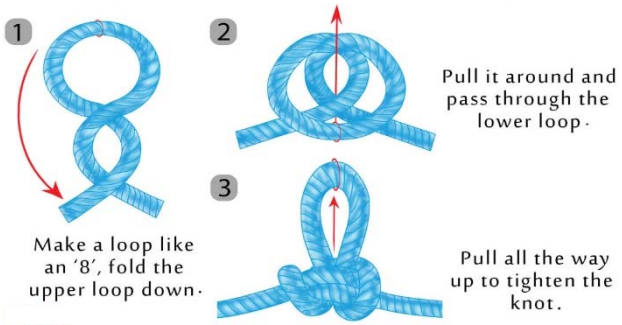
Pioneering Merit Badge

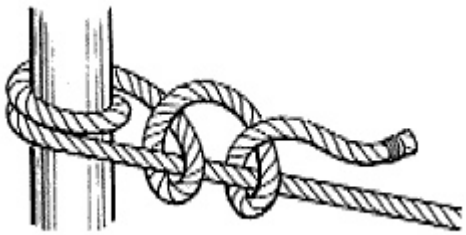
1. **Do the following:**
    a. Explain to your counselor the most likely hazards you might encounter while participating in pioneering activities and what you should do to anticipate, help prevent, mitigate, and respond to these hazards.
    b. Discuss the prevention of, and first aid treatment for, injuries and conditions that could occur while working on pioneering projects, including rope splinters, rope burns, cuts, scratches, insect bites and stings, hypothermia, dehydration, heat exhaustion, heatstroke, sunburn, and falls.
2. **Do the following:**
    a. Demonstrate the basic and West Country methods of whipping a rope. Fuse the ends of a rope.
    West Country Whipping Tying: Pass the twine round the rope and tie a Half Knot. Repeat behind the rope and tie another. Continue making Half Knots in front and behind until the length of the whipping equals about the diameter of the rope. Finish with several Square (Reef) knots. Pull them through the rope and trim the ends.
    b. Demonstrate how to tie the following knots: clove hitch, butterfly knot, round-turn with two half hitches, rolling hitch, water knot, carrick bend, sheepshank, and sheet bend.

- **Clove Hitch:** Pass the end of the rope around the pole. Continue over the standing end and around the pole a second time. Thread the end under itself and pull tight to form the clove hitch.

- **Butterfly Knot:** Wrap the rope around your hand twice. At the end of turn one, position the rope close to your fingertips. Continue around and complete turn two back near your thumb. Pick up the turn near your fingertips. Wrap it around the other two turns. Slide the knot off your hand and tighten by pulling on the loop and the ends.



- **Round-turn with Two Half Hitches:** Pass the end around the post twice. This takes the strain while you tie the knot. Go around the standing end to make the first Half Hitch. Pull this tight. Continue around in the same direction to make the second Half Hitch. Pull tight to complete the knot.



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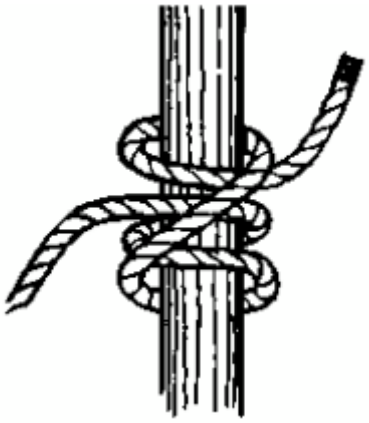
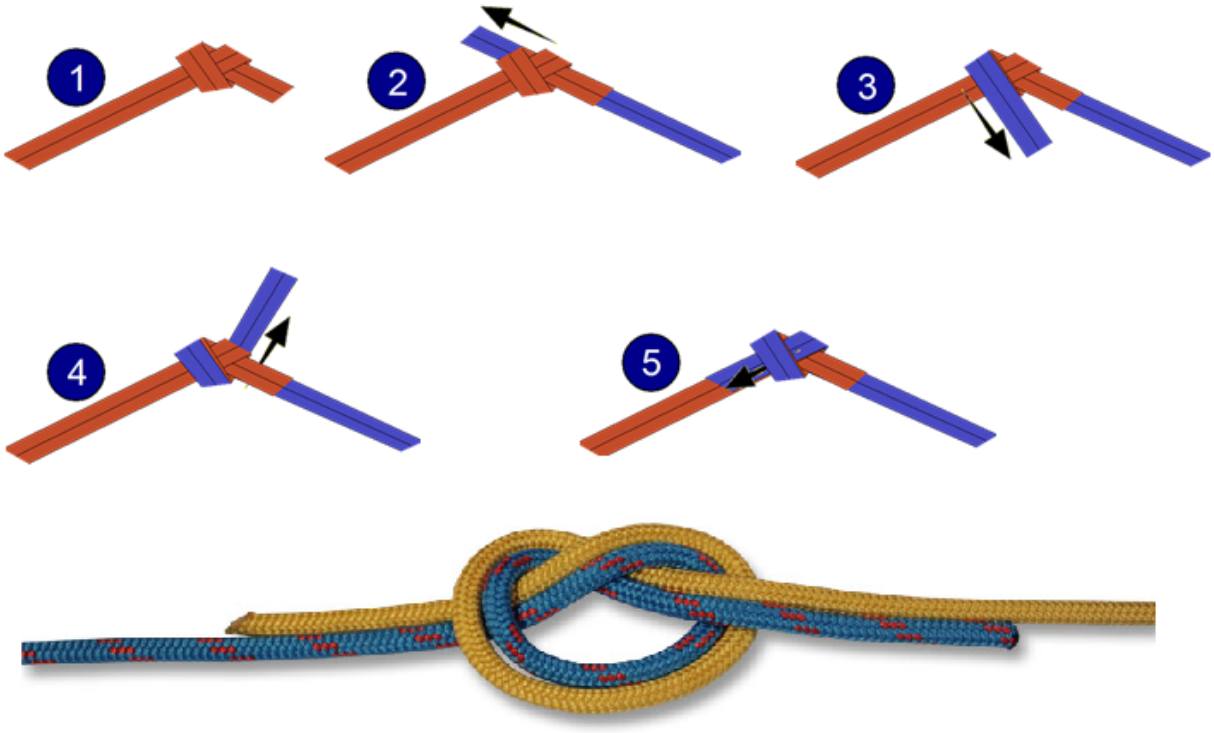
- **Rolling Hitch:** Pass the end around the main rope to make a Half Hitch. Continue around going over the first turn. Tuck the rope between the standing end and the first turn. Tighten to make it secure (this introduces a slight dog-leg in the main rope). Continue around to add a final Half Hitch.



- **Water Knot:** Tie a loose overhand knot in the end of the strap. Thread the other strap in the reverse direction following the exact path of the first overhand knot. Pull the knot tight.



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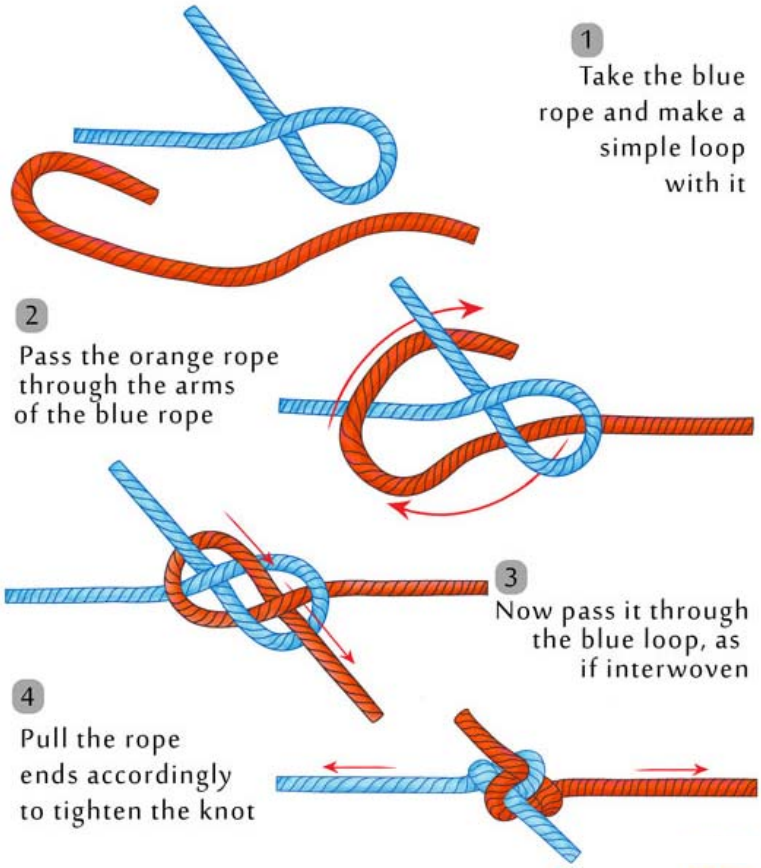
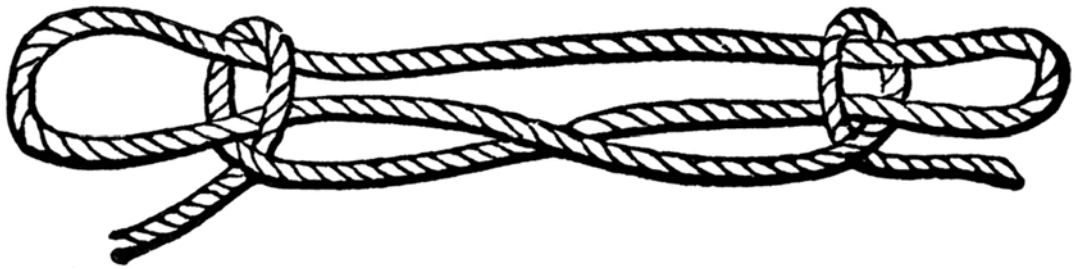
- **Carrick Bend:** With one rope, form a loop with the tail under the standing end. Pass the other rope under the first loop and then over and then under. Thread the tail of the other rope across the loop passing under itself. Then pull both standing ends to tighten the knot.



- **Sheepshank:** Fold the rope to approximately the desired new length. Form a Half Hitch in one standing end, drop it over the adjacent bight, and tighten it. Form a Half Hitch in the other standing end, drop it over its adjacent bight, and then tighten it too. Apply the load carefully.



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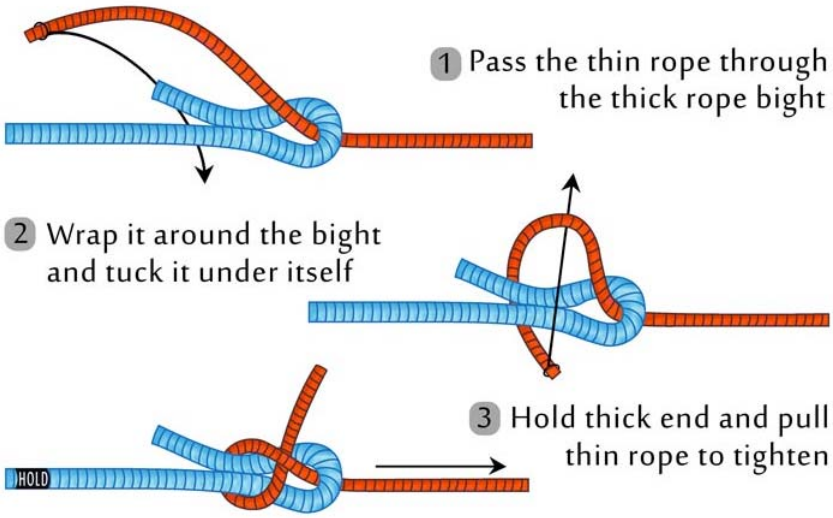
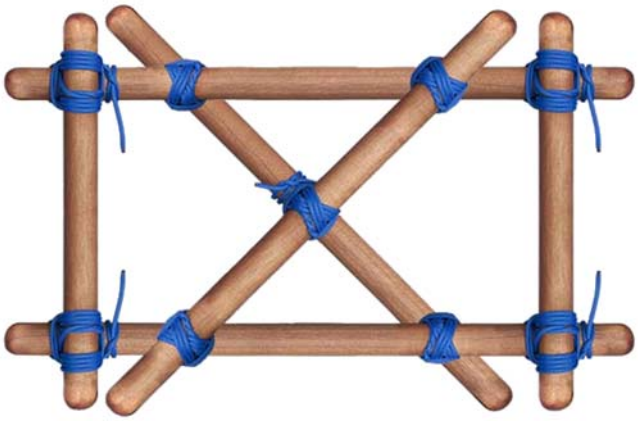
- **Sheet Bend:** Form a bight in the thicker rope and hold it in one hand. Pass the thinner rope through the bight and behind the thicker rope's tail and standing ends in that order. Finally, tuck the smaller rope under itself to finish the knot.



c. Demonstrate and explain when to use the following lashings: square, diagonal, round, shear, tripod, and floor lashing.

- **Square Lashing:** Used for joining sticks at right angles.

- **Diagonal Lashing:** Used for joining sticks at angles.



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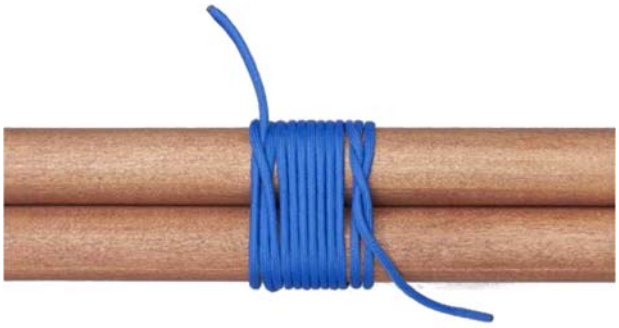
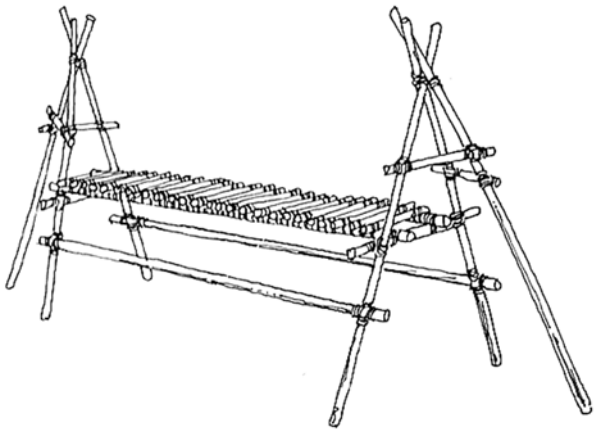
- **Round Lashing:** Used to form a rigid joint between parallel poles to make a longer or stronger pole.



- **Shear Lashing:** Used for joining parallel sticks that need to bend outward

- **Tripod Lashing:** Used to make a tripod to suspend something, making a support for a beam of a larger structure, or to start the basis of a raft.

- **Floor Lashing:** when building any kind of raised surface for a: platform, deck, raft, table, bench, chair, or Chippewa kitchen.



3. Explain why it is useful to be able to throw a rope, then demonstrate how to coil and throw a 40-foot length of 1/4- or 3/8-inch rope. Explain how to improve your throwing distance by adding weight to the end of your rope.

Figure 8 Coil

4. Explain the differences between synthetic ropes and natural-fiber ropes. Discuss which types of rope are suitable for pioneering work and why. Include the following in your discussion: breaking strength, safe working loads, and the care and storage of rope.

The main differences between synthetic and natural fiber ropes are the materials used during construction. Each material can greatly affect the use and longevity of each product, making material selection an important decision before purchasing and using.

Materials: Synthetic rope is constructed of materials such as polypropylene, polyester, and nylon. Most natural fiber ropes are constructed from cotton, sisal, and hemp fibers. There are ropes with blends of both fibers.

Longevity: Synthetic rope has a 30 percent longer life span than natural fiber rope. It is stronger than natural fiber rope and is resistant to water, mildew, and UV rays.

Durability: Synthetic rope is lightweight and has a 20-percent stronger tensile strength than natural fiber ropes. Synthetic rope does not shrink when wet, like natural fiber ropes. It will melt though when exposed to heat, unlike natural fiber ropes that are damaged only by direct contact with fire.

Uses: Synthetic rope has higher elasticity rating and increased shock absorbency, making it ideal for towing, lifting, and marine applications. Natural rope is designed for lightweight applications like packaging and has a better grip, making it ideal for tying and knotting, unlike synthetic that is prone to slipping.

Environmental Effects: Synthetic rope is created using plastics with dangerous chemical byproducts, while natural fiber ropes are woven from jute, sisal, and, hemp--all renewable and biodegradable resources with no chemical byproduct.

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5. Explain the uses for the back splice, eye splice, and short splice. Using 1/4- or 3/8-inch three-stranded rope, demonstrate how to form each splice.

- **Back Splice:** Form a Crown Knot by passing each strand over its neighbor and then tighten the knot. Splice each strand into the rope by passing it over and under alternate strands in the standing end. Complete a second and a third set of tucks to complete the back splice.

- **Eye Splice:** Tape (or whip) rope. Unravel enough for 5 tucks. Arrange strands. Pass center one under a standing strand. Pass lower one under lower adjacent standing strand. Pass the upper strand under the upper adjacent standing strand. Repeat the process for the remaining sets of tucks. Remove the tape (or whip).

- **Short Splice:** Tape (or whip) the rope. Unravel enough for about 5 tucks. Push the ends into each other and tape the middle. Make the first complete set of tucks, and then another. Repeat this using the other end. Remove the tapes (or whip), tighten, and complete the remaining tucks.

6. Using a rope-making device or machine, make a rope at least 6 feet long consisting of three strands, each having three yarns. Whip the ends.
7. Explain the importance of effectively anchoring a pioneering project. Describe to your counselor the 1-1-1 anchoring system and the log-and- stake anchoring methods.

- **1-1-1 Anchoring System:** As the name implies, the 1-1-1 anchor is made by driving stakes in a series of single stakes to form the anchor. First drive in the set of three single stakes in the ground about 12 inches apart. Connect the stakes by tying a rope from the top of the first stake to the bottom of the middle stake, and then from the top of the middle stake to the bottom of the single stake. Use at least two loops of 1/4 inch manila rope, or six to eight loops of binder twine. Then twist the rope tight using a small stick as a tourniquet. After the rope is twisted tight, push the end of the stick in the ground to keep it from unwinding. Depending on the strain the anchors need to withstand, you can use other configurations, such as 3-2-1, 2-1-1, or even 1-1 for a light strain.
- **Log-and-Stake Anchoring System:** This type of anchor is easy to make and can hold a considerable amount of pull. You can tie the line directly to the log, or you can use a ring with a rope grommet as shown in the photo below. To make the log-and-stake anchor, place a log 4 to 6 inches in diameter perpendicular to the pull of the line. Then drive in four large stakes in front of the log. Next, slip the rope grommet through the ring and then slip the ends of the grommet around the log. Drive a second row of stakes 24 inches behind the front stakes. Then anchor the front stakes to the rear stakes with a tourniquet made of binder twine or rope.

8. With the approval of your counselor, demonstrate and use a rope tackle. Be sure the rope tackle is secured properly. Explain the advantages and limitations of using a rope tackle. Describe the potential damage that friction can do to a rope.

The Rope Tackle is the go-to method for putting strain on a line and assuring that the strain is maintained. We apply a rope tackle, (also known as the Trucker's Hitch, Lineman's Hitch, Load Binder, and Harvester Hitch) where the guylines meet the anchors for pretty much all our pioneering projects. For safety reasons, Taut-Line Hitches should

never be used in any pioneering work, because if the tension is eased the knot can slip. The rope tackle is one of the many skills learned for pioneering that can be used in a variety of situations for many years to come. Frequently, we use a rope tackle when creating a ridge line between two trees for dining flies and tarps, and love using them whenever there's an appropriate need to hold the strain on a line being tightened. When you want to lift or pull more than your own strength will permit, or when you want to make a heavy lifting job a little easier, the rope tackle is a device that can be used. The idea behind a rope tackle is similar to that of a tackle using blocks and pulleys. In a rope tackle, one lead (end) of the rope has to be fixed. That is, it has to be anchored around a spar or tied through a ring or other piece of hardware that doesn't move.

Making a Rope Tackle

Using a butterfly knot (or bowline), make a fixed loop in the standing part of the line, and then pass the running end of the line through the loop to start pulling the hauling end against a pre-set anchor. Once the threshold of tension has been reached, tie two half hitched with the remainder of the rope to secure the tension. *NOTE: Where there is a lot of line, form a bite in the running end of the line, feed it through the fixed loop, tighten, and then secure the tension with two half hitches. This will ensure you have additional line if you need it.

Advantages and Limitations

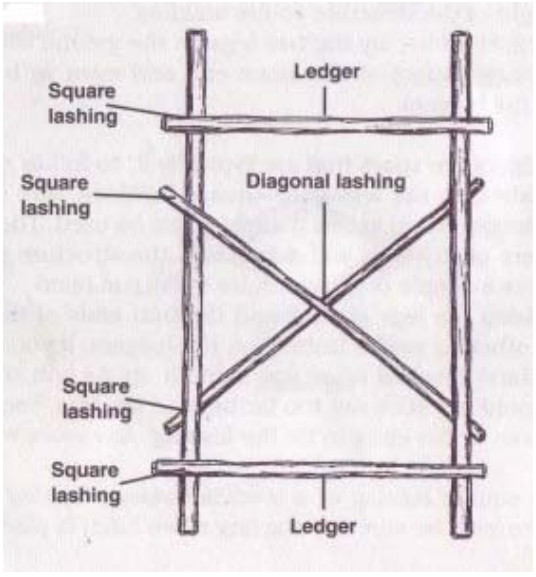
The rope tackle works on the same principles as any other tackle using mechanical blocks or pulleys. The rigging method develops twice the lifting or pulling power that's applied to the hauling end. In other words, you can lift a fifty-pound weight using only twenty-five pounds of force on the hauling end. To determine how much force is needed to lift a weight, the general rule is that you count the number of ropes passing through the ring where the object (load) is, and then divide the number into the weight being lifted. Let's assume that the weight being lifted is fifty pounds. The answer is twenty-five pounds, which is the amount of pull required to lift the fifty pounds with the rope tackle. *NOTE: When you take into consideration the friction of the ropes rubbing together, you will have to apply a bit more than the twenty-five pounds to make the lift. But even with the loss caused by friction, the rope tackle is quite effective.

Pioneering Uses

- To adjust the strain on the guylines of a pioneering project or a flagpole (see figures 98 and 99)
- To put the strain on a picket line used for tying up horses or canoes
- To tie down and secure your equipment on a trailer or truck (see figure 100)
- To hoist or lower equipment in rock climbing
- To tie a line to air your sleeping bag or to make a clothesline for wet clothes
- To tighten hold-down ropes on large tents and flies

9. By yourself, build a trestle using square and diagonal lashings. Explain why trestles are used when constructing pioneering projects.

A trestle is the basic component for building a bridge in a pioneering project. It is used to support the walkways. The most basic form of a trestle is an H-frame. It consists of two legs, two ledgers, and two cross braces. When building a bridge, the top ledger is also called a transom. This is the part that supports the walkways.



To make an H-frame trestle, the two ledgers are lashed near the top and bottom of the legs and the cross braces are added, lashing them to the legs.

All of the lashing on the H-frame trestle is done with two types of lashings: a square lashing and a diagonal lashing. The ledgers are lashed to the legs with square lashings. Although it might not look like it, the cross braces are also lashed to the legs with square lashings, not a diagonal lashing. A diagonal lashing is used to lash the two cross braces together where they cross in the center.

When setting out to build an H-frame trestle, choose the two spars for legs first. These spars can be most any length, depending on the type and height of the structure you're building.

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To build a basic H-frame, lay the two legs on the ground with the two butt ends of the spars at the same end and even with each other. Then add the ledgers.

Ledgers: The ledgers are spars that are typically 2 to 2-1/2 inches in diameter. They are lashed to the legs with square lashings. Any of the three (3) square lashings (shown in this pamphlet) can be used. The position of the ledgers on the legs will depend on the structure you're building. There are a couple of general rules to keep in mind.

First, always keep the legs parallel and the butt ends of the legs even with each other as you're lashing on the ledgers.* If you don't, the trestle will stand crooked when you stand it up. As you add the ledgers, they should not stick out too far beyond the legs. You must leave enough room at the ends to tie the lashing, Any more will get in the way.

When using a Traditional Square Lashing or a Modified Square Lashing to tie the ledgers to the legs, be sure the starting clove hitch is placed on the leg so it's beneath the ledger. When the clove hitch is below the ledger it will support it when the trestle is stood upright. As you tie the lashings, make sure they ar all very tight.

If you use a Japanese Mark II Square Lashing, you can start this lashing with a clove hitch in the middle of the rope to help support the ledger.

Cross Braces: Next, the cross braces are added. The cross braces are spars that are usually 2 inches in diameter. They are lashed to the legs in a particular sequence.

First, flip the trestle over and work on the opposite side from the ledgers. Lash one cross brace to the back side of both legs. As mentioned before, use a square lashing (not a diagonal lashing) to attach the ends of the cross braces to the legs.

The second cross brace is added so that the bottom end is on the same side as both ends of the first cross brace. The other end is placed on the front side, the side with the ledgers. This is done so that the cross braces are standing slightly apart. There will be a gap where they cross at the center.

Diagonal Lashing: After the ends of the ledgers and the cross braces are lashed to the legs, stand the trestle up on end. Adjust the trestle so that the legs are parallel. Also check to see that the top ledger is parallel to the ground. If it is not, lower the trestle, untie the lashing, and adjust it.

When the legs are parallel, and the top ledger is parallel to the ground, you're ready to tie the diagonal lashing to the cross braces while the trestle is standing upright. This lashing is very important to the strength of the trestle.

The diagonal lashing creates triangles that are important to stiffen the arrangement of the spars and to keep the trestle from racking. Look around at steel towers, bridges, or buildings being erected and you will see the triangle used in many places for the same reasons as we use it to build a trestle.

When the cross braces are lashed to the legs, there is a slight gap between them where they crossed at the center. A diagonal lashing is used here because it starts out with a timber hitch. The timber hitch pulls the cross braces tightly together. This adds strength to the whole trestle. You have to keep a strain on the lashing rope as you complete the diagonal lashing with three wraps in each direction around the X. Then make two frapping turns between the cross braces to pull the wraps tight. Finally finish by tying another clove hitch on one cross brace.

Once the possibility of racking has been taken care of with the diagonal lashing, the trestle's vertical legs provide support for a large downward load. Since this is a downward force, also known as a shearing force, the legs don't have to be very big. In fact, the overall shape of the trestle is an engineered structure that is able to support quite a bit of weight with rather small-diameter spars for legs.

10. With the approval of your counselor and using appropriate lashings and pioneering techniques, build and use one full-size pioneering project from either group A or group B. Your project must comply with the requirements of the Guide to Safe Scouting. (Requirement 10 may be done at summer camp, at district or council events, or on a troop camp outing.)
    - Group A: Tower OR bridge
        - Anchor your project as appropriate and necessary. Explain how your anchoring system works.
        - Group A projects may be worked on in a group and with others.
    - Group B: Camp chair OR camp table
        - Group B projects must be worked on individually.