Fibres and Fabrics

A sound basic knowledge of fibres and fabrics is essential for success. Students need to understand how the combined properties of the fibres and the fabric construction make fabrics appropriate for their intended use.

Fibres

Fibres are the basic building blocks of fabrics. Fibres must be twisted (spun) together to make a yarn before they can be made into a fabric.

<table>
<thead>
<tr>
<th>Fibres</th>
<th>Yarns</th>
<th>Fabrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibres</td>
<td>Yarns</td>
<td>Fabrics</td>
</tr>
<tr>
<td>Fibres</td>
<td>Yarns</td>
<td>Fabrics</td>
</tr>
<tr>
<td>Fibres</td>
<td>Yarns</td>
<td>Fabrics</td>
</tr>
</tbody>
</table>

Fibres are either man-made or natural in source.

Natural fibres can come from animal or plant sources.

Regenerated fibres are made from natural cellulose which has been chemically modified.

Synthetic fibres are made from chemicals based on oil products.

The following table shows a simple classification of fibres in common use, including some brand names of fibres belonging to the fibre group.

<table>
<thead>
<tr>
<th>Natural plant/vegetable (cellulosic)</th>
<th>Natural animal (protein)</th>
<th>Regenerated</th>
<th>Man – made</th>
</tr>
</thead>
<tbody>
<tr>
<td>cotton</td>
<td>wool</td>
<td>viscose modal Lyocell® Tencel®</td>
<td>polyesters Trevira® Polartec®</td>
</tr>
<tr>
<td>linen</td>
<td>silk</td>
<td>acetate triacetate</td>
<td>polyamides eg nylon Tactel®</td>
</tr>
<tr>
<td>bamboo</td>
<td>cashmere</td>
<td>elastomeric fibres eg Lycra® Spandex</td>
<td>acrylic</td>
</tr>
</tbody>
</table>

Fibres have different properties according to where they come from.
**Cellulose fibres (cotton, linen)** tend to be strong and good at absorbing moisture; this means they are comfortable to wear but can take a long time to dry. They do not need to be handled gently and can be washed and ironed at high temperatures. Unfortunately they crease badly and shrink, but they can be given special finishes to overcome this. They are also easy to set alight so can be dangerous.

In order to understand the fibre properties better, it is helpful to see what it looks like under a microscope.

An immature cotton fibre has a round cross-section which is where the plant nutrients pass along the fibre as it is growing. When it is picked, the fibre dries out and collapses into a flattened bean-like cross section. It also twists along its length so that it looks like a twisted and flattened ribbon. The smooth surface prevents air from being trapped between the fibres, making cotton a poor insulator so cool to wear. The flat twisted form does not reflect light well so cotton does not have a lustre.

Linen has a many-sided cross section and a long, regular length to the fibres. This regular surface is able to reflect light quite well which gives linen its slight lustre. The cross markings across the fibre length are called *nodes* and these give linen its slubbed appearance.

*Source: ‘Textiles Technology to GCSE’*
**Wool** is soft and warm because it has a natural crimp – like curly human hair! Wool does not crease easily and is naturally water-repellent. It is also very good at absorbing moisture!

Wool's bad points are that it shrinks badly – known as *felting*. This makes it a problem to wash but it can be given a special finish to prevent shrinking. Because it is so very absorbent it takes a long time to dry, especially as most wools will shrink if put in the tumble dryer. It is also attacked by moths.

Wool does not set alight easily and when it does, it puts itself out.

When seen under a microscope wool is a very interesting fibre.

*The wool fibre is similar to human hair. The surface of the fibre is covered by overlapping *scales* which protect the inner part of the wool. The outer surface of the wool is covered with natural grease called *lanolin*, and this makes the wool fibre water repellent.*

*Source: ‘Textiles Technology to GCSE’*

*The scales on the wool fibre can lock together when the fibre is in the presence of heat, moisture and friction – the very conditions that are in a washing machine or tumble dryer. This will make the wool shrink and the property is used when making felt from wool fibres. It also explains why wool can be difficult to care for, and why it needs gentle hand washing or dry cleaning.*

*Source: ‘Textiles Technology to GCSE’*

*Wool fibres also have a natural crimp and when many fibres are spun together, the crimp, and the scales, will cause them to stand away from each other and trap air. This is what gives wool its ability to insulate.*

*Source: ‘Textiles Technology to GCSE’*
Silk is very smooth and has lustre. It is a very strong fibre but becomes weak when wet, so it needs careful washing. It is warm and absorbent so it feels nice next to the skin. It can crease very badly and is very expensive. Silk comes from a silk worm which is specially reared for its silk.

The silk worm spins 2 triangular shaped filaments, one from each side of its mouth. These 2 filaments are held together with sericin which is a natural gum produced by the silk worm. This triangular cross section gives silk its lustre because light is able to bounce off the smooth sides. It also gives softness to the fibre.

Manufactured fibres have different properties according to their source. Viscose is made from cellulose which comes from trees, so it has similar properties to cotton and linen. It is very absorbent but not a very strong fibre, especially when wet, so it will need gentle handling when it is washed. It can also shrink very badly. Most viscose fabrics are given special finishes to reduce shrinking and creasing. Viscose has a silky feel to it.

Many new viscose-type fibres are being manufactured, eg Tencel® and Lyocell®, which are stronger and do not crease and shrink.

Viscose fibre.

Viscose filaments have a smooth surface which makes them soft to touch.

Cross section of viscose fibre

Viscose fibre has an irregular cross section. The relatively smooth surface is able to reflect light.
**Synthetic** fibres, such as polyester and nylon, are very strong, good at resisting abrasion, and lightweight. Most synthetic fibres are not good at absorbing moisture so they can be uncomfortable next to the skin, and they dry quickly – this is not the same as being waterproof!

Synthetic fibres do not crease much during normal use. They will become soft when hot so should not be washed at high temperatures; otherwise they will become badly creased during the washing and spinning process. These creases are not easy to remove as the fabrics melt under a very hot iron with disastrous consequences!

Synthetic fibres do not set alight easily but will melt and drip – this molten fibre is very hot and can cause serious burns.

---

Synthetic fibres are produced as continuous filament and look like glass rods. This very smooth surface enables them to reflect a lot of light. Because they are so smooth they do not trap air and are therefore poor insulators.

*Source: ‘Textile Science’*

---

The cross section of nylon and polyester is circular. This helps them to reflect light so they have a lustre.

*Source: ‘Textile Science’*

---

The cross section of nylon can be modified to a tri-lobal shape. This means that the fibre surface will have less contact with skin when worn, so that it becomes more comfortable.

*Source: ‘Textile Science’*
A fibre can be short, called a **staple fibre**, or a very long continuous length, called a **filament fibre**.

All natural fibres, except silk, are staple fibres.
All manufactured fibres and silk are filament fibres.

**Yarns**
Fibres, no matter where they come from are not very useful on their own and all fibres, whether they are staple or filament, must be made into yarns before they can be woven or knitted into a fabric.

Yarns are basically long, continuous strands made by twisting fibres together.

**Continuous filament yarns** are made by lightly twisting filament fibres together.

**Staple yarns** are made from short staple fibres; these have to be carded, or combed, so that they all lie in the same direction before being twisted together to form a yarn.

Filament fibres can be chopped up into short staple fibres; this means that they will need to be twisted together to make a yarn. If a filament fibre is to be blended with a staple fibre the long filaments need to be cut into staple before being spun into yarn.

Filament fibres give smooth yarns but staple fibres give hairy yarns.
Hairy yarns are good at trapping air between the fibres – this means that they are **good insulators** and will make fabrics which are warm. Smooth yarns are not so good at trapping air and so make fabrics which are not good at insulating.

**Air is a very good insulator** – think of all the air included in the structure of polystyrene cups and loft insulation materials!
So if a warm fabric is needed, it is important to try and trap air somewhere in the fabric – this can be in the fibres, the yarn, or the way in which the fabric is constructed.
The hairy yarns can also trap moisture between the fibres.

Most modern fabrics contain **more than one fibre**.

This is because there is no such thing as a perfect fibre so manufacturers include different fibres in a **blend**. This enables a fabric to be made which will be better suited to the product.
Polyester and cotton are commonly used to make a wide variety of fabrics. Different percentages of cotton and polyester are included according to what the fabric is to be used for. The polyester helps cancel out the shrinking, creasing and slow-drying of cotton. The cotton makes the fabric better at absorbing moisture and makes the fabric feel nicer next to the skin.

But, polyester/cotton blends are very dangerous when they set alight. This is because the cotton burns easily and holds the polyester in place. As the polyester gets hot it starts to melt and drip. The fabric burns very fiercely at high temperatures and gives off a lot of black smoke.

Elastomeric fibres like Lycra are blended with many other fibres, The Lycra gives the fabric some stretch – the higher the percentage of Lycra, the more the fabric will stretch. Only very small amounts of Lycra are needed to give a lot of stretch as it has incredible stretch and recovery properties – 300 – 700% stretch. This is why Lycra is never used on its own to make a fabric.

The Lycra also makes the fabric more crease-resistant. Fabrics containing Lycra should not be washed and ironed at high temperatures as this can damage the Lycra. It is affected by chlorine which is found in household bleaches, but it is resistant to the effects of sun tan oils and perspiration.

Viscose fibres are used in many blends. They help make the fabric more absorbent and soft to handle. As viscose is cheap to manufacture, it can help reduce the price of the fabric. Because viscose is a weak fibre it is often blended with a stronger fibre such as polyester to improve the overall strength.

Some common fibre blends include:
- wool and nylon
- viscose and nylon
- polyester, wool and Lycra
- cotton and Lycra
- linen and polyester

The main reasons for blending fibres are:
- To help reduce the cost of the fabric
- To give different effects in the texture and handle of the fabric
- To make a fabric with specific qualities for a particular end use
- To make the fabric stronger
- To make a fabric easier to care for
- To enable fabrics to be more crease resistant
Making Fabrics

Woven and knitted fabrics are made from yarns which have been spun from fibres.

**Woven fabrics** are produced by **interlacing two sets of threads** at right angles to each other. The **warp** threads are fixed in the loom and run the length of the fabric. The **weft** threads run across the fabric from selvedge to selvedge. There are **three main types** of weave: plain, twill and satin. Other weaves are variations on one of these types.

**Plain weave** is the simplest weave.

The main features of plain weave are:

- It is the **simplest** and therefore the **cheapest** weave to produce.
- It has a **plain surface** and makes a good background for **printing**.
- It has the maximum number of interlacing points and thus produces **firm, strong fabrics** which look the **same on both sides**, eg calico, lawn, poplin, chiffon, taffeta, organdie, flannel.
- A variety of **decorative effects** can be produced by using dyed yarns, eg gingham, madras, chambray. Fancy yarns can also introduce interest to the fabric.

**Twill weaves** produce **diagonal lines** on the cloth.

The main features of twill weaves are:

- It is the **hardest wearing** weave.
- It is **more complicated** to produce thus **more expensive**.
- Fabrics have a definite **right and wrong side**.
- Because of their **uneven surface** twill weaves **show dirt less** than other fabrics.
- It makes a **firmer** fabric which is **more likely to fray** because there are fewer interlacing points.
- There are **more variations** possible with twill weaves, eg denim, gabardine, drill, herringbone twills, cavalry twill, dog’s-tooth check.
**Satin weave** fabrics have a smooth and lustrous appearance.

![Warp and weft threads in satin weave](image)

The main features of satin and sateen weaves are:

- The weft yarns are almost completely hidden by the **warp yarns** which 'float' over them in **satin weaves** eg satin
- Because the threads do not interlace very often, satin weaves **fray easily**
- Satin weave fabrics have a **right and wrong side**
- The **shiniest satins** are made from **filament yarns such as silk and polyester**
- The **floats snag** easily so satins are **not very hardwearing**
- There are **not many variations** possible.
- **Fabrics** made from satin and sateen weaves include duchesse satin, satin-back crepe, heavy bridal satins, lighter weight satins for linings and lingerie.

**Knitted fabrics** consist of **yarns looped together** in a variety of ways.

The two main types of looping are **weft knit** and **warp knit**. Other fabrics are variations on one of these types.

**Weft knit** is the simplest type; it can be produced by hand, on a domestic knitting machine or industrially. It is made up when one yarn travels the width of the fabric, in the same way that a weft thread goes across from selvedge to selvedge in a woven fabric.

Each successive row of loops is drawn through the previous row of loops in the fabric.

The **horizontal row** of loops is called a **course**.

Each **vertical row** of loops is called a **wale**.
The main features of weft knit are:

- It has a **lot of stretch** and is easily distorted, especially when washed;
- It **drapes softly** and easily takes the shape of the figure
- Fabrics **do not crease** easily
- Fabrics **trap air** and are good insulators in still air. But moving air is able to get through the gaps in the fabric thus making it cool to wear in these conditions
- It **ladders easily** if snagged
- There is a distinct back and front (face) of the fabric.

Weft knitting can produce tubular fabrics.

**Polyester fleece** is a weft knitted fabric which has an extra yarn knitted into it. The fabric is brushed on both sides to give a soft dense nap which is able to trap air. This makes it a good insulator.
Warp knit is a more complicated structure using many separate yarns which are interlaced sideways. The loops are formed along the length of the fabric in the same way that the warp thread runs parallel to the selvedge of a woven fabric.

The horizontal row of loops is called a course.

Each vertical row of loops is called a wale.

The main features of warp knit are:

- It is less stretchy than weft knit and thus produces a firmer fabric
- Fabrics do not ladder and cannot be unravelled 'row by row'
- There is greater scope for the production of a variety of fabrics
- It is faster than weft knitting and the cheapest method of fabric production using yarns.
Non-woven fabrics are made directly from fibres which have not been spun into a yarn. They include felts and bonded fabrics.

Felt made from wool fibres uses the natural felting ability of wool to cause the fibres to matt together using heat, mechanical action and moisture. Wool felt is expensive.

Needlefelts are made from synthetic fibres such as acrylic. They are matted together by mechanical action when barbed needles tangle the fibres to produce felted fabric.

Diagram to show the principle of needle felting.

Bonded fabrics are made from webs of fibres held together in various ways:
- adhesive bonding
- solvent bonding which uses a solvent to soften and fuse the fibres together at the points where they touch
- thermal bonding which utilises the thermoplastic properties of some or all of the fibres, to fuse all the fibres together using heat and pressure
- stitching with thread (stitch bonding).

The main features of non-woven construction are:
- Cheap to manufacture as fabrics are made straight from fibres
- Because there is no ‘grain’ they are cheaper to use
- They do not fray when cut
- They are not as strong as woven or knitted fabrics
- They do not drape as well as woven or knitted fabrics

Typical uses for bonded fabrics include disposable products, interfacings, filters, insulation and liners.
Fabric Finishes

Fabrics need to be fit for their intended use. Many fibres used to make fabrics have disadvantages. It is possible to cancel out some of these disadvantages by applying a fabric finish. An applied finish always costs money, so a manufacturer will need to think about how important it is to put a special finish on to a fabric depending on what it is to be used for.

Finishes can be used for many reasons:
- making a fabric easier to care for by reducing shrinkage and creasing or keeping pleats and other creases in place
- they can make a fabric safer, eg by preventing it from catching fire or burning quickly
- making a fabric more comfortable to wear by stopping water passing through it, eg on outdoor jackets
- they can make a fabric warmer to wear by increasing the amount of air trapped
- they can help keep a fabric cleaner and fresher for longer by preventing stains from attaching themselves to the fabric or deodorising the fabric.

Some common fabric finishes are:
- shrink resistant; use on cotton and woollen fabrics
- crease resistant/non-iron finish used on cotton, linen and viscose fabrics
- flame retardant used on cotton, linen and viscose fabrics, and those intended for children’s nightwear or furnishings in public buildings
- water-repellent used on fabrics for outdoor wear
- stain repellent, eg Teflon
- heat setting, using synthetic fibres, makes fabric crease and shrink resistant and retains pleats and intentional creasing such as that used in some fashion garments
- a brushed finish produces a nap and traps air, eg on cotton fabrics, and makes a fabric softer, warmer to wear but more flammable
- antibacterial finish, eg on socks, which deodorises fabric

Putting a special finish on a fabric can have disadvantages as well as making a fabric better for its use. The finish will make the end product more expensive for the consumer. Some fabrics with special finishes can be more difficult to wash eg crease-resistant finishes are spoiled by chlorine bleach, flame-retardant finishes will react with soap to make the fabric more flammable than it would have been without the finish. A finish may make the fabric easier to tear, or stiffer which may put the consumer off buying the product. So there is always a balance to be thought about when deciding on whether or not to use a finish.
Modern Fibres and Fabrics
Textile fibres and fabrics are constantly being updated and new ones developed. New fibres can be engineered to have properties needed for specific uses. There are many new laminating and finishing processes which give fabrics special qualities. Below are a few examples of new developments – there are many more.

Microfibres are an important new development. These are extremely fine synthetic fibres, mainly polyester and polyamide. Microfibres are very lightweight, soft and drape well, and are used for a variety of clothing products. They are often blended with natural fibres to give high performance fabrics for outdoor and sports use.

Tactel is a polyamide microfibre, eg Tactel Aquator, Tactel Diabolo.

Tencel is a modern type of regenerated fibre engineered from cellulose. This group of fibres is classed as lyocells. Tencel can be used on its own or blended with other fibres and is bio-degradable.

Non woven fabrics are being made from a wide variety of fibres, and can produce interesting fabrics using the heat-setting (thermoplastic) properties of synthetic fibres.

Tyvek is a modern non-woven fabric.

Laminated fabrics such as Gore-Tex® and Sympatex® are membrane systems which prevent water and wind from penetrating whilst allowing perspiration to escape. They are used for outdoor clothing, particularly for extreme conditions.

Micro-encapsulated fabrics

Various health and cosmetic chemicals can be incorporated into the hollow centres of microfibres. The chemicals are released slowly and absorbed through the skin of the wearer. The chemicals break down slowly, so the effects last for a long time. The micro-encapsulated microfibres are covered with other fibres in a core-spun yarn.

Source: ‘Textiles Technology to GCSE’

Smart Fabrics

A smart material is defined as one which is able to react to external stimulus or changes in the environment without human intervention.

Smart or intelligent fabrics are able to react to their environment and change their properties as they are needed. They are able to sense and react to conditions around them, eg light, heat, power.
Smart fabrics include those which can warn users of changes, such as loss of heat or presence of pollutants, and fabrics which incorporate electronic components, such as music systems. Many of these fabrics are used in health and safety or sportswear applications.

**Smart Materials** include ones that:
- monitor body functions and administer medicines/give warnings;
- maintain a personal micro-climate, eg Stomatex, Outlast;
- can provide buoyancy and support, eg bodysuits for medical/physiotherapy support;
- have chromatic properties and change colour in response to specific situations;
- have shape memory, eg Corpo Nove shirt which adjusts to differing temperatures;
- are self-cleaning, eg nano-technology fabrics triggered by sunlight;
- use biomimetics that imitate nature, eg Fastskin, Stomatex;
- can generate solar power when exposed to sunlight;
- can sense and track movement, eg SensFloor Smart carpets.

**Technical and Modern Materials** are not the same as smart materials and include the following examples:
- Gore-Tex
- Kevlar & Nomex
- Phosphorescent textiles
- Reflective textiles using glass beads
- Fabrics that wick moisture away from the body, eg Coolmax
- Microencapsulated fibres, eg those which release scents
- Fabrics which protect against bacteria, eg Purista, Chitopoly
- Fabrics with electronics, eg GPS systems,
- Geotextiles
- Materials using Nano-technology
- Microfibres
Care and maintenance of fabrics.

Textile products need to be looked after properly in order to prolong their life and keep them in good condition. A care label telling the consumer how to care for the product is usually attached to the product or on the packaging. The label will say what fibres the fabric is made from, eg

| 100% cotton,      | 60% polyester/40% cotton |

This information is required by law.

It may have warnings for the consumer, eg *Keep away from fire.* The label may carry other information such as where the product was made or the size of the product.

Some of the most important information on the care label will be the instructions on how to look after the product. This information is presented through a series of symbols. These symbols are the same in the UK and Europe, and many other parts of the world. The symbols represent the main processes involved in caring for a textile product:

- The wash tub tells the consumer how the product should be washed.
- The circle in a square relates to the drying of the product.
- The iron symbol relates to ironing the product.
- The triangle relates to chlorine bleaching of the product.
- The circle tells the consumer about dry-cleaning the product.

There is further information given in each symbol.

The washtub symbol has a number below the waterline. This number tells the consumer the maximum temperature of the water (in °C). For example:

- Maximum wash temperature is 95°C. This is very hot and would only be used for fabrics which could stand high temperatures, eg white cotton.
- Maximum wash temperature is 40°C. Water at this temperature feels slightly warm to the touch and is suitable for washing fabrics which might be damaged by hotter water, eg nylon and polyester which can become badly creased with too much heat.
In addition to the water temperature, the washtub symbol also gives information about the amount of **agitation** provided by the action of the washing machine. This will include the speed of the spinning process and is shown as a bar underneath the washtub symbol.

![Single bar](image)

A single bar means that the machine action should be medium or reduced. This is usually recommended for fabrics which could become too creased with excess machine action, eg nylon and polyester, and for fabrics with special finishes. The spin speed will also be reduced to avoid over-creasing the fabric.

![Two bars](image)

2 bars mean that there should be minimum or much reduced machine action, including a slower spin speed. This is recommended for delicate fabrics such as wool.

![No bar](image)

No bar means that the fabric is able to be washed with maximum machine action and full spin speed. This will be recommended for fabrics which are not damaged by friction, eg cotton and linen.

![Hand](image)

A washtub with a hand in it means that the fabric should only be washed by hand. This will usually apply to delicate fabrics such as those made from wool or silk.

![Cross](image)

A washtub with a cross through it means that the product should not be washed.

The drying symbol refers to **tumble-drying**. There will also be further information with the symbol.

![Tumble-dry](image)

The symbol tells the consumer that the product can be tumble-dried. Most fabrics can be safely tumble-dried.

If there is a cross through the symbol, it means that the product should not be tumble-dried. This is recommended for delicate fabrics and those which might shrink with the action of the dryer, eg wool and silk fabrics.

The ironing symbol tells the consumer **how hot the iron should be** for the product.

![Cool iron](image)

This is a cool iron. It is recommended for fabrics made from nylon, polyester and acrylic which will melt if the temperature is too high.

![Warm iron](image)

This is a warm iron recommended for fabric made from polyester blends and wool.

![Hot iron](image)

This is a hot iron recommended for fabrics which are not damaged by heat and need a hot iron to remove creases, eg cotton and linen fabrics.

![Do not iron](image)

Do not iron.
The triangle tells the consumer whether or not chlorine bleach can be used on the product. This type of bleach will remove stains from fabric but will also take away the colour and may damage some special finishes, even on white fabrics. It will also damage certain fibres, eg wool and silk.

- The product can be treated with chlorine bleach.
- Do not use chlorine bleach.

The circle tells the consumer whether or not the product can be dry-cleaned. Dry-cleaning is a special process which uses chemicals instead of water to wash the product. Most fabrics can safely be dry-cleaned but it is an expensive process and has to be carried out by a specialist cleaner so consumers will try to avoid using it if the fabric can be washed at home. Dry cleaning involves heat and friction but no water. It is important that those fabrics which are badly damaged by water eg some viscose and silk fabrics, are not washed in the usual way. In addition, those products which are difficult to wash at home are usually dry-cleaned, eg woollen garments and those with complicated linings and components such as shoulder pads.

- These symbols all mean that the product can be dry-cleaned. The letters refer to the different chemicals used and are for the dry cleaner’s information.
- The product should not be dry-cleaned.
Textiles and the environment

The manufacture, use and disposal of textile materials and products can have serious consequences for the environment in the following ways:

- fibre sources; growing cotton uses fertilisers and pesticides which can pollute the atmosphere and waterways, synthetic fibres are made from petrochemicals which come from non-renewable sources.
- changes to the landscape because of intensive farming and deforestation, eg when growing cotton crops and producing wood for regenerated fibres.
- manufacturing and finishing processes use chemicals such as those found in dyestuffs, and their effluent can be damaging. Water and energy are also necessary for these processes.
- waste is produced when fabrics are made into products, and this may end up in landfill sites.
- the manufacture of components may use plastics and metals as well as energy.
- packaging of products can be wasteful of paper, card, plastics, printing inks, and the energy used to produce and transport the packaging.
- caring for textile products requires the use of detergents, dry cleaning fluids, energy and water.
- transportation of raw materials and finished goods produces CO2 emissions from transport systems, these contribute to global warming and damage to infrastructures.
- discarded textile products are often sent to landfill sites. Fabrics and components can take many years to decompose with the consequent methane production, and leeching of heavy metals from components such as zips.

There are many ways in which textiles can be made ‘greener’ and reduce their carbon footprint. These include:

- recycling of fabrics and the production of new fabrics from recycled materials can reduce waste.
- development of new fibres, such as Tencel, which come from sustainable sources and use ‘clean technology’ in their manufacture. Ingeo, a new fibre to replace polyester, is made from plant starches and is fully bio-degradable.
- use fewer dyes or develop fibres which grow ‘coloured’. Microfibres and dark colours use enormous amounts of dye and water to achieve the desired colour.
- assessing a product’s life cycle and considering its impact on the environment from ‘cradle to grave’.
- reduce the amount of packaging; ensure it is bio-degradable and recyclable.
- use detergents which are effective at lower temperatures (30°C), and washing machines which are energy efficient and use less water. Only wash clothes when they are dirty and dry them outside when possible.
• consider using energy produced from renewable resources.
• use more environmentally friendly forms of transport and consider manufacture of materials and products nearer to the places they will be sold.
• reduce the need to discard perfectly serviceable products just because fashion has changed by having fewer changes in fashion.

**Moral issues relating to Textiles manufacture.**
The manufacture of textiles and textile products can have a huge impact on the lives of other people in the following ways:
• land space used to grow cotton in less economically developed countries could be used to grow food crops for the local population
• deforestation is causing changes in the climate in some countries, leading to drought and floods
• pesticides and fertilisers used to make the cotton grow are very poisonous and may poison supplies of drinking water and surrounding land so that other crops will not grow there
• local rivers and lakes may be poisoned by pesticides, killing fish which could be used as food for local people
• fishermen may lose their livelihoods if there are no fish to catch
• if the farmers breathe in the spray from the chemical fertilisers, or it comes into contact with their body, it can cause serious health problems
• growing and processing cotton uses up a lot of water, often in countries were there is a shortage of water for people to drink and use to grow food
• dyeing and processing fibres and fabrics uses a lot of water and chemicals which must be disposed of properly or they can pollute waterways
• machinery used for producing the fibres and fabrics can be dangerous for the workers if it is not used and maintained properly – this is often not done in countries outside of the UK
• workers are often forced to work in sweatshop conditions for very little pay so that products can be made cheaply and sold for huge profits
• a lot of precious fossil fuels are used to manufacture and transport textile products – these fuels are rapidly running out and nuclear power is taking over, leading to some very serious safety issues.