Chapter Seven



Weaving

Introduction to a Weaving Project

Through weaving you will learn to express your creativity in a constructive way while developing a skill that is relaxing and fun. You will also have the opportunity to learn more about the history of weaving, when and where it originated, how it has passed down through the ages, and other information you may discover in your research on weaving as an art form.



Weaving is a process of making fabric from two sets of yarn that interlace at right angles to each other. The lengthwise or vertical yarns are referred to as the warp and the crosswise or horizontal yarns are called the filling or weft. Weaving is done on a loom, which allows the interlacing yarns to create a pre-arranged pattern.



You may want to experiment with different yarns to make unusual articles for yourself, others and your home. Visit with weavers in your community to discover how they learned to weave, what projects they have made and what suggestions they would give to a beginner. Check for additional resources in your local Extension office, the Internet, library or yarn shops to get new ideas. Most importantly, have fun!





Project Evaluation

Hand woven garments or articles should be evaluated on:

Overall Appearance

- Clean and neat
- Design elements and principals utilized
- Color, design, texture are harmonious, uniform

Workmanship

- Even and consistent tension
- Even and consistent weaving
- Straight yarn
- Joining and raw edges hidden
- Straight, even selveges
- No broken yarn
- Consistent pattern
- Ends finished securely

History of Weaving

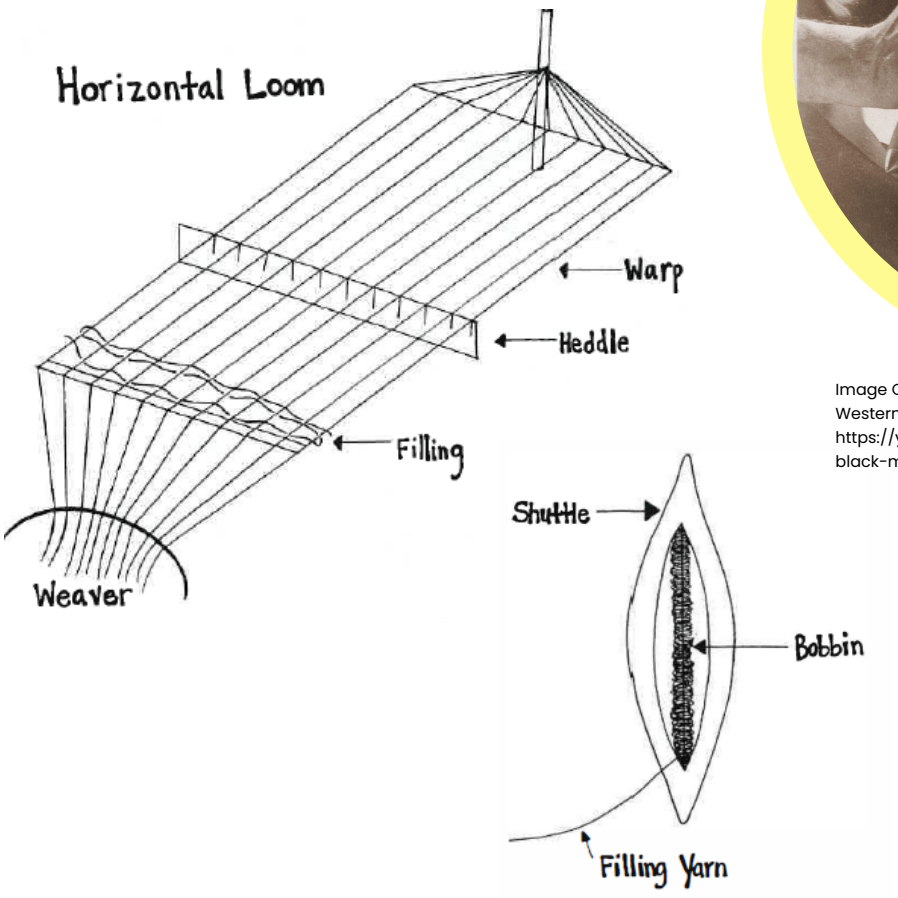
The earliest looms consisted of warp yarns hung vertically from a beam. The weaver interlaced the filling yarns, manipulating them in an over-under movement. The first improvements on this system consisted of attaching stones or metal weights to the ends of the warp yarn to provide tension and improve the quality of the woven cloth.



Image Credit: https://www.dreamstime.com/stone-age-loom-exposed-alba-iulia-museum-ancient-vertical-wooden-weaving-weights-history-image368787439

History of Weaving

Horizontal looms were used by the early Egyptians nearly 7,000 years ago. In its simplest form, this type of loom had a bar holding the warp yarns that was anchored to the ground. A bar at the opposite end of the warp was attached to the weaver who used the weight of her body as a source of tension for the warp. The filling yarns were inserted by the weaver in an over-under motion from a sitting position. Primitive weavers improvised a device called a heddle that enabled alternate warp threads to be raised together. This created a shed, or an opening between the groups of raised and lowered warp yarns, through which the weft yarn could be passed more efficiently.



At some time before the Middle Ages, tribes in what is now Great Britain constructed a frame for weaving that included a warp beam to hold warp yarns and a cloth beam to hold the woven cloth. The weft yarn, which had been moved through the shed as a ball of yarn or wound around a stick, was placed in a spool. This boat-shaped device was known as a shuttle, and it allowed the weaver to control the weft as it passed from side to side during the weaving process.



Image Credit: Alex Reed's hands and loom, n.d. Photograph by Claude Stoller Western Regional Archives, State Archives of North Carolina https://yalebooks.yale.edu/2024/02/28/ep-131-the-history-of-weaving-at-black-mountain-college/

Weaving Basics



Image Credit: User:Javier Carro, CC BY-SA 3.0 <http://creativecommons.org/licenses/by-sa/3.0/>, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Webmaschine_in_Tirolervolkskunstmuseum.JPG

It was not until 1733, during the Industrial Revolution, that the first modem improvements on the hand loom were made. Weaving became faster and more efficient with the introduction of the fly shuttle and innovations that made it possible for one weaver to manipulate several shuttles at a time.

The Weaving Process

A simplified explanation of the weaving process involves the following steps:

1. Preparation. The warp yarn is wound on a beam. All the yarns are arranged parallel to each other.

2. Warping. From the warp beam, the yarn is led over a whip-roll, through the eyes of the needles in the harness, and then through the splits or dents of the reed. This makes it possible to manipulate the various warp yarn according to a pre-arranged plan to create a pattern.

3. Shedding. By using the harness and heddles, the warp yarns are separated into two layers, creating an opening called a shed.

4. Picking. The shuttle and bobbin, containing the filling yarn, is passed through the shed.

5. Beating-in. The filling yarn is beaten into place in the cloth by the reed.

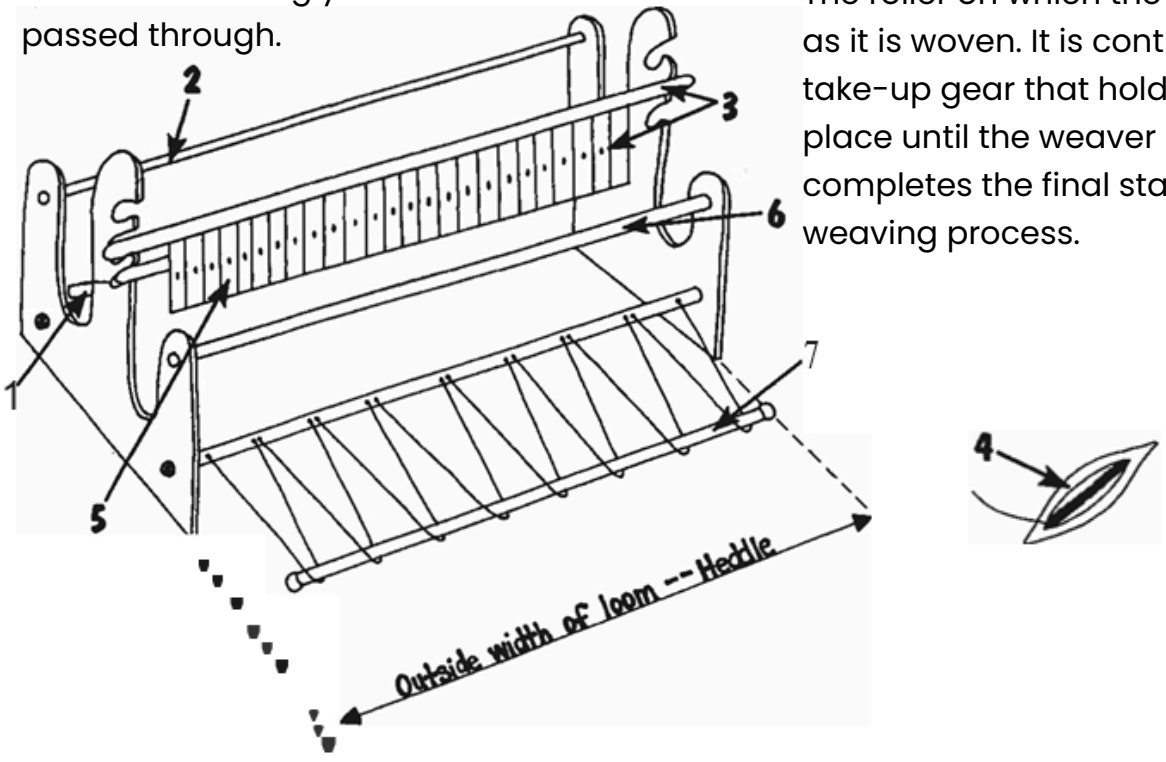
6. Take-up. As the fabric is woven, it is wound around the cloth roller at the front of the loom.

Parts of the Loom

1. **Warp Beam**
   The roll or cylinder around which the warp yarns are wound in a uniform and parallel arrangement.

2. **Whip Roll**
   This is a guide roller which directs the warp yarns on their way to the heddles.

3. **Heddles and Harnesses**
   The heddles are short vertical steel wires or plastic bars that control the warp yarn. Each heddle bar controls one warp yarn that is threaded through an eye in the center of the heddle. The huddles are set into a harness, or rectangular wooden frame, that allows groups of warp yarn to be raised and lowered together. As the harness frames are raised and lowered, they produce a shed so that filling yarn can be passed through.



5. **Bobbin and Shuttle**
   The filling yarn is wound on a bobbin, which sets into a boat-like shuttle or bobbin container. As the shuttle passes back and forth through the warp shed, it releases yarn from the bobbin and forms the cloth.

6. **Reed**
   This is essentially a comb made up of steel wire rods set vertically into a frame. The spaces between the wires are called splits or dents. The warp yarns pass through these reed dents and are kept even and parallel. The reed also beats the filling yarn into place in the cloth.

7. **Breast Beam**
   This is a bar at the front of the loom over which the cloth passes on its way to the cloth beam.

8. **Cloth Beam**
   The roller on which the cloth is wound as it is woven. It is controlled by a take-up gear that holds the beam in place until the weaver moves it and completes the final stage of the weaving process.

Deciding on a Project

Answering the following questions will help you decide what type of project you want to make:

What type of loom do you have?
Rigid heddle and four-harness table looms are most frequently used by beginners. On a rigid heddle loom, the needle is also the reed. This means that the slots and holes in the heddle separate the yarn and form the shed, and the heddle is also moved forward on the weaving to beat in the filling yarn. A plain weave fabric can be created on a rigid needle loom.

A four-harness stable loom has four separate harnesses, each with heddles that separate the yarns. On this type of loom, each yarn is threaded through a heddle eye in one of the harnesses. The harnesses are raised and lowered with a series of levers on the side of the loom to create the shed. The reed at the front of the loom moves forward to beat in the filling yarn. On this type of loom, you can produce a plain or twill weave fabric.

The weaving instructions in this project are for a rigid heddle loom. Page 18 contains instructions for making this type of loom. If you are using a four-harness stable loom, you will need to consult one of the books in the reference section for specific warping instructions.

What do you want to make and how will it be used?
The type of fiber, yarn and weave structure that you choose will be very important for your project. For example, household items such as table runners or place mats must lie flat on the table and be washable. A plain weave fabric made from a medium weight cotton yarn would make a good table runner or place mat. A scarf or muffler that will be worn must be comfortable and drape or hang well. Soft wools spin into fluffier yarns and loosely woven cloth are good choices for such a project.

Warp yarn, for any project, must be firmer, stronger and smoother than the filling yarn so it will not break during weaving. Yarns with a lot of surface variation, such as designer or fancy yarns, are not strong enough to use them only in the filling direction.

Preparing the Loom

There are several necessary steps in preparing your loom before weaving. These steps include:

- figuring the amount of yarn needed for your project,
- measuring the warp and securing the cross that will separate the yarns so that the shed can be formed during weaving, and
- attaching the warp yarn to the loom, a process that is generally called warping the loom.

Figuring the Amount of Yarn

The sett or dent on a rigid heddle loom is the number of slots or dents and eyes or holes in one inch of the reed. Reeds come in a variety of setts. A twelve-dent reed means that each woven inch of fabric would contain 12 warp yarns. The dent or sett may also be called the ends per inch or e.p.i..

A twelve-dent heddle would make a fairly tightly woven fabric suitable for the placemats or table runners that we talked about in our last example. An eight- or six-dent reed would make a more loosely woven fabric and be appropriate for a muffler or scarf, especially if you use designer yarns in the filling.

The amount of warp yarn needed for your project equals the total length of your item, plus extra yarn that is used to tie onto the loom. This extra yarn is usually called the wastage, and it is generally about 12 inches — six inches in front and six in back. You will also need to include extra warp yarn to account for the weaving process. This amount is referred to as the weaving take-up and is generally about 10 inches on a small project. Also include any yarn you need to separate projects if you warp your loom for more than one item. Here is an example of how to figure the warp for a project.

1. Calculate the total number of warp yarns in the width of your project:
   (number of dents per inch on the heddle) x (width in inches of project) = Total number of warp Yarn

2. Calculate the total length of the warp in inches:
   First compute the length of the project:
   (length of the item) + (amount of Yarn separating items) + (12 inches for tie-ups) + (10 inches for weaving take-up) = total length of the project in inches
   (total number of warp yarns, from step 1) x (length of project in inches) = total length of warp in inches

3. Since most yarn is sold by the yard, not the inch, calculate the number of yards of yarn needed:
   (total length of warp in inches from step 2) + (35 inches per yard)

4. Determine how many skeins of yarn you will need:
   (total number of yards) + (number of yarns in a skein) = number of skeins of yarn

Example
Suppose you want to make two 10 inch by 16 inch placemats, and your reed has 12 dents per inch.

1. Calculate the total number of warp yarn:
   (12 dents per inch) x (10 inch width of place mats) = 120 total number of warp yarns

2. Calculate the total length of the warp in inches:
   Compute the length of the project:
   32 inches for place mats (16 inches for each place mat) x 2 + (4 inches between place mats) + (12 inches for tie-ups front and back) + (10 inches for weaving take-up) = 58 total inches in length
   (120 total warp yarns) x (58 total inches in length) = 6,960 inches, total length of warp

3. Convert inches to yards:
   (6,960 inches total warp) + (36 inches per yard) = 193.34 yards of warp yarn, rounded up to 194 yards.

4. Determine how many skeins of yarn you will need:
   (194 yards of warp) + (150 yards per skein) = 1.2 skeins

   Note: You will have to buy two skeins because a portion of a skein is usually not available.

Filling or Weft Yarn

As a rule of thumb, approximately the same amount of filling yarn is needed as warp yarn. Finer yarns require more yardage, so if you use a different yarn for the filling than the warp, be sure to pay attention to the size of the yarn you choose. In the placemat example, you would need two skeins of yarn for the filling making a total of four skeins of yarn for the project.



Basic Weaving Terminology

Arc
A weft yarn laid in an open shed in a bow-like manner. Thicker yarns require more yarn to go over and under the warp, therefore a wider or higher arc is necessary. If the weft comes down tight and draws in, the arc isn't high enough. If there is a loop at the selvage, the arc is too big.

Beam
Front and back stationary loom support. The warp beam carries the warp at the back of the loom and the cloth beam carries the cloth at the front.

Bobbin
Carries the weft yam in the shuttle.

Dents
Holes and slots in the heddle between the reed wires.

e.p.i. or Sett
Ends per inch, also referred to as sett.

Gamp or Swatch
A weaving sample.

Heddle
Looped cord of varnished string with an eye in the center through which a warp end is threaded in the shafts. Also used as a beater to secure weft yarns and as a reed to keep them properly spaced.

Ratchet
Gears to secure roller tension bars in place on looms.

Reed. Beater or Batten
Used to secure weft in place and also keeps warp properly spaced.

Selvage
The firmly woven edge of a cloth; finished sides or edge of weaving.

Sett
Equals one inch on a heddle. On a rigid heddle, this is predetermined.

Shed
The opening between the upper and lower warp yarns when separated (in which the shuttle is inserted).

Shuttle
Implement used to carry the weft through the shed. Weft yarn is wound on a bobbin in the shuttle.

Square Knot
Made when crossing two ends. Cross left over right, then right over left. This knot is used in front and back warp tie-ups. A reef knot or weaver's knot is also used.

Tie-up
Warp thread ends are tied in groups of four or six warp yarns in a square knot. They are tied to the warp rod secured to the roller tension bar.

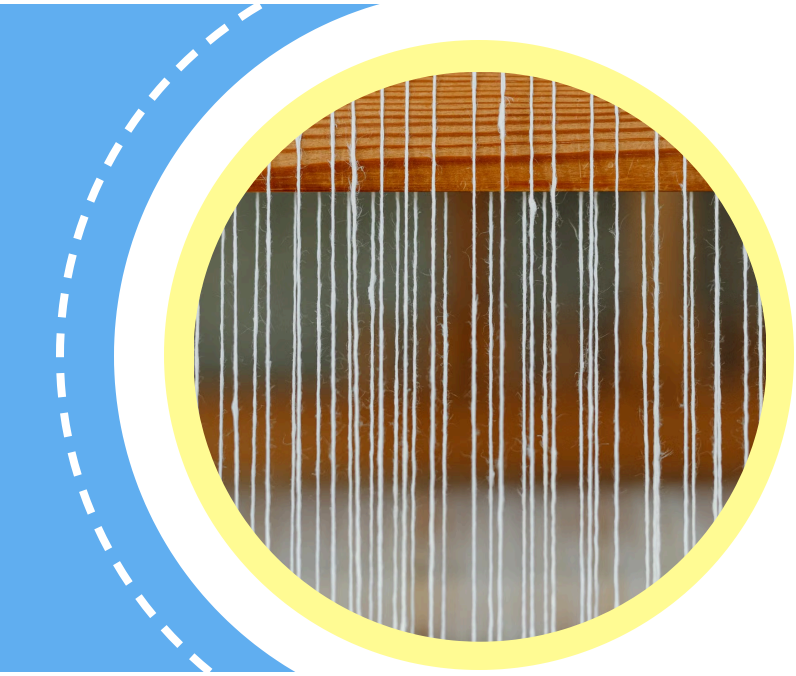
Basic Weaving Terminology

Warp
Yarns running vertical or lengthwise of the cloth. Warp yarns should be strong enough to be pulled and tied firmly on the loom. There is much friction, so use a firm, smooth yarn for the warp.

Warp rods (front and back)
Warp yams secured to the rod with square knot.

Warp Roller (tension bars)
Warp yam is rolled on the back roller; woven fabrics rolled on the front roller.

Weft or Filling
Threads that run from selvage to selvage across the cloth; horizontal or crosswise yarn. Weft yarn can be just about any type depending on the project.



Building a Rigid Heddle Loom

1. Loom Supply List

1. high grade of three-quarter inch plywood, 24 feet by 32 inches to make sides of loom.
2. 1-inch dowels, the width of the heddle plus 2 inches for frontend back stationary beams.

2. 1-inch dowels the width of heddle plus 2 inches for front and back roller tension bars.
3. ratchets to hold tension bars in place.
4. Strong rods the size of the inside width of the loom (width of heddle times one inch) for front and back warp rods, and at least two small shed sticks (shed sticks should be two inches wide, one-quarter inch thick and the length of the width of the loom; sand until smooth and tapered at each end).
5. yards of chalk marking cord or similar strong cord to secure warp rod to roller tension bar.
    1. heddle in one of the standard widths available from a weaving supply store.

Shed sticks, two inches wide, one-quarter inch thick and the length of the outside width of loom.

Several shuttles, two inches wide, less than a quarter-inch thick and one foot long of any fine grain wood. Cut out and sand.

Reinforcement board,one inch wide by eight inches long and as wide as the inside of the loom.

Building a Rigid Heddle Loom

Assemble Loom
If planning to make a loom, purchase the heddle first. The heddle comes in various widths. The width of the heddle determines the width of the loom. It must be smooth so yarn does not snag as it passes through its eyes and slots.

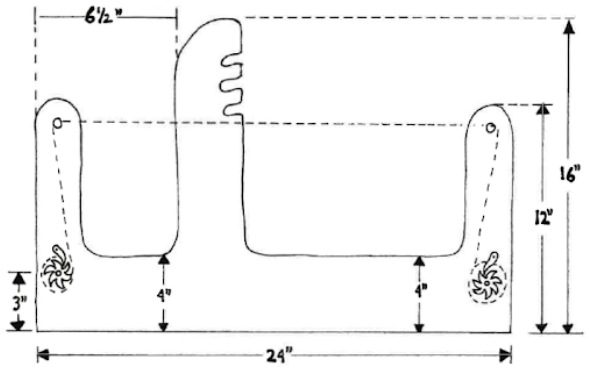
After obtaining supplies, assemble the loom.

Prepare Sides of Loom
Draw the pattern on newspaper, cut it out and trace it onto the plywood. Cut two sides of the plywood. Sand to very smooth so yarn will not snag.
Drill Holes for Dowels

Dowels may not be a true inch wide, so check their width before drilling. Drill four holes on each side. Insert the dowels in the holes for the beams. Front and backbeams should be snug but warp roller tension bars should tum freely.

Drill one-eighth inch wide holes about four inches apart through the dowels for the roller tension bars. Drill through the dowel from front to back. Make sure your holes are large enough to allow cord to pass through.

Insert four dowels on one side of the loom, then connect the other side.



Assembly
Front and back beam. Glue in the beams in place and secure them with a screw.

Warp roller tension bars. Attach four ratchets, clockwise, according to the directions received with them at each end of dowels. Ratchets with square inserts work best.

Warprods. Drill one-eighth inch holes an inch in from either end. Divide five yards of cord in half. Use 2 ½ yards for front warp rod and 2 ½ yards for back warp rod. Secure at one end of the rod, thread through bar, around rod, through bar, and continue across ending with the hole in the rod. Secure with a square knot. The warp rod should be approximately eight inches from the warp roller tension bar. The rod hangs loosely until the warp yarn is secured to it. Reinforcement may be put across the bottom center from side to side. Screw the reinforcement board in place. Screws are better than nails because nails work loose.

