Chapter 4
Fiber Examination

Fibers can be classified as:

1. **Natural fibers** – derived from animal or plant sources

2. **Synthetic/Manufactured fibers** – chemically produced
Fibers may be classified as to structure:

• One type of fiber – polymeric – cotton

• Blends – heteropolymeric – two or more polymers blended

• Co-polymeric – differing, natural polymers - wool & silk
Natural Animal Fibers

• Hair from sheep (wool), goats (mohair, cashmere), camels, llamas, alpacas and vicunas
• Fur from mink, rabbit, beaver or muskrat
• Webbing from poultry
• Can be examined and identified microscopically
Natural Plant Fibers

Cotton is the most common appearing having a ribbon-like shape with twisted fibers
Synthetic Fibers

- Rayon introduced in 1911
- Nylon made in 1939
- Generic families of fibers include:
  - Dacron
  - Fortrel
  - Kodel
Synthetic Fibers

• Are produced solely from chemicals
• Include nylons, polyesters and acrylics
• Are often polymers (macromolecules) in long chains
Regenerated Fibers

• The first man-made products were produced from cellulose wood fibers and cotton
• These include rayon, acetate and triacetate
Fiber Analysis

Pass light through synthetic fibers emerges polarized and produces a **specific refractive index** which can be compared to known standards.
Some collected fibers

• Notice the similarities & differences
Collect fibers

• Under a microscope, measure diameter & sketch each fiber with a written description

• Obtain crime scene evidence and compare to fibers from each suspect
Fibers - beautiful & easy to photograph
Study weave patterns
Fiber Count

Linen

Lycra

Viewer

Microscope
<table>
<thead>
<tr>
<th>Type of Weave</th>
<th>Diagram</th>
<th>Description</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain</td>
<td><img src="image" alt="Plain Weave Diagram" /></td>
<td>Alternating warp and weft threads</td>
<td>firm and wears well, snag resistant, low tear strength, tends to wrinkle</td>
</tr>
<tr>
<td>Basket</td>
<td><img src="image" alt="Basket Weave Diagram" /></td>
<td>Alternating pattern of two weft threads crossing two warp threads</td>
<td>an open or porous weave, does not wrinkle, not very durable, tends to distort as yarns shift, shrinks when washed</td>
</tr>
<tr>
<td>Satin</td>
<td><img src="image" alt="Satin Weave Diagram" /></td>
<td>One weft crosses over three or more warp threads</td>
<td>not durable, tends to snag and break during wear, shiny surface, high light reflectance, little friction with other garments</td>
</tr>
<tr>
<td>Twill</td>
<td><img src="image" alt="Twill Weave Diagram" /></td>
<td>Weft is woven over three or more warps and then under one. Next row, the pattern is shifted over one to the left or right by one warp thread</td>
<td>very strong, dense and compact, different faces, diagonal design on surface, soft and pliable</td>
</tr>
<tr>
<td>Leno</td>
<td><img src="image" alt="Leno Weave Diagram" /></td>
<td>This uses two warp threads and a double weft thread. The two adjacent warp threads cross over each other. The weft travels left to right and is woven between the two warp threads.</td>
<td>open weave, easily distorted with wear and washing, stretches in one direction only</td>
</tr>
</tbody>
</table>

Weave Patterns
Blue shirt comparison
Jeans comparison
Make permanent slide sets
Burn Testing of Fibers

Fiber Testing - Ignite fibers

1. **a. fiber melts**
   - shrinks away, melts, very hot

2. **b. fiber does not melt**
   - **a. no smoke**
     - acid smell, hard ash, irregular, crumbles
   - **b. black smoke**
     - sweet smell, residue round hard, shiny bead melts & burns at same time hard to extinguish
   - **c. white smoke**
     - burned plastic smell

3. **a. ignites quickly**
   - steady flame

4. **b. ignites slowly**
   - fibers closest to ash very brittle difficult to identify

5. **a. burning hair smell**
   - nylon (polyamide from petroleum)
   - **b. no smell**
     - cellulose, animal fibers

6. **a. yellow flame**
   - wool (hair with oils)
   - **b. non-yellow**
     - acetate (wood fibers)
     - rayon (wood fibers & cotton)

- **a. blue flame**
  - silk (worm cocoon)

- **b. no flame**
  - steady flame hard to keep burning hard or gummy bead

- **c. white smoke**
  - cotton fabric can be blown out fine, light gray ash plant

- **d. drips**
  - acetate (wood fibers) flickering flame hard to extinguish

- **b. non-drips**
  - slight ash rayon (wood fibers & cotton)
Other Tests on Fibers

- Seizing – scrape off starch
- Mercerization & tensile strength
- Microscopic examination & comparison
- Acetate – dissolve in acetone
- Fiber Etch® – dissolves cellulose
  - Nitric acid – cotton, wool or blend?
  - Boil & dissolve in KOH
- Protein – heat fiber in water, check for base