Yarns

Unit: Science of Textiles and Manufacturing

Problem Area: Fabric Construction

Lesson: Yarns

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Explain how fibers are made into yarn.**
2. **Explain various types of yarn.**

Resources.

The following resources may be useful in teaching this lesson:

Collier, Billie J., Martin Bide, and Phyllis G. Tortora. *Understanding Textiles,* 7th ed. Pearson / Prentice Hall, 2008.

Franquemont, Abby. "Plying, Part 1," *YouTube*. Accessed Dec. 7, 2001. <http://www.youtube.com/watch?feature=fvwp&v=Yt5nOBM8SsM&NR=1>.

"How It Is Made: Cotton Yarn," *YouTube*. Accessed Dec. 7, 2011. <http://www.youtube.com/watch?v=kH_b3Heo48I&feature=related5>.

Kadolph, Sara J. *Textiles,* 11th ed. Pearson / Prentice Hall, 2010.

Liddell, Louise A., and Carolee S. Samuels. *Apparel: Design, Textiles, and Construction,* 10th ed. Goodheart Willcox, 2012.

"Yarn Construction and Specialist Yarns," *YouTube*. Accessed Dec. 7, 2011. <http://www.youtube.com/watch?v=Fh6E5-yTPWU>.

Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms.

The following terms are presented in this lesson (shown in bold italics):

- absorbency
- blended yarns
- cord
- elasticity
- extrusion
- fibers
- filament yarns
- low twist yarn
- monofilament yarn
- multifilament yarn
- pills
- ply
- S twist
- sheen
- single-ply yarn
- staple yarns
- spinneret
- spun yarn
- tight twist yarn
- thread
- two-ply yarn
- wrinkle resistance
- yarn
- Z twist

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Share the following lyrics (or the song): "Let's twist again like we did last summer. Let's twist again like we did last year. Twisting time is here. Round and round and up and down we go again." Explain that the song describes a dance that was popular before the students were born. Tell them to think of the song when considering the twisting of fibers to make yarn.*

> *If available, separate cotton fibers from a roll of absorbent cotton; pull a few fiber strands out to demonstrate a simple method to make yarn by holding one end stationary and twisting the other end. Let students observe the newly twisted yarn with a magnifying glass.*

> *Show students the "Yarn Construction and Specialist Yarn" YouTube video (just the yarn construction part). Discuss the differences/similarities between how you made the simple twisted yarn by hand and the method they saw in the video.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Explain how fibers are made into yarn.

Anticipated Problem: How are fibers made into yarn?

I. Yarn

A. ***Yarn*** is a continuous, usually plied, strand (or thread or cord) of textile fibers that are twisted together. These long yarns are created from natural or humanmade fibers or filaments used to weave or knit fabrics. ***Fibers*** are natural or synthetic filaments capable of being spun into yarn, which is the final product of cotton and wool spinning (where twisting occurs) processes. Threads, yarns, and cords are made by twisting (winding and intertwining) two or more fibers around a central core to make a single strand. Twisting gives yarn strength and makes the fibers cling together.

1. The first yarns were twisted by hand.
2. The spinning wheel was used to create yarn around 500 B.C.
3. Now machinery is used to make yarn.
4. Cotton fibers are made into abrasives, awnings, household goods, clothing, gloves, hosiery, luggage, rugs, shoes, upholstery, explosives, and tents.
5. Woolen fibers are made into clothing, rugs, blankets, and other items.

B. Classifications

1. A ***ply*** is one of the strands in a yarn. ***Single-ply yarn*** is numerous individual fibers and/or strands plied or twisted together. ***Two-ply yarn*** is the twisting together of two or more single yarns.
   a. ***Staple yarns*** (e.g., wool and rayon) are short fibers that when spun and twisted together form a yarn rather than a filament. Natural staple fibers often require the additional process of spinning to form yarns. Silk yarn is a continuous filament yarn and is derived from silk cocoons. Most synthetic yarns require no additional spinning to form yarns. ***Extrusion*** is the process of forcing a synthetic liquid, semi-liquid, or polymer through small openings in a spinneret to form synthetic yarns. A ***spinneret*** is an extrusion die with multiple small holes or openings through which the synthetic liquid or polymer flows and is shaped.
   b. ***Filament yarns*** are long, continuous fibers twisted together into a single thread. Filament yarns may be classified as monofilament or multi-filament yarns.

2. Yarn construction
    a. Complex or novelty yarns are constructed from single or plied types often with irregularities (e.g., slub-type yarns), varying sizes of yarns, and/or twist effects.
    b. Metallic yarns are a monofilament flat yarn made by lacquering aluminum pigment or by laminating aluminum foil between layers of plastic.
    c. Textured yarns are produced by physical, chemical, or thermal manipulation of fibers and yarns so they are no longer straight and are no longer uniform.
    d. Bulked or lofted yarns have added texture. Bulky yarns are subjected to additional crimping, looping, curling, and crinkling processes to produce the bulk and/or loft.
    e. Stretch yarns can be made from natural and human-made fibers. The stretch properties are added by chemical or mechanical means.
3. A ***cord*** is two or more ply yarns twisted together with the final twist usually applied in the opposite direction of the ply twist. Sample twist patterns are:
    a. SZS are S-twisted singles made into Z-twisted plies that are then combined with an S-twist.
    b. ZSZ are Z-twisted singles made into S-twisted plies that are then combined with a Z-twist.

C. ***Thread*** is a filament or a group of filaments twisted together into a continuous strand. Thread is usually made with two or more plies from cotton or silk fibers.
1. Thread is coated with chemicals to make it easy to use (to pass through fabric).
2. Thread is used in home and industrial settings.
3. Thread is used in the weaving process and to sew sections of garments and products together.

Teaching Strategy: *Have students read the section in your textbook pertaining to yarn. Then use a "game show" format with the class to practice the key terms. Project VM–A and facilitate a discussion. Show the following YouTube videos: "Plying Part I" and "How It Is Made: Cotton Yarn" found in the Resources section of this lesson plan. Answer any student questions.*

Objective 2: Explain various types of yarn.

Anticipated Problem: What are types of yarn, and how does twist affect yarn?

II. Yarn types

A. Filaments
1. ***Monofilament yarn*** is a single, untwisted synthetic thread, such as:
    a. Fishing line

b. Plastic thread used to hem some garments
c. Hosiery yarn

2. ***Multifilament yarn*** is two or more synthetic (human-made) or natural (silk) threads (filaments) twisted together.

B. ***Spun yarn*** is thread constructed from short staple fibers (e.g., cotton, wool, silk, and human-made) wrapped around a core fiber. Spun yarn has a nubby texture, such as that of rope. Short fibers protrude, making the spun yarn appear fuzzy. Spun yarns are prone to snagging and have a bulkier, rougher feel. They pill more than filament types. Some spun yarns fall apart when untwisted. Fibers used in spun yarn include:

1. Natural fibers: cotton, wool, and silk
2. Human-made fibers

C. ***Blended yarns*** are a combination of natural and human-made fibers constructed at the fiber stage rather than the ply stage. Blended yarns include polyester and viscose, acrylic and polyester, acrylic and cotton, polyester and linen, cotton and nylon, cashmere and wool, and cashmere and silk. Properties and performance characteristics of blended yarns include:

1. Abrasion resistance
2. Wrinkle resistance
3. Soil resistance
4. Increased strength
5. Easier to spin and weave
6. Less expensive to produce
7. Improved hand and texture in fabrics
8. Improved fabric appearance
   a. Smoother ***sheen*** (brightness; shine)
   b. Bulkier textures
   c. Rougher textures

D. Twist direction (turning by rotating)

1. An ***S twist*** is a left turning rotation. Woolen and worsted yarns are usually S twists.
2. A ***Z twist*** (pronounced zet) is a right turning rotation. A Z twist is used to make most yarns (especially cotton and flax).

E. The effect of twist on yarns

1. A ***tight twist yarn*** is a close, compact, and smooth strand.
   a. It keeps fibers from shifting.
   b. It decreases the diameter size of the yarn.
   c. It increases ***elasticity*** (the ability to stretch). As a result, yarn or fabric will return to its original length, shape, or size almost immediately after the removal of the stress—usually stretching.
   d. It sheds soil due to a smoother surface.

e. It lowers ***absorbency*** (the ability to take up moisture).
f. It increases ***wrinkle resistance*** (the ability to resist creases and wrinkles).
g. It retains heat.
h. It resists abrasion (the process of eroding or roughening).

2. A ***low twist yarn*** is an open, fluffy, and loose strand.
   a. The fibers shift easily.
   b. It has a rough surface (rougher than that of a tight twist yarn).
   c. The fibers may pull and snag.
   d. It releases heat.
   e. It wrinkles more easily than a tight twist yarn.
   f. It stretches out and does not return to its original shape/size.
   g. It ***pills*** (becomes rough by matting into small balls of fibers due to abrasion and/or wear).

Teaching Strategy: *Assign LS–A through LS–D. Facilitate a discussion of any reflection questions on the lab sheets.*

Review/Summary.

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may be used in the Review/Summary.

Application.

Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. b
2. d
3. a
4. f
5. e
6. c

Part Two: Completion

1. blended

2. wrinkle
3. short
4. two-ply
5. hand
6. pills

Part Three: Multiple Choice

1. a
2. c
3. b
4. d
5. c
6. d

Sample Test

Name _____

Yarns

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. cord
b. monofilament yarn
c. S twist
d. spun yarn
e. yarn
f. Z twist

_____1. A single, untwisted synthetic thread

_____2. Thread constructed from short staple fibers wrapped around a core fiber

_____3. Two or more ply yarns twisted together, with the final twist usually applied in the opposite direction of the ply twist

_____4. A right turning rotation

_____5. A continuous, usually plied, strand of textile fibers that are twisted together

_____6. A left turning rotation

Part Two: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. When human-made and natural fibers are combined, they produce a _____ yarn or fabric.
2. One main reason to combine cotton and polyester yarns is to make the fabric more _____ free.
3. Staple yarns are made from _____ fibers.
4. When two single-ply yarns are twisted together, they produce a _____ yarn.
5. The first yarns were made by _____.
6. Small nubby balls that appear on fabric and are often caused by abrasion and/or wear are called _____.

Part Three: Multiple Choice

Instructions: **Circle the letter of the correct answer.**

1. Thread is usually made from _____ fibers.

    a. cotton or silk
    b. rayon and silk
    c. wool and linen
    d. human-made

2. Water-repellant fabrics are made from _____.

    a. spun yarns
    b. pilled yarns
    c. blended fibers
    d. elastic fibers

3. Silk thread is _____.

    a. a monofilament
    b. a multifilament
    c. a spun yarn
    d. human-made

4. Yarn twist affects the _____.

    a. appearance of the yarn and fabric
    b. elasticity of the yarn and fabric
    c. ability of the yarn/fabric to hold heat
    d. All of the above

5. A low-twist fabric _____.

    a. resists wrinkle because it stretches
    b. resists abrasion
    c. results in more pill and lint in the yarn and fabric
    d. decreases the diameter of the yarn and fabric

6. A tight-twist fabric _____.

    a. resists wrinkling
    b. keeps fibers from shifting
    c. sheds soil
    d. All of the above

THE EVOLUTION OF YARN MAKING

The first yarns were made by hand.

Around 500 B.C., yarns were made by spinning wheels.

Now yarns are made by textile machine methods.

Silk filaments are spun from cocoons.

VM–B

ADVERTISEMENT RUBRIC

Criteria	Excellent 4	Good 3	Fair 2	Needs More Info 1	Points	Comments
Properties & characteristics are clearly identified						
Gets the reader's attention						
Layout is effective						
Graphics are appropriate						
Creative advertisement						

TOTAL Points earned: _____

Name _____

Blended Yarn or Fabric Advertisement Handout

Purpose

The purpose of this activity is to increase firsthand knowledge about blended yarn or fabric.

Objectives

1. Research characteristics of a blended yarn or fabric.
2. Describe its properties and performance characteristics.

Materials

- lab sheet
- writing utensil
- paper
- VM–B
- computer with Internet
- books and other resources

100% cotton label

Procedure

1. Review the Advertisement Rubric (VM–B).
2. Research a blended yarn or fabric. Have your teacher approve your selection so he or she can make sure the entire class does not select the same fabric.
3. Describe the properties and performance characteristics of the blended yarn or fabric using the words you found in your research. Write a succinct paragraph.

4. Redesign the label on this handout (that reads “100% cotton”) to reflect your blended yarn or fabric. Use the space provided.

5. Design an advertisement for a garment made from the blended fabric on the label you designed. Use a second sheet of paper for this task.

6. Display your label as well as the properties and performance characteristics according to your instructor’s direction.

Blended Yarn or Fabric Advertisement Handout

1. Review the Advertisement Rubric with students at the beginning of the assignment.
2. Some key words that describe the properties and performance of a blended fabric are:
   a. Breathes freely
   b. Comfortable
   c. Wrinkle free
   d. Durable
   e. Abrasion resistant
   f. Absorbent
   g. Unique color blend
   h. Water repellant
   i. Other key words per your discretion
3. After students complete the advertisement, evaluate it with the VM–B Rubric. Students should evaluate their own advertisement. Then you and other students should evaluate the advertisements according to the rubric.
4. Post the advertisements on a bulletin board.

Name _____

Make Cotton Yarn

Purpose

The purpose of this activity is to make yarn and a cord.

Objectives

1. Twist the cotton fibers with S or Z twists.
2. Make single- and two-ply yarn, and evaluate them.
3. Make a cord.

Materials

- lab sheet
- writing utensil
- six segments of 6-inch absorbent cotton (per student)
- scissors
- stapler

Procedure

1. Work individually to complete the yarn tasks. Collect the supplies for all tasks. The hand process of making yarn from fibers is the one you will use in this lab. Later, the yarn is woven or knitted into a fabric.
2. STEP 1: Make a single-ply cotton yarn.
   a. Pull apart one of the absorbent cotton segments into six smaller segments.
   b. Select a twist process: S twist or Z twist.
   c. Make a single-ply yarn by individually twisting each of the six segments. You should have six single-ply pieces of yarn.

d. Staple one of the single-ply segment samples in the space provided. Label it “Single-Ply Yarn.”

3. STEP 2: Make a two-ply yarn.

   a. Select a twist process: S twist or Z twist.
   b. Twist together two of the remaining single-ply yarns you prepared in STEP 1 to form a two-ply yarn.
   c. Staple the two-ply yarn sample in the space provided. Label it “Two-Ply Yarn.”

4. STEP 3: Make a cord.

   a. Select a twist process: S twist or Z twist.
   b. Twist together the remaining three single-ply yarns to form a cord.
   c. Staple the cord sample in the space provided. Label it “Cord.”

5. Answer the following questions concerning the yarns you made by hand.

   a. Did you twist your cotton fiber to the right or to the left (S twist or Z twist)?

   b. Of the three yarns, which is the weakest? Explain your answer.

c. Of the three yarns, which is the strongest? Explain your answer.

d. Which two are more likely to be used in apparel?

e. What are four uses for cord?

(1)

(2)

(3)

(4)

Make Cotton Yarn

1. Cut absorbent cotton rolls in 6-inch lengths prior to the lab.
2. Answer Key for Question 5:
   a. To the right (Z twist) or left (S twist)
   b. Single ply because one ply is not as strong as two or three plies
   c. Three-ply
   d. One- and two-ply yarns
   e. Rope, netting, seats in chairs, etc. Other answers are acceptable at your discretion.

Name _____

Yarn Types

Purpose

The purpose of this activity is to examine various types of yarn.

Objectives

1. Identify monofilament and multifilament yarn.
2. Identify spun yarn.

Materials

- lab sheet
- writing utensil
- paper
- magnifying glass (about one per four students)
- ruler
- 1 spool of silk thread
- 1 spool of fishing line
- 1 yard of fabric made from a tight twist yarn (1 swatch per student)
- 1 yard of fabric made from a low twist yarn (1 swatch per student)
- 1 yard of spun yarn (or 1 yard of fabric made with spun yarn) (1 swatch per student)
- scissors

Procedures

1. Work individually to complete the following tasks. You may need to share a magnifying glass with others.

2. Cut a 12-inch length of silk thread from the spool. There will be two to three filaments twisted together to make the thread. Look at the thread under the magnifying glass.

   a. Draw what you see in the space provided or on a separate sheet of paper if you prefer.

   b. Is the thread monofilament or multifilament? _____
   Explain your answer in the space provided.

   c. Separate the thread by pulling the filaments apart (unraveling the thread). Look at one of the filaments from the silk thread under the magnifying glass. Is this a monofilament or a multifilament? _____
   Explain your answer in the space provided.

3. Cut a 6-inch piece of fishing line from the spool. Look at it under the magnifying glass.

   a. Draw what you see in the space provided.

   b. Is the plastic fishing line a monofilament or a multifilament?
   _____

   c. Explain your answer in the space provided.

4. Participate in a discussion about your findings.

5. Turn in your completed lab sheet to your instructor.

Name _____

Yarn Twist

Purpose

The purpose of this activity is to examine low and tight twist yarn and/or fabric under magnification.

Objectives

1. Examine the effect of a low twist on yarn performance.
2. Examine the effect of a tight twist on yarn performance.

Materials

- lab sheet
- writing utensil
- 6 yards low twist yarn (cut into about 8-inch lengths; one per student)
- 6 yards tight twist yarn (cut into 8-inch lengths; one per student)
- 1-yard low-twist fabric (1 swatch per student)
- 1-yard tight-twist fabric (1 swatch per student)
- magnifying glass (about one per four students)
- sandpaper

Procedures

1. Work individually to complete the following activities. Collect the materials for your experiment.
2. First, examine the tight and the low twist yarns under a magnifying glass. Describe and sketch what you see (appearance) in the space below.
   a. Tight twist

b. Low twist

3. Next, examine the tight and the low-twist fabric swatches under a magnifying glass. Describe and sketch what you see (appearance) in the space below.

   a. Tight twist

   b. Low twist

4. Further examine the low and the tight twist yarns and fabrics and answer the questions in the space provided.

   a. STRETCHING: Stretch the tight twist and low twist yarns and fabrics. Record which yarn and which fabric stretches do not return to their original shape.
      (1) Yarn _____
      (2) Fabric _____

   b. Using the yarn and fabric that you stretched: Record which yarn and which fabric do not allow fibers to shift easily.
      (1) Yarn _____
      (2) Fabric _____

   c. WRINKLING: Squeeze the tight twist and low twist swatches of fabric in your hand for about 20 or 30 seconds. Which fabric best resists wrinkling?

      _____

d. SNAGGING: Which fabric is more likely to snag: tight twist or low twist?

_____

(1) What would explain your answer? Use the space provided below to write your argument for your answer.

e. ABRASION: Rub the tight twist and the low twist yarns and fabric swatches across a piece of sandpaper. Which yarn and which fabric best resist abrasion?

(1) Yarn _____

(2) Fabric _____

5. Participate in a discussion of your experiments. Share your thoughts about which fabrics best resist stretching, snagging, and abrasion.
6. Turn in your completed lab sheet to your instructor.

Yarn Twist

2. a. Low-twist yarns are bulkier, larger in diameter than the tight-twist yarns, and appear fuzzy under the magnifying glass.
   b. Tight-twist yarns are hard and compact and should appear smaller in diameter than the low-twist yarns.
3. a. Low-twist fabrics are bulkier, larger in diameter than tight-twist fabrics, and should appear fuzzy and thicker than the tight-twist fabric under the magnifying glass.
   b. Tight-twist fabrics are hard and compact and should appear thinner than the low-twist fabric under the magnifying glass.
4. a. STRETCHING
      (1) Yarn: Tight twist
      (2) Fabric: Tight twist
   b. STRETCHING and SHIFT
      (1) Yarn: Tight twist
      (2) Fabric: Tight twist
   c. WRINKLING: Tight-twist fabric is less likely to wrinkle than low twist.
   d. SNAGGING: Low-twist fabric is more likely to snag than tight-twist fabric.
      (1) Student explanations for answers may include: Low-twist fabric is bulkier and more likely to catch or be pulled by a sharp corner, rough wall, brick, or metal. Loops in the fabric may catch on jewelry, handbags, etc.
   e. ABRASION: Tight-twist fabric is more likely to resist abrasion.