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INTRODUCTION TO FABRIC SCIENCE

Clothes are as important as food and shelter. You use them for covering, protecting and even decorating yourself. You must be having different types of clothes for different occasions like your casual attire, office wear, party dresses, your night suit and so on.

Clothes are made from fabrics and today many types of fabrics are available in the market. Do you know what these fabrics are and how they are made? How do they come in so many different varieties? Why do some fabrics shine more than the others? Why are some fabrics light in weight whereas others are heavy? In this lesson you will find answers to these and many other related questions.



OBJECTIVES

After studying this lesson you will be able to:

- state the meaning and establish the scope of fabric science;
- define the term fibre and classify fibres according to their origin and length;
- explain the properties and uses of different types of fibres and;
- identify a fibre type by means of a physical test.

22.1 SCOPE OF FABRIC SCIENCE

Just look around you and pinpoint all the fabrics in your room. You will find that you are not only wearing a fabric, but also sitting on it and perhaps, have a piece of fabric hanging on the wall as a wall hanging or as curtains on the doors. This



Notes

means that fabrics not only make your clothes but are also used at home and outside. Can you think of some more uses of fabric? Yes, you are right. Some of the other uses of fabrics at home are in the kitchen as napkins, in the bathroom as towels, on the beds, sofas, and even on our floors as carpets. Fabrics also offer many uses in industry, medical field and even in automobiles.

What is a fabric?

A fabric is any piece of cloth.

A study of all the aspects of a fabric is called fabric science and it explains the behaviour of a fabric under different conditions.

You must have realised that different fabrics are not only different in their appearance but also in their properties, uses and their care procedures. Silk is smooth and shiny, cotton is smooth but dull. Wool is rough, but keeps you warm and cotton is cool to wear. Cotton can be washed easily but needs to be ironed after washing for a neat look. Nylon and polyester also are washed very easily and need almost no ironing after washing. Silk is either dry cleaned or washed with gentle soaps. These and many more concepts of fabrics are explained in fabric science. The market today is flooded with variety of fabrics in all types of colours, textures and designs. They all vary in their price range as well. To be an intelligent consumer, an exposure to fabric science is important as it helps us to understand a fabric better.

22.2 FIBRE

Have you ever wondered what makes a fabric? Find out yourself. Pull out a thread from a fabric and then open it out. You will find that this thread is made of small hair like strands twisted together. This single hair like strand is called a fibre. In other words, the **basic unit of a fabric is a fibre**.

22.2.1 Classification of Fibres

1. Fibres come as short fibres and long fibres and their length is an important property of fibres. To see a short fibre, take a ball of cotton and pull out fibres from it. Notice that these fibres are quite small. Now try and pull out fibres from a nylon fabric. These, you will see, are longer fibres. The short fibres are called **staple** and the long ones are called **filament**.
2. Fibres also can be classified according to their origin. Some fibres are obtained from natural sources i.e. from plants, animals or minerals. These are called **natural fibres**. The other fibres are **manmade**.



Notes

- a) **Natural Fibres** :— There can be vegetables fibres, animal fibres and mineral fibers. Let us study these in detail.

(i) **Vegetable Fibres**

Fibres that come from plants are called vegetable fibres and can be obtained from different parts of a plant. You must have seen the white cotton fibres growing on plants. These are the seed hair fibres. Cotton is an example of seed hair fibres. Similarly, fibres can be obtained from the stem of a plant e.g. jute and flax, and from the leaves like pineapple fibres. Fibres are also obtained from the outer covering of a fruit, like coir from coconut husk. All the plant fibres are made up of cellulose.

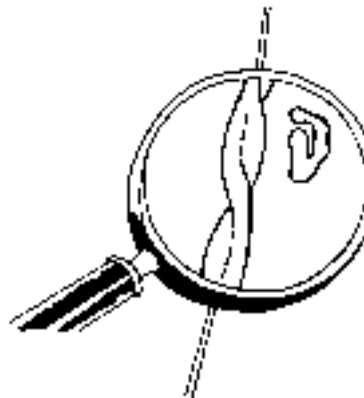


Fig. 22.1 : Vegetable Fibres-Cotton

(ii) **Animal Fibres**

Can you name the animals which give us fibres? Sheep is the most common animal whose hair is used as wool. Some other animals are camel, goat, and rabbit. Silk is also an animal fibre. It is the secretion of an insect called the silkworm. Do you know that silk is the strongest natural fibre? The animal fibres are made up of proteins.

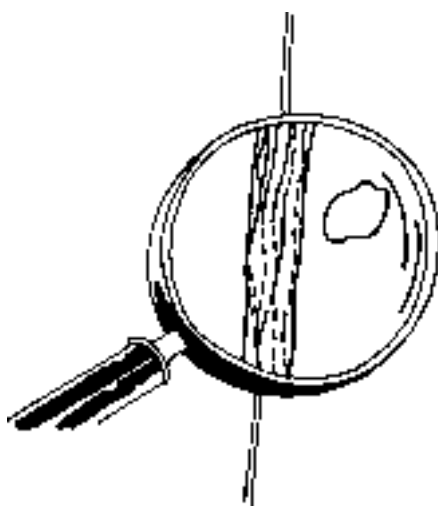


Fig. 22.2 : Animal Fibres - Silk



Fig. 22.3: Animal Fibres - Wool



Notes

(iii) Mineral Fibres

Natural fibres obtained from the minerals are called mineral fibres, eg. asbestos. You must have seen sheets of asbestos being used as rooftops. Can you think of other uses of asbestos? It is used by firefighters as clothes because it is fireproof.

Natural fibres are usually staple fibres with the exception of silk which is a filament fibre.

(b) Manmade Fibres There is another class of fibres called the manmade fibres. As the name suggests these fibres are not obtained directly from nature but made by using chemicals. Manmade fibres are of two types:

1. Regenerated fibres
2. Synthetic fibres

Let us find out more about man-made fibres.

(i) Regenerated fibres

These are made from natural raw material eg., cellulose, (waste cotton fibres or wood pulp) or protein depending upon the fibre to be made. This natural raw material is regenerated with the help of chemicals. Rayon is a regenerated cellulose fibre.

(ii) Synthetic fibres

On the other hand Synthetic fibres are obtained from chemical substances and are totally synthetic in nature, e.g., Nylon, Polyester, Acrylic (Cashmilon). Manmade fibres are generally filament fibres. Of course, they can always be cut in to small pieces to form staple fibre, if required.

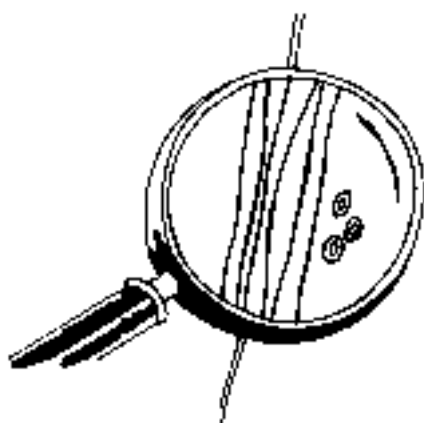


Fig. 22.4: Manmade synthetic fibres
Polyester

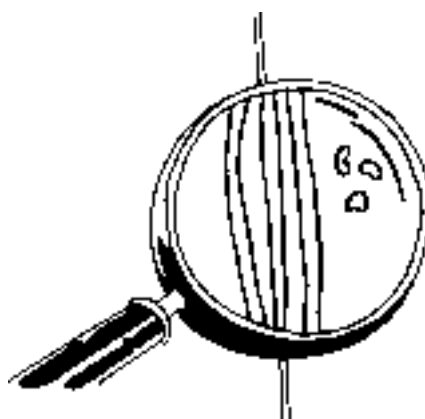
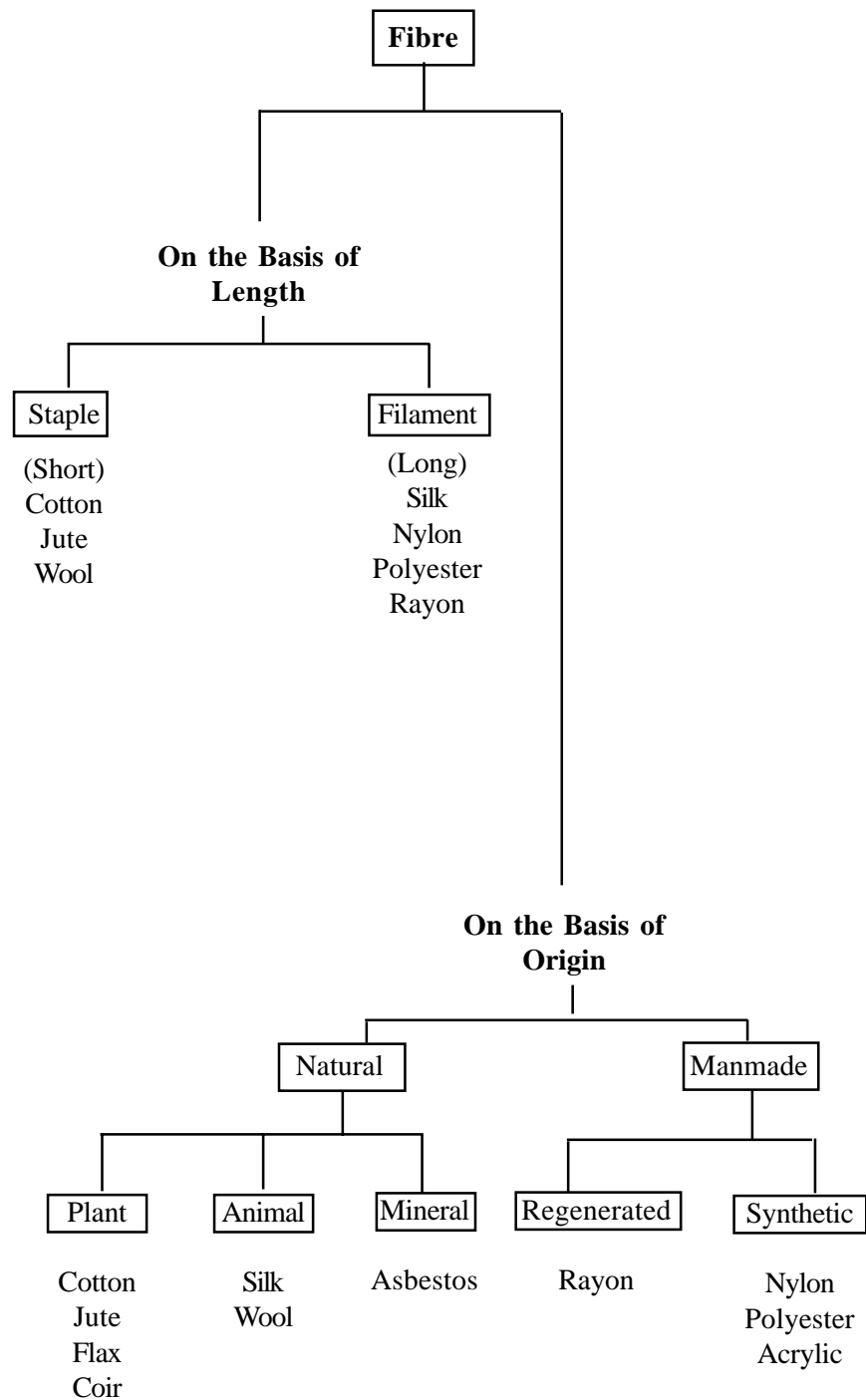


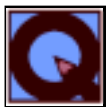
Fig. 22.5: Manmade synthetic fibres
Acrylic



Notes

Let us put the two classifications together:





INTEXT QUESTIONS 22.1

1. The missing words in the following sentences are hidden in the wonder box. The words are written downwards, across and sideways. Find and encircle these words and complete the sentence.

WONDER BOX

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| X | S | Y | Z | B | A | C | E | G | R |
| B | Y | F | D | U | F | H | J | L | E |
| A | N | A | I | I | Y | A | A | H | G |
| S | T | A | P | L | E | C | S | H | E |
| E | H | N | N | D | A | D | H | H | N |
| E | E | I | S | I | O | M | E | M | E |
| D | T | M | E | N | N | O | E | A | R |
| H | I | A | E | G | A | H | P | N | A |
| A | C | L | M | B | A | K | Y | M | T |
| I | Y | O | C | L | O | T | H | A | E |
| R | G | O | A | O | A | S | H | D | D |
| A | M | D | U | C | O | C | Q | E | R |
| R | P | A | A | K | G | T | R | Y | A |
| B | S | R | T | S | E | I | A | K | D |

- A fabric is any piece of _____
- Short fibres are called _____ and long fibres are called _____.
- Fibres are the _____ of a fabric.
- Fibres can be classified into natural and _____
- Manmade fibres can be _____ or synthetic.
- Wool is a _____ fibre obtained from _____.
- Polyester is a _____ fibre.
- Cotton comes from the _____ of a plant.

2. Match column A with column B

- | A | B |
|-------------|------------------------------|
| a) Rayon | i) Synthetic fibre |
| b) Cotton | ii) Stem fibre |
| c) Silk | iii) Regenerated fibre |
| d) Nylon | iv) Natural cellulosic fibre |
| e) Wool | v) Leaf fibre |
| f) Jute | vi) Animal fibre |
| g) Asbestos | vii) Animal secretion |
| | viii) Mineral fibre |



Notes

Table 22.1 : Properties of fibre

| Characteristics | Cotton | Wool | Silk | Rayon | Nylon | Polyester | Acrylic (Cashmilon) |
|---|--|--|--|--|--|--|---|
| 1. Length of the fibre as rayon. | Fabric is made up of staple fibres | It is staple fibre, generally coarser fabrics like blankets, etc., are made of longer fibres. | longest of all natural fibres. | It is filament fibre and can be attained in any desired length. | It is a man-made, | Same as rayon. | Same as rayon. |
| 2. Appearance | It is a dull fibre so gets dirty quickly. | Dull, wavy and rough fibre. | Smooth, shiny and straight so sheds soil and dirt easily. It does not look dirty even after many wears. | Its appearance is smooth and shiny so sheds dirt easily. | Smooth and shiny, so resistant to dirt and easy to wash. | Smooth surface so does not absorb stains and can be washed easily. | Wool appearance, but does not absorb stains and lighter in weight. |
| 3. Moisture absorption | Cotton absorbs moisture easily and also dries up quickly. So it is useful for towels and wiping cloths. It can absorb perspiration from the body and because it also dries up quickly, it does not stick to the body and gives a cooling effect. It is suitable for summer wear and undergarments. | It is somewhat water repellent in nature. However, the fibre can absorb large quantities of water. They do not dry up quickly and can hold high amount of moisture without feeling damp. | Can absorb large amount of water, without feeling damp. | Like cotton, absorbs moisture readily and also dries up fast. | Does not absorb moisture easily. It is also warm to wear and does not absorb perspiration. | Absorbs least amount of moisture compared to other fibres. Garments appear uncomfortable in not absorb perspiration. | Does not absorb moisture easily-this makes it difficult to dye the fiber. summer because it does |
| 4. Heat Conduction | Good conductor, i.e. conducts the heat away from the body and keeps it cool. | Bad conductor of heat, therefore conserves body heat and keeps it warm. | Poor conductor of heat making it a warm fabric. Due to smooth surface, unlike wool it cannot provide good insulation. | Good conductor of heat and therefore cool to wear, though not as cool as cotton. | Poor conductor of heat. | Poor conductor of heat. | Poor conductor of heat. Therefore it is warm to wear. |
| 5. Strength | Stronger when wet so can be rubbed hard without damage while washing. | Weak fibre, becomes, weaker when it is wet, therefore can be damaged if it is rubbed hard during washing. | Though it appears delicate it is a very strong fibre, it loses strength when wet. | It loses strength when wet, should not be rubbed hard. | Strongest among all fibres. Excellent resistance to rubbing, does not lose any strength when wet, so is important for industrial use. | Extremely strong fibre, although not as strong as nylon. | Satisfactory strength both when dry and wet. Its strength is not as high as nylon and polyester but adequate for many uses in apparel and home furnishings. |
| 6. Resilience (Good resistance to fabric to wrinkling and creasing) | Wrinkles and creases readily during use. After washing these wrinkles need to be ironed out. | A flexible and pliable fibre, readily springs back to shape after crushing or creasing. | The creases hang out well. But not as quickly or completely as in wool. Needs ironing after washing. | Wrinkles and creases very easily. | recovery from creasing and wrinkling requires little ironing, after washing. | Shows very good recovery from creasing and wrinkling. It requires little or no ironing after washing. | Shows excellent recovery from wrinkling and creasing. |
| 7. Uses used for carry bags, fishing | Summer wear-shirting, suits, sportswear and undergarments, sheets, curtain and wiping cloth making blankets, carpets like napkins, towels | Winter wear-knitted into sweaters, gloves, caps, suits, material & fabric dress material, suits, for coats, blankets, carpets and home furnishing | Considered a high value fabric. Used as sarees, suits, material & fabric dress material, suits, for coats, blankets, carpets and home furnishing | Summer wear dress materials. Being slippery it is used as men's ties, scarves, etc. jackets. Also used in carpets, and home furnishings. | Used in hosiery items like socks, dress materials and sweaters. Due to high lining for heavy coats and ropes and tyre cords. Also used at home and furnishing fabrics. | Dress materials for both men and women. Used for making ropes, strength, used for making | Winter wear, very popular substitute for wool; for sportswear, also strength, used for making |

22.4 IDENTIFICATION OF FIBRES

The vast variety of fabrics available today, makes their identification important. You know that variety is created by using different fibres in combination. Knowledge of the fibre content of a fabric is therefore necessary to know its suitability, use and care. Sometimes you may have been cheated by an imitation fibre, like a fabric looking like silk but turning out to be artificial silk or imitation silk. Labels and salespersons are not always able to guide you.

Burning test is a simple and reliable test and can be done alongwith the visual inspection of the fabric. It can help you to choose the fabric according to your requirements. The burning test does not identify the fibre in particular but indicates its group. Cotton, flax and rayon will have similar results when burnt as they are all basically cellulosic in nature.

a) Visual Inspection

You can identify a fabric by its appearance but accuracy in identifying comes through experience. The appearance properties of different fibres given earlier in this lesson can help you in identifying a fabric e.g., Silk is smooth, shiny and fine. Cotton is also smooth but looks dull, wool is most definitely rough.

b) Burning Test

To conduct the burning test, take a small piece of fabric (2 x 2cm) and hold it with a pair of forceps. Then do the following :

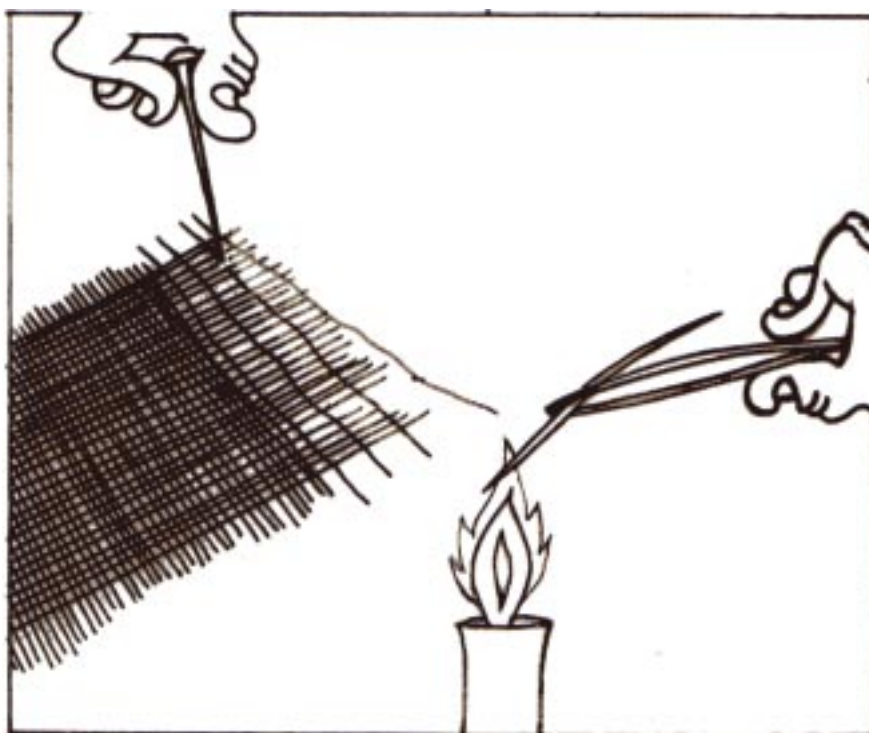


Fig. 22.6



Notes



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Table 22.2 : Burning Test of Fibres

| Name | Approaching Flame | In Flame | Removed From Flame | Odour | Residue |
|---|---|-------------------------------------|--|------------------------------|--|
| (a) <i>Natural</i> Cellulose fibre– Cotton, Linen | Does not shrink away and catches fire on contact. | Burns quickly. | Continues burning, shows an afterglow. | Like burning paper. | Light, feathery, gray in colour. |
| Manmade cellulose fibre– Rayon | -do- | -do- | -do- | -do- | Light, fluffy very small amount. |
| Protein Fibre– Wool | Curls away from the flame. | Burns slowly. | Stops burning after removing from flame. | Like burning hair. | Small black bead, brittle, crushable. |
| Silk | -do- | Burns slowly and sputters in flame. | -do- | -do- | Bead-like, black, crushable. |
| (b) <i>Manmade</i> Synthetic– Polyester | Melts and shrinks away from the flame. | Burns slowly and melts. | -do- | Smell of chemicals. | Bead formed, hard, tough, black-brown in colour. |
| Nylon | -do- | -do- | -do- | Synthetic or chemical odour. | -do- |
| Acrylic | -do- | Burns quickly and sputters. | Continues to burn, melts and molten fibre drops. | Acidic (vinegar) odour | Irregular black beads, hard but crushable. |



INTEXT QUESTIONS 22.2

- Choose the correct answer. Give reasons for your choice.
 - Which of the fabrics is most suitable for winters?
 - Cotton
 - Nylon
 - Wool
 - Polyester



Notes

Reason

ii) Which is the strongest fibre?

- a) Silk b) Nylon c) Acrylic d) Polyester

Reason

iii) Which fabric will require least ironing after washing?

- a) Cotton b) Rayon c) Silk d) Polyester

Reason

iv) When cotton burns the odour is that of-

- a) Burning paper b) Burning hair
c) Acid d) Chemical

Reason

v) Synthetics, when brought near the flame will-

- a) Curl away b) Melt and shrink
c) Catch fire but not melt d) Remain unaffected.

Reason

vi) Residue of burnt rayon is

- a) Hard bead-like, not crushable
b) Crushable bead-like
c) Light grey, feathery
d) Fluffy, small amount.

Reason

3. Give Reasons

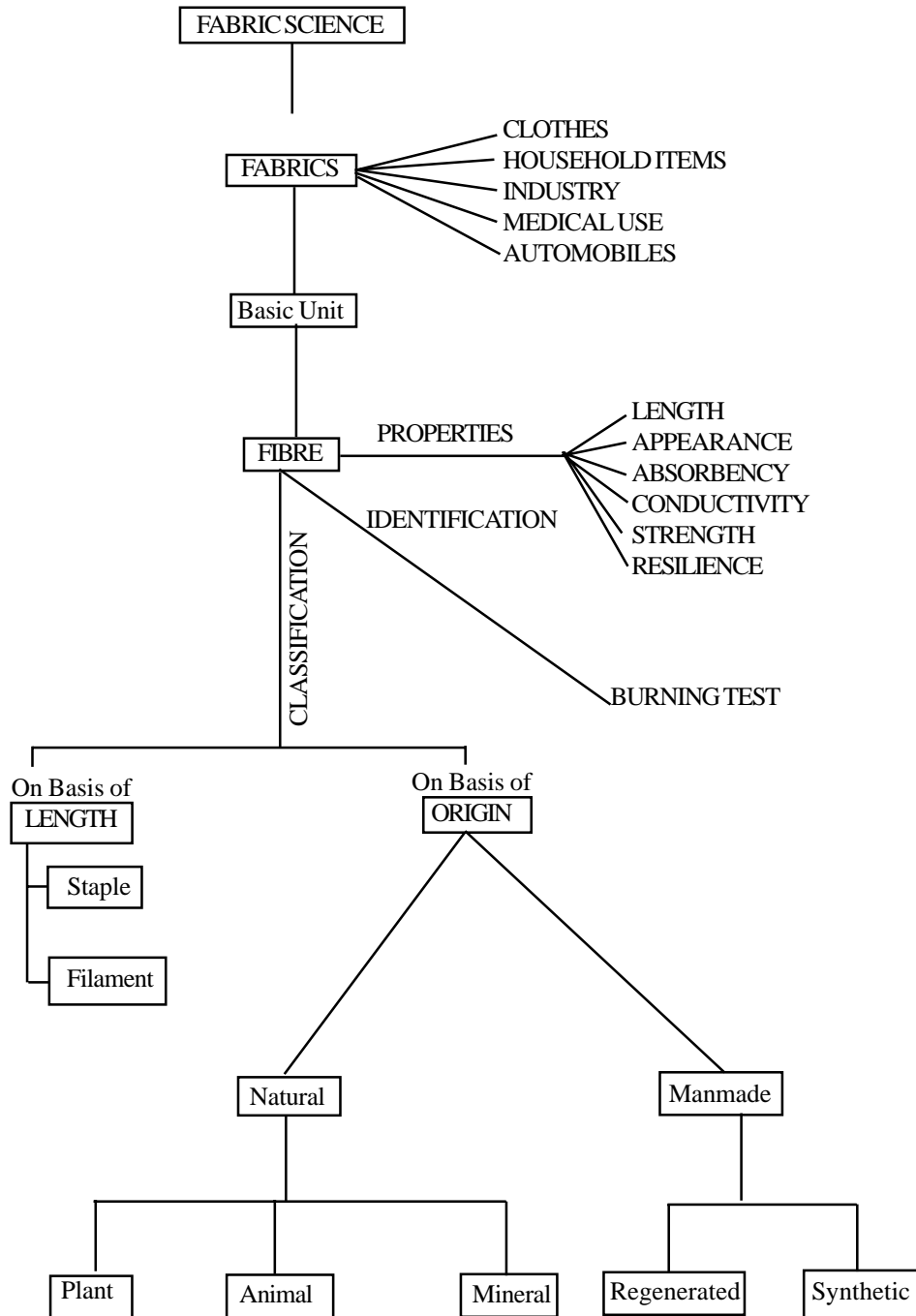
- i) Cotton is suitable for summer wear and undergarments.
ii) Nylon is used for making ropes
iii) Nylon garments are uncomfortable in summers.



Notes



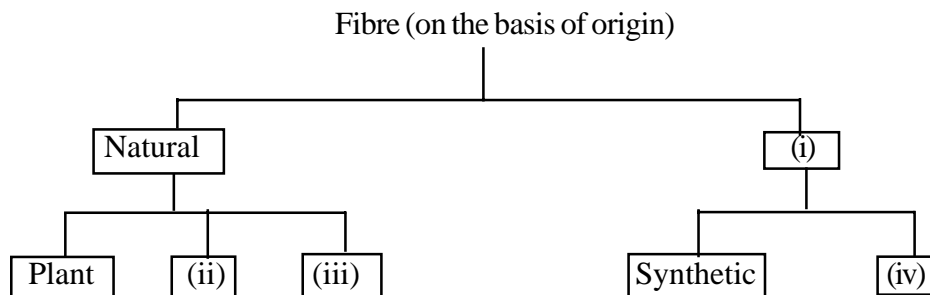
WHAT YOU HAVE LEARNT





TERMINAL EXERCISES

1. Define a fabric and elaborate on its various uses.
2. Classify fibres on the basis of their origin.
3. Name the fabric which is suitable for summer wear and state its important properties.
4. How will you identify a rayon fibre?
5. Distinguish between natural and manmade fibres.
6. Complete the following flow chart:-



ANSWERS TO INTEXT QUESTIONS

22.1

WONDER BOX

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| X | S | Y | Z | B | A | C | E | G | R |
| B | Y | F | D | U | F | H | J | L | E |
| A | N | A | I | I | Y | A | A | H | G |
| S | T | A | P | L | E | C | S | H | E |
| E | H | N | N | D | A | D | H | H | N |
| E | E | I | S | I | O | M | E | M | E |
| D | T | M | E | N | N | O | E | A | R |
| H | I | A | E | G | A | H | P | N | A |
| A | C | L | M | B | A | K | Y | M | T |
| I | Y | O | C | L | O | T | H | A | E |
| R | G | O | A | O | A | S | H | D | D |
| A | M | D | U | C | O | C | Q | E | R |
| R | P | A | A | K | G | T | R | Y | A |
| B | S | R | T | S | E | I | A | K | D |



2.
 - a) and (iii)
 - b) and (iv)
 - c) and (vii)
 - d) and (i)
 - e) and (vi)
 - f) and (ii)
 - g) and (viii)
3. (i) Manmade (ii) Animal (iii) Mineral (iv) Regenerated

22.2

1.
 - i) c, because wool is bad conductor of heat
 - ii) b, because it has excellent resistance to rubbing and does not lose strength when wet
 - iii) d, because it has excellent recovery from creasing and wrinkling
 - iv) a, because it is cellulosic in nature
 - v) b, because it is made up of chemicals
 - vi) d, because it has cellulose as its raw material
2.
 - i. It is cool and absorbant.
 - ii. It is the strongest fibre.
 - iii. Nylon does not absorb moisture.

For more information

Log on to [http:// www.fabriclink.com/fabriccare.html](http://www.fabriclink.com/fabriccare.html)