cortical cells are long filaments called macrofibrils. These are made up of bundles of even finer filaments called microfibrils, which are surrounded by a matrix region.

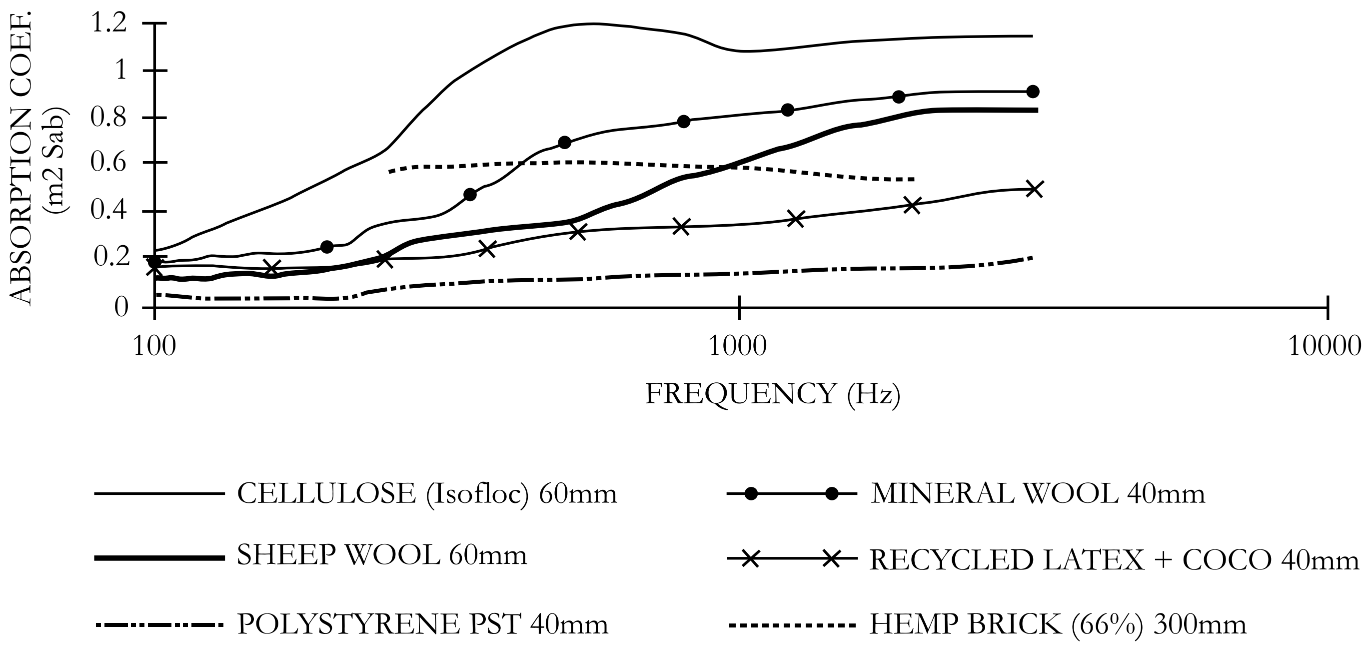
MATRIX
The matrix consists of high sulfur proteins. This makes wool absorbent because sulfur atoms attract water molecules. Wool can absorb up to 30% of its weight in water and can also absorb and retain large amounts of dye. This region is also responsible for wool's fire resistance and anti-static properties.

MICROFIBRIL
Within the matrix area, there are embedded smaller units called microfibrils. The microfibrils in the matrix are rather like steel rods embedded in reinforced concrete to give strength and flexibility. The microfibrils contain pairs of twisted molecular chains, called photofibrilis and inside the keratin molecure.

TWISTED MOLECULAR CHAIN AND HELICAL COIL
Within the twisted photofibrilis molecular chains are protein chains called keratin molecure, that are coiled in a helical shape much like a spring. This structure is stiffened by hydrogen bonds and disulphide bonds within the protein chains. They link each coil of the helix, helping to prevent it stretching. The helical coil - the smallest part of the fiber - gives wool is flexibility, elasticity and resilience, which helps wool fabric keep its shape and remain winkle-free in use. The keratin molecure effectively and permanently removes VOC's from indoor air due to the high reactivitiy of the toxins to the amino-acid side chains.

Figure 5.2

ACOUSTIC ABSORPTION



ACOUSTIC PERFORMANCE OF BUILDING ELEMENTS WITH ORGANIC INSULATION MATERIALS

33rd Internoise | 2004 | Prague, CZ

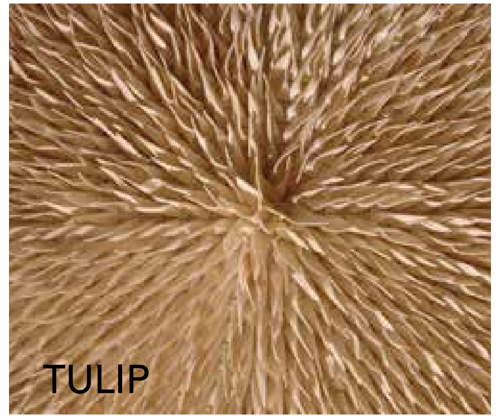
Figure 5.3

INDUSTRIAL FELT PANEL ACOUSTIC TESTING

ANNE KYYRO QUINN STUDIO | LONDON, ENGLAND

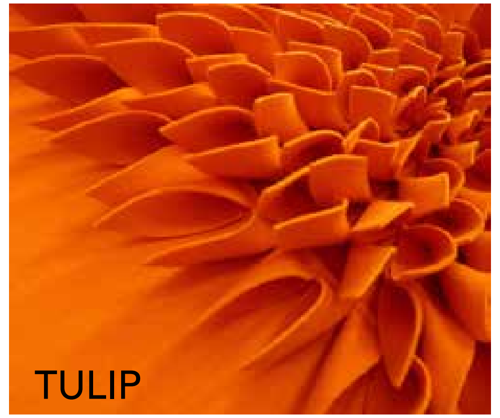
FELT TAPESTRY PANEL

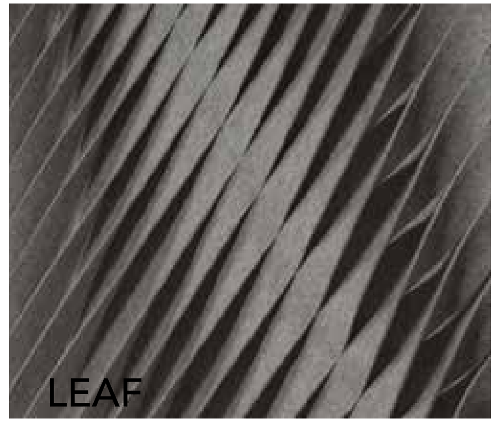
Figure 5.4



ACOUSTIC MOUNTED PANEL

Figure 5.5





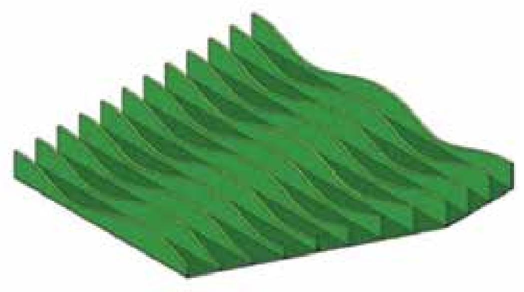


Figure 5.6

3-D FELTS, 2MM, ABSORPTION COEFFICIENTS										
Felt Style	Frequency (Hz)								ISO Class	NRC
	63	125	250	500	1000	2000	4000	8000		
Laine	0.28	0.20	0.23	0.36	0.56	0.65	0.76	0.69	D(H)	0.45
Tulip	0.22	0.18	0.19	0.32	0.57	0.64	0.72	0.65	D(H)	0.43

- ISO CLASS : D
- STRONG HIGH EFFICIENCY RATING
- MID TO HIGH-RANGE FREQUENCIES (1000 Hz OR GREATER)
- APPLICATION: USEFUL TO LIMIT NOISE FROM CONVERSATIONAL SPEECH, FOOTFALLS OR HIGH PITCHED MACHINEIRY

FELT TAPESTRY PANEL

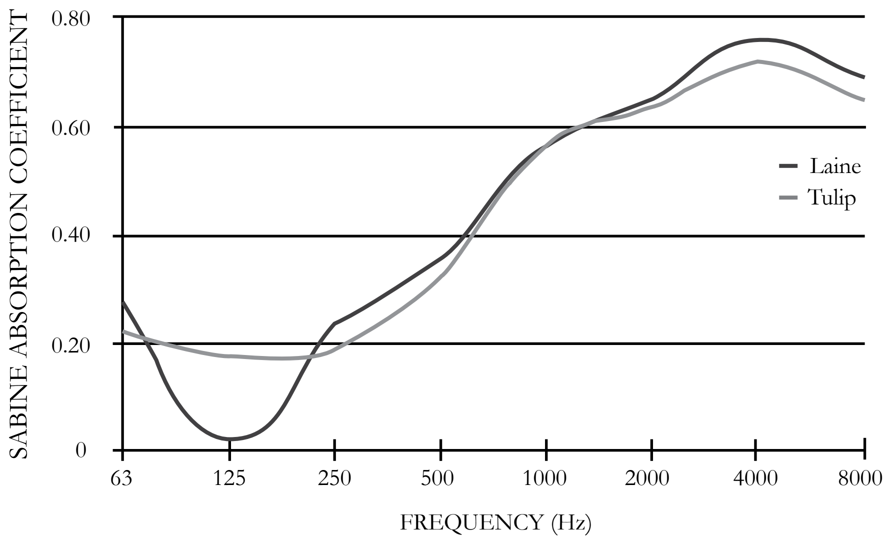


Figure 5.8

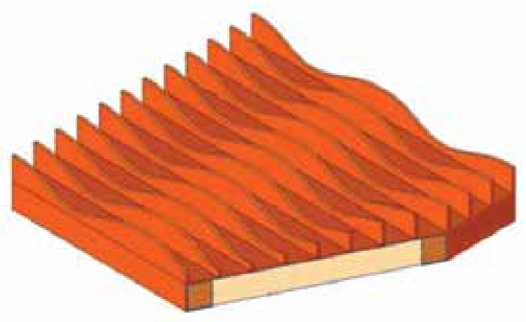


Figure 5.7

ACOUSTIC PANEL, 100MM, ABSORPTION COEFFICIENTS										
Felt Style	Frequency (Hz)								ISO Class	NRC
	63	125	250	500	1000	2000	4000	8000		
Leaf	0.00	0.28	1.20	1.38	01.10	1.13	1.00	1.83	A	1.20
Tulip	0.00	0.37	0.22	1.32	1.15	01.07	1.09	2.12	A	1.19

- ISO CLASS : A
- HIGHEST RANKING
- 50mm FOAM FILLING
- CONTROLS ECHOES AND REVERBERATION
- APPLICATION: USEFUL WHERE STRONG SOUND ABSORPTION AND SPEECH INTELLIGIBILITY ARE REQUIRED

ACOUSTIC MOUNTED PANEL

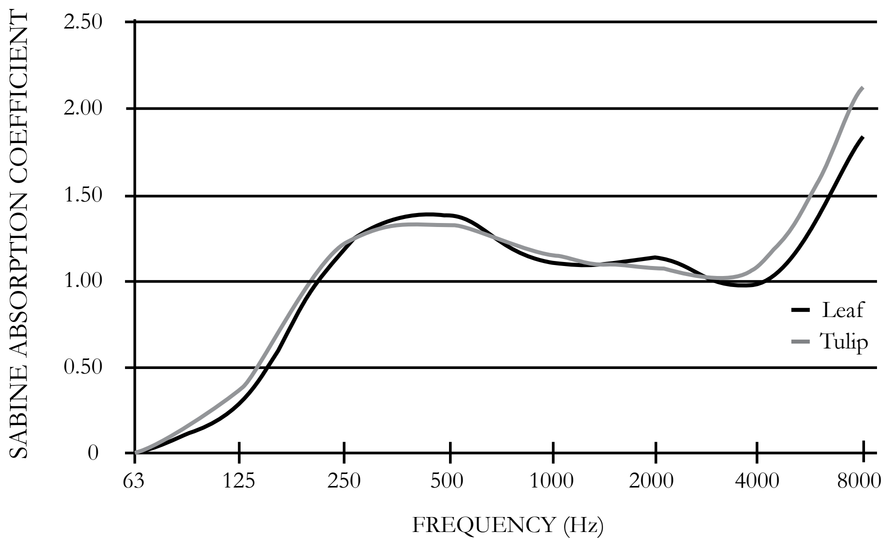
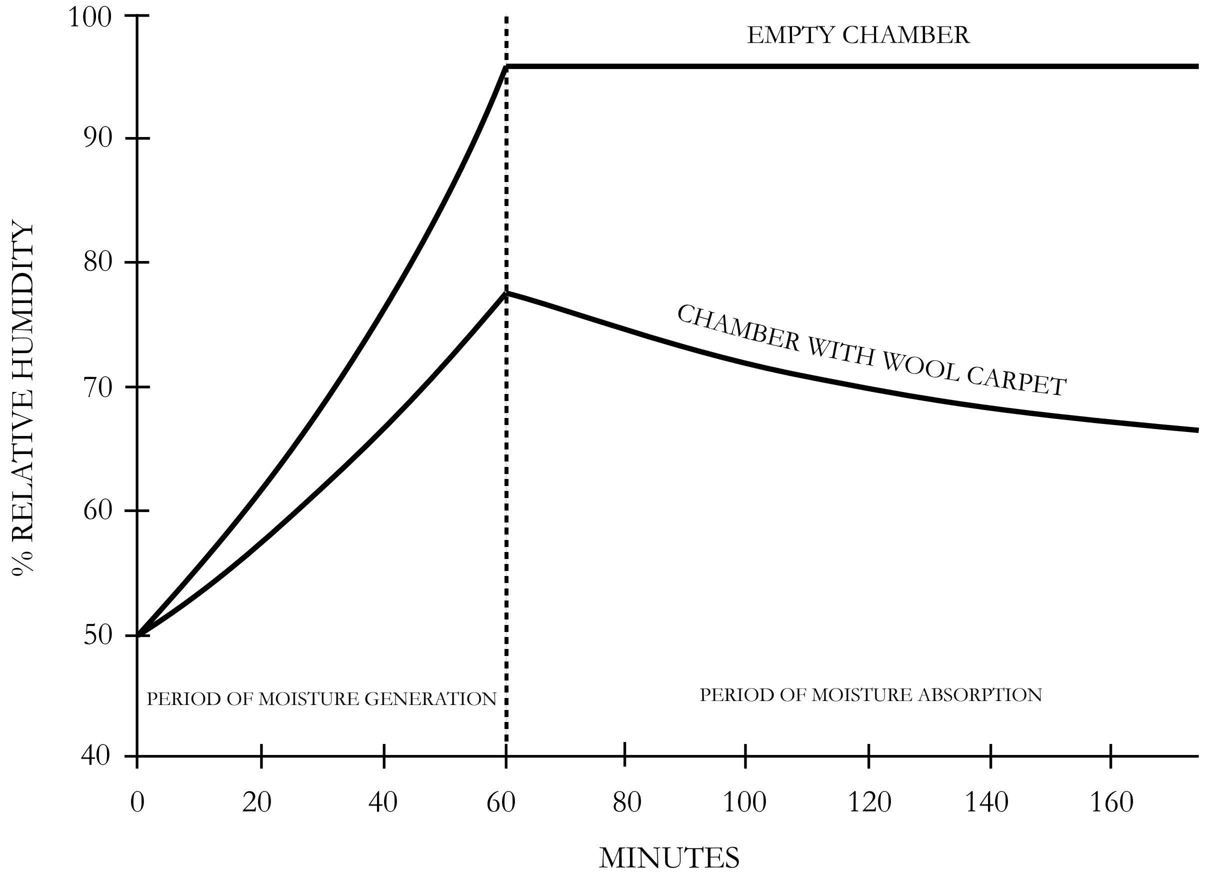


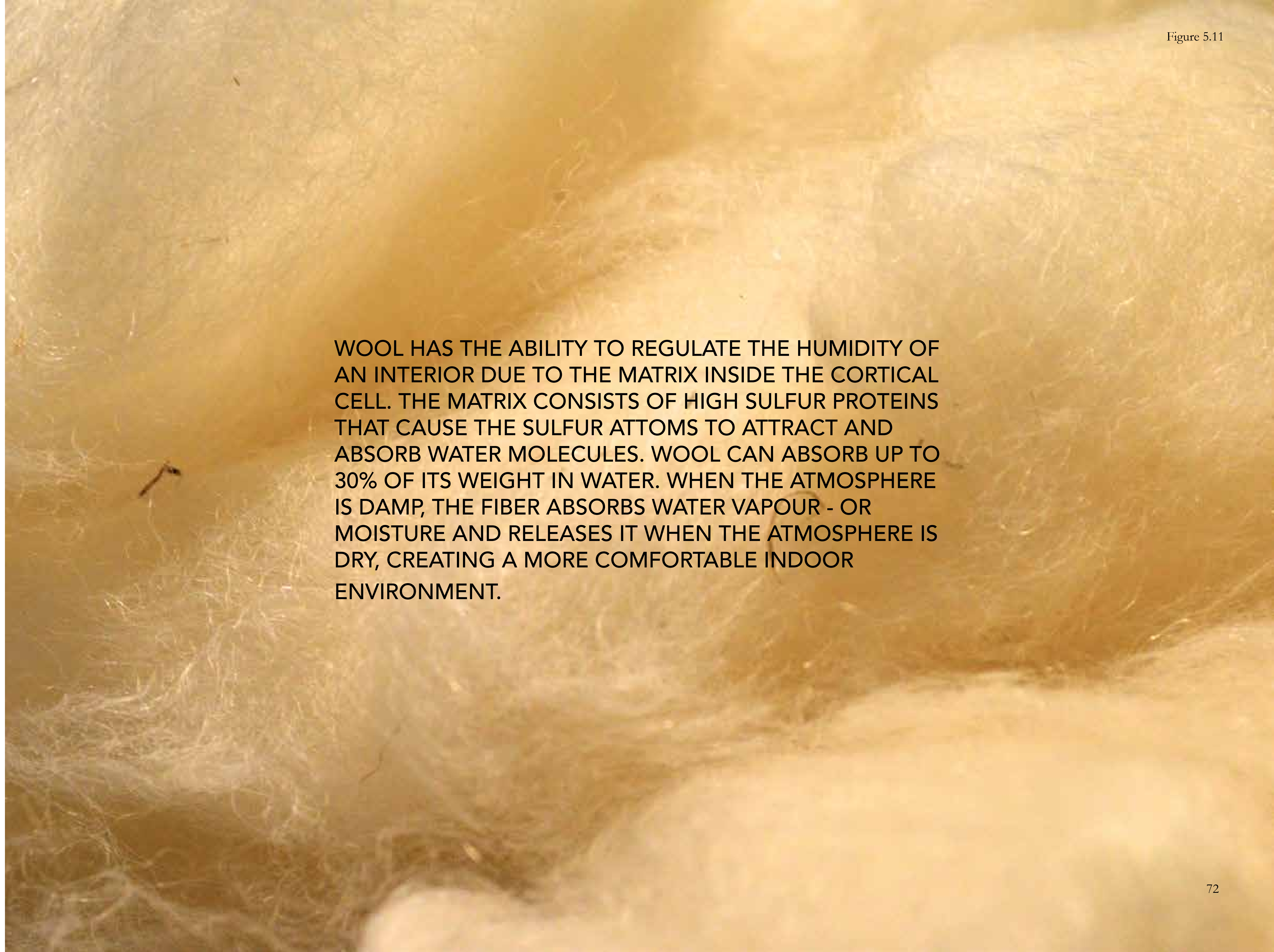
Figure 5.9

HUMIDITY REGULATION



EFFECT OF WOOL FIBER USED FOR CARPETS ON
AMBIENT RELATIVE HUMIDITY IN A SMALL TEST CHAMBER
Meade European Community Respiratory Health Study | 1998
Figure 5.10

Figure 5.11



WOOL HAS THE ABILITY TO REGULATE THE HUMIDITY OF AN INTERIOR DUE TO THE MATRIX INSIDE THE CORTICAL CELL. THE MATRIX CONSISTS OF HIGH SULFUR PROTEINS THAT CAUSE THE SULFUR ATTOMS TO ATTRACT AND ABSORB WATER MOLECULES. WOOL CAN ABSORB UP TO 30% OF ITS WEIGHT IN WATER. WHEN THE ATMOSPHERE IS DAMP, THE FIBER ABSORBS WATER VAPOUR - OR MOISTURE AND RELEASES IT WHEN THE ATMOSPHERE IS DRY, CREATING A MORE COMFORTABLE INDOOR ENVIRONMENT.

INDOOR AIR QUALITY TERMINOLOGY

IEQ - INDOOR ENVIRONMENTAL QUALITY

"Indoor Environmental Quality (IEQ) refers to the quality of a building's environment in relation to the health and wellbeing of those who occupy space within. IEQ is determined by many factors, including lighting, air quality, and damp condutions. Workers are often concerned that they have symptoms or health conditions form exposure to contaminants in the buildings where they work, this of often referred to as Sick Building Syndrom (SBS)" - Center For Disease Control and Prevention

IAQ - INDOOR AIR QUALITY

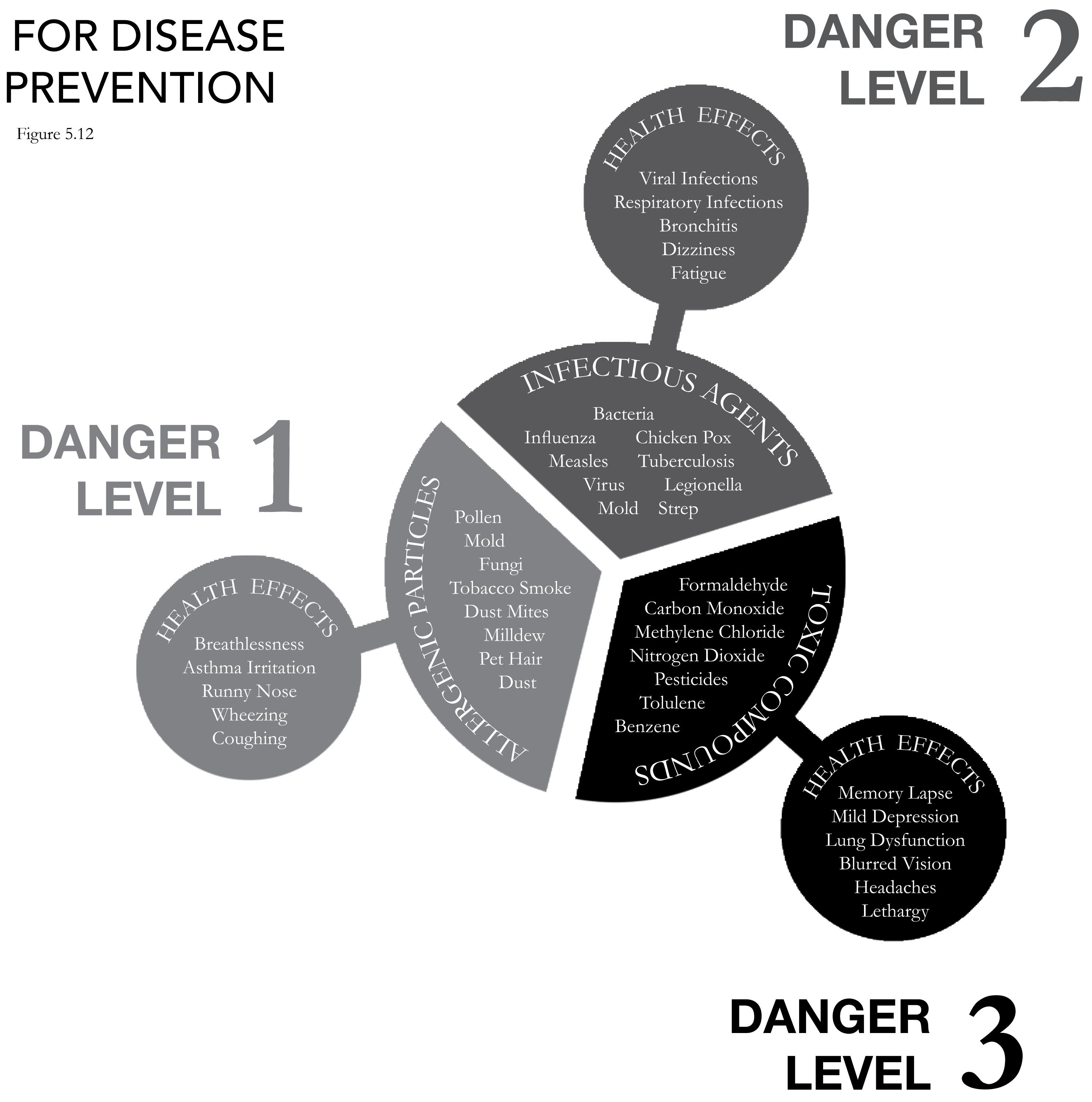
"Indoor Air Quality (IAQ) is a term referring to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants." - Environmental Protection Agency

VOC - VOLATILE ORGANIC COMPOUND

"Volatile Organic Compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide variety of products numbering in the thousands. Examples include: paint and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings and office equipment." - Environmental Protection Agency

U.S. CENTER FOR DISEASE CONTROL + PREVENTION

Figure 5.12



9 PRIORITY CHEMICAL POLLUTANTS IN US HOMES:
INDOOR ENVIRONMENT DEPARTMENT, ENVIRONMENTAL ENERGY TECHNOLOGIES DIVISION

ACETALDEHYDE
CANCER + NONCANCER
"primary source in indoor environments is construction lumber. Secondary source comes from the combustion of hydrocarbons during cooking, smoking and drinking alcohol"

ACROLEIN
NONCANCER
"used as a chemical intermediate in the production of acrylic acid and its esters. It is used directly as an aquatic herbicide and algicide in irrigation canals, as a microbiodice in oil wells, liquid hydrocarbon fuels, cooling-water towers and water treatment ponds, and as a slimicide in the manufacture of paper. In addition, acrolein is produced from the combustion of fossil fuels, tobacco smoke and pyrolyzed animal and vegetable fats"

BENZENE
CANCER
"formed from both natural processes and human activities. Natural sources include volcanoes and forest fires and is a natural part of crude oil, gasoline and cigarette smoke. Benzene is also used industrially to make other chemicals in the production of plastics, resins, nylon and other synthetic fibers, rubbers, dyes, detergents, drugs and pesticides. Benzene found indoors comes from glues, paints, furniture wax and detergents."

1,3-BUTADIENE
CANCER
"primary sources of 1,3-butadiene in indoor environments is tobacco smoke. The overheating of certain cooking oils release butadiene into the air, as well as the fugitive emissions from wood stoves and fireplaces."

1,4-DICHLOROBENZENE
CANCER
"is used as a fumigant for the control of moths and mildew and as a space deodorant for toilets and refuse containers. The general population is mainly exposed to 1,4-Dichlorobenzene through breathing vapors from products containing the chemical, used in the home for mothballs and toilet deodorizer blocks."

FORMALDEHYDE
CANCER + NONCANCER
"An important chemical used widely by industry to manufacture building materials and numerous household products. Sources indoors include: building materials, smoking, household products and the use of unvented, fuel burning appliances like gas stoves or kerosene space heaters. Formaldehyde is also used to add permanent-press qualities to clothing and draperies, as a component of glues and adhesives and as a preservative in some paint and coating products. In homes, the most significant source of formaldehyde is likely to be pressed wood products using urea-formaldehyde (UF) resins. Pressed wood products used indoors include: particle board (used as subflooring, shelving, cabinetry and furniture); hardwood plywood paneling (used for decorative wall covering, cabinets and furniture); and medium density fiberboard (MDF) (used for drawer fronts, cabinets and furniture tops). Medium density fiberboard contains a higher resin-to-wood ratio than any other UF pressed wood products and is generally recognized as being the highest formaldehyde-emitting pressed wood product. Formaldehyde is also released through combustion sources and in tobacco smoke"
-Oven cleaning for 5.5h – released a concentration of 417 (lg/m3)
-Cooking fish for 3h – 129(lg/m3)

NAPHTHALENE
CANCER + NONCANCER
"used as a fumigant for the control of moths and as a space deodorizer for closets or toilet bowls. Naphthalene is very common in building materials: flooring (vinyl flooring, carpet, underpad), pressed wood materials, vinyl furniture, foam, paint, primer, coating, caulking, adhesives and many common cleaning products."

NITROGEN DIOXIDE
NONCANCER
"primary source of nitrogen dioxide in indoor environments are combustion processes, such as unvented combustion applianzed ex. Gas stoves, vented appliances with defective installations, kerosene heaters, welding and tobacco smoke."
-Unvented fireplace use for 1h - 2422 (lg/m3)
-Oven cleaning for 5.5h – 1435 (lg/m3)
-Cooking French fries on gas stove for 2.5h – 722 (lg/m3)

FINE PARTICLE POLLUTION
NONCANCER
"fine particle pollution describes particulate matter that has 2.5 micrometers in diameter and smaller than 1/30th the diameter of a human hair. Fine particle pollution can be emitted directly or formed secondarily in the atmosphere. Example: Sulfates are a type of secondary particle formed from sulfur dioxide emission from power plants and industrial facilities."

VOC SOURCES + HUMAN HEALTH

Figure 5.13

VOC - VOLATILE ORGANIC COMPOUND	SOURCE	ADVERSE HUMAN HEALTH EFFECTS
FORMALDEHYDE		
NITROGEN DIOXIDE		
SULFUR DIOXIDE		

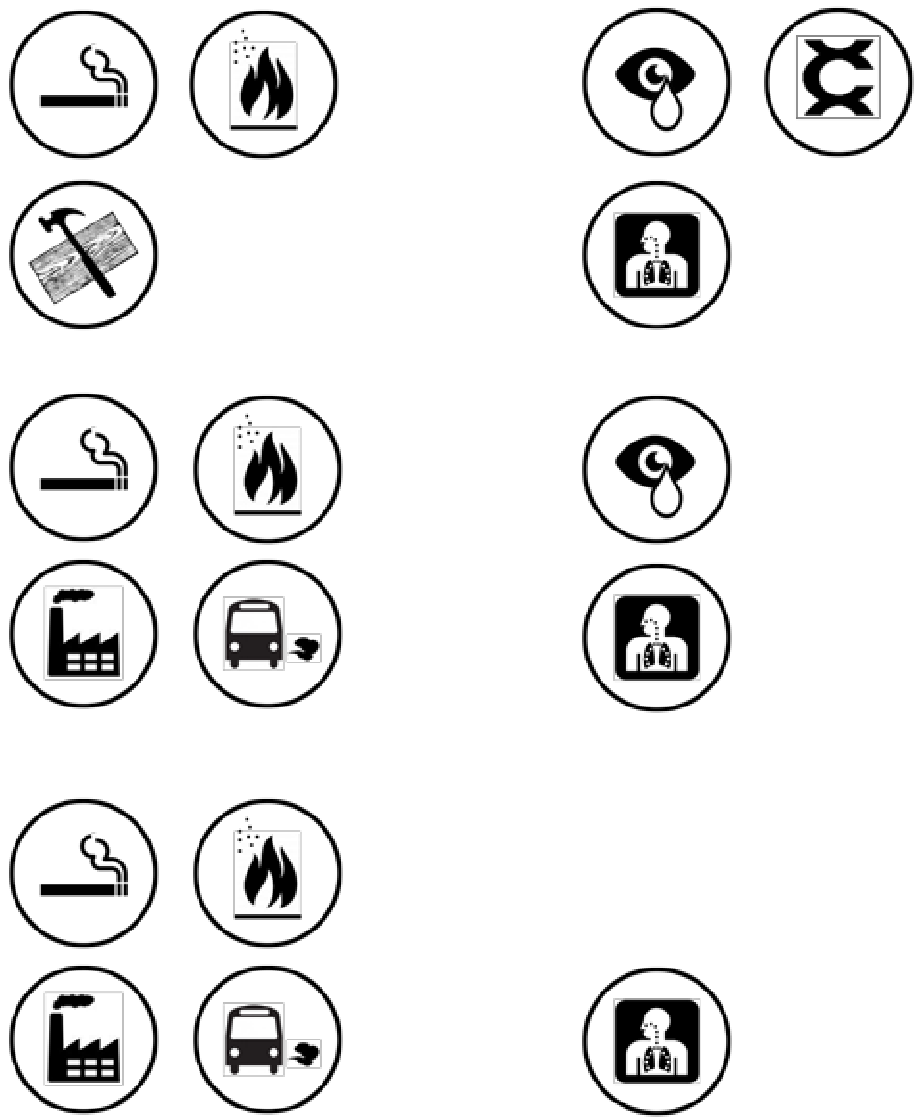
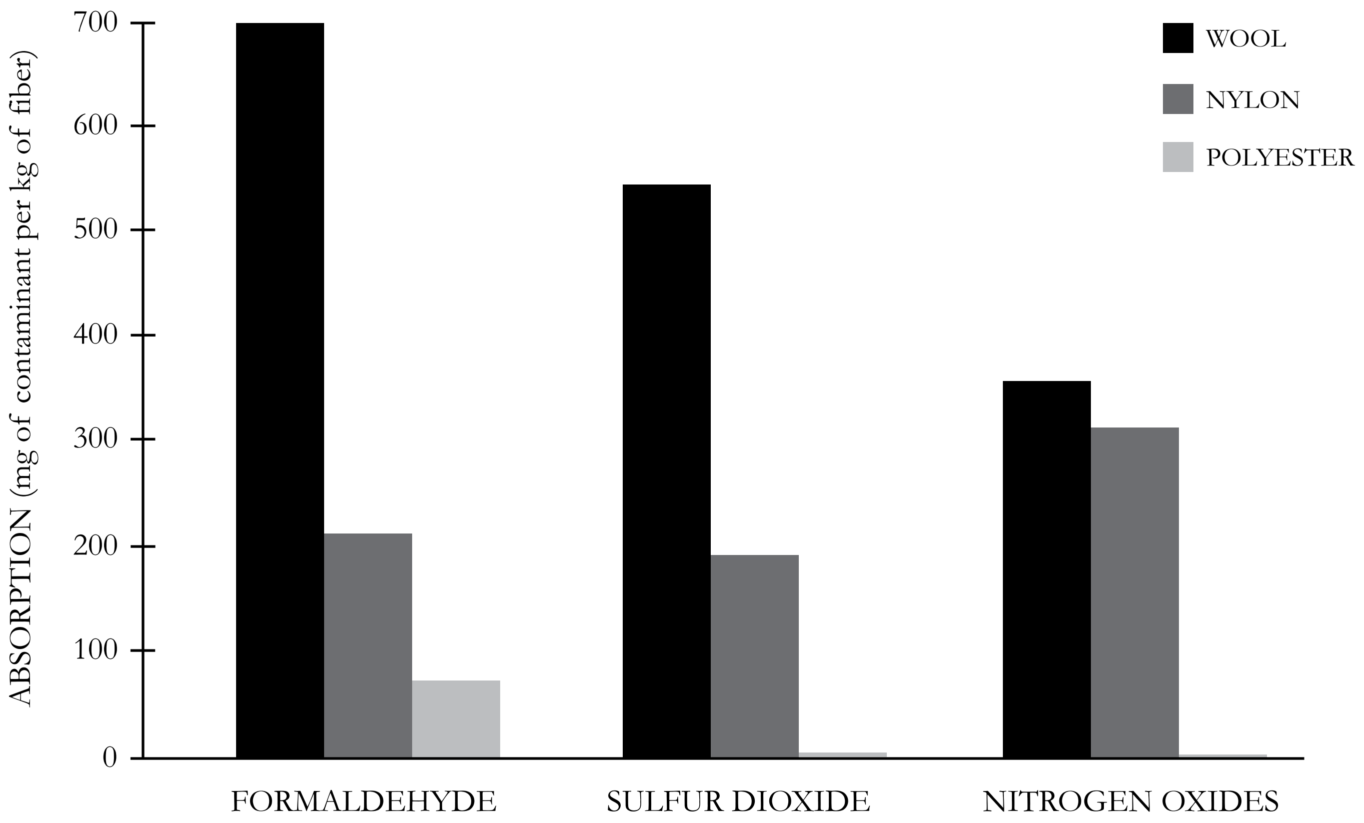


Figure 5.14

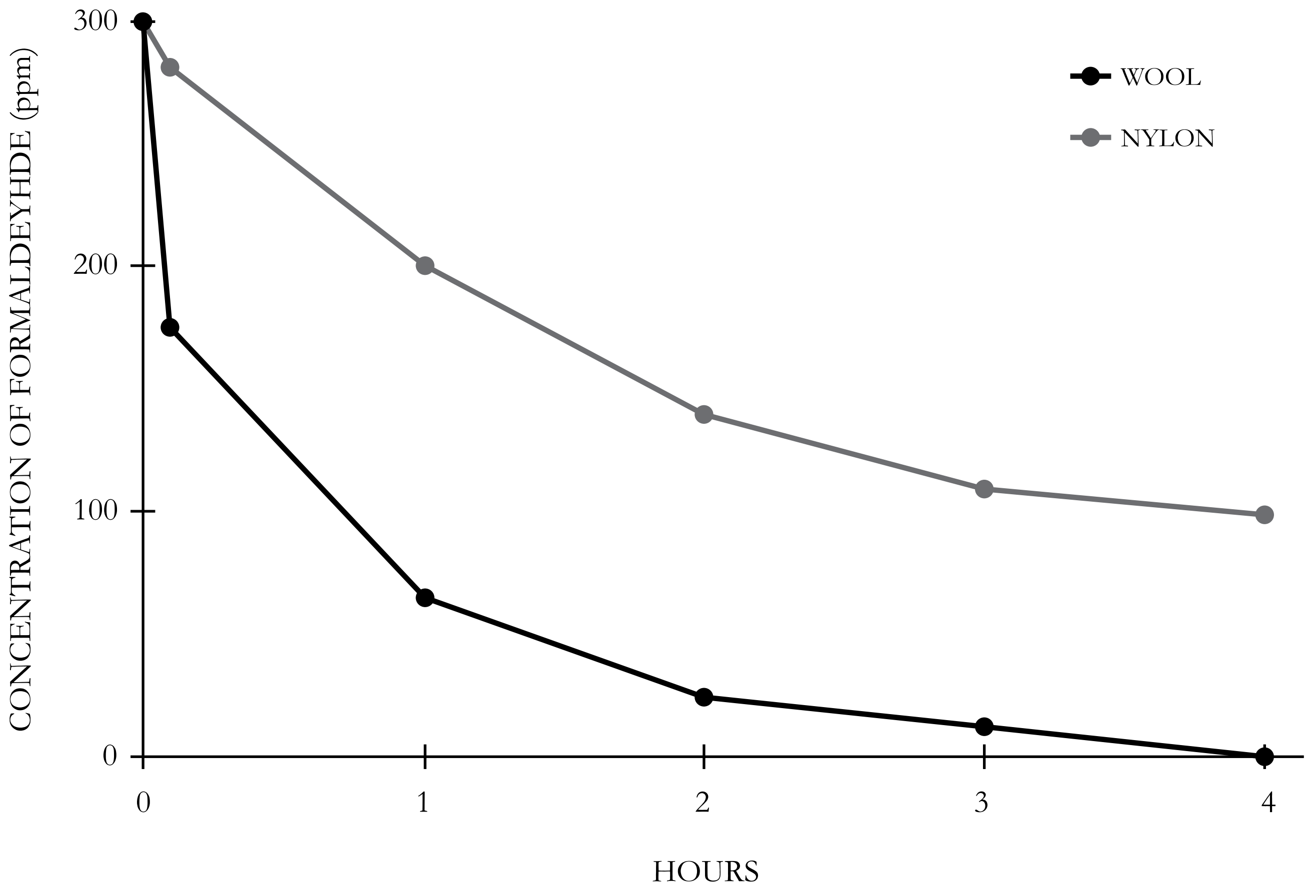
FIBER ABSORPTION OF INDOOR AIR CONTAMINANTS



COMPARISON OF THE ABSORPTIONS OF INDOOR AIR CONTAMINANTS BY CARPET PILE FIBERS SUSPENDED IN A TEST CHAMBER FOR 24 HRS

AgResearch Lincoln | Christchurch, New Zealand

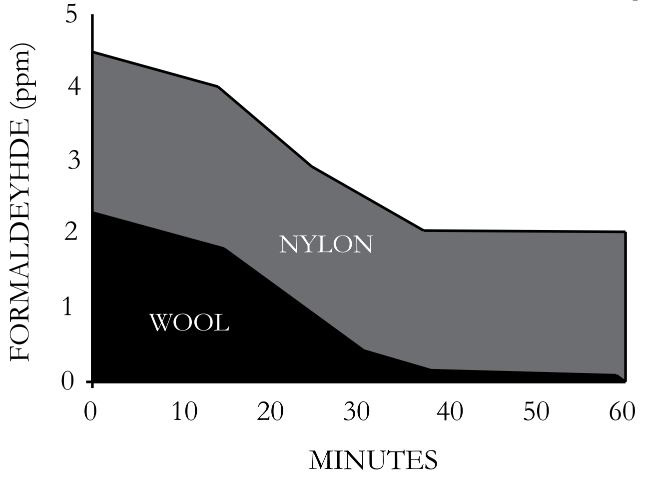
Figure 5.15



COMPARISON OF THE ABSORPTIONS OF INDOOR AIR CONTAMINANTS BY CARPET PILE FIBERS SUSPENDED IN A TEST CHAMBER FOR 24 HRS + 60 MINS

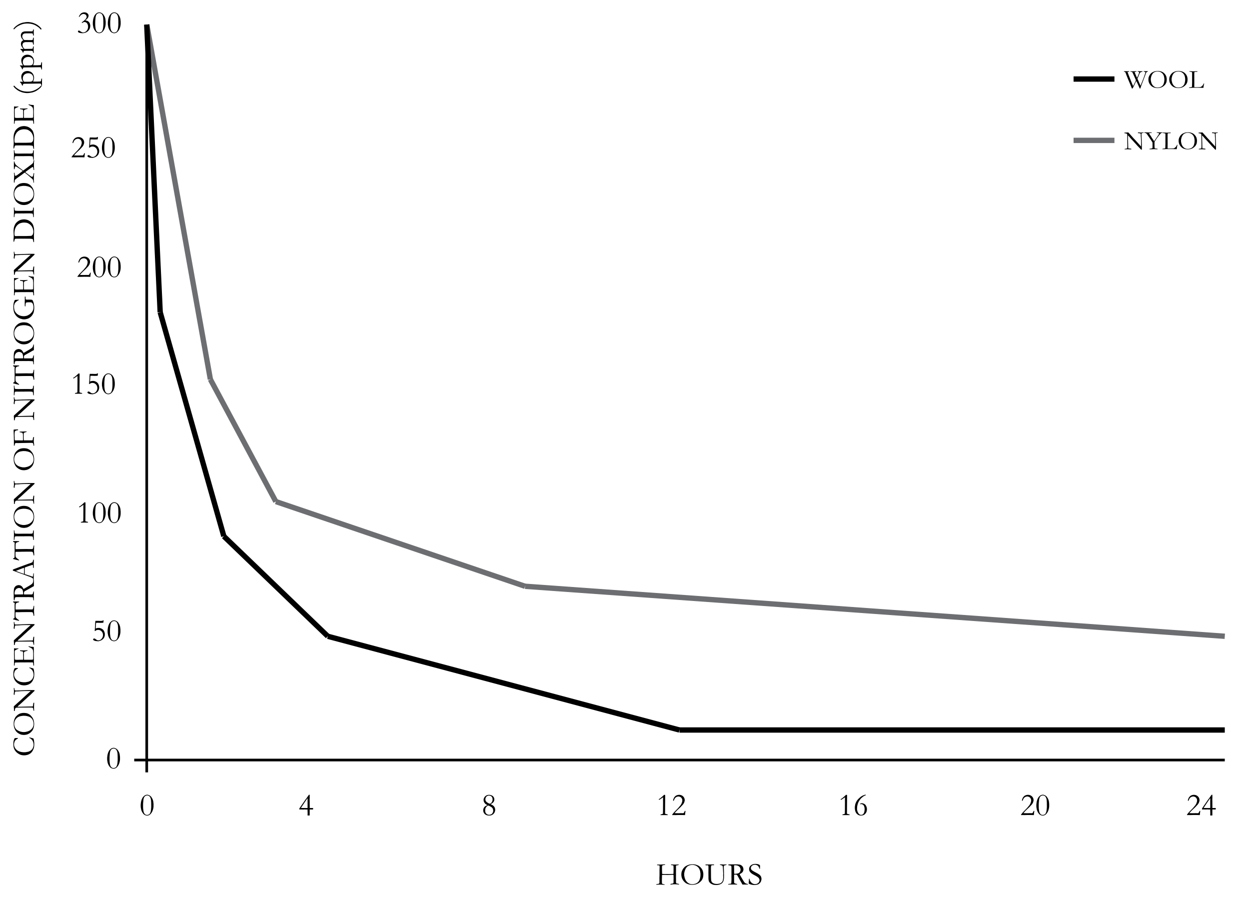
AgResearch Lincoln | Christchurch, New Zealand

Figure 5.16



FORMALDEHYDE

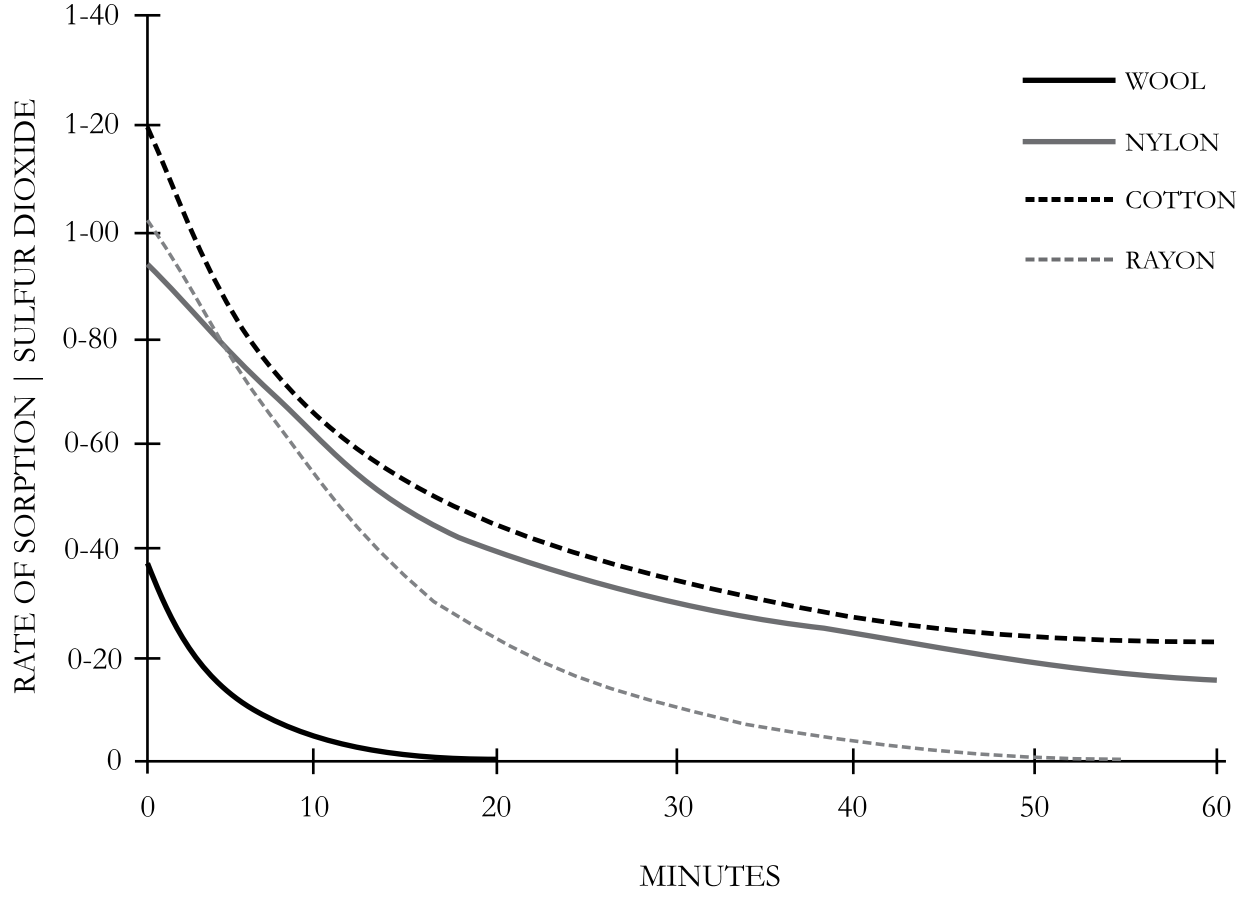
NITROGEN DIOXIDE



ABSORPTION RATE COMPARISON OF NITROGEN DIOXIDE USING WOOL AND NYLON HANKS IN A TEST CHAMBER FOR 24 HOURS
WRONZ Euro Lab Ltd. | West Yorkshire, United Kingdom

Figure 5.17

SULFUR DIOXIDE



COMPARISON OF SULFUR DIOXIDE SORPTION RATES FOR WOOL, COTTON, RAYON AND NYLON FIBERS IN A TEST CHAMBER, EQUILIBRATED AT 84 F
Environmental and Medical Sciences Division of UK Atomic Energy Research | United Kingdom

Figure 5.18

PRECEDENTS

CLAUDY JONGSTRA

LOCATION : SPANNUM, NETHERLANDS

MATERIAL : 100% WOOL ROVING

PROCESSING : RAISES HER OWN SHEEP, MAKES BY HAND, NATURAL DYE WITH GARDEN PLANTS

FINISHED PIECES: ACOUSTIC WALL PANELS, ART PANELS, OVERSCALE ART INSTALLATIONS

Figure 6.1

Figure 6.2

Figure 6.3

Figure 6.4

Figure 6.5

Figure 6.6

Figure 6.7

Figure 6.8

Figure 6.9

JANICE ARNOLD

LOCATION : NEW YORK, NY

MATERIAL : INDUSTRIAL FELT + NATURAL WOOL ROVING

PROCESSING : MECHANICAL MANUFACTURING + HAND WORK, SYNTHETIC + NATURAL DYES

FINISHED PIECES: ACOUSTIC PANELS, SPACE INSTALLATIONS, CURTAINS + ART PIECES

Figure 6.10

Figure 6.11

ROBERT MORRIS

LOCATION : NEW YORK, NY

MATERIAL : INDUSTRIAL FELT

PROCESSING : MECHANICAL MANUFACTURING + HAND WORK, SYNTHETIC DYES

FINISHED PIECES: INSTALLATION ART + SCULPTURE

Figure 6.12

Figure 6.13

Figure 6.14

Figure 6.15

Figure 6.16

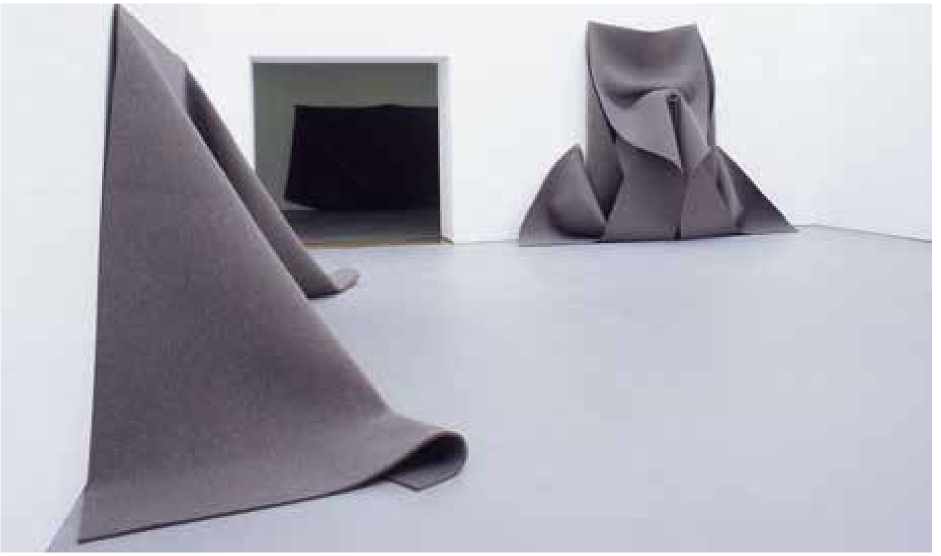


Figure 6.17

Figure 6.18

Figure 6.19

Figure 6.20

Figure 6.21

ANNE KYYRO QUINN

LOCATION : LONDON, UK

MATERIAL : INDUSTRIAL FELT

PROCESSING : MECHANICAL MANUFACTURING + HAND WORK, SYNTHETIC DYES

FINISHED PIECES: ACOUSTIC WALL PANELS, ART PANELS, SOFT INTERIOR DECOR FURNISHINGS

Figure 6.22

Figure 6.23

Figure 6.24

DANA BARNES

LOCATION : NEW YORK, NY

MATERIAL : 100% WOOL ROVING, YARN + INDUSTRIAL FELT

PROCESSING : BY HAND, SYNTHETIC DYES

FINISHED PIECES: OVERSCALE ART, RUGS, WALL COVERING, SEATING

Figure 6.26

Figure 6.25

Figure 6.27

Figure 6.28

Figure 6.29

Figure 6.30

Figure 6.31

Figure 6.32

KATHRYN WALKER

LOCATION : TORONTO, CANADA

MATERIAL : INDUSTRIAL FELT

PROCESSING : MECHANICAL MANUFACTURING + SYNTHETIC DYES

FINISHED PIECES: ACOUSTIC WALL + CEILING PANELS, ART PANELS, SOFT INTERIOR DECOR FURNISHINGS

Figure 6.33

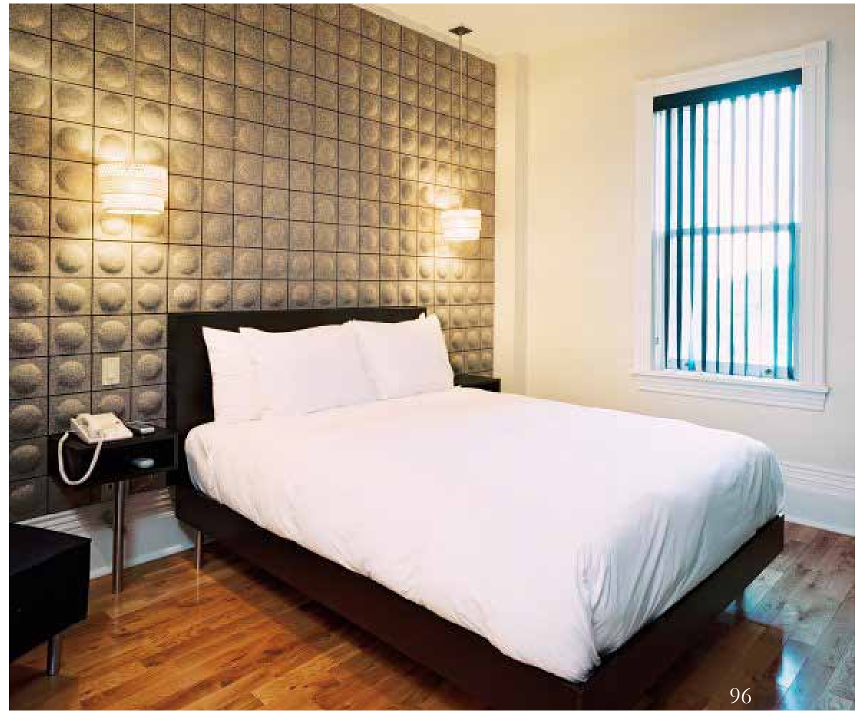


Figure 6.34

JOSEPH BEUYS

WAS LOCATED IN GERMANY

MATERIAL : INDUSTRIAL FELT

PROCESSING : MECHANICAL MANUFACTURING + NATURAL COLOR

FINISHED PIECES: LARGE SCALE ART INSTALLATIONS

Figure 6.36

Figure 6.35

Figure 6.37

Figure 6.38

Figure 6.39

Figure 6.40

Figure 6.41

RUFF COLLAR + RUFF ROSE PANEL

FALL 2012

A MODERN VERSION OF A 17TH CENTURY RUFF COLLAR MADE WITH INDUSTRIAL FELT. THIS FORM THEN INSPIRED THE CREATION OF AN INTERIOR SKIN, ALSO USING INDUSTRIAL FELT AND SYNTHETIC DYES USING A WICKING TECHNIQUE TO CREATE FORCED DEPTH WITHIN THE FORM. THIS PANEL WAS CREATED AS AN ACOUSTIC PANEL FOR CEILING OR WALL APPLICATION.

Figure 6.42

Figure 6.43

Figure 6.44

Figure 6.45

Figure 6.46

Figure 6.47

Figure 6.48

Figure 6.49

NATURALLY DYED WOOL ROVING

1. TO PREPARE NATURAL DYE: CHOP PLANT, VEGETABLE, FRUIT OR ROOT INTO SMALL PIECES.
2. BOIL ORGANIC MATERIAL IN A POT OF WATER AND SIMMER FOR AN HOUR.
3. WHILE PREPARING DYE, SOAK WOOL IN A SALT BATH FOR BERRY DYES OR A VINEGAR BATH FOR PLANT DYES.
4. DRAIN ORGANIC MATERIAL FROM DYE AND KEEP LIQUID.
5. DRAIN ALL EXCESS WATER FROM WOOL IN DYE BATH.
6. PLACE WOOL IN LUKE WARM DYE WATER ON THE STOVE AND SLOWLY BRING TO A BOIL. BE CAREFUL NOT TO STIR TOO OFTEN OR CAUSE AGITATION, AS IT WILL START FELTING. BOIL TILL THE WATER RUNS CLEAR AND DYE IS ABSORBED INTO WOOL.
7. RINSE WOOL AND HANG TO DRY

Figure 7.1

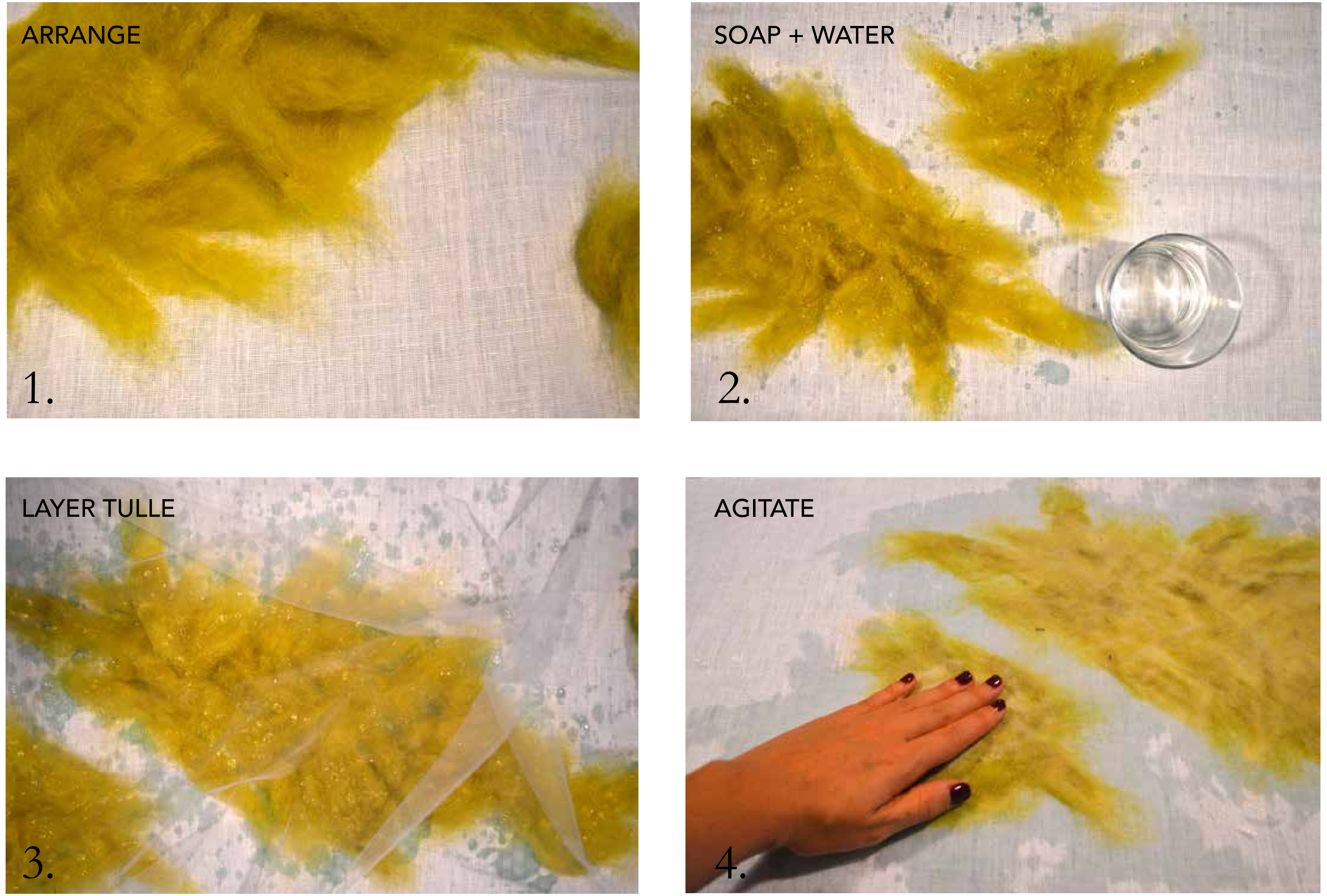


Figure 7.2

HOW TO WET FELT :

- 100% organic white linen textile
- Naturally dyed wool roving
- Roll of bubble wrap
- 1+ yards of undyed tulle textile
- Natural olive oil soap
- Water

Figure 7.3

Figure 7.4

Figure 7.5

Figure 7.6

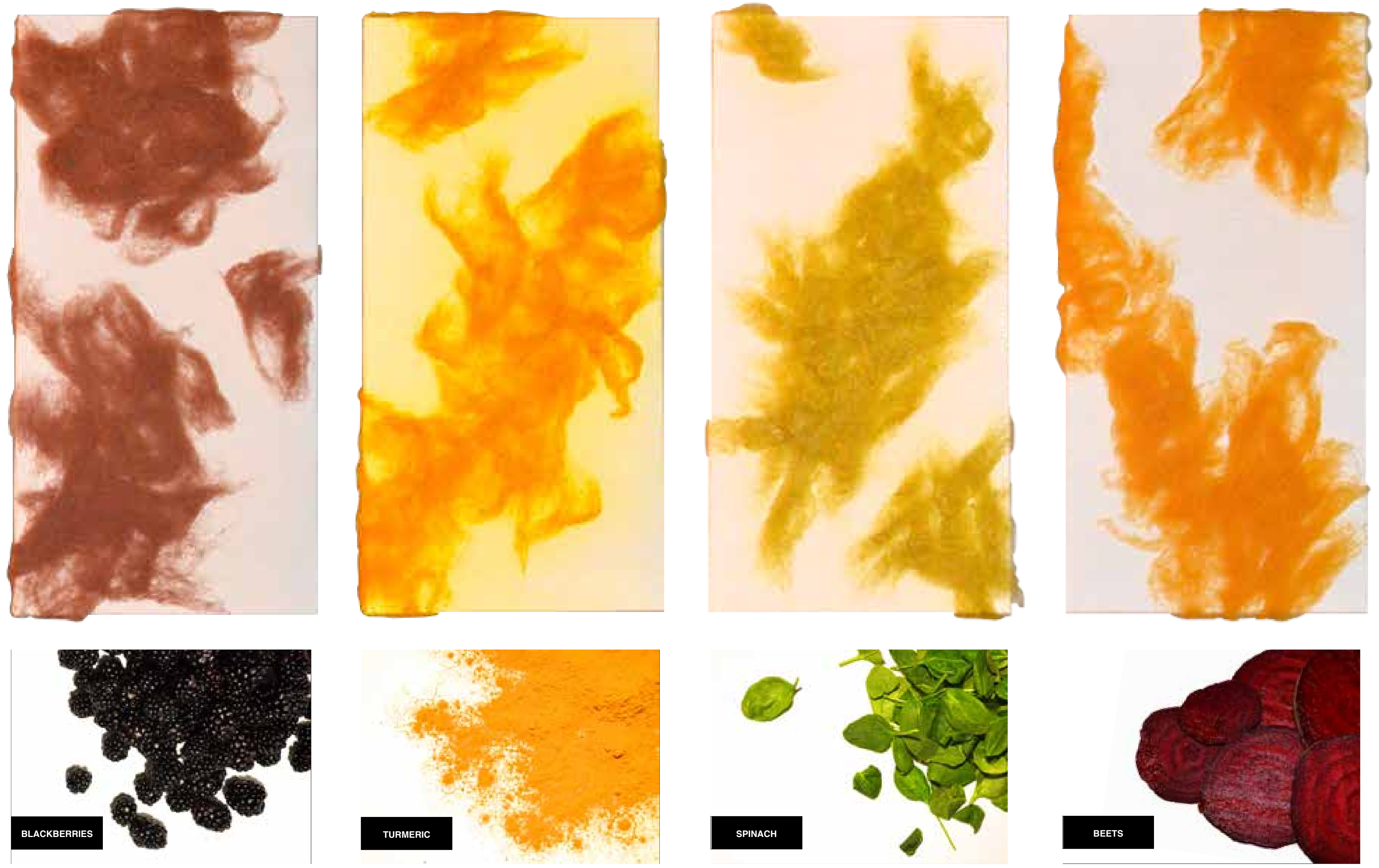
SPINACH

BEETS

Figure 7.7

NATURAL DYE COMPOSITION

Figure 7.8



NOTES + FURTHER RESEARCH POINTS

SUCCESSFUL

- VINEGAR + SALT DYE BATHS GREATLY INCREASE COLORFASTNESS

- COARSE WOOL ABSORBS DYE WELL + IS OPTIMAL FOR WET FELTING

- BLACKBERRIES AND SPINACH WERE BOTH SUCCESSFUL DYES

UNSUCCESSFUL

- FINE SPICES OR GRAINY ORGANIC MATERIAL IS HARD TO RINSE CLEAR OUT OF WOOL AND BLEEDS WHEN WET FELTED

- BEETS DID NOT PRODUCE A DEEP RED COLOR AS EXPECTED - TRY OTHER ORGANIC OPTIONS

FURTHER RESEARCH FOUND

- DYE DECREASES THE WOOLS ABSORPTION RATE, EVEN WHEN NATURAL

- THEREFORE, WOOL SHOULD BE LEFT IN THE MOST NATURAL STATE POSSIBLE

WOOL PROTOTYPES

WOOL PROTOTYPES

Figure 8.2

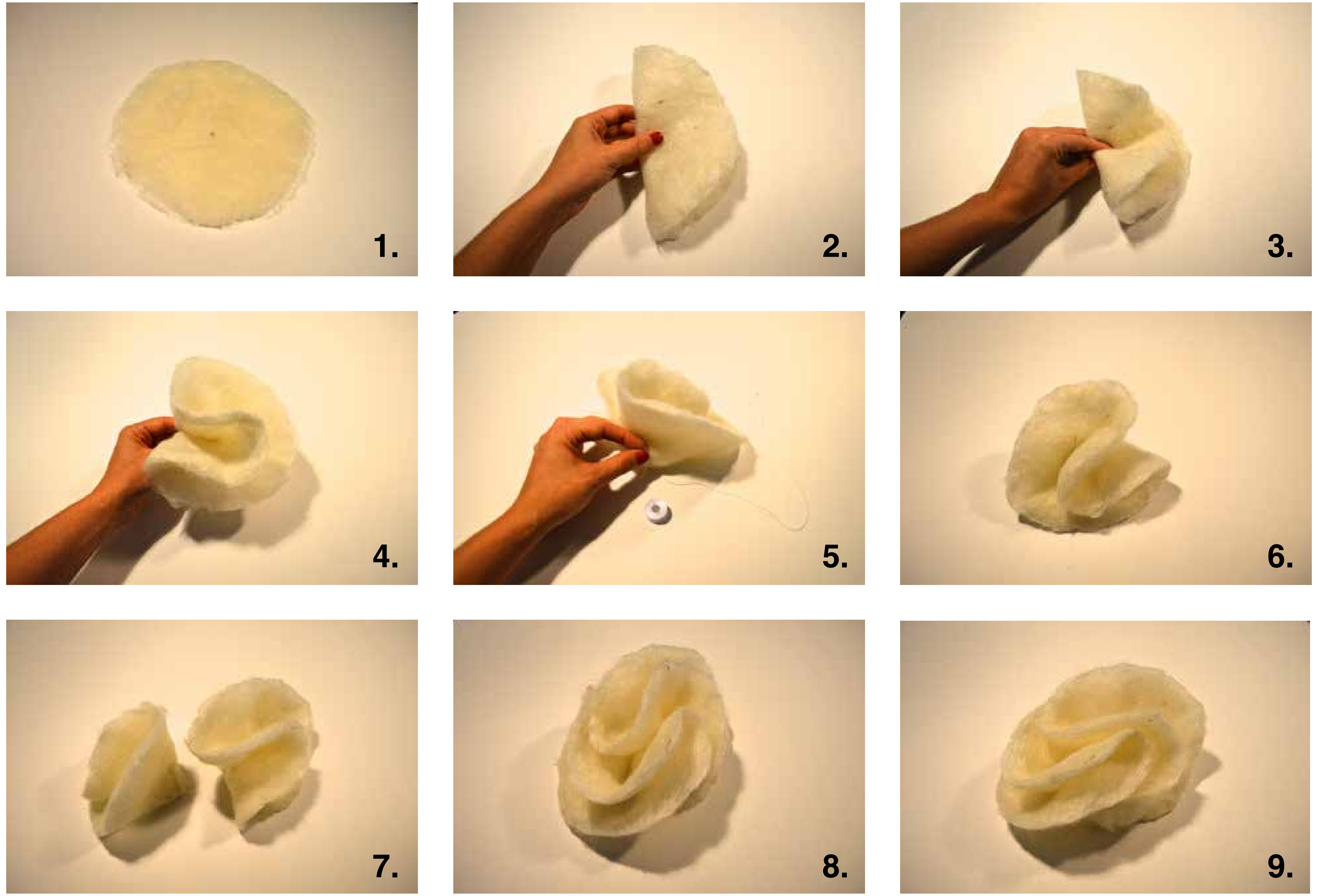


Figure 8.3

SOFT ROSE TRANSLATION

WET HAND FELTING NATURAL ROVING

Figure 8.4

Figure 8.5

Figure 8.6

Figure 8.7

Figure 8.8

CIRCULAR FELT FORM + TECHNIQUE EXPLORATION

Figure 8.9

Figure 8.10

MOVING FORWARD | NATURAL UNFELTED WOOL

Further research has stated that the wool fiber's absorption capacity is best when completely untreated, in it's natural roving state. This is true for hand-processed, toxin-free natural wool roving; an ideal design would incorporate unfelted wool fiber's, as wet felting requires soap. Natural olive oil based soap was considered, but also proven to decrease the fiber's absorption abilities. All further design prototypes will implement fabrication methods that require no felting, fasteners or adhesives.

DESIGN CONSTRAINTS

Figure 6.1

NO INDUSTRIAL FELT [TOXIC PROCESSING] - USE ONLY NATURAL ROVING

NO MASS PRODUCTION OR MODULAR SYSTEM - NO INDUSTRIAL FELT OR MECH. PROCESSING

NO SYNTHETIC DYES [CHEMICALS] OR NATURAL DYES - HINDERS ABSORPTION CAPACITY

NO CHEMICAL BASED SOAPS [TOXINS] - IDEALLY NO WET FELTING TO SOAP REQUIRED

DESIGN FOR INCREASED SURFACE AREA - IMPROVES ACOUSTIC, HUMIDITY + VOC ABSORPTION

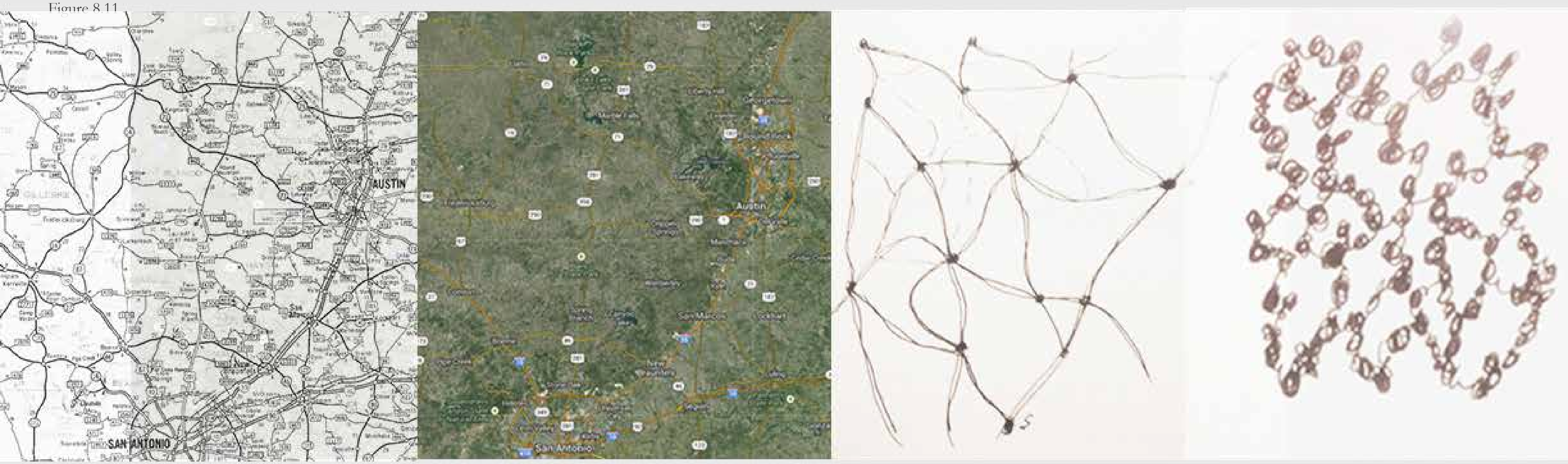
LOCAL WOOL ROVING SOURCES - ELIMINATES TRANSPORTION EMISSIONS + FUEL REQUIREMENTS

SMALL-SCALE FIBER PRODUCTION - HAND PROCESSING : NO TOXINS + NO MECHANICAL ENERGY

NATURAL WOOL ROVING + CUSTOM DESIGNED APPLICATIONS - UNIQUE + SUSTAINABLE

MAKING - HANDMADE, CUSTOM PRODUCT WITH CONSIDERATION FOR THE ENTIRE LIFECYCLE

Figure 8.11



INSPIRATION | HILL COUNTRY MAPPING | CENTRAL TEXAS

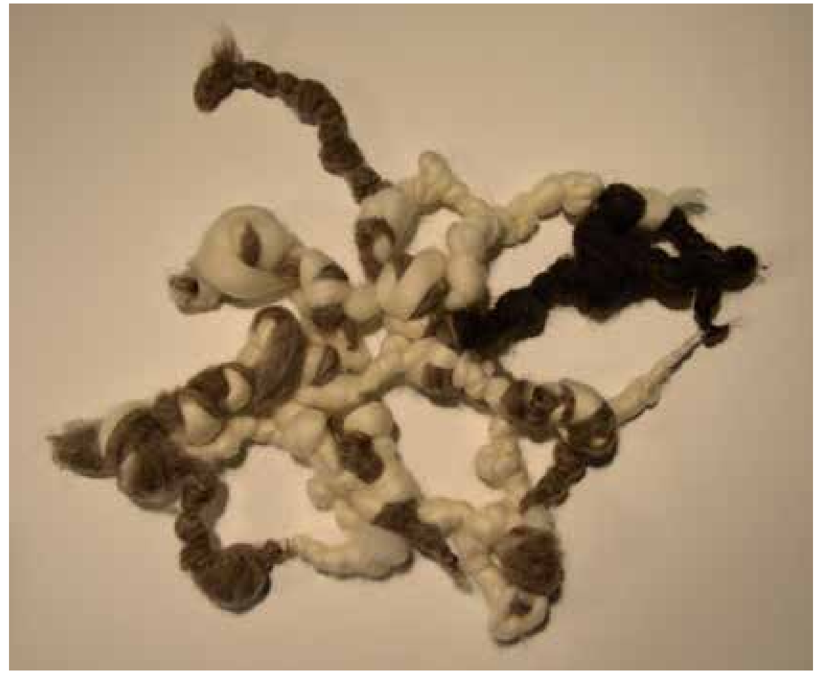


Figure 8.12

Figure 8.13

Figure 8.14

INSPIRATION | HILL COUNTRY LANDSCAPE | CENTRAL TEXAS

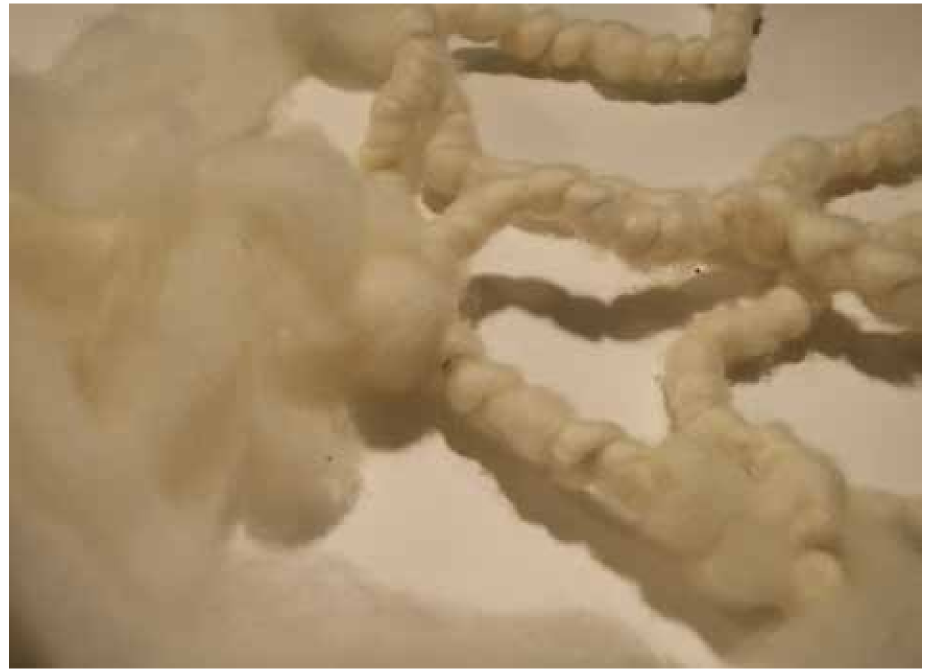


Figure 8.15

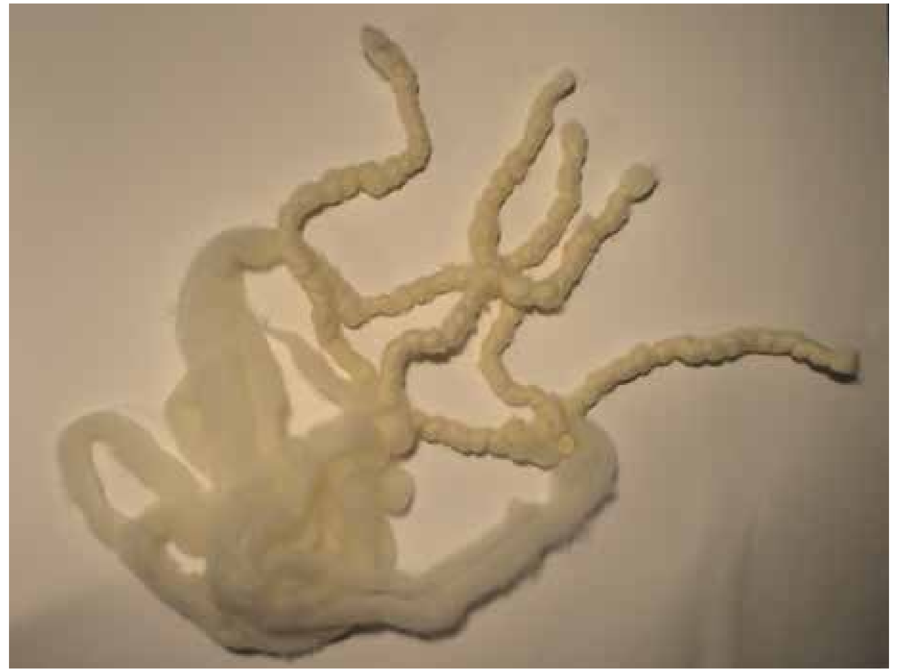


Figure 8.16

Figure 8.17

INSPIRATION | HILL COUNTRY NATIVE VEGETATION | THE YUCCA

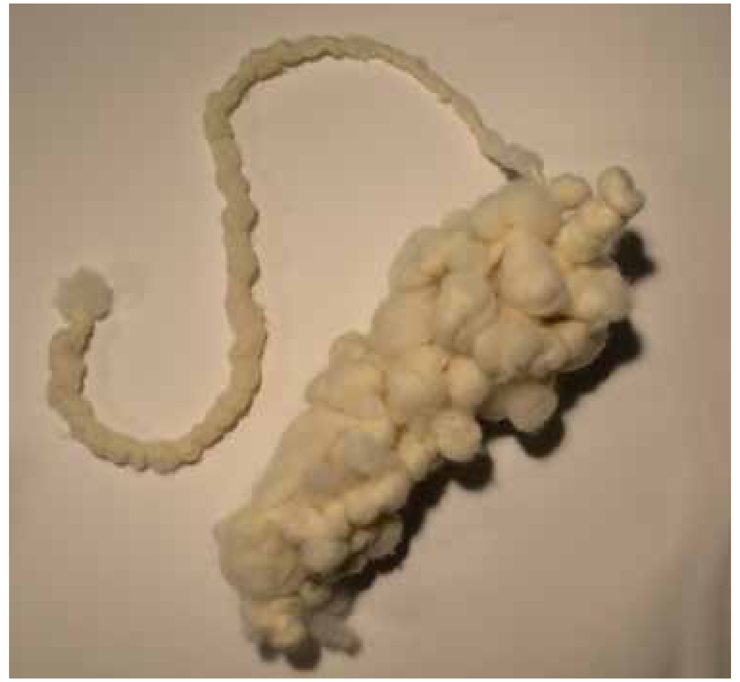


Figure 8.18

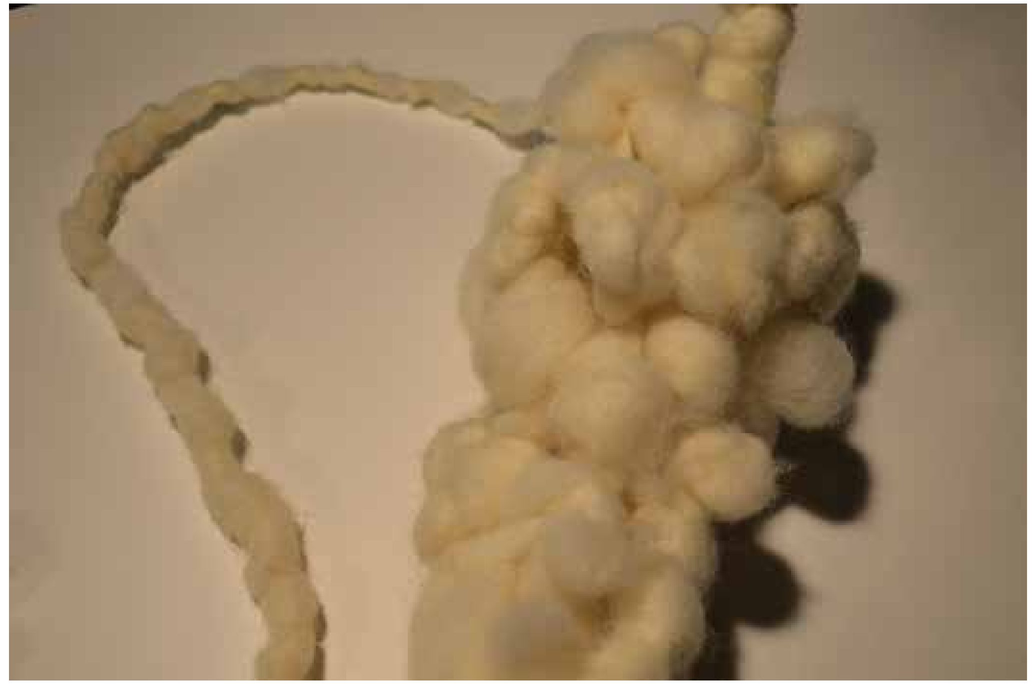


Figure 8.19

MAKING METHODS: EXPLORING CROCHET

Figure 8.20

Figure 8.21

Figure 8.22

MAKING METHODS: EXPLORING CROCHET

Start with crocheting a bowl-like form, varrying single crochet stitches once or twice through each loop. This will form tension as the piece grows, causing the wave-like edges as you continue.

Figure 8.23

Figure 8.24

Figure 8.25

Figure 8.26

CHRISTOPHER WOOL INSPIRED BOOK COVER

Figure 8.27

Figure 8.29

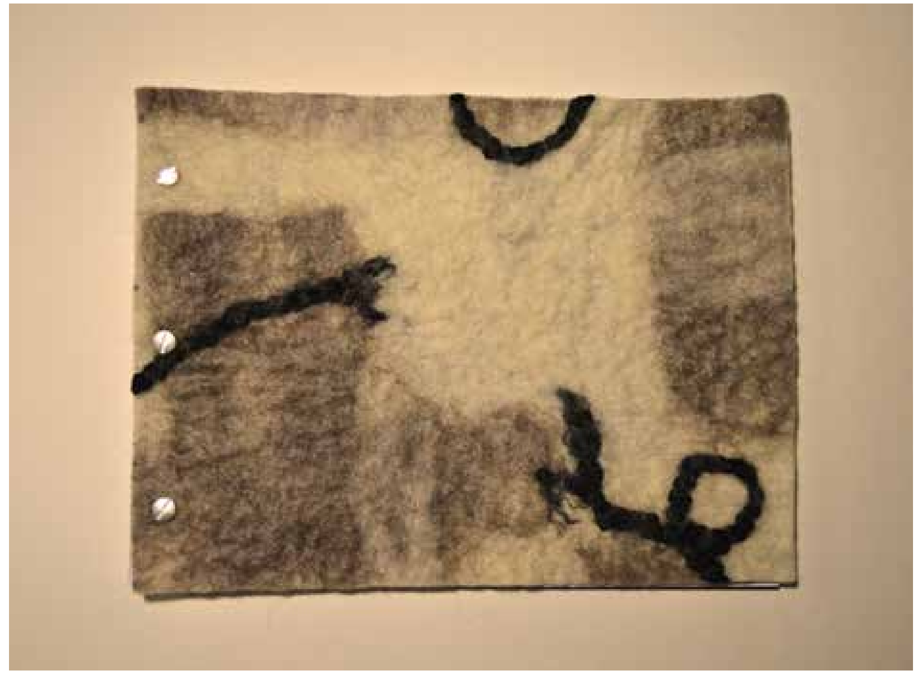


Figure 8.28

Figure 8.30

Figure 8.31

KEY PROPERTIES FOR A SUCCESSFUL DESIGN

LOCAL WOOL SUPPLIER - SUPPORT LOCAL ECONOMY + SMALL FARMS

HAND PROCESSED WOOL ROVING - LOW ENERGY DEMAND + LOW-ZERO CHEMICAL USE

COARSE FIBER WOOL - MORE DENSE TO ABSORB HIGHER QUANTITIES OF VOCs, HUMIDITY + NOISE ENERGY

COARSE FIBER WOOL - LOWER COST + IN LESS DEMAND IN COMPARISON TO MERINO

UNDYED + NATURAL STATE - DYEING + TOXINS HINDER ABSORPTION CAPABILITIES IN WOOL FIBER

VERNACULAR-BASED DESIGN - CUSTOM DESIGN BASED ON LOCAL WOOL FIBER + INTERIOR INTERVENTIONS

INCREASED SURFACE AREA - FOR OPTIMAL ACOUSTIC CONTROL, HUMIDITY REGULATION + VOC ABSORPTION

HANGING VS. FLOOR APPLICATION - BASED ON THE INTERIOR CHARACTERISTICS + CLIMATE OF THE LOCATION + WOOL FIBER ATTRIBUTES. DESIGNING BASED ON THE SPECIFIC PERFORMANCE NEEDS OF THE INSTALLATION.

AFTERLIFE + DISPOSAL CONSIDERATIONS

TEXTILE RECOVERY FACILITIES

TEXTILE CAN BE "PULLED" APART INTO A FIBROUS STATE AND REUSED BY THE TEXTILE INDUSTRY FOR LOW-GRADE APPLICATIONS, SUCH AS CAR INSULATION OR SEAT STUFFING.

A COMPOST PRODUCT

WASTE WOOL IS USED IN AGRICULTURE AND COMPOSTING. WHEN BURRIED IN THE SOIL, WOOL IMPROVES THE WATER RENENTION AND WATER DISTRIBUTION IN SOIL ACTING AS A SLOW RELEASE FERTILIZER.

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