Nylon

- **First commercially available synthetic** fiber
- **Polyamide**, ISO equivalent of nylon
- Nylon 6 and nylon 6,6 - most commonly used
- **Derived from petroleum products**
  - Limited production of bio-based nylon
- **Thermoplastic, melt spun**
- Dominates hosiery, carpet, and activewear industries
- **Recyclable;** carpet fiber is available with certified recycled content
Fiber Structure

- **Varying sizes**
  - Microdenier and finer fibers – apparel
  - Coarser yarns - rugs and carpets

- **Varying shapes**
  - Round cross-section - common
  - Trilobal - carpets
  - Hollow - insulation

- **Inherently lustrous**
  - Delusterant - medium or low luster
Nylon Fibers with Round Cross-section – Commonly used for pantyhose and apparel
Nylon Fiber with Hollow Cross-section Used for Carpets
Nylon Performance Highlights

- Strength varies depending on extent of drawing and heat setting
  - Very high strength - seat belts and industrial products
  - High strength - carpets
  - Moderate strength - apparel
- High flex and flat abrasion resistance
- Drape varies
- Excellent wrinkle resistance
- High elastic recovery and resilience
- High extensibility
- Good dimensional stability
Nylon Performance Highlights

- Low moisture absorbance, hydrophobic
  - Not very comfortable in hot/humid conditions
  - Can be engineered to enhance liquid transport (wickability)
  - Dry quickly
  - Prone to static buildup

- Damaged by sunlight

- Rot resistant, not biodegradable

- Melts, thermoplastic
End Uses

- **Apparel**
  - Nylon/spandex blends: swimwear, leotards, and form-fitting garments requiring stretch
  - Legwear, hosiery, lingerie, socks
  - Tightly woven nylon fabrics: wind- and rain-resistant apparel

- **Textiles for Interiors**
  - Coarse nylon fibers with excellent crush resistance - residential tufted carpets
End Uses

- **Household & Institutional Textiles**
  - Flocked blankets and upholstery fabrics

- **Technical Textiles**
  - Luggage, bags, and belts
  - Outdoor tents, sleeping bags, and other sporting goods
  - Automobile upholstery, headliners, interior panels, and carpets
Care

- **Launder or dry clean**
  - Not damaged by detergents, stain removal agents or dry cleaning solvents

- **Dry at low temperature;** remove promptly

- **Attracts soil and oil**
  - “Scavenger fiber”
  - Clinging soil makes nylon grey and dingy
  - Easily stained in wash water by dyes from other items

- **Ironing**
  - Iron with care at low temperature
Polyester

- **Derived from petroleum**

- Poly(ethylene terephthalate), or PET, is most frequently used

- **Elasterell-p** - generic name of a sub-class of inherently elastic polyester

- **Triexta** - generic name of a sub-class of inherently stain resistant polyester, stronger than PET

- **Thermoplastic, melt spun**
Versatility of Polyester

- **Easily blended with most fibers**
  - Apparel and home furnishings
  - Similar to cotton in modulus (resistance to extension), and better suited than nylon for blending with cotton

- **Engineered to resemble natural fibers**
  - "linen look"
  - "silk-like"
  - "wool-like"
Triexta Carpet Fibers with Trilobal Cross-section

Note: In 2009 the Federal Trade Commission approved triexta as a generic sub-class of polyester.
Polyester Performance Highlights

- **Strength varies** from medium to high, depending on extent of drawing and heat setting

- **Excellent abrasion resistance**
  - Susceptible to pilling; pills do not readily detach

- **Drape varies**
  - Microfiber fabrics drape well

- **Excellent wrinkle resistance**

- **High elastic recovery and resilience**
  - Stretches and recovers well at low levels of elongation, but does not recover well when at higher levels of elongation
Polyester Performance Highlights

- Good dimensional stability, good shape retention in use

- Low moisture absorbance, hydrophobic
  - Not comfortable during hot/moist conditions
  - Blended with cellulosic fibers
  - Engineer to improve wickability
  - Dries quickly when wet
  - Prone to static buildup; clings in dry conditions

- Bulked fibers provide thermal insulation by trapping air between fibers

- Not damaged by sunlight

- Rot resistant, not biodegradable

- Melts, thermoplastic
Pilling in a Quilted Polyester/Cotton Bedspread

Magnified view
Polyester Fabric with Heat Set Pleats

Note: The jacket collar is made of pleats that are heat set in the polyester fabric.
Examples of End Uses

- **Apparel**
  - Blend with cotton or rayon - strong, easy care, comfortable garments
  - Blend with wool - men's suits
  - Pants, shirts, children's clothes, and outerwear fabric
  - High performance, moisture transport properties - sportswear

- **Textiles for Interiors**
  - Draperies, bedspreads, upholstery, tufted carpets and rugs
  - Recycled - upholstered furniture and carpets
End Uses

- **Household & Institutional Textiles**
  - Blends - bed linen, comforters, blankets, and table linen
  - Hollow fiberfill - comforters, pillows, and cushions

- **Technical Textiles**
  - Sleeping bags, tents, sails, ropes, fishing line, car seat belts, webbing, and luggage and other bags
  - Recycled - nonwoven fabric outdoor applications
Nonwoven Fabric Produced with Recycled Polyester

Samples courtesy Foss® Manufacturing Company, LLC
Care

- **Wash or dry clean**
  - Not damaged by detergents, stain removal agents or dry cleaning solvents
  - Easy-to-care-for fiber
  - **Oleophilic fiber;** oil-based stains are difficult to remove

- **Dry at low temperature,** and remove promptly

- **Iron at low temperature**
Oil-based Stain on a Men’s Polyester Shirt
Polyester recycling

- **Physical recycling**
  - PET bottles cleaned, chipped, melted and made into fibers
  - More common and less expensive

- **Chemical recycling**
  - Waste is chemically depolymerized, monomers used to create new polymers
  - More expensive

- Used for bags, floor coverings, furniture, apparel, and outdoor products
Physical Recycling of Polyester—Polyester produced from 100% post-consumer recycled plastic PET bottles for different end uses

Note: A physical recycling process is used to convert plastic bottles into Eco-fi™ polyester fibers. The finer 1.7 decitex fiber is typically blended with cotton to produce T-shirts and undergarments. The coarser and longer fiber is used for carpets and wall coverings.

Samples and information courtesy Foss® Manufacturing Company, LLC
Chemical Recycling of Polyester Fibers

1. “Crushing” collected waste
2. Granulation
3. Decolorization
4. Raw material (DMT)
5. Polyester pellets
6. Polyester fiber

Note: The steps on this slide are used for manufacture of chemically recycled ECO CIRCLE™ FIBERS, a trademark of TEIJIN FIBERS LIMITED. Courtesy TEIJIN FIBERS LIMITED.