Fibers **Key**

# Using Fibers as Evidence (Pages 128-130)

1. Of what are **fibers** made? **Many filaments twisted or bonded together to form a yarn or thread**
2. Describe the structure of **textiles**. **Fabrics woven in a distinctive pattern, except for felts which lack a pattern.**
3. Fibers are considered **class**  evidence because they are **mass produced in large quantities** .
4. Give an example of how fibers can have *probative value*. **A suspect may deny his connection with a crime scene or suspect, but fiber evidence can nevertheless demonstrate that connection.**
5. Investigators must examine both **physical** and **chemical** properties of fibers in order to narrow down a fiber’s **source**.
6. Something that is related to an entire group or class of products is called **class evidence**.
7. A pink cotton fiber was found on a gray jacket of a victim. After testing 270 pink sweatshirts, the lab found a fiber matched 15 of them. By chance alone, what is the probability that the crime scene fiber and the one from the jacket matched?
$$p= \frac{15}{270}= \frac{1}{18}$$
8. Design a sampling procedure to estimate the number of attendees at an outdoor concert. (See pg. 130.)
**Give out 30 brightly colored concert hats to concert attendees. Have spotters stand near park exits and count the number exiting and the number exiting wearing hats.**
9. Illustrate your procedure above using a set of ‘dummy data’ you have made up.
$$\frac{30 hats}{x}= \frac{5 hats observed}{150 attendees}$$$$x≅900 total attendees $$

## Sources and Types of Fibers (pgs. 131-133)

1. **Fibers** are usually made of twisted **filaments.**
2. Define **filament**. **Single strands of material, usually twisted together with other filaments to make a thread or fiber**
3. The three sources of natural fibers are **animal**, **vegetable** and **inorganic (such as asbestos or fiberglass.**
4. What element is not found in *inorganic* *fibers*? **carbon**
5. Fibers that are synthesized or made from altered natural sources are **synthetic or artificial**
6. List two examples of textiles: cloth and carpeting
7. List two examples of cordage: rope, string, nets
8. Two ways in which textiles are commonly manufactured are weaving\_\_\_ and knitting\_\_\_.
9. Match the textile patterns to their names.
 \_\_\_\_\_satin\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_plain\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_twill\_\_\_\_\_\_\_\_\_\_\_\_\_
10. Sketch and identify one of these patterns below.
11. Compare the T-shirt micrograph on page 132. Which of the above patterns is it? \_\_\_\_\_plain\_\_\_\_\_\_\_\_\_\_\_\_
12. In textiles, the lengthwise yarn is the \_\_warp\_\_\_\_\_\_\_\_\_, while the crosswise yarn is the \_\_weft\_\_\_\_\_\_\_\_\_\_\_.
13. The **warp** is usually \_\_stronger\_\_\_\_\_\_, \_\_\_smoother\_\_\_\_\_\_\_\_, and \_\_more even\_\_\_\_\_\_\_\_\_\_ than the **woof**.
14. Fabric **blends** are usually produced by \_\_using a warp that is different from the weft
15. List three examples of **natural fibers**: silk, wool, cotton
16. All fibers are \_\_polymers\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, or long chains made of simple molecules.
17. List three examples of **artificial fibers**: rayon, nylon, polyester, acrylic

## Fiber Morphology (pgs. 133-143)

### Fiber Cross Sections

1. Use Figure 6.3 to match up and label the fiber cross sections pictured here.

Round, trilobal, irregular, multilobed, octalobal, 4-lobed

1. Liquid synthetic materials are extruded through a nozzle called a \_\_\_spinneret\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

### The Chemical Structure of Fibers

#### Animal Fibers

1. Wool, and other animal hair is made of a protein called \_\_\_keratin\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Use the terms *polypeptide* and *helix* to describe the structure of keratin. Keratin is a helix-shaped protein formed by linked amino acids called polypeptides.
3. The amino acid found in keratin that has a large number of ***–S—S—*** bonds is cystine .
4. What makes the structure of silk simpler than wool? Roughly 60% of silk is made up of only 2 different amino acids

#### Cellulosic Fibers

1. When cotton burns is smells like burning leaves because it is made up of cellulose (like wood)
 .
2. Summarize the chemical make-up of cotton. straight chain polymer of glucose

1. Why does cotton have relatively low *probative value*? Cotton is used in more textiles than any other fiber.
2. Contrast linen from cotton. Cotton from cotton plant, linen from flax. Both made of cellulose.
3. Compare linen with cotton. Linen has longer fibers. Flax is more brittle lending it more suitable to blends.
4. Linen fibers are often found in blends because Flax is more brittle

#### Synthetic fibers

1. How are Rayon and acetate different from other natural fibers? They have been chemically altered.
2. What is a **plastic**? A polymer substance that can flow under heat and can be molded into various shapes.
3. The first mass-produced plastic fiber is nylon.
4. What synthetic fiber is manufactured in the greatest quantity? polyester

### Synthetic Polymers

1. The functional group for polyamides, such as **nylon**, is the amide\_\_\_\_\_\_\_\_\_\_\_\_.
2. The functional group for **polyesters**, such as Dacron, is the ester\_\_\_\_\_\_\_\_\_\_\_\_.
3. Contrast the physical properties of linear polymers and cross-linked polymers.Linear polymers are flexible whereas cross-linked are rigid.
4. **Polyesters** are found in such products as clothing, carpets, curtains, ropes, nets, and fiberfill .
5. **Acrylics** are often found in sweaters, sportswear, blankets, and area rugs .
6. What is a quick test for identifying acrylics?blue litmus turns red under heat
7. What two types of fibers can be found in **Spandex**? Polyurethane and polyether
8. Olefins contain the polymer polypropylene\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
9. What is one distinctive property of olefins?resistant to weathering and chemicals
10. Olefins are found in consumer products including carpeting, upholstery, auto interior fabric, and rope .

## Fiber Analysis (Pages 143-157)

1. The four tests used in this section are BURN, THERMAL DECOMPOSITION, CHEMICAL, REFRACTIVE INDEX

### Density

1. How is density calculated? MASS / VOLUME
2. What makes olefins different from other fibers? THEY FLOAT ON WATER
3. How design a simple density test to distinguish nylon from rayon? NYLON SHOULD SIND IN SALT WATER. RAYON SHOULD FLOAT

### Refractive Index

1. Define **refractive index (RI)**.MEASURE OF THE BENDING OF A RAY OF LIGHT AS IT PASSES FROM AIR INTO A SOLID OR LIQUID.
2. What happens to a fiber when it is placed into a liquid that has the same refractive index (RI)?

BECOMES INVISIBLE

1. What is a Becke line?HALO-LIKE SHADOW APPEARING AROUND AN OBJECT IMMERSED IN A LIQUID OF A DIFFERENT REFRACTIVE INDEX.
2. When Becke lines appear inside a fiber, then the liquid has a \_\_LOWER\_\_\_\_\_\_\_\_\_ refractive index than the fiber.
3. If Becke lines do not appear, then the refractive index (RI) is the \_SAME\_\_\_\_\_\_\_\_\_\_ as the fiber.
4. Match the diagram to the description of Becke lines below.
α. RI of liquid > RI of fiber A
β. RI of liquid < RI of fiber C
γ. RI of liquid = RI of fiber B

|  |  |
| --- | --- |
| **Liquid** | **Refractive Index** |
| Water | 1.333 |
| n-butyl alcohol | 1.402 |
| Olive oil | 1.467 |
| Caster oil | 1.482 |
| Clove oil | 1.543 |

### Fluorescence

1. What causes fluorescence? Dyes, optical brighteners or by chem./cryst. Properties of the fiber
2. What light source can be used to find fibers for collection based on fluorescence? UV

### Dyes

1. Why are forensic scientists interested in the color of fabrics? Different types of fabrics act differently to dye molecules. Color is a good way to match fabrics/fibers. Dyes can be separated into components.

### Chromatography

1. Describe **chromatography**.
2. Does fabric dye have high or low *probative value*? Explain your response.
3. How is Retention factor (Rf) calculated? Write the equation in the space below?

## Other Tests for Fiber Evidence (pgs. 157-158.)

1. How is Fourier Transform Infrared Analysis (FTIR) used to identify fibers?
2. What is the most useful tool in identifying fibers?
3. Summarize the process of pyrolysis gas chromatography—mass spectrometry.

(This instrument is also used to identify narcotics.)
4. After reading the article, “In Their Jeans,” summarize how the wear pattern on jeans produces a unique ‘bar code.’

(Pretty sharp, don’t you think?)

## Fiber Transfer and Persistence (pg. 158)

1. Why is the transfer and persistence of fibers at a location a challenge to the prosecution?