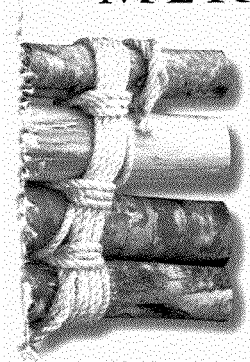
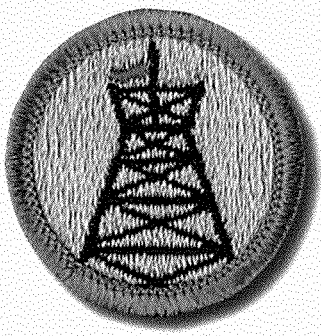
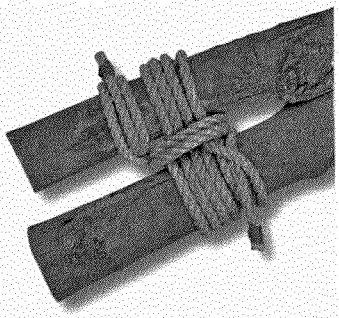
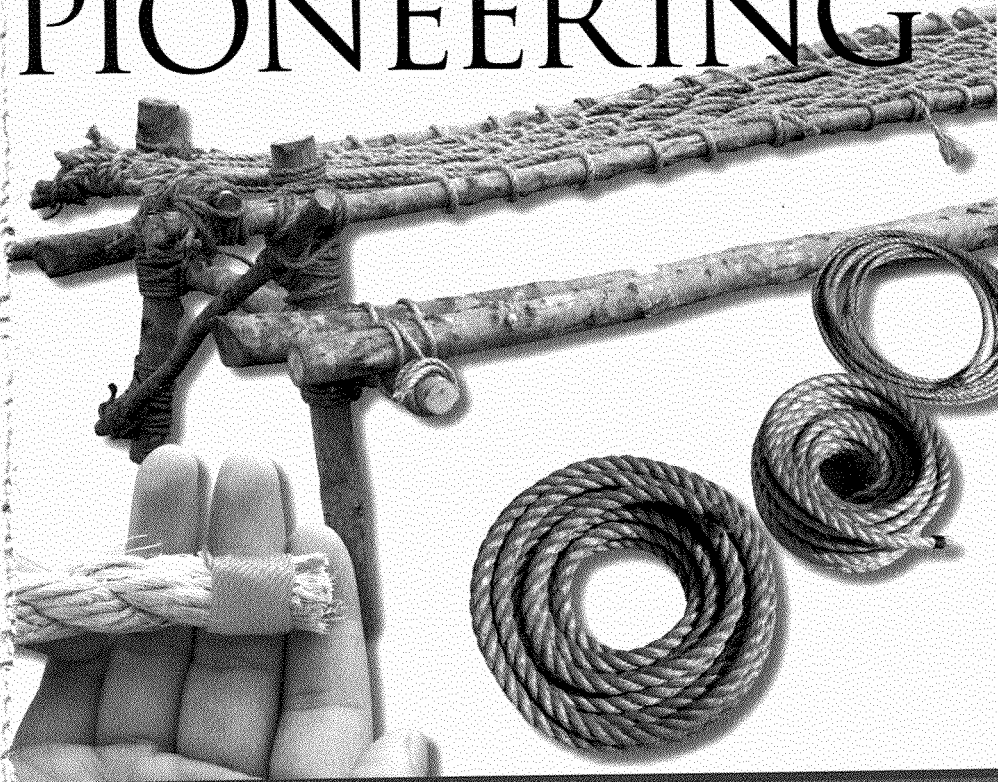
MERIT BADGE SERIES







PIONEERING



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How to Use This Pamphlet

The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

Your counselor can be as important to you as a coach is to an athlete. Use all of the resources your counselor can make available to you. This may be the best chance you will have to learn about this particular subject. Make it count.

If you or your counselor feels that any information in this pamphlet is incorrect, please let us know. Please state your source of information.

Merit badge pamphlets are reprinted annually and requirements updated regularly. Your suggestions for improvement are welcome.

Who Pays for This Pamphlet?

This merit badge pamphlet is one in a series of more than 100 covering all kinds of hobby and career subjects. It is made available for you to buy as a service of the national and local councils, Boy Scouts of America. The costs of the development, writing, and editing of the merit badge pamphlets are paid for by the Boy Scouts of America in order to bring you the best book at a reasonable price.

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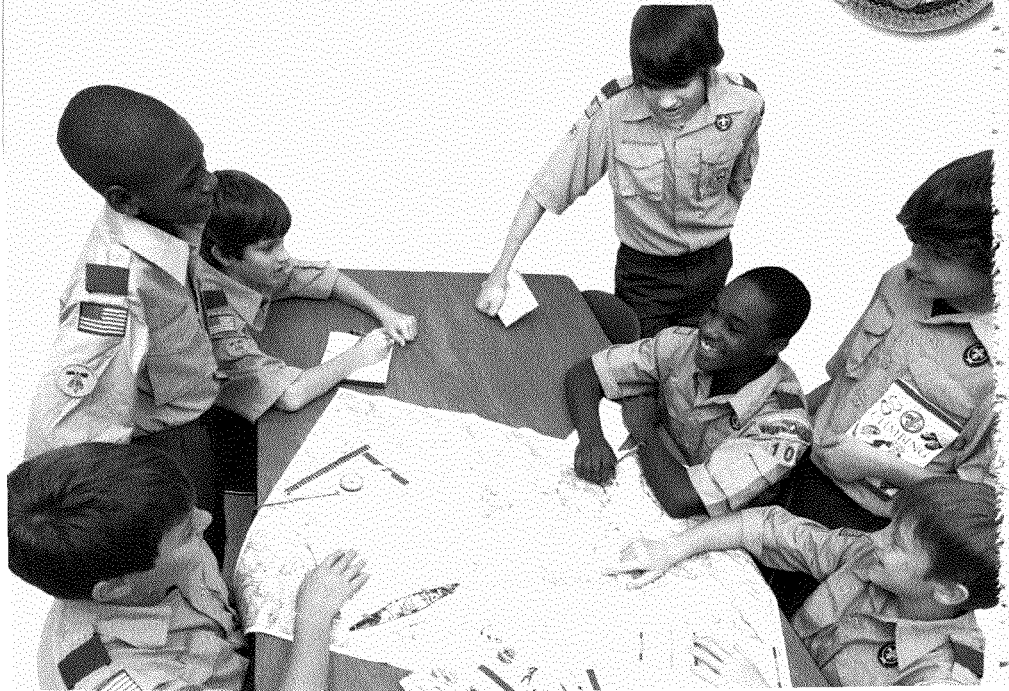
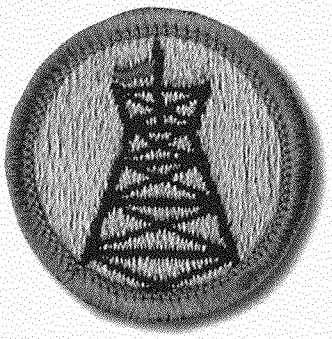


BOY SCOUTS OF AMERICA
MERIT BADGE SERIES

PIONEERING



"Enhancing our youths' competitive edge through merit badges"

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Note to the Counselor

Before counseling Scouts, Pioneering merit badge counselors must become familiar with the *Guide to Safe Scouting*, an essential planning tool for all Scouting volunteers. The *Guide to Safe Scouting* provides an overview of Scouting policies and procedures. Unit leaders are also expected to review the additional reference materials cited (such as the *Boy Scout Handbook* and the *First Aid* merit badge pamphlet) before conducting certain activities. Counselors can access the *Guide to Safe Scouting* online at http://www.scouting.org/HealthandSafety/GSS.aspx.

Counselors should also ensure that Scouts follow the principles of Leave No Trace in their pioneering projects. Just as hiking and camping without a trace are signs of an expert outdoorsman, protecting the environment is a mark of responsible pioneering. Minimize impacts to the land. Use your judgment and experience to help Scouts tailor their pioneering projects to the environment where the activities will occur.

To help keep participants safe during Scouting activities, the Boy Scouts of America has an established set of procedures for physical activities called the "Sweet 16 of BSA Safety." In an effort to assist Pioneering merit badge counselors, the following considerations provide additional guidance of special interest to them.

Qualified Supervision. The Pioneering merit badge counselor should have knowledge of the proper use of pioneering project tools and equipment, structural limitations, and fall protection appropriate for projects.

Safe Area or Course. Counselors should take reasonable measures to provide participants with a safe outdoor environment.

Equipment Selection and Maintenance. Counselors should ensure project building tools and equipment are well-maintained and in good condition. Ropes, anchors, and spars should be checked prior to each use.

35931
ISBN 978-0-8395-3377-1

2019 Printing

Safety Procedures and Policies. Counselors must ensure compliance with safety procedures for certain projects such as controlled access of participants, compliance with Safe Swim Defense for projects located over water, and adherence to the 6-foot height limit for pioneering projects. (See "Working at Heights and Elevations" in the *Guide to Safe Scouting*.)

Discipline. Counselors should take reasonable measures to ensure all participants are using pioneering tools and equipment properly.

The Sweet 16 of BSA Safety procedures are accessible online by visiting http://www.scouting.org/HealthandSafety/Sweet16.aspx.

Because this pamphlet will be used throughout the United States, merit badge counselors should understand that not every method can be fully described here. Different parts of the country might use other names for a knot, a method, or a piece of equipment. Counselors may employ other methods described and illustrated in other Scouting literature, provided that no requirements are omitted, added, or altered in order to accommodate them.

Some pioneering skills or methods called for in the requirements will take practice and time to master. Therefore, having multiple hands-on sessions to earn the merit badge is advisable. The term "demonstrate" in the requirements means just that—the Scout should show that he has learned the skill and can use it.

Keep in mind that, because of equipment availability, parts of some requirements might have to be done at summer camp, at district or council events, or on a troop camp outing. In such cases, *the person conducting the review and approving any partial completion must be approved to do so by the local council.*

The appearance of a finished project or structure is not as important as the correctness of individual knots and lashings. The project should be judged for its structural soundness, to determine if it was built to safely withstand the use for which it was intended. Only the approved designs shown in this pamphlet or other official Boy Scouts of America literature are recommended.

In earning this merit badge, the Scout has a chance to learn skills that will be useful in a wide variety of Scouting and non-Scouting activities. These skills should become an ongoing part of a Scout's advancement and his growing participation in new and challenging adventures. Earning the Pioneering merit badge could equip him to later teach younger Scouts, or could add another dimension to his value as a camp staff member.

Planning ahead, making certain as you go, and ensuring safety go hand in hand with the Scout motto, Be Prepared. In pioneering, discipline is essential. Pioneering is a challenge that can instill long-term habits of doing things right the first time.

Requirements

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.
    b. Demonstrate how to tie the following knots: clove hitch, butterfly knot, roundturn with two half hitches, rolling hitch, water knot, carrick bend, sheepshank, and sheet bend.
    c. Demonstrate and explain when to use the following lashings: square, diagonal, round, shear, tripod, and floor lashing.
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 ¼- or ⅜-inch rope. Explain how to improve your throwing distance by adding weight to the end of your rope.
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.

5. Explain the uses for the back splice, eye splice, and short splice. Using ¼- or ⅜-inch three-stranded rope, demonstrate how to form each splice.
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.
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.

All pioneering projects constructed for this merit badge must comply with height standards as outlined in the *Guide to Safe Scouting*.

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

Contents

Pioneering Past and Present

Scouting's founders believed that pioneering was an important way for Scouts to gain confidence in their abilities and to be prepared to make the most of outdoor experiences.

Pioneering—the knowledge of ropes, knots, and splices along with the ability to build rustic structures by lashing together poles and spars—is among the oldest and most honored of Scouting's skills. Practicing rope use and completing projects with lashings also allow Scouts to connect with past generations, ancestors who used many of these skills as they sailed the open seas and lived in America's forests and prairies.

Knots, splices, and lashings are formed today the same ways they have been done for a long time. The pioneering projects you complete will look very much as they would have at any time in Scouting's history.

Of course, there are a few differences. One important change in pioneering is Scouting's deep commitment to the principles of Leave No Trace. *Where* pioneering projects are built can be every bit as important today as *how* they are built. Protecting the environment, using appropriate materials, and removing all evidence of your activities after an event lie at the heart of responsible Scouting—and pioneering—in the 21st century.

Scouts follow the principles of Leave No Trace wherever they participate in outdoor activities—including pioneering.

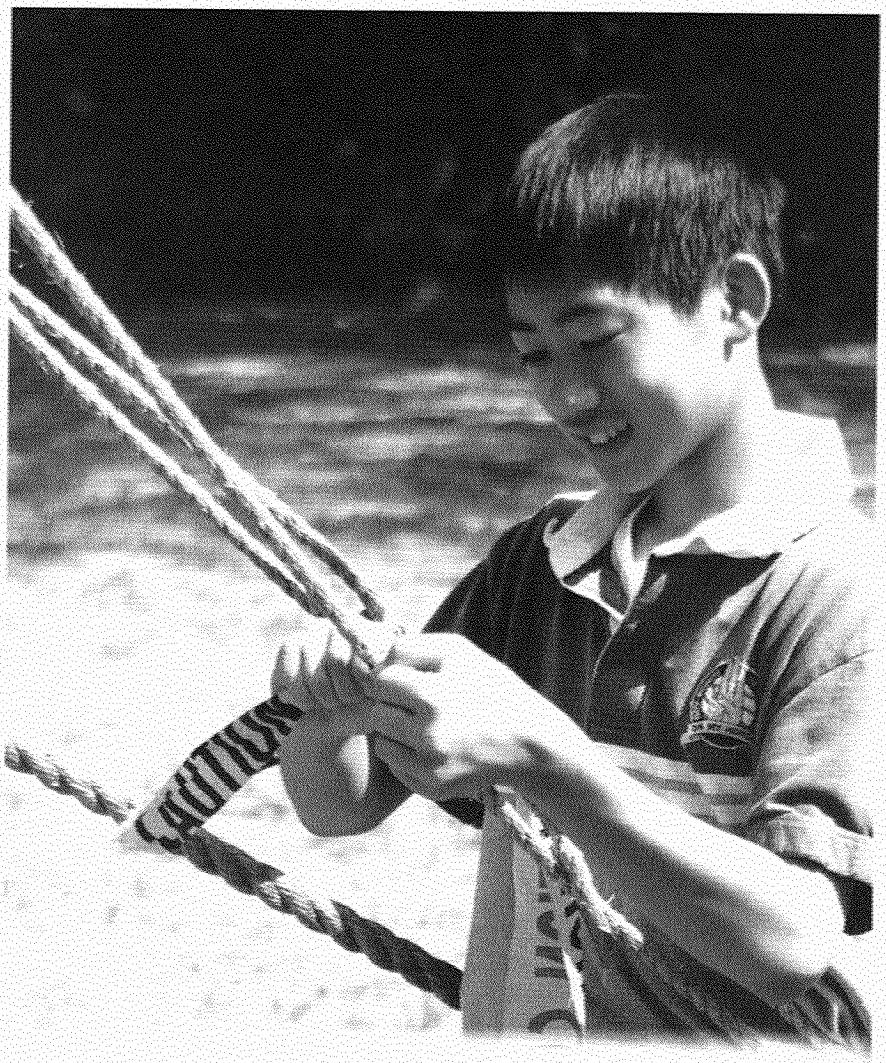
- Planning and preparing will help ensure that you have chosen the right place for your activities and that the materials you use come from environment-friendly sources.
- Select durable surfaces for building pioneering projects to minimize the trampling of vegetation, and arrange for access to toilet facilities.
- Follow all Leave No Trace principles to be certain you are also respecting wildlife that make their homes in your pioneering project area.
- Be considerate of visitors who happen upon pioneering projects. Politely share information about what you are doing and about Scouting. Also give guidance that will help ensure their safety, perhaps by escorting them around a project in progress or by showing them where to stand while they watch. You might even invite them to participate to learn some pioneering skills.
- Minimize campfire impact by using a camp stove when a pioneering event includes cooking a meal. Where campfires are allowed, manage yours in a way that lets you remove all evidence it was ever there.
- Leave what you find, and leave the area in the same condition you found it. Dismantle structures when you are done with them, and store all building materials.
- Dispose properly of waste, and clean up all bits of rope and other building materials at the end of a pioneering event.

Pioneering the Leave No Trace Way

- Plan ahead and prepare.
- Travel and camp on durable surfaces.
- Respect wildlife.
- Be considerate of other visitors.
- Minimize campfire impacts.
- Leave what you find.
- Dispose of waste properly.

As you plan your pioneering projects, make sure you consult with your merit badge counselor along the way, and get your counselor's approval before you begin building.

With its rich history and dynamic projects, pioneering pulls together the best features of Scouting. As you plan and build your pioneering project, make it a fun, safe, and positive adventure.



Prevention goes hand in hand with mitigation, which means "to lessen in force or intensity" and "to make less severe." By taking precautions to manage risk and the possibility of injury, you can be prepared to anticipate, help prevent, mitigate, and respond to just about any incident that might happen while working on pioneering projects.

Pioneering Safely

Constructing full-sized towers and bridges requires a keen eye toward safety. Manage risk during pioneering projects by being alert to your surroundings and by taking action whenever you notice a potential hazard. Doing so will help prevent accidents, avert emergencies, and ensure a fun, safe time.

Managing risk includes being prepared to handle emergencies that might occur during pioneering.

Pioneering Safety Guidelines

Follow these guidelines whenever building and using pioneering structures.

- Dress for the weather. When necessary, wear gloves to protect your hands.
- Use ropes and materials that are in good condition and appropriate for the project.
- Coil and store ropes when they are not in use.
- Avoid wrapping a rope around your arm or waist when dragging or lifting a load.
- Do pioneering work only when it is nice outside, never during rainy weather or in wet conditions that can make ropes and spars slippery.
- Practice good body mechanics when lifting and hauling. Lift no more weight than you can handle safely.
- Use flagging tape to mark all anchor lines, ropes stretched between trees, hanging loops of rope, and cords or ropes that could trip or entangle someone.
- Stand clear of any weight suspended by a rope.
- Stay off to the side of (*never* in line with) a rope that is *tensioned* (under strain from a load). A tensioned rope may snap back if it breaks, if a knot comes loose, or if an anchor gives way.

First-Aid Preparedness

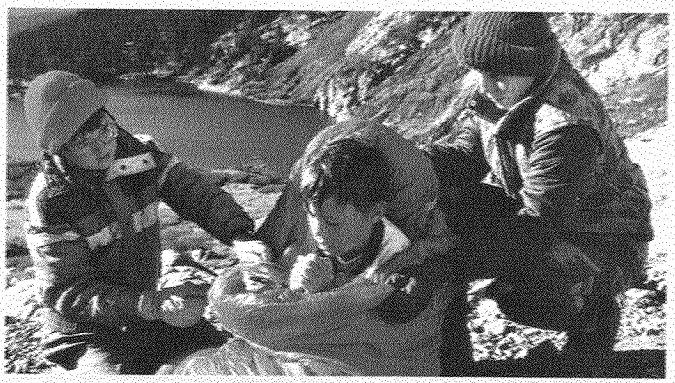
Pioneering calls for knowledge of first aid. Make it a point to know how to respond in an emergency. Being prepared helps ensure that you and your pioneering friends will have glitch-free fun.

Whenever you participate in pioneering activities, you and your group should have a first-aid kit onsite and know how to use it. In advance, discuss how to summon medical assistance in case of an emergency (usually by calling 911).

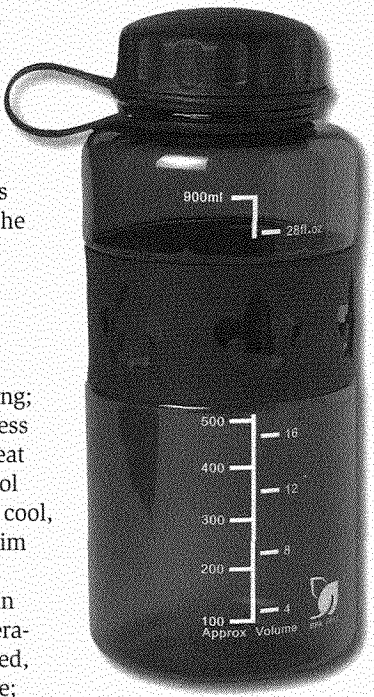
The *Boy Scout Handbook, Fieldbook, and First Aid* merit badge pamphlet give more detailed information about first aid.

Cold- and Hot-Weather Factors

Hypothermia occurs when the body's core temperature drops so low that it can no longer keep warm. Hypothermia can happen in relatively mild weather, but cool, windy, and rainy weather are particularly dangerous. Prevent hypothermia by staying warm and dry and eating plenty of energy foods (nuts, dried fruits, peanut butter). Do not push yourself to a dangerous point of fatigue. Early signs of hypothermia include bluish lips and shivering. As the victim becomes colder, the shivering will stop. Other symptoms may include fatigue, irritability, and disorientation. Begin treatment for hypothermia by removing damp clothing and warming the person. Prevent further heat loss; move the victim to a shelter and cover the head for warmth. If the victim is able to swallow, offer hot drinks and food. Severe hypothermia requires immediate medical attention.



If you suspect hypothermia because someone is acting strangely, challenge the person to walk, heel to toe, a 30-foot line scratched on the ground. If the person shows unsteadiness, loss of balance, or other signs of disorientation, take immediate action to get the victim warm and dry.



Dehydration, or lack of water in the body, can occur at any temperature if a person is sweating profusely and/or not drinking enough liquids. Avoid dehydration by drinking plenty of fluids and eating enough throughout the day. Do not wait to drink until you feel thirsty. If someone in your group becomes weary or confused, or develops a headache or body aches, have the person rest in the shade and sip water until the symptoms subside.

Heat exhaustion is one result of dehydration. The body becomes overheated because its cooling methods fail. Watch for these signs: elevated body temperature (between 98.6 and 102 degrees); pale, clammy skin—even cool to the touch; heavy sweating; nausea, dizziness, and fainting; pronounced weakness and tiredness; headache; muscle cramps. To treat heat exhaustion, have the victim lie down in a shady, cool spot with the feet raised. Loosen the clothing. Apply cool, damp cloths to the skin, or use a fan. Have the victim sip water.

Heatstroke (sunstroke) is far more serious than heat exhaustion. Watch for these signs: body temperature above 102 degrees (often above 105 degrees); red, hot, and dry skin; no sweating; extremely rapid pulse; confusion or disorientation; fainting or unconsciousness; convulsions. The skyrocketing body temperature of heatstroke is life-threatening. Cool the victim immediately. Place the person in a cool, shaded spot face-up with head and shoulders raised. Remove outer clothing, sponge the bare skin with cold water, and soak underclothing with cool water. Apply cold packs, use a fan, or place the victim in a tub of cold water. Dry the skin after the body temperature drops to 101 degrees. Obtain medical help immediately.

Sunburn is a common but potentially serious result of overexposure to the sun. Long-term exposure can result in skin damage and skin cancer. To prevent sunburn, limit your exposure to the sun, wear loose-fitting clothing that covers the arms and legs, and wear a broad-brimmed hat to shade the neck and face. To protect exposed skin, apply sunscreen with a sun protection factor (SPF) of at least 15. Reapply sunscreen often and as needed.

When applying sunscreen, don't forget the ears, the back of the neck, and, if wearing shorts, the backs of the legs.

Minor Injuries

Most minor injuries can be treated on the spot, without complications.

Minor cuts and abrasions usually require only cleaning and disinfecting with soap and water. Leave them to heal in the air, or cover lightly with a dry, sterile dressing or bandage to help prevent infection. Unless a cut is serious, bleeding probably will stop on its own or with slight pressure on the wound.

If a wound is so severe that it does not stop bleeding readily, apply direct and firm pressure using a sterile dressing or compress. It may help to raise the injured limb (if no bones are broken) above heart level. Apply pressure to the local artery. If the bleeding is prolonged, treat for shock and seek medical attention immediately.

Bruises bleed under the skin. Applying an ice pack to a bruise will reduce pain and swelling.

Rope burns, or friction burns, can happen when a rope slides too quickly through your hands or when any part of the body encounters a fast-moving rope. A rope burn leaves skin raw, red, and sometimes blistered. The best protection against rope burns on the hands is, of course, to wear protective gloves. If a burn does occur, clean the area with mild soap and water to help prevent infection.

Always consider blood to be a potential source of infection; never touch someone else's blood with bare skin. Always use a protective barrier such as disposable gloves, and wash thoroughly afterward with soap and water.

A pioneering first-aid kit should include basic items for treating minor injuries and to provide initial care should a more serious emergency arise. Include a few adhesive bandages, two 3-by-3-inch sterile gauze pads, a small roll of adhesive tape, scissors, tweezers, one 3-by-6-inch moleskin, a small bar of soap, a small tube of antiseptic, a tube of 0.5 percent hydrocortisone cream, moleskin or molefoam for blisters, one roller bandage, a pair of latex gloves, plastic goggles or other eye protection, a mouth-barrier device (for rescue breathing or CPR), and a pencil and paper. This can all fit in a resealable plastic bag.

Blisters form when skin is irritated, usually by friction or heat. A hot spot signals the beginning of a blister. Stop immediately and protect the tender area by cutting a piece of moleskin or molefoam and covering the affected area. If a blister forms, build up several layers of moleskin or molefoam, as needed, to take off the pressure. Blisters are best left unbroken. Treat a broken blister as you would a minor cut.

Remove **splinters** with tweezers. Encourage the wound to bleed to flush out foreign matter. Then wash with soap and water, and apply antiseptic. Cover with an adhesive bandage.

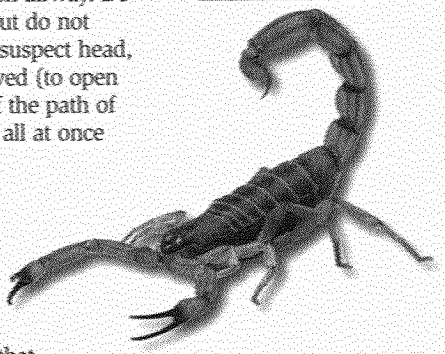
A **sprain** from twisting or wrenching a joint is usually quite painful and may swell. To treat a sprain, raise the injured area and keep the victim still. Apply cold compresses for the first 24 hours, then apply mild heat. For severe or persistent pain, seek medical attention.

Treat injuries from **falls** with great caution. Whenever someone has fallen, assume there is an injury to the head, neck, or back. Such injuries can be hard to detect because the victim might not show any physical symptoms. Until medical help arrives, stabilize the head and neck—a first-aider or a bystander can hold the victim's head and neck steady. Do not move the person or let him or her move unless threatened by an immediate danger. If the victim is having trouble breathing, gently adjust the position of the head and neck just enough to maintain an open airway. Do not put a pillow under the head. Treat for shock but do not unnecessarily change the victim's position. If you suspect head, neck, or back injuries and the victim must be moved (to open an airway, for example, or to get the person out of the path of danger), ask for help in moving the victim's body all at once without causing any twists or turns.

If you have it, apply 0.5 percent hydrocortisone cream to help soothe insect stings and bites.

Stings and Bites

No matter how much insect repellent you apply, insects will sting and bite, so pay attention where you walk and stand. Treat **ordinary insect stings** by scraping the stinger out with the blade of a knife. Do not try to squeeze it out; that will force more venom into the skin. Raise the affected part, gently wash the area, and apply hydrocortisone cream if available.

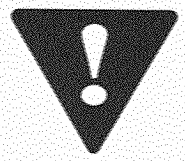


Brown scorpion

Fire ant stings can be extremely painful and—in some cases—cause a severe allergic reaction. You can spot fire ants by their distinctive loose mounds of dirt. When disturbed, these aggressive ants will swarm and attack as a group and sting repeatedly. Their stings form tiny blisters; take care not to break the blisters. Wash the injured area well with antiseptic or soap and water, then cover with a sterile bandage.

The stings of the **common scorpion** usually are not as dangerous as bee stings. The stings often cause severe, sharp pain, swelling, and discoloration, but generally leave no lasting ill effects. To relieve itching and pain from a common scorpion sting, apply ice packs or a cold compress if you have it. An over-the-counter antihistamine also can be given. If the victim has a history of allergic reactions to insect stings or shows signs of illness (persistent pain and swelling, numbness, breathing difficulties), get medical help as soon as possible.

Rarely, you might encounter a **venomous spider or scorpion.** Of particular concern are the bites of the black widow spider (identified by a red hourglass on the underside of its abdomen) and the brown recluse spider (recognizable by the fiddle-shaped mark on its back). Less common are stings from the venomous scorpions found in the desert areas of Arizona, California, and New Mexico. To treat a bite or a sting from one of these creatures, ice the area. Have the victim lie still and, if possible, keep the area lower than the heart. Tie a constricting band (loose enough to slip a finger between it and the skin) between the bite or sting and the heart. Treat for shock, and watch for difficulty in breathing; give rescue breathing if required. Seek immediate medical attention.



Always avoid direct contact with a tick because disease can be transmitted by finger contact.

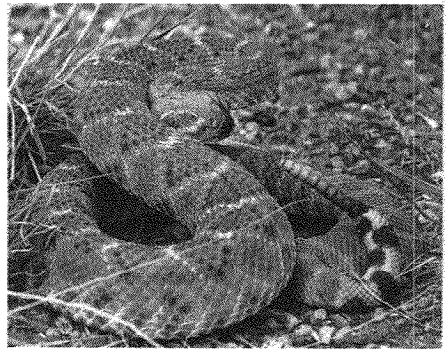
Ticks can carry diseases such as Lyme disease and Rocky Mountain spotted fever. Remove a tick as soon as it is discovered by grasping its head as close to the skin as possible with tweezers or gloved fingertips; gently tease the creature from the wound. Don't squeeze, twist, or jerk the tick; that could break off the mouthparts, leaving them in the skin. Wash the wound area carefully with soap and water or an alcohol swab, and apply antiseptic. After handling a tick, wash your hands thoroughly.

Wasp, hornet, bee, or fire ant stings can cause severe **allergic reactions** in some people. Those people should take a field treatment kit with them on all outings, and their companions should be familiar with its use. If a sting reaction on an arm or leg is particularly severe, isolate its effect by tying a constricting band between the sting and the heart. The band must be loose enough for a finger to slide under it. Cool the wound with water (or ice, if available). Monitor the victim's breathing and do rescue breathing if necessary. Seek medical help.

Snakebite

If you are bitten by a snake, assume that it is venomous unless it can be positively identified. Learn to recognize venomous varieties to know when there's danger and what action to take.

Two types of venomous snakes are found in the United States. Pit vipers (rattlesnakes, copperheads, cottonmouths) have triangular-shaped heads with pits on each side in front of the eyes. Coral snakes have black snouts and bands of red and yellow separated by bands of black. Coral snakes inject a powerful venom that works on the victim's nervous system; pit viper venom affects the circulatory system.



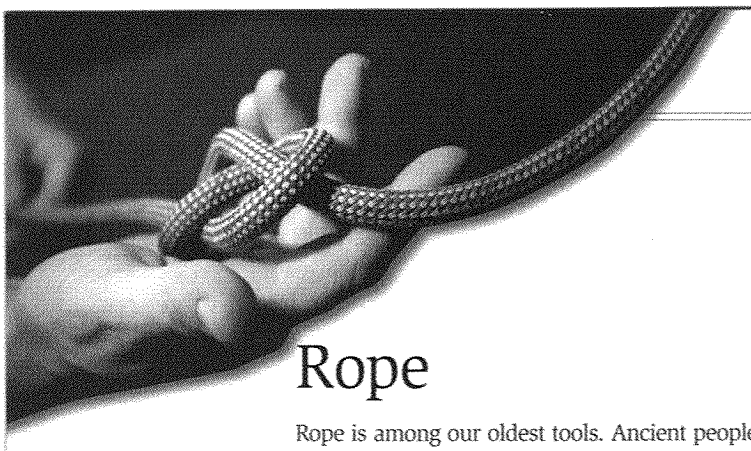
Western diamondback rattlesnake

Suspect a pit viper bite if there are puncture marks, pain and swelling (possibly severe), skin discoloration, nausea and vomiting, shallow breathing, blurred vision, and shock. A coral snake bite is marked by a slowing of physical and mental reactions, sleepiness, nausea, shortness of breath, convulsions, shock, and coma.

Get immediate medical help for the snakebite victim. While doing so, it is important to limit the spread of the venom and to maintain vital signs. Keep the victim still and the wound below the level of the heart. Tie a broad constricting band an inch or wider between the bite and the victim's heart (2 to 4 inches above the bite). Do not use constriction bands on fingers, toes, the head, the neck, or the trunk. Swelling may cause watchbands, rings, clothing, and shoes to restrict circulation; remove these items from the bite area. Treat for shock. Do not apply ice or give alcohol, sedatives, or aspirin.

Weather-Related Dangers

You should always remain aware of the weather, especially if lightning is in the area or is forecast. The weather doesn't have to be stormy or rainy for lightning to strike. Even if you don't see lightning, it can strike suddenly from gray, low clouds that could be rain clouds. Do not seek shelter under a tree or under an open shelter, and stay away from water. If a severe, sudden storm strikes, seek immediate shelter in a ravine, if possible. Before pioneering, always check the weather forecast. If severe weather is forecast, stay sheltered and postpone your pioneering.



Rope

Rope is among our oldest tools. Ancient peoples made useful lines by twisting or braiding roots, reeds, plant fibers, or strips of leather and used them to haul and lift loads and to harness animals. With rope, they could lash together tools, fishing nets, and shelters.

Rope is still important for work and for play. Without it, pioneering projects would be impossible. When choosing a rope for a pioneering task, consider how strong it is, how much it stretches, how easily it handles, and how well it resists mildew, rot, and exposure to sunlight. You will also want to note whether it is made of natural fibers or of synthetics.

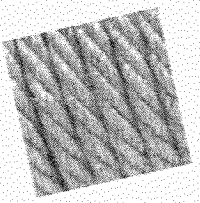
Natural-Fiber Rope

Rope makers have settled on a handful of plants as the best producers of natural fibers for manufacturing ropes. Each type of natural fiber has its advantages. The fibers most often used are manila, sisal, cotton, and coir.

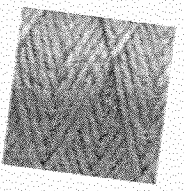
Just as in prehistoric days, natural-fiber rope is still produced from plants. Fibers taken from stalks or leaves are twisted together to form thin *yarn.* Lengths of yarn are then twisted together in the opposite direction to form a thicker *strand.* Next, groupings of strands are twisted together, again in the original direction, to make a small rope. Finally, three of these small ropes are twisted together the opposite way to form the finished rope. The *lay* of the rope—the shape that results from alternating the directions for twisting the yarn, strands, and small ropes—allows a rope to hold its shape and resist unraveling.

To better understand the anatomy of a rope, take apart a short piece of three-strand natural-fiber rope. As you unravel the rope, notice how the smaller ropes, the strands, and the yarn have been twisted. Finally, unravel a single bit of yarn and you will find plant fibers—the raw material from which natural-fiber ropes are made.

Manila. Manila rope is made of fibers harvested from the leaf stems of the abaca plant *(Musa textilis)*, a native of the Philippines. It takes its name from the city of Manila, the Philippine capital. Fibers can grow 10 feet long, making them ideal for constructing rope. Manila rope is easy to handle and, when new, has a smooth, silky feel. It is strong, does not stretch much, and is fairly resistant to the damaging effects of sunlight. For tying knots and making splices and lashings, quarter-inch manila rope is a good choice.

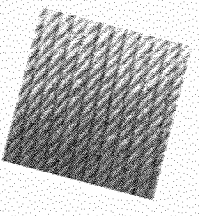


Sisal. Sisal fiber comes from a plant in the cactus family, *Agave sisalana*, found in arid regions of East Africa, Central America, and Mexico. (The name *sisal* comes from a small town in the fiber-growing region of Mexico's Yucatan peninsula.) Because the fibers are shorter than those of manila rope, sisal rope has only about two-thirds the strength of manila. Sisal fibers also have a tendency to splinter. This rope is not as flexible as manila and so is not as practical for lashings and for practicing knots. If knots in sisal rope become wet, kinks may remain in the rope after the knots are untied.



Cotton. The same cotton plant fibers used to make clothing can also be twisted or braided to form rope. Cotton rope is not very strong, but it is soft and easy to handle. It is ideal for clotheslines, tying up packages, and other uses that don't require it to bear much weight. Cotton rope is not useful for pioneering structures.

Coir. Originating in the islands of the Pacific, coir rope is made of fibers taken from coconut husks. It is a coarse rope, light in weight, that will float and is not harmed by salt water. The chief disadvantage of coir rope—and it is a big one—is that its very short fibers make it the weakest of major natural-fiber ropes. It is not recommended for use in pioneering projects, especially those that will bear weight.



Synthetic Rope

Synthetic rope is manufactured by twisting or braiding together fibers made from synthetic (mainly petroleum-based) materials, giving a variety of rope types that can be produced in almost any color and matched to many uses. Some synthetic ropes can be more vulnerable to sunlight than natural-fiber ropes. However, they generally resist rot and mildew better than natural-fiber ropes and, in many cases, are stronger.

Binder twine is made from loosely twisted fibers of sisal or jute that have been treated with chemicals during the manufacturing process. Its principal use is for tying bales of hay as they are formed in the field by baling machines.

The single-strand construction of binder twine gives it none of the strength that comes from twisting strands together to form the lay of a rope. Binder twine has a breaking strength of only a hundred pounds or less. It should *never* be used for pioneering projects except when lashing together camp gadgets that will bear little weight (such as a stand for a washbasin), and for making rope (see the "Making Rope" section later in this pamphlet).

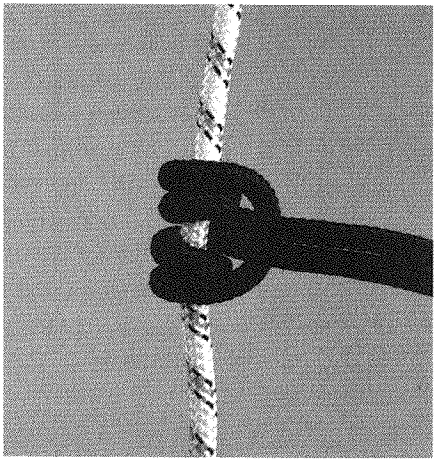
Polyester. Polyester rope usually is found in braided, rather than twisted, form. This strong, durable rope handles well and doesn't stretch much. It is less affected by sunlight than most other synthetic fibers. Polyester rope is excellent for practicing knot tying and for use in many pioneering projects on a selected basis.

Nylon. Modern nylon rope is more than twice as strong as manila rope of the same diameter. It is available in braided form and twisted strands. Nylon rope has more stretch than other synthetic or natural-fiber ropes, but it recovers its original shape after tension from a load has been released. Nylon rope a quarter-inch in diameter works well for practicing knot tying, but because it is slippery and has a high stretch factor, it should not be used for lashings.

Parachute cord. A core of nylon strands covered with a braided nylon sheath, this cord takes its name from the role it plays with parachute rigging. It has a thousand uses around camp. However, for pioneering, parachute cord can be used only for small projects (camp table, rack for drying clothes). The relatively low breaking strength of parachute cord (generally 200 to 500 pounds) means it should never be used for full-sized towers, bridges, or other weight-bearing pioneering projects.

Polypropylene. Polypropylene rope will float, making it a good rope for waterfront activities and in wet conditions. Polypropylene rope handles well, but its slippery finish makes it unreliable for holding knots or forming secure lashings, especially when the rope is new. While polypropylene has about twice the strength of manila rope of equal diameter, it also stretches more.

This rope can be used in pioneering projects as a line for pulling towers into position, as guy ropes anchoring structures in place, and as hand lines for monkey bridges. Its strength makes it suitable for anchoring systems and for any uses involving heavy strain. Its slippery surface reduces the friction of rope tackle systems.



Polyethylene. Polyethylene is an inexpensive braided rope. Knots and lashings will leave kinks in polyethylene rope that has been under tension, which makes it unsuitable for most pioneering projects. Polyethylene (also known as Dacron®) does float, giving it limited use at waterfronts, for example as towropes for water-skiers.

Kernmantle. Today, the only rope approved for BSA climbing and rappelling activities is nylon *kernmantle* rope. This strong rope has a core of parallel or braided nylon strands (the kern) surrounded by a woven nylon sheath (the mantle).

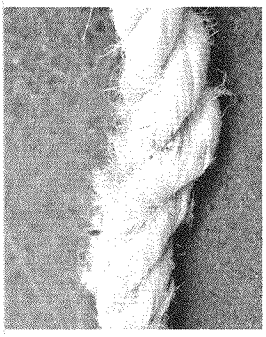
Rope that will be used for climbing and rappelling—set aside at a Scout camp climbing program area or a COPE course, for example—must *never* be used for pioneering projects.

Care of Rope

Inspect the full length of a rope before and after a pioneering event to ensure there are no cuts or abrasions. Any rope that has cuts, abrasions, or more than a few broken fibers might need to be retired. The same is true if rope fibers have lost their luster and appear dry and brittle. Feel for lumps in braided rope and look for internal fiber puffing through the weave of the braid. A section of line that seems thinner than the rest of the rope can be another sign of a weak spot.

Twist open the lay of a natural-fiber rope in several places and inspect the interior fibers. Light-colored fibers suggest the rope probably is in good shape. A rope with a dark or spotted interior, or that smells bad, is not safe to use.

Construct pioneering projects only with rope that is safe to use.



Damaged—and therefore unusable—rope

Prolong a rope's useful life by taking care of it. The following guidelines will help you prevent rope from being damaged.

- Always step over a rope, never on it. Avoid dragging it along the ground where grit might get into the fibers.
- Protect rope from abrasion by using layers of canvas or tarp to shield it from sharp edges such as a cliff.
- Protect rope from heat, chemicals, petroleum products, and prolonged exposure to sunlight.
- Keep a rope under tension only as long as is necessary.
- Allow wet rope to air-dry completely before putting it into storage.

A rope's safe working load will diminish as it is used. Tension placed on the rope, exposure to the elements, and the effects of knots, lashings, and *drop loading* (using a rope to suddenly stop a moving weight) can all reduce rope strength.

Safe Working Loads

New rope will have breaking strength and safe working load information printed on its packaging or included with the rope as a tag or pamphlet. The *breaking strength* of a rope indicates how many pounds of strain it will take before failing. The *working load* of a rope, usually less than 20 percent of its breaking strength, indicates the manufacturer's recommended maximum load.

A typical comparison of safe working loads and breaking strengths for new ropes of various kinds—in this case, ropes of ⅜-inch diameter—looks like this.

⅜-Inch Rope	Approximate Safe Working Load*	Approximate Breaking Strength
Manila	122 pounds	1,220 pounds
Sisal	108 pounds	1,080 pounds
Cotton	90 pounds	900 pounds
Coir	65 pounds	337 pounds
Polyester	334 pounds	3,340 pounds
Nylon	278 pounds	3,340 pounds
Polypropylene	340 pounds	2,440 pounds
Polyethylene	410 pounds	3,725 pounds

*For exact load limits of a particular rope, see the manufacturer's information printed on spools or packages of new rope.

Drying Rope

Rope must be dry before it is stored. Damp or wet rope may develop mildew and rot. If a rope has become muddy and wet, rinse it off with a hose. Loosely coil the rope, hang it outdoors, and allow it to dry completely. Hasten drying by leaving space between the coils.

Storing Rope

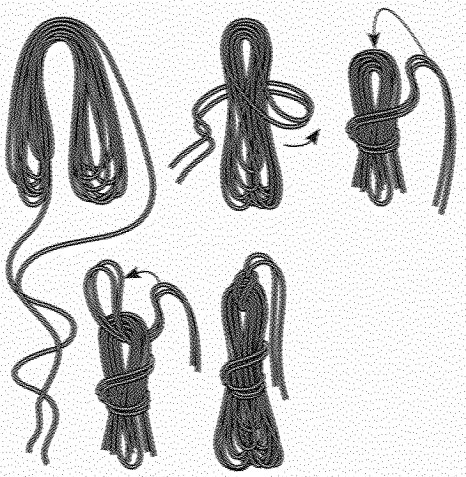
Store rope the right way and it will be ready the next time you need it. Start by making sure the rope is clean and dry. Coil and hang pieces of cord and short lengths of rope on pegs, or stow them in clean cloth bags. For long ropes or ropes of large diameter, either coil the rope and hang the coil on a smooth round peg in a gear room, or loosely stuff the rope into a clean canvas duffle bag.

COILING A ROPE FOR STORAGE OR THROWING

Ropes can be coiled for storage or in preparation for throwing one end across a stream or over a tree branch. Begin every coil by removing any knots and hardware from the rope.

Coiling a thick rope for storage. For long lengths of rope ½ inch in diameter and larger, drape large neat coils across the back of your neck or in your hand.

Coiling a thin rope or a cord for storage. Lengths of cord and ropes of small diameter can be coiled by laying loops of equal size in one hand. When only a few feet of rope or cord are left, use your other hand to wrap the remainder around the coil four or five times. Finish by passing a bend of the cord or rope through the coil, then run the end of the line through the bend and pull the end to snug the bend against the coil. To avoid kinks in natural-fiber rope, make large coils and bind them together with a clove hitch.



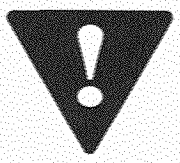
Butterfly coil

Coiling a rope for throwing. Tossing a rope over a tree limb or throwing a line across a creek is a challenging and fun skill. It can be important for hanging a bear bag to protect food in camp, for beginning a monkey bridge that will be built over a body of water or ditch, and for many other uses.

Secure one end of the rope so it doesn't take off when you throw the coil. Have a partner hang onto it, or tie it around a tree. Do not tie it around your waist.

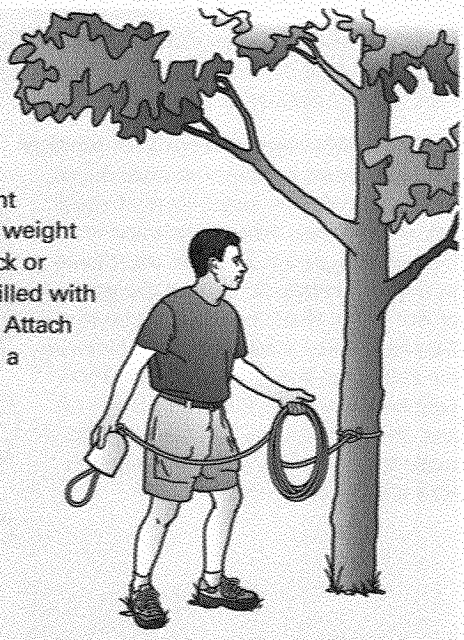
If the end of the rope is weighted, neatly coil the rope in your non-throwing hand. Place the coils next to one another so that when the rope is thrown, the coils run out smoothly without tangling. Throw the weighted sock or stuff sack either underhanded or overhanded toward the target. Never use a rock to weight a rope.

If there is no weight on the rope, coil it neatly and hold it in your throwing hand. Swing the coil in an underhand motion, releasing all the rope at once and allowing it to uncoil as it moves toward the target.



Never tie the rope to your wrist or around your waist. You may need to get rid of your end of the rope without becoming entangled in it.

Throwing a parachute cord or a rope with a diameter less than a quarter-inch might require adding a weight to one end. A sock or small stuff sack filled with sand works well. Attach it to the line with a clove hitch.



Fusing Rope Ends

Part of caring for rope includes preventing the ends from unraveling. For synthetic rope, that means fusing them. For natural-fiber rope, that means whipping the ends. The ends of three-strand ropes also can be protected with back splices.

For instructions on making a back splice, see "Splicing Rope" later in this pamphlet.

Rope and cord made of synthetic materials will melt under high heat. An electric blade cutter, often found in stores that sell rope, is the safest means of neatly fusing rope ends. You can also use a match, butane lighter, or candle to fuse a rope. Working in a well-ventilated area, melt and fuse the strands by holding each rope end a few inches above the open flame.

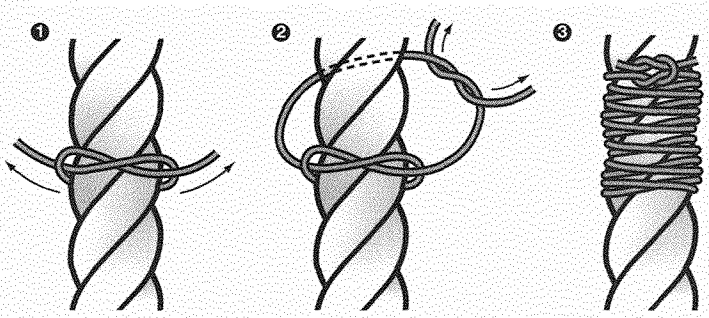
Melted synthetic materials are extremely hot and sticky, and will cause burns. Don't touch the fused end of the rope until it has cooled.

Whipping Rope Ends

Because natural fibers burn rather than melt, the ends of manila, sisal, cotton, or other natural-fiber ropes are protected by whipping. Whipping keeps rope ends from fraying or unraveling by tightly binding them with strong cord. Among the styles of whipping are basic, West Country, and the sailmaker's.

The West Country and sailmaker's whipping methods are illustrated here. To review the steps for making a basic whipping, see the *Boy Scout Handbook*.

West Country whipping. Famous for seafaring traditions, the counties west of Bristol, England, lend the name West Country to a form of whipping that works well on any type of rope. The success of West Country whipping depends on the tightness and neatness of the knots formed with the whipping cord. To make the West Country whipping, start with about 14 inches of waxed flax cord.



The best cord to use for whipping is waxed flax cord that can be purchased at leathercraft stores and shoe repair shops.

Step 1—Bring the cord around the rope near one end and secure the cord with an overhand knot.

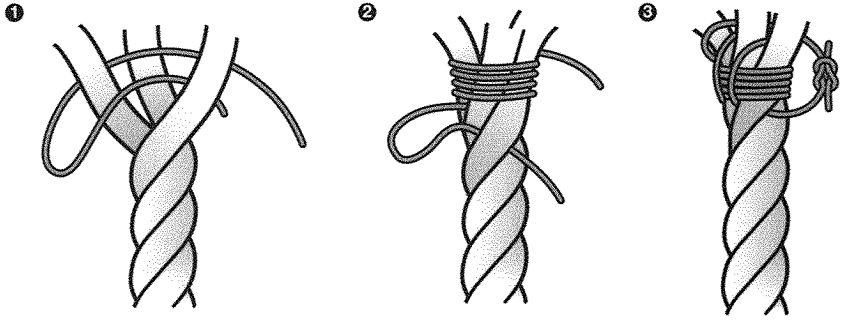
Step 2—Take the two ends of the whipping cord around to the back of the rope (away from you), and tie another overhand knot.

Step 3—Continue to tie overhand knots, alternating them between the front and back of the rope, until the whipping has been formed. As a rule, make the whipping at least as long as the diameter of the rope.

Always tie each overhand knot the same way (for example, right over left, or left over right) so that the knots lie tightly together to form a smooth whipping. Finish the whipping with a square knot and trim the excess cord.

Ropes securing a ship's sails snapping in the wind can quickly fray if the ends have not been protected. The sailmakers of old knew that spending a little extra effort whipping rope ends would make their work much easier in the long run.

Sailmaker's whipping. The sailmaker's whipping can be used on three-strand rope. It differs from basic whipping in that the cord is secured around one of the rope strands before the whipping begins. That will help keep the whipping from coming off even if the rope is heavily used. Here is how to make the sailmaker's whipping.

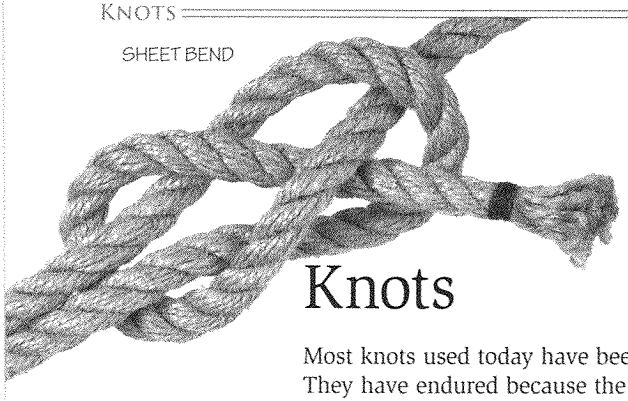


Fuse the ends of three-strand synthetic rope before whipping.

Step 1—Unlay the three strands for about 1 inch from the end of the rope. Form a bight near the end of a 16-inch length of cord and slip it over one rope strand, allowing several inches of the bight to remain. Lay the running ends of the cord between the other two strands of the rope.

Step 2—Twist the strands of the rope back together. Using the longer end of the cord, make wraps around the rope. Keep the wraps tight against each other.

Step 3—After completing the wraps, loop the bight over the end of the same strand around which it began. Run the longer end of the cord through the bight, then pull the two ends of the cord to tighten the bight against the whipping. Finish by tying the ends of the cord with a square knot and trimming the excess cord.



SHEET BEND

Knots

Most knots used today have been around for centuries. They have endured because the way they're formed—their architecture—has proven to be ideal for certain uses.

Knots and Rope Strength

Tying knots in a rope causes bends and loops that place uneven strain on the fibers. That can reduce the strength of the rope and decrease its breaking strength. Also, the effects that knots and splices have on a rope vary according to the condition of the rope and the nature of the knot or splice. For instance, knots such as the square knot that create tight bends weaken a rope more than knots with wide bends such as the timber hitch and bowline.

Three tests of a good knot:

- It is easy to tie.
- It stays tied.
- It is easy to untie.

This list shows the approximate percentage of strength left in a rope tied or spliced in certain ways.

Full strength of dry rope	100 percent
Eye splice	90 percent
Short splice	80 percent
Timber hitch, roundturn, half hitch	65 percent
Bowline, slip knot, clove hitch	60 percent
Square knot, sheet bend	50 percent
Overhand knot	45 percent

The Language of Knots

A little terminology can help you learn how to tie knots and understand their advantages.

running end. The end of the rope that is used to tie a knot. This end is also called the *working end.*

standing part. All of a rope that is not the running end.

overhand loop. Formed when a loop is made so that the running end of the rope is on top of the standing part.

underhand loop. Formed when the running end of the rope is placed under the standing part of the rope.

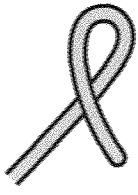
bight. Formed by doubling back a length of the rope against itself to form a U. The running end of the rope does not cross the standing part. (If that happens, the shape it forms is a loop, not a bight.)

turn. To *take a turn,* wrap the rope once around a spar or a stake. The friction created by the turn can help you control a line that has tension on it, especially if you are letting out line or taking it in.

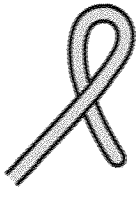
roundturn. Make a *roundturn* by wrapping the rope once around a spar or stake and then halfway around again so that the running end of the rope is going back toward the standing part. A roundturn creates additional friction for controlling a line under strain.

hitch. A knot that secures a rope to a spar or other stationary object.

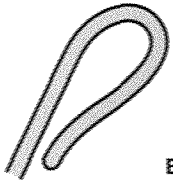
dress a knot. To adjust a new knot so that everything is in its place. Dressing a knot ensures that the knot will perform as expected.



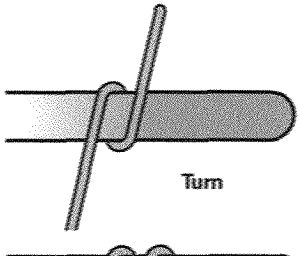
Overhand loop



Underhand loop



Bight

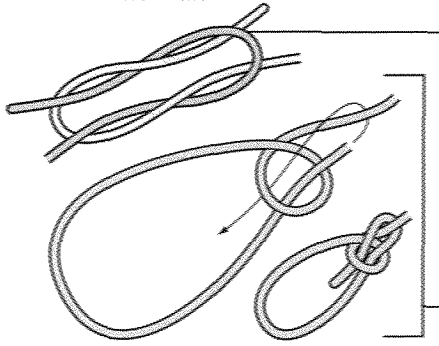


Turn

Roundturn

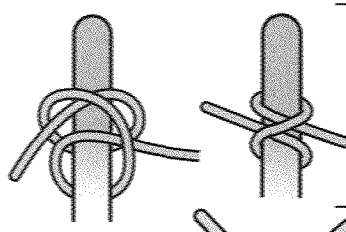
Basic Knots

The knots listed here are important basic knots for use in pioneering and other Scouting activities. These are the knots important to rank advancement. A Scout earning the Pioneering merit badge should be able to tie each of these knots quickly and well.

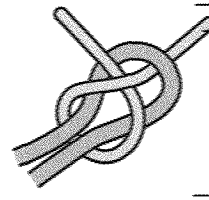


The **square knot** is used to tie together the ends of two lines of the same diameter. It is not a reliable knot when used with larger ropes, but is ideal for finishing some lashings and whippings.

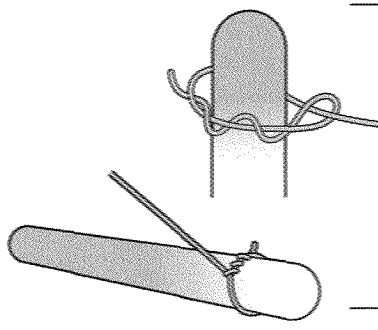
The **bowline** makes a fixed loop that will not slip. It is easy to untie.



The **clove hitch** can be tied with the end of the rope or tied along the standing part of the rope and slipped over a spar. It is used to start several lashings.



The **sheet bend** is the preferred knot for tying together two ropes of the same or different diameters. The *bend* of the sheet bend is formed in the larger of the two ropes.

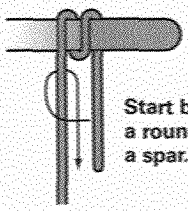


The **timber hitch** is used for dragging a log and for starting a diagonal lashing. As tension is put on the rope, the timber hitch gets tighter but is always easy to untie.

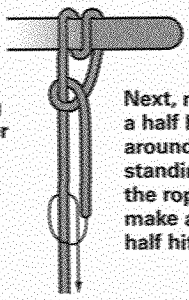
Other Useful Pioneering Knots

For pioneering projects, you will need to add these additional knots to your repertoire.

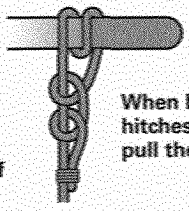
Roundturn With Two Half Hitches. Use the roundturn with two half hitches to secure the ends of foot ropes and hand ropes for a monkey bridge, and to tie off guylines. If desired, you can secure the running ends with safety knots. This knot is especially useful because it is secure and is easy to tie and untie when adjustments are needed. To make a roundturn, take the running end of the rope around a spar. That will allow you to hold tension on a line while you complete the two half hitches.



Start by making a roundturn over a spar.



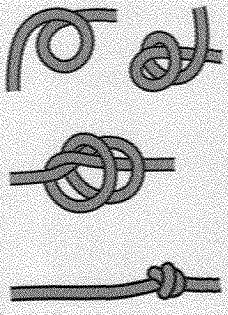
Next, make a half hitch around the standing part of the rope. Then make another half hitch.



When both half hitches are made, pull them tight.

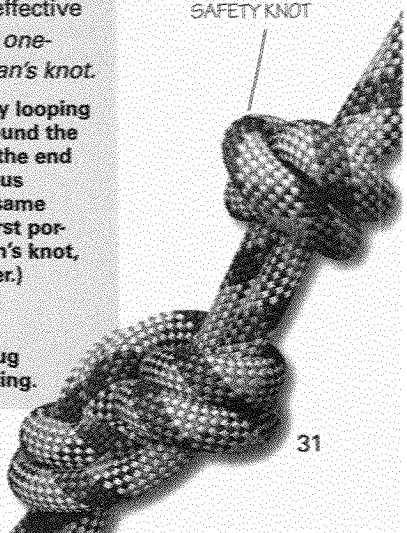
Safety Knot

A safety knot (also known as a *stopper knot),* added to a knot such as the roundturn with two half hitches and the figure eight follow-through, will help keep the free end of the rope from working itself loose. The most effective safety knot goes by several names—*barrel knot, one-sided grapevine knot,* and *half a double fisherman's knot.*

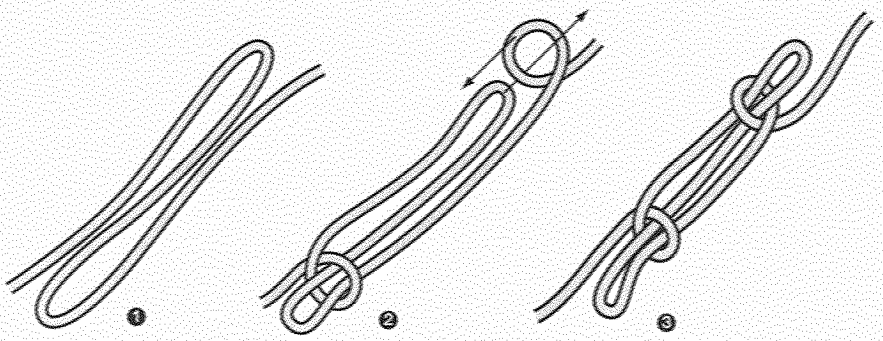


Form a safety knot by loosely looping the tail of the rope twice around the standing part, then running the end up through the two loops thus formed. (This is exactly the same method you use to tie the first portion of the double fi sherman's knot, described later in this chapter.)

Work out any slack from the safety knot so that it lies snug against the knot it is protecting.



Sheepshank. Use the sheepshank to temporarily shorten a rope's length or to bypass a weak spot in the rope. To begin, take up the slack to shorten the line. This forms two long bights next to each other (1). Secure one bight by forming an overhand loop in the standing part of the rope ahead of the bight and slip it over the end of the bight (2). Form another overhand loop ahead of the second bight and use it to hold that bight in place (3).



A sheepshank will stay tied only if the entire rope is under tension.

More Pioneering Knots

The following knots are useful in many pioneering projects, and it is a good idea to become familiar with each of them. Knowing these knots will enhance your skill, increase your knowledge, and provide plenty of enjoyment and satisfaction.

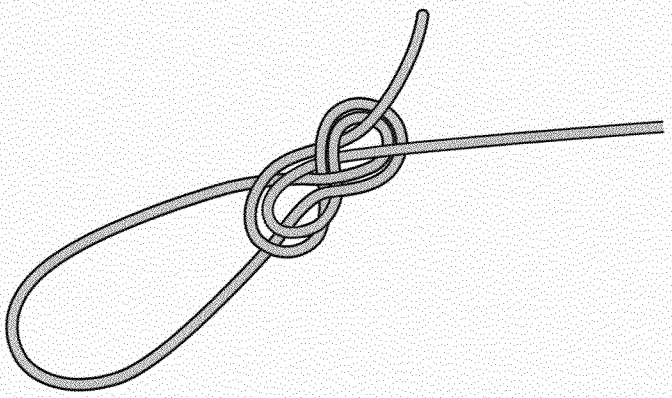


Figure Eight on a Bight. Forming a bight (a bend) in a rope and then tying a figure-eight knot with it results in a loop that will not slip or come loose. When this knot is tied in the end of a rope, back it up with a safety knot.

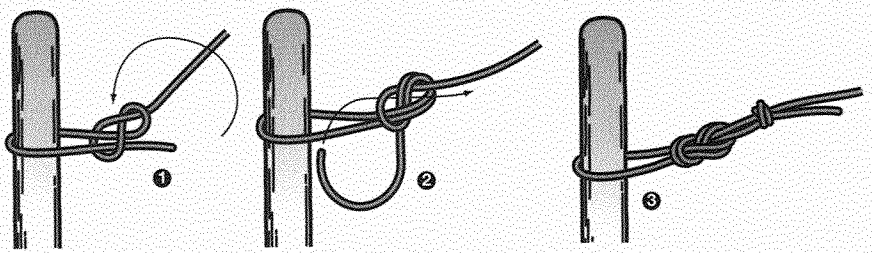
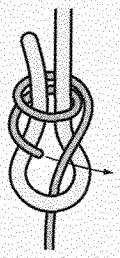


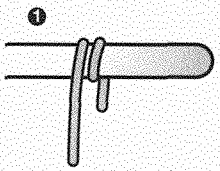
Figure Eight Follow-Through. This is the same knot as the figure eight on a bight, except when it is made, it can be tied around a tree or stake or through an anchor ring. Begin by tying a simple figure-eight knot in a rope. Run the end of the rope around an anchor or through the ring to which you want to attach it (1). Then trace the end of the rope back through the figure-eight knot (the "follow through") (2). Back it up with a safety knot (3).



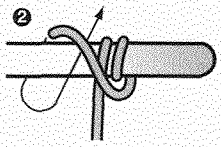
Form a bight in the larger rope. Then wrap the smaller rope around the bight at least twice. Use more wraps if needed to hold it tight.

To finish off the knot, tuck the running end under the standing part of the small rope.

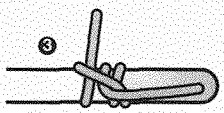
Double Sheet Bend. The double sheet bend has more holding power than a simple sheet bend. It comes in handy when tying together two ropes that vary widely in diameter. It also works well for tying together wet or slippery ropes. Tie it as you would a regular sheet bend, but make two or more turns around the bight.



Start the rolling hitch by making a roundturn around a spar.

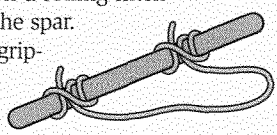


Cross the running end over and make a round turn. Then tuck the end under the turn.

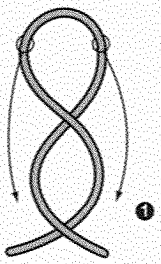


Strain can be applied either parallel or perpendicular to the spar to tighten the hitch.

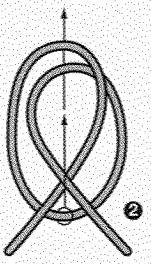
Rolling Hitch. The rolling hitch has many uses, such as tying a rope to a stake or a spar, or forming a hand or shoulder loop to pull a spar. Essentially it is a clove hitch tied around a spar with an extra turn. Pull can be exerted on a rolling hitch either perpendicular to or parallel with the spar. It will untie easily. When you need extra gripping power, make additional turns as you tie the hitch.



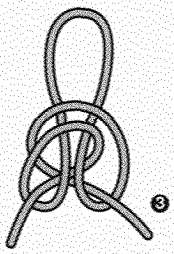
To form shoulder or hand loops for pulling a spar, tie two rolling hitches, one at each end of a short length of rope.



Start a butterfly knot with an overhand loop. Then twist the rope to form a second overhand loop. Drop the upper loop down in back.



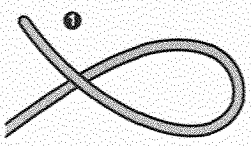
When the upper loop is dropped down, pull it under the two crossed standing parts of the rope. Then pull it up through the top loops to complete the knot.



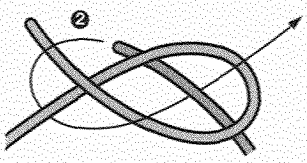
To pull the butterfly knot tight, pull the upper loop while holding the standing parts of the rope at the bottom.

Butterfly Knot. This knot creates a fixed loop anywhere along the standing part of a rope. The butterfly is secure, is easy to untie, and can withstand tension from any direction. When using a rope to pull a heavy object (such as a log), tie a series of butterfly knots to form loops for each person's hand or shoulder. When climbing a rope, tie a series of the knots to form loops for your hands and feet. This knot also is used when forming a trucker's hitch. (See the "Rope Tackle" section later in this pamphlet.)

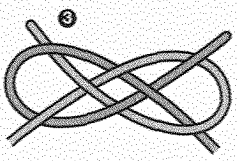
To tie up horses or anchor canoes on shore, tie a series of the butterfly knot in a picket line, one for each horse or canoe.



Start a carrick bend by making an overhand loop at the end of one rope.



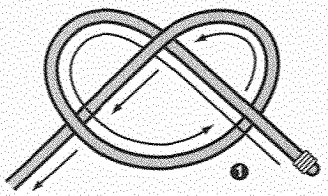
Bring the end of the other rope under the overhand loop. Then complete the knot as shown, weaving over and under as you go.



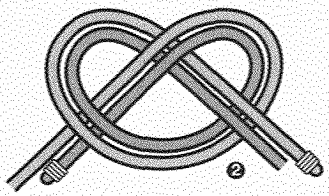
The carrick bend looks symmetrical when first tied and still loose. But pulled tight, it looks quite different.

Carrick Bend. Use this knot for tying together two large-diameter ropes, especially if there will be a heavy strain on the rope. The knot will tighten under strain but won't slip and is usually easy to untie. It works well with wet or slippery ropes. The carrick bend looks symmetrical as it is being tied, but pulling it tight greatly changes its appearance.

The term *carrick* comes from an old word, *carrack*, the name given to certain ships of the 14th, 15th, and 16th centuries.



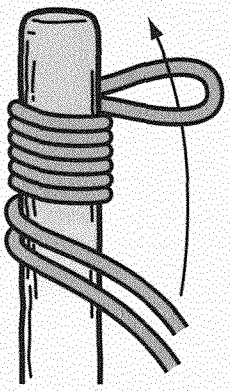
To tie a water knot, begin with a loose overhand knot in one end of the rope or webbing.



With the other end of the rope or webbing, trace the first end all the way back through the overhand knot. Straighten the knot (dress it), then pull it as tight as possible. Tie safety knots with the remaining tails.

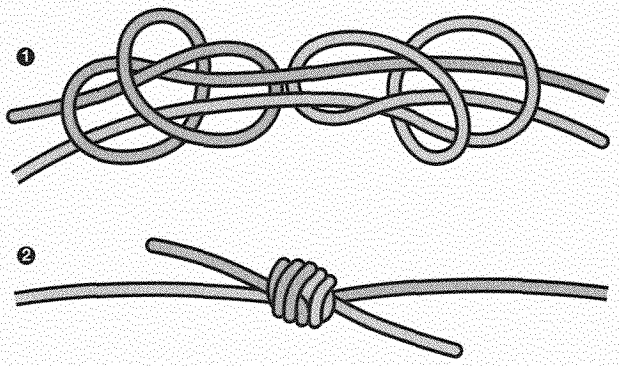
Water Knot. Use this knot to tie together the ends of a piece of rope (such as a flagpole rope) or nylon webbing to make a sling for using with anchoring systems. The water knot won't slip once it has been tightened and is almost impossible to untie—a good thing when used with anchor slings. Back up the water knot with safety knots.

Pipe Hitch. A pipe hitch creates enough friction to keep a rope from slipping and gives considerable grip as you pull on a pipe or spar, or pull a stake or post out of the ground. Tie the pipe hitch with four, five, or six turns; add more turns to get the friction you need. Draw the turns snug as you make them so that you get the full effect of their friction.

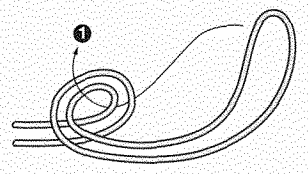


To make a pipe hitch, form a bight in the rope and wrap it around the spar. Use at least four wraps, more for more gripping power. Finish the knot by pulling the standing end of the rope through the bight.

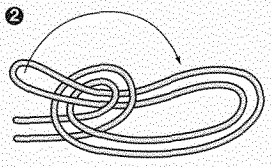
Double Fisherman's Knot (Grapevine Knot). For tying together the ends of two ropes of equal diameter (especially ropes made of synthetic materials that tend to slip easily), this is the most reliable knot. It also can be used to secure the ends of a rope or cord to form a fixed loop (grommet), which is particularly useful with braided rope that cannot be spliced.



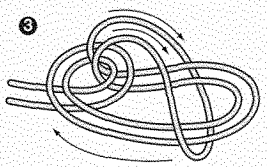
Begin the double fisherman's knot by laying about 2 feet of the ends of two ropes alongside each other, ends opposite. Loosely loop one rope end twice around the other, then thread the end of that rope through the loops. Repeat the process with the second rope end. Carefully tighten the two parts of the knot, then slide them against each other. If they don't fit together neatly, the knot is incorrectly tied.



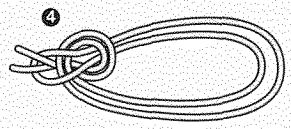
To form a bowline on a bight, first form an overhand loop with a long bight in the rope. Make the bight large enough for the two loops you need.



Bring the bight up through the overhand loop.



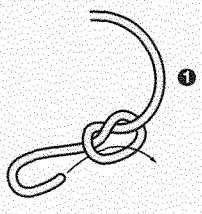
Slip the bight over the bowline loops and up to the standing part of the rope.



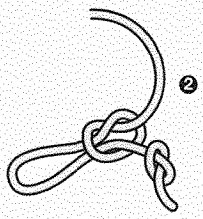
The completed bowline on a bight has two loops that can be adjusted in size before pulling it up tight.

Bowline on a Bight. The bowline on a bight creates two loops anywhere along a rope that you can slip over one or more stakes. It can provide hand and shoulder loops for heavy pulls, and form loops for tying in other lines. Make a bight long enough so that the two loops formed are the sizes you need. Adjust the loop lengths before tightening.

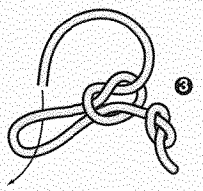
Honda. The honda knot forms a fixed loop in the end of a rope to put over a stake or spar. It may also form a running loop when you want the knot to tighten as you pull. The knot consists of two overhand knots snugged tightly together to form a fixed loop with a diameter of about 3 inches. The standing part of the rope, passed through the fixed loop, forms the large running loop that will be thrown at a target. Tension on the rope can make the honda almost impossible to untie.



To begin the honda, tie an overhand knot about 12 inches from the running end of the rope, and pass the running end up through the overhand knot from the back.

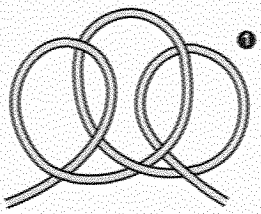


Tie another overhand knot in the running end. Pull the two overhand knots tight to form the fixed honda loop.

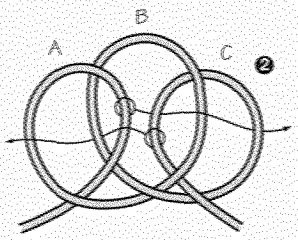


To form a running loop that will tighten as you pull, bring the standing part of the rope through the honda loop.

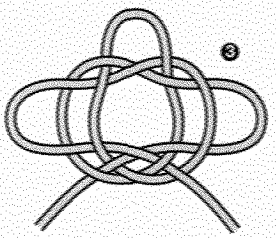
Used by cowboys, the honda forms the loop in a lariat for roping cattle and horses.



Start the masthead knot by making three overhand loops, laying the second under the first, and the third under the second.

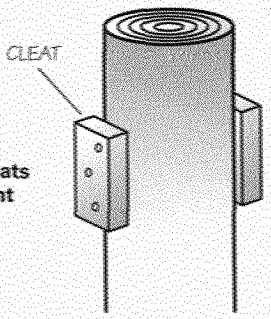


Hold the top of loop B in place while pulling loops A and C over and under as the arrows show.



Add a fourth loop to the finished knot by tying the running ends with a square knot. Secure the ends with safety knots.

Masthead (Jury) Knot. Use this knot when erecting a vertical spar that must be held in position with guylines, or when attaching guylines at the top of a pole. The masthead or jury knot provides four loops for the four guylines. It should be tied with a rope that has a larger diameter than the guylines secured to it. The knot itself creates only three loops. You form the fourth loop by tying the two running ends together with a square knot. Be sure to secure the ends of the square knot with safety knots.



The masthead knot does not cinch tightly around the spar. It must be supported with cleats attached to the spar to prevent it from sliding down.

Learning the Ropes

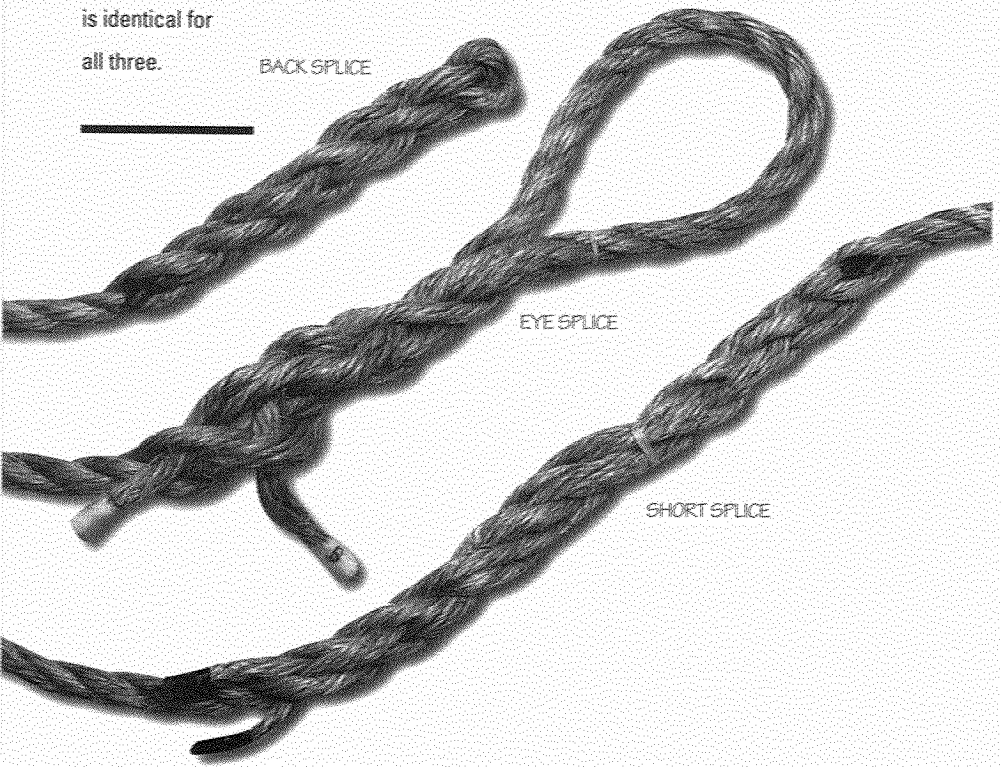
In the days of large sailing ships, a thorough knowledge of handling ropes was important to the safety and success of a voyage. Sailors who had mastered the skills of using knots, splices, ropes, and rigging systems were said to have *learned the ropes.*

Splicing Rope

Each of the three splices (back, eye, short) begins in a special way. Once a splice has been started, the rest of the process is identical for all three.

Splicing is a means of weaving the strands of any natural-fiber or synthetic three-strand rope to protect a rope end from unraveling, to form a secure loop in a rope end, or to join together two rope ends. Though splices can take longer to form than knots, they have several advantages. They are permanent, reliable, and less bulky than knots, and they reduce a rope's strength much less than knots that serve the same purpose.

Splicing takes practice. It is easiest to learn if you can sit down with someone who can help you master each step of weaving the strands together. Three-strand manila rope with a ¼-inch diameter works well for learning to splice.



Back Splice

The back splice permanently prevents the end of a rope from unraveling. Because splicing increases the diameter of a rope end more than whipping does, tying knots in back-spliced rope can be more awkward than when using rope protected with whipping.

Step 1—Unlay rope strands about five twists. Bend strand A back between strands B and C and hold it against the standing part of the rope. Allow the bend in strand A to extend upward about an inch.

Step 2—Wrap strand B around the base of the loop formed by strand A.

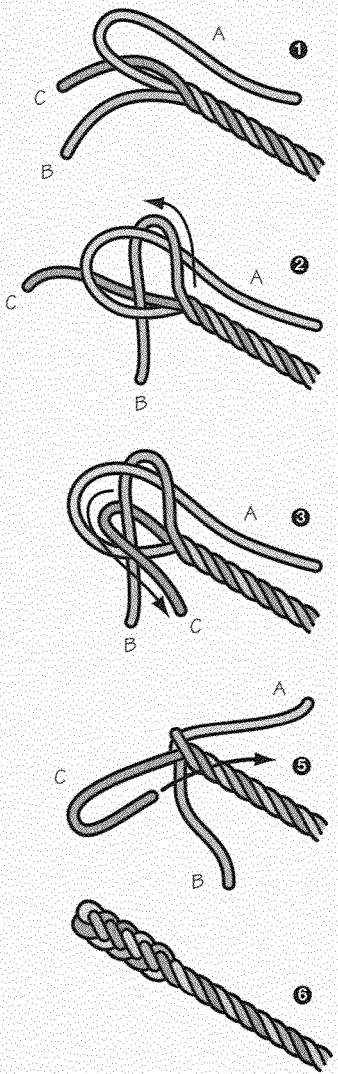
Step 3—Bring strand C through the loop formed by strand A.

Step 4—Tighten the strands, gently tugging on them to snug them neatly against one another. Doing so makes the *crown knot* symmetrical, with all three strands identically positioned.

Step 5—Pass one strand *over* the strand directly below it and then tuck it *under* the strand alongside that one. (You will need to twist open the lay of the rope to make the tuck.)

Step 6—Continue by passing each strand in turn over the strand directly below it, then tucking it under the strand alongside that one. Repeat this process two more times, going in order with the strands.

After making three tucks with all the strands, cut away half the fibers of each strand. Make a fourth tuck with the reduced strands to taper the splice. Trim the remaining fibers.



Use the eye splice to splice a rope into an eyebolt at the bow of a canoe, or to splice the throwing line into a ring buoy at the waterfront.

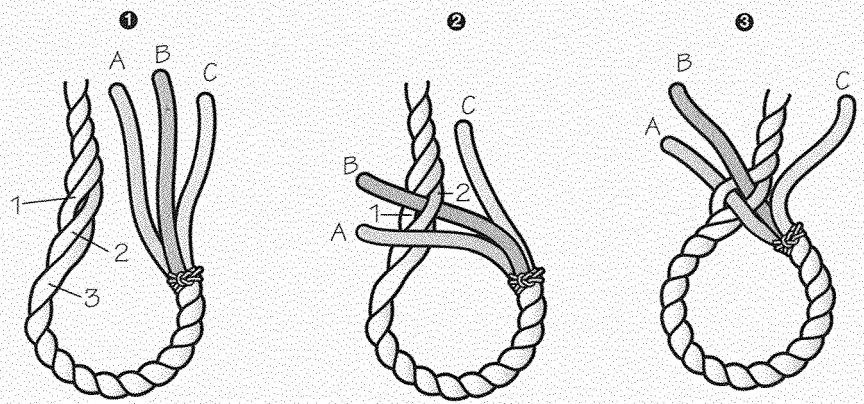
Eye Splice

The eye splice creates a fixed loop at the end of the rope. Use this splice to make a fixed loop in the end of a guyline or to splice a rope into the grommet of a tent or dining fly, or to splice eyes into the ends of a rope to be used as an anchor sling.

Step 1—Use a square knot to tie a piece of whipping cord around the rope about 6 inches from the end. Unlay strands A, B, and C back to the cord and spread them apart. Bend the rope to form an eye of the size you want.

Step 2—Twist open the lay of the rope and tuck center strand B under a strand on the standing part of the rope.

Step 3—Pass strand A over that strand, then tuck strand A under the strand beside it.



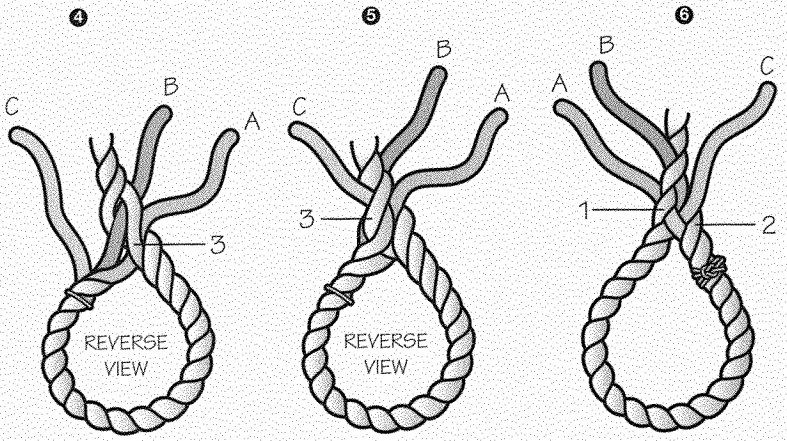
Step 4—Turn the eye over.

Step 5—Find the strand next to the one with strand A tucked under it. Twist open the lay of the rope and tuck the end of strand C beneath that strand. At this point, the eye will be formed and the three strand ends will be symmetrical.

Step 6—Complete the splice as you would a back splice:

- Pass strand A *over* the strand directly below it and then tuck it *under* the strand alongside that one.

- Pass strand B over the strand directly below it, then tuck it under the strand alongside that one.
- Do the same with strand C, going over the strand directly below it and then under the next one.
- Repeat the process twice more, going in order with strands A, B, and then C.
- For a tapered finish, reduce the diameter of the strands and make a fourth tuck.



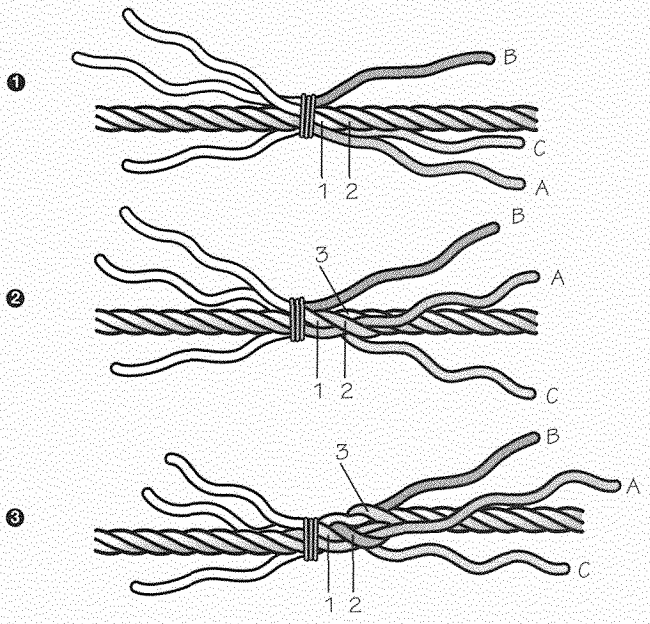
Short Splice

A short splice is used to join two rope ends together. It can be used to join several shorter ropes to form a longer line or to rejoin a rope that has been cut to remove a damaged section. It may also be used to splice the ends of a short length of rope to form a fixed loop that can be used as an anchor sling (also known as a *grommet* or a *strop*) for anchoring pioneering projects.

Step 1—Unlay the two rope ends 5 to 6 inches. Interlace the strands of one rope end with those of the other. Use whipping cord to secure the strands in place at the point where they meet.

Step 2—Pass strand A *over* the strand directly below it and then tuck it *under* the strand alongside that one. (To make the tuck, first twist open the lay of the rope.)

Step 3—Roll the splice toward you. Pass strand B over the strand directly below it, then tuck it under the strand alongside that one. (Strand B will be tucked under the strand lying next to the strand with A tucked under it.)



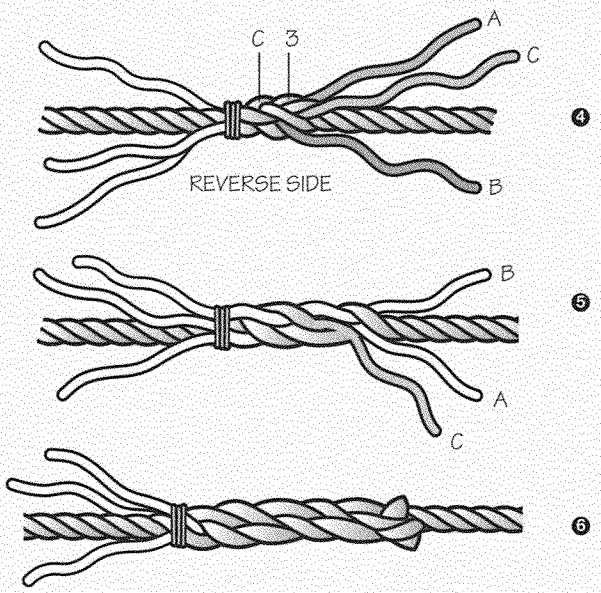
Step 4—Again roll the splice toward you. Pass strand C over the strand directly below it and then under the next one. (Strand C will be tucked under the strand lying next to the strand with B tucked under it.)

Step 5—Continue the splice as you would complete a back splice or an eye splice.

- Pass strand A over the strand directly below it and then tuck it under the strand alongside that one.
- Pass strand B over the strand directly below it, then tuck it under the strand alongside that one.
- Do the same with strand C, going over the strand directly below it and then under the next one.

- Repeat the process twice more, going in order with strands A, B, and then C.
- For a tapered finish, reduce the diameter of the strands and make a fourth tuck.

Step 6—Remove the whipping cord from the splice. With the remaining three strands, complete the splice on the other side by following steps 2 through 5.



Three-strand synthetic rope can be spliced the same way as natural-fiber rope. Since nylon, polypropylene, and other synthetic ropes can be slippery, add extra security by making at least four full tucks with each strand.

Making Rope

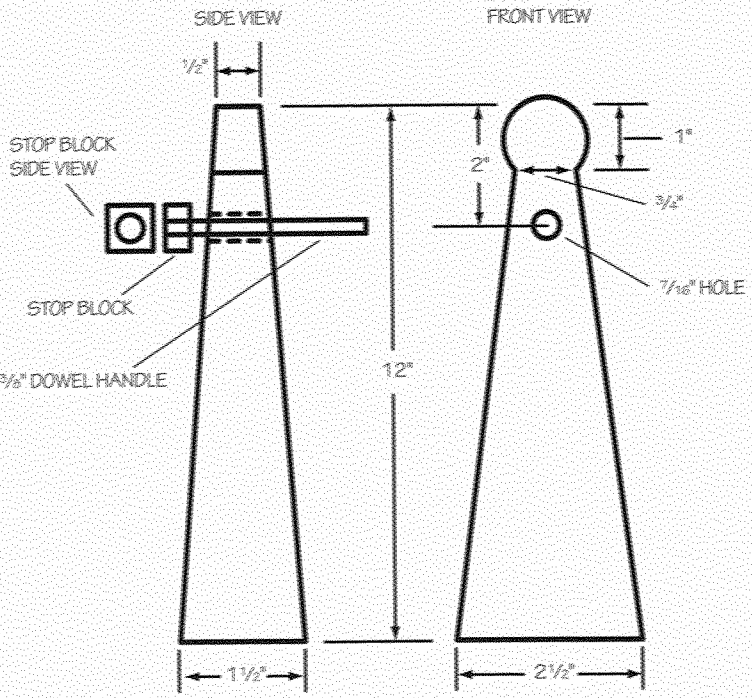
To better understand the structure of rope, make your own. The basic process of making rope consists of twisting fibers to form strands, then twisting the strands together to form rope. You can use either a rope spinner or a rope-maker.

A coping saw is needed to make a rope spinner, so be sure there is appropriate adult supervision. To make a cutout in a piece of wood, first bore a hole, ¼ inch or larger, just inside the shape you want to cut out. Remove the blade of the coping saw, slip the blade through the bored hole, and replace the blade in the saw frame. With the blade thus "inside" the wood, saw along the cutting line.

Making a Rope Spinner

A thousand years ago, American Indians living in what is now Arizona used a *rope spinner* to make rope from the fibers of cactus plants. Using binder twine instead of cactus fibers, Scouts today can make rope the same way. To make a rope spinner, start with a 12-inch piece of 2-by-4-inch construction lumber.

The sides of the spinner are tapered to produce a shape with more weight at the bottom to aid in spinning. The knob at the top is shaped to hold twine and strands in place.



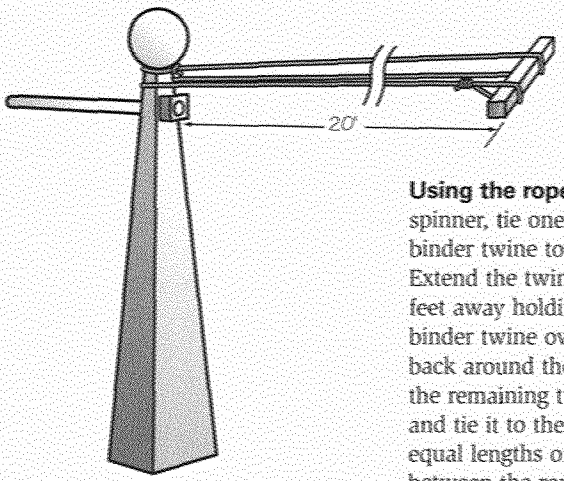
Step 1—Draw the outline of the spinner on the face of the wood, then cut it out using a coping saw.

Step 2—Drill a 7/16-inch-diameter hole, positioning it 2 inches from the top of the spinner. The hole will be fitted with the handle.

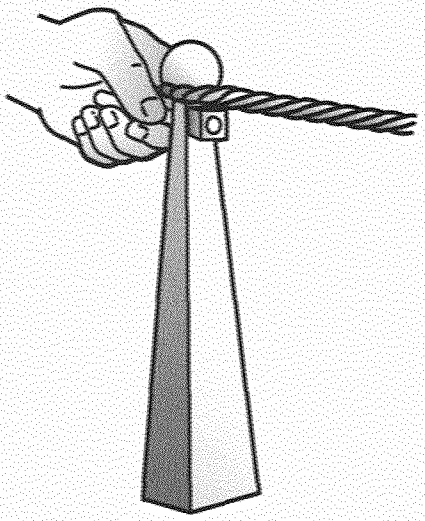
Step 3—For a spinner handle, use a wooden dowel ⅜ inch in diameter and about 10 inches long. Make a stop block for the handle from a piece of wood about ¾ inch square. Drill a ⅜-inch-diameter hole through the center of the block, and glue the dowel end into the hole.

Step 4—Assemble the rope spinner by slipping the handle into the hole in the spinner.

When using hand tools, be sure to follow the *Guide to Safe Scouting*, available online at http://www.scouting.org/HealthandSafety/GSS.aspx.



Using the rope spinner. To set up the rope spinner, tie one end of a 60-foot length of binder twine to the neck of the spinner. Extend the twine to a person standing 20 feet away holding a sturdy stick. Loop the binder twine over the stick and then run it back around the head of the spinner. Run the remaining twine out to the other person and tie it to the stick. You will have three equal lengths of binder twine stretched between the rope spinner and the stick.



Spinning a strand. Holding the handle, twirl the spinner clockwise, twisting the three lengths of binder twine into a single strand. A little practice will tell you how tightly to spin the strand.

Spinning a rope. Follow these steps to spin your rope.

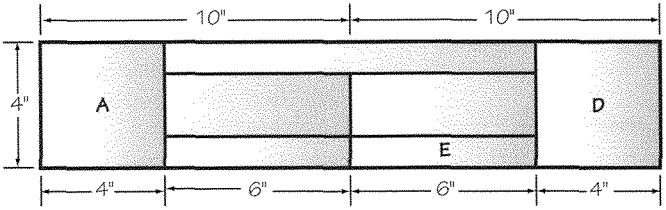
Step 1—Leave the newly twisted strand stretched between the spinner and the stick. As the person holding the stick moves forward, loop the strand over the stick and loop it around the neck of the spinner so that you have three lengths of the strand, each about 7 feet long, stretched between the spinner and the stick.

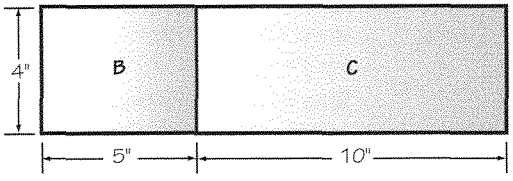
Step 2—Now twirl the spinner *counterclockwise,* twisting the three strands together to form a rope.

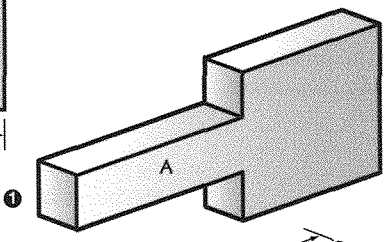
Step 3—Temporarily secure each end of the new rope by tying a piece of twine around it. Remove the rope from the stick and the spinner. Whip each end to prevent unraveling, and you will be the proud owner of a rope you made yourself.

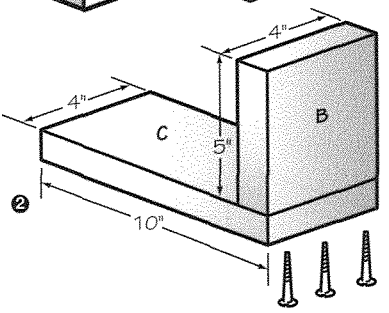
Making a Rope-Maker

Farmers a hundred years ago used binder twine with their hay balers. With a little ingenuity, those farmers devised hand-cranked machines to twist the twine into rope. The pieces for the rope-maker are cut from two pieces of ¾-inch-thick plywood about 4 inches wide, one about 20 inches long and another about 15 inches long.







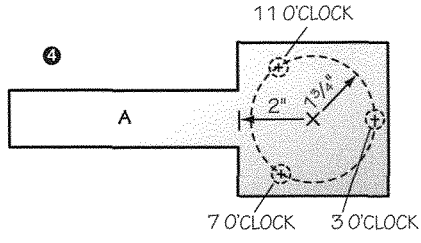


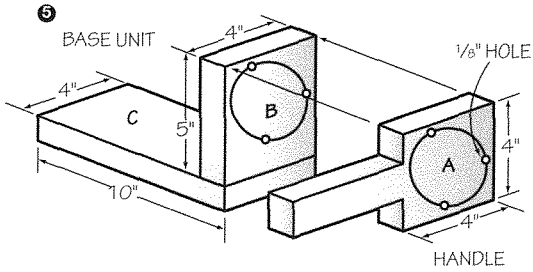
Step 1—Cut piece A, the handle, to shape. (Do not drill the holes yet.)

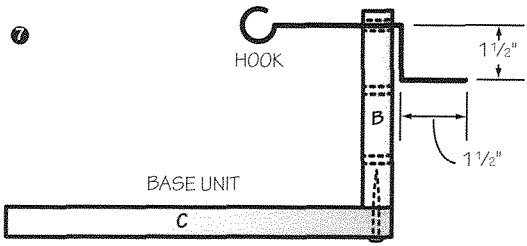
Step 2—Cut pieces B and C. Glue and screw them together to form the base.

Step 3—Cut piece D, the separator paddle, to the same shape as the handle. (Do not cut out the notches yet.)

Step 4—Mark holes in the handle. First draw a 3½-inch-diameter circle (1¾-inch radius) on the handle. The center of this circle should be 2 inches from the end of the handle. The edge of the circle will be ¼ inch from each of three edges of the handle. Then, using a protractor, mark the positions of the three holes for the turning hooks. Mark the holes on the circle at 120-degree intervals—the 3 o'clock, 7 o'clock, and 11 o'clock positions.





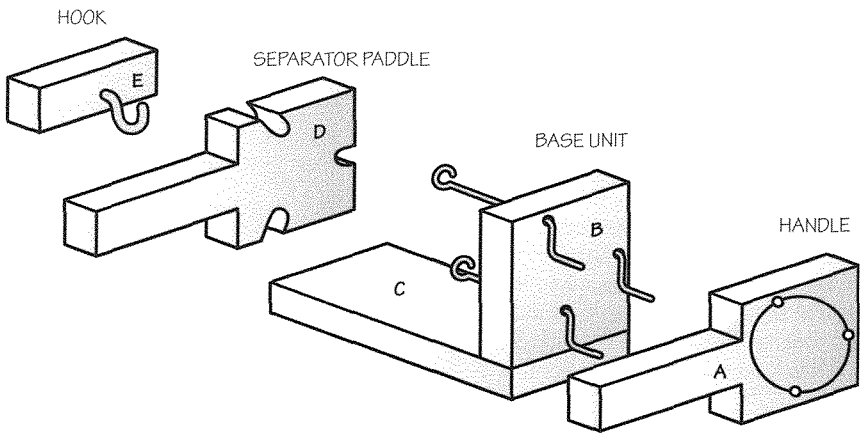


Step 5—Drill the holes. Clamp the handle and the base unit together, as shown. Using a ⅛-inch bit, drill the three holes through both pieces of wood.

Step 6—Make the hooks. Cut three pieces of coat-hanger wire about 8 inches long. Use pliers to make two bends in each wire to form an L-shaped end. Each bend should be about 1½ inches in length.

Step 7—Insert the three wires through the holes in the upright piece of the base, then bend the straight end of each wire into a hook.

Step 8—Notch the separator paddle. The separator paddle will be used to keep the strands separated as they are being twisted into rope. To position the notches, place the handle (A) directly on top of the paddle (D). Push a nail through the holes in the handle and press down on the nail to mark the positions on the paddle. Remove the nail. Sketch the shape of notches that will touch the nail marks on the paddle. Using a coping saw, cut out the notches.



Step 9—Make the end hook. Screw a 3-inch-long screw hook into the center of a piece of wood. (You can use a piece of scrap wood left over from making the handle.)

Practice will help you determine how fast to turn the handle and how quickly to move the separator paddle to make a good piece of rope. Too few turns will produce rope that is loose. Too many turns will produce rope that is twisted too tight and might be hard to use.

Using the rope-maker. Follow these steps to use your rope-maker.

Sixty feet of twine will produce a rope 6 feet long.

Step 1—Clamp the base unit of the rope-maker to a table or a bench. Tie one end of a 60-foot length of binder twine to one of the turning hooks.

Step 2—Ask another Scout to hold the end hook about 6 feet in front of the base unit. Run the binder twine around the end hook, back to the first turning hook, and then back to the end hook. There will be three strands extending from the first turning hook to the end hook.

Step 3—Continue threading the twine back and forth until you have three lengths of binder twine going from each turning hook to the end hook. Keep enough tension on the end hook to remove any slack from the twine.

Step 4—Ask a third Scout to stand just in front of the end hook and fit the lengths of twine coming off each turning hook into the notches of the separator paddle. As the rope is turned, the Scout holding the separator paddle should move the paddle toward the base unit, making sure the strands do not become fouled.

Step 5—Start turning the handle so that the hooks turn clockwise. As you turn the handle, the binder twine will begin to form into twisted strands, and these strands will also twist to form rope.

Step 6—Temporarily secure each end of the new rope by tying a piece of twine around it. Finish the project by whipping the ends.

Anchors and Rope Tackle

Building pioneering projects often requires reliable anchor points for attaching guylines and for both ends of a monkey bridge. You also need secure anchoring when using rope tackle to move or hoist loads.

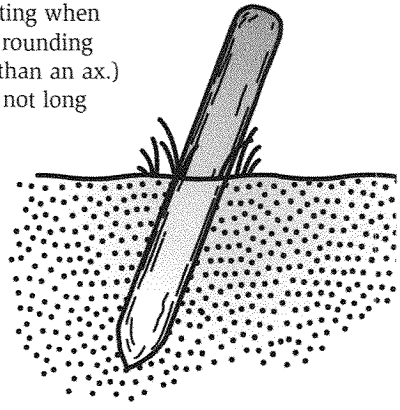
Anchors

A sturdy tree or a large, immovable rock might be just right for use as an anchor. Otherwise, pioneering stakes driven into the ground can serve as anchors.

Stakes

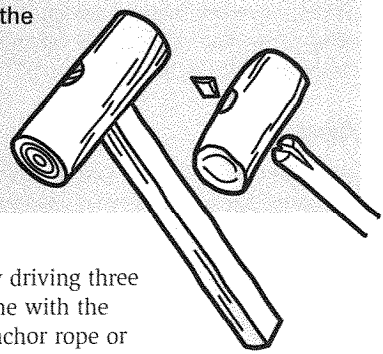
When nature does not provide a solution, anchors can be constructed using stout pioneering stakes. Ideally, pioneering stakes are made of hardwood. The most common size of stake for the projects shown in this pamphlet is 2 to 3 inches in diameter and about 24 to 30 inches long. After cutting the stake to size, use an ax to shape a point on one end. Bevel the top of the stake to prevent it from mushrooming or splitting when the stake is driven into the ground. (For beveling or rounding the top of an anchor stake, a file might work better than an ax.) Do not use tent pegs as pioneering stakes—they are not long enough or strong enough to make a secure anchor.

Before using an ax, you must earn the Totin' Chip, which grants you the right to carry and use woods tools. Use an ax only in a safe location. See the *Boy Scout Handbook* for details.



Make a Mallet

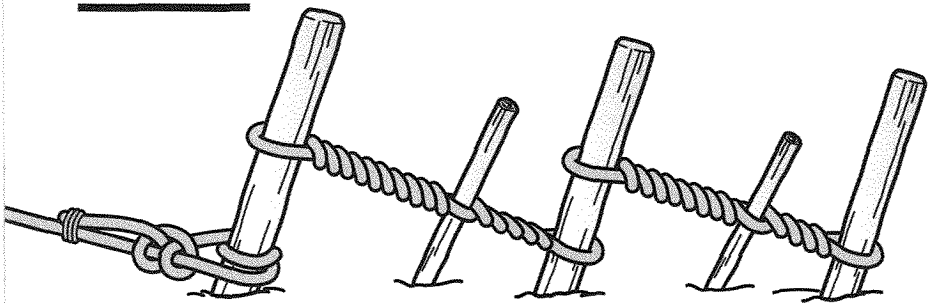
Using a sledgehammer to drive a stake into the ground might damage the stake. A better choice is a heavy wooden mallet. You can make your own. Form the head from an 11-inch length of hardwood about 4 inches in diameter. Drill a 1-inch-diameter hole through the head. Shape the mallet handle from a 24-inch length of hardwood; use a sharp knife to whittle one end of the handle to fit the hole in the mallet head. Saw a slot into the whittled end of the handle. Drive the handle all the way into the hole, then secure the handle in place with a wedge driven into the slot.



Depending on the load an anchor will bear and the stability of the soil, you can add stakes to the anchor in configurations such as 2-1-1 or 3-2-1.

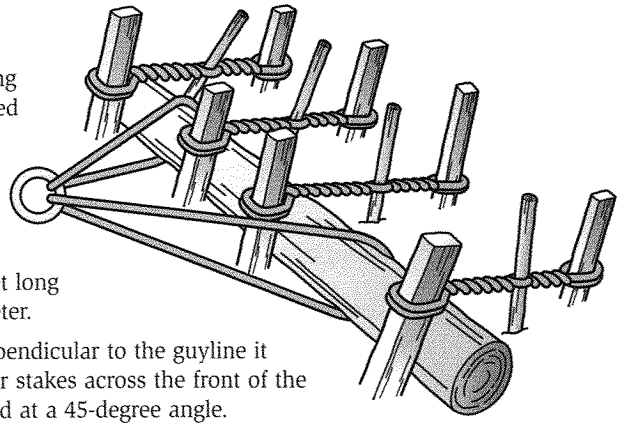
1-1-1 Anchor

The 1-1-1 anchor is made by driving three stakes in a row directly in line with the direction of the pull of an anchor rope or guyline. Secure a loop of rope between each pair of anchor stakes, then use a stick to twist the rope tight. Push the end of the stick into the ground to keep the rope from unwinding.



Log and Stake Anchoring System

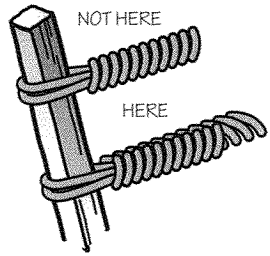
The log and stake anchoring system relies on a log staked to the ground. Discuss the anchoring needs with your merit badge counselor to determine how large the log needs to be—probably at least 5 feet long and 4 to 6 inches in diameter.



Step 1—Place the log perpendicular to the guyline it will anchor, then drive four stakes across the front of the log, leaning them backward at a 45-degree angle.

Step 2—Position a rope sling around the log. A carabiner (see the *Climbing* merit badge pamphlet) or steel ring secured to the sling will provide a point to tie the guyline.

Step 3—Drive another set of stakes 24 to 36 inches behind the first. Place a loop of rope between each pair of front and back stakes, then tighten by twisting the loop with a stick.

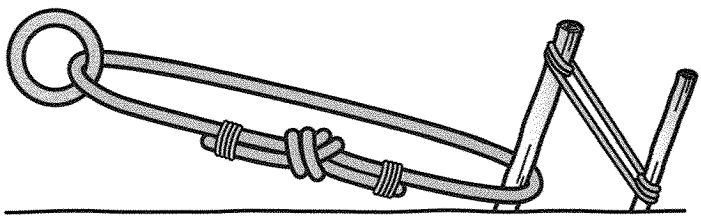


Place an anchor sling or guyline around the stake close to the ground. A line higher on the stake might have enough leverage to pull the stake loose.

The sling you use should be made of a larger-diameter rope than the guyline it will anchor to avoid creating a weak link in the anchoring system.

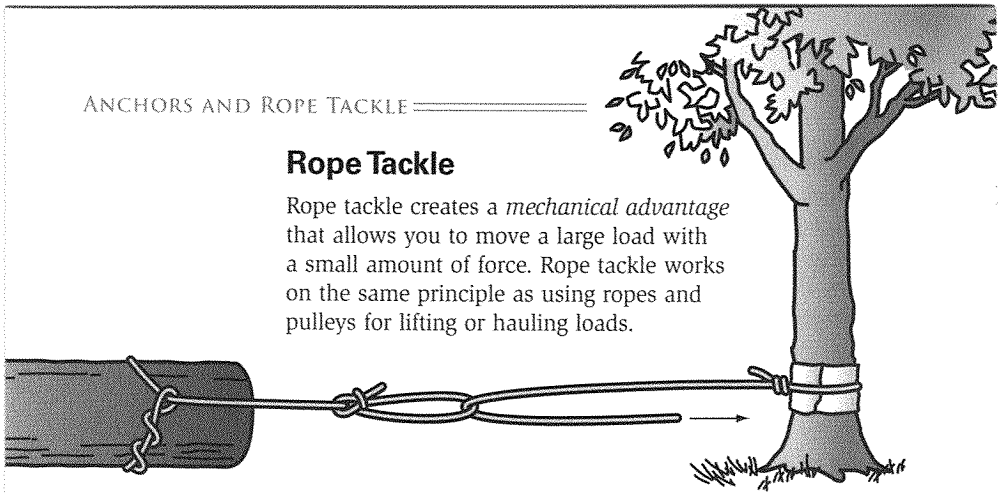
Rope Sling

A rope sling (also known as a grommet) is often used as part of an anchoring system. To make a sling from a 10-foot length of ½-inch manila or polypropylene rope, splice the ends together with a short splice, or tie them with a water knot or double fisherman's knot. (Use safety knots or lashings to secure the rope ends.)



Rope Tackle

Rope tackle creates a *mechanical advantage* that allows you to move a large load with a small amount of force. Rope tackle works on the same principle as using ropes and pulleys for lifting or hauling loads.



The principles of mechanical advantage can be demonstrated with rope tackle set up to move a log. The type of rope you choose for a rope tackle should have a low stretch factor, such as manila rope. Some synthetic ropes have a slick surface that helps reduce friction, but they might also stretch a lot, lessening the effectiveness of rope tackle.

Step 1—Tie one end of your rope to a tree or other secure anchor. To protect a tree against bark injury, place thick padding, wooden shims, or sticks between the rope and the tree trunk.

Step 2—Tie one end of a shorter rope around the log with a timber hitch (with an extra half hitch after the timber hitch). Form an eye in the other end of the short rope by making an eye splice or by tying a bowline or figure eight on a bight.

Step 3—Pass the running end of the long rope through the eye in the short rope. Pull the slack out of the long rope.

Also known as blocks, pulleys are metal or wooden shells holding wheels over which the rope, known as tackle, can run.

Step 4—Check that the anchor is secure, the timber hitch is well-tied, and the eye in the short rope is correctly formed.

Step 5—Move the log by pulling on the running end of the long line. The mechanical advantage of the system is 2:1; for every 2 feet of rope you pull through the system, the log will move 1 foot. The effort required to move the log is only half what it would be to pull the log with a rope that was not formed into tackle.

Have everyone not involved in moving the log stand well clear of the rope tackle. To reduce friction on the ropes and thus increase the mechanical advantage, snap a carabiner into the loop on the short rope and pass the running end of the long rope through that.

Trucker's Hitch

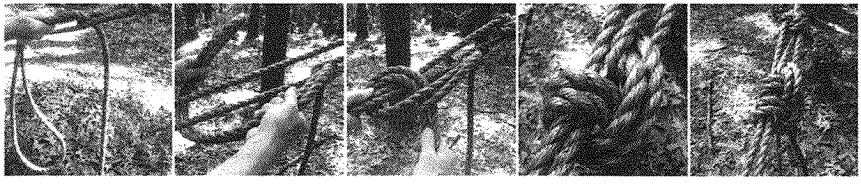
A useful form of rope tackle is the trucker's hitch. Use it to put tension on lines stretched between two trees, to lift a weight, to tie down and secure your equipment on a trailer or truck, and to tighten guylines.

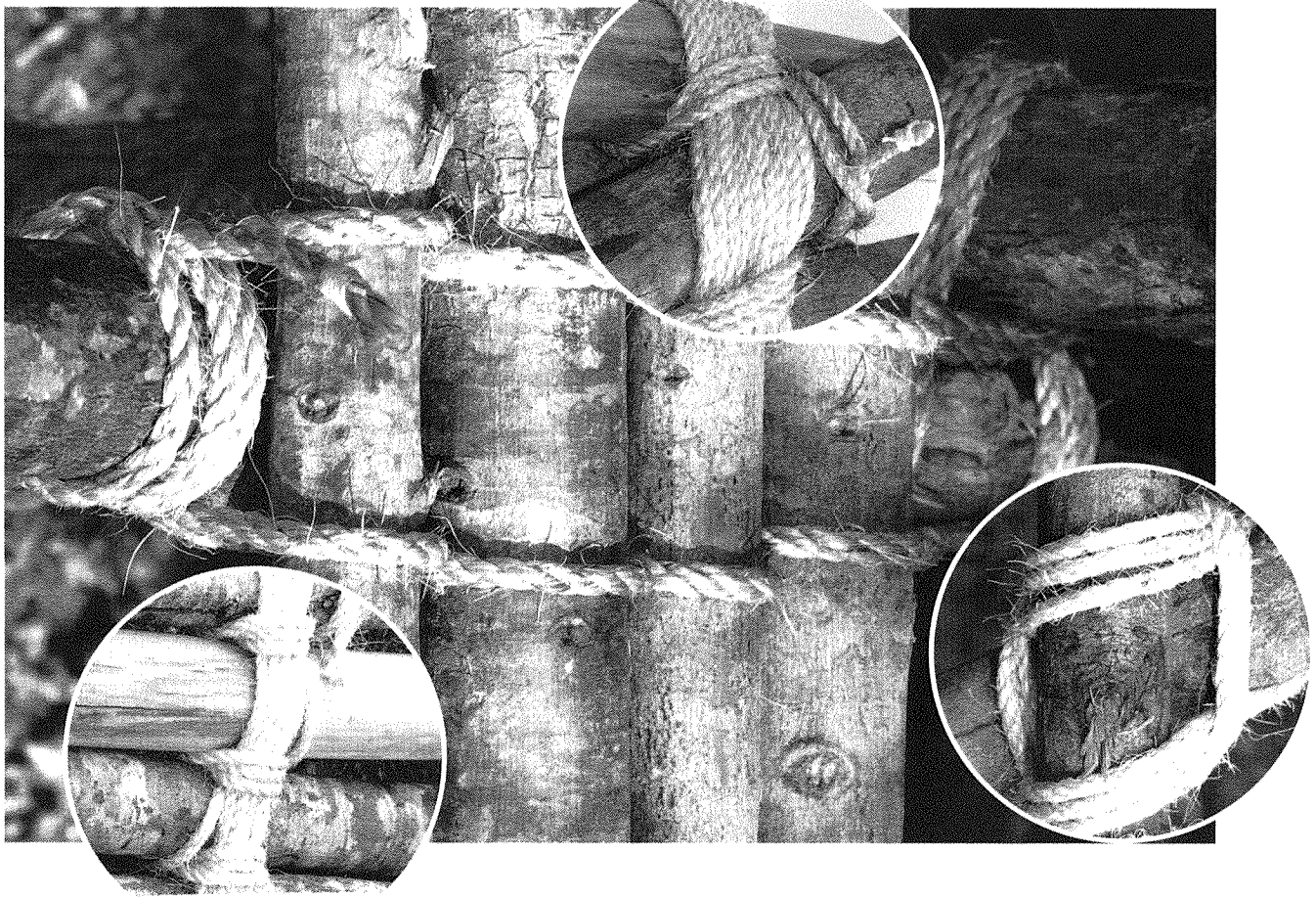
The mechanical advantage created by rope tackle can double the strain placed on a rope. It also can concentrate the tension on loops and knots. Rope moving through a loop causes friction that can generate heat and added strain. Over-loading and heat from friction can damage rope fibers and reduce the efficiency and safety of rope tackle.

Stay within safe working limits by using rope tackle only for loads that can easily be managed with the kind and diameter of rope available. While tackle is in use, keep an eye on all knots and anchors to ensure that they remain secure. Ropes used to make the tackle should be inspected regularly for damaged fibers.

To complete this hitch, first tie one end of the rope to a fixed object. About midway along the rope, tie a slippery half hitch to form a loop in the middle of the line. Next, make a wrap around another fixed point opposite the tie-in point and feed the free end through the loop. Using the loop as a pulley, pull down with the free end as tight as possible and secure the knot with two half hitches around one or both lines.

To maintain the tension created by a rope tackle (securing the guylines used to stabilize a pioneering project, for example), form a bight in the hauling end of the rope and tie it off with a tight half hitch snugged up against the loop formed by the butterfly knot.





Lashings

Lashing is a way of using rope to securely join spars. Lashings, like knots, have been a part of human knowledge for thousands of years. In fact, the lashings formed today are practically identical to those made by Scouts since Scouting's earliest days.

Scouts who have earned First Class rank will be familiar with using square, shear, and diagonal lashings to join two or more poles or staves together.

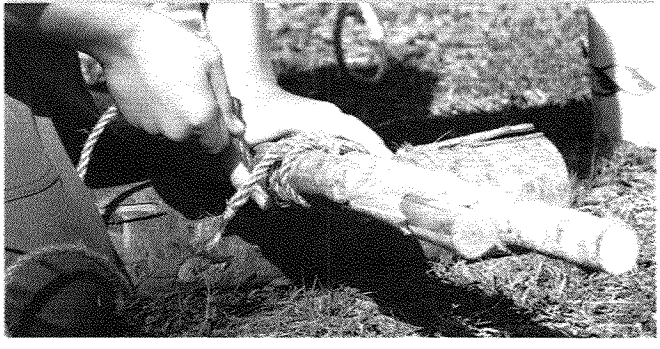
The Language of Lashings

The following terms will help you understand how to make lashings.

wrap. A wrap is a turn made *around* the two spars to hold the spars tightly together. Usually three wraps are made to form a square lashing. Other lashings might require more wraps.

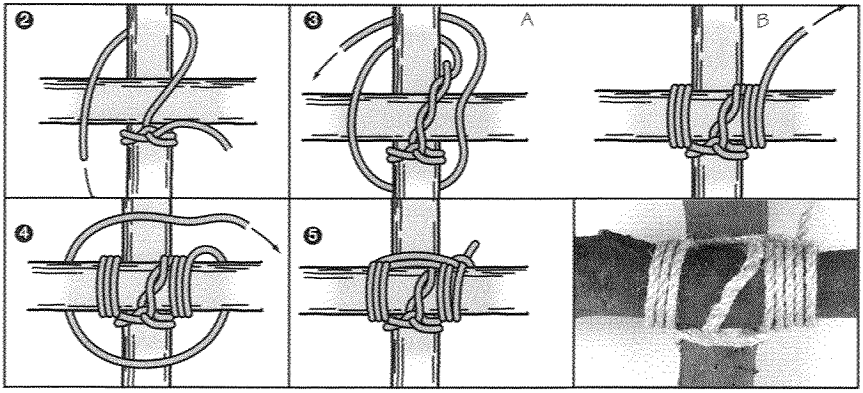
frap. A frap is a turn made *between* the spars. It goes around the wraps to pull the wraps tighter. Usually two frapping turns are made on a lashing.

spar. A spar is generally a large, heavy pole, usually made of wood. Spars are used as the structural members of pioneering projects.



Square Lashing

The most common and frequently used lashing is the *square lashing*, which gets its name from the wraps being "square" to the poles or spars. Square lashings bind spars that are in contact and cross each other at any angle from 45 degrees to 90 degrees.



Step 1—Place the spars in position.

Step 2—Tie a clove hitch around the bottom spar near the crosspiece.

Step 3—Make three tight *wraps* around both spars, securing the end of the clove hitch as you would a timber hitch. As you form the wraps, lay the rope on the *outside* of each previous turn around the top spar, and on the *inside* of each previous turn around the bottom spar.

Step 4—Make two *fraps* around the wraps, pulling the rope very tight.

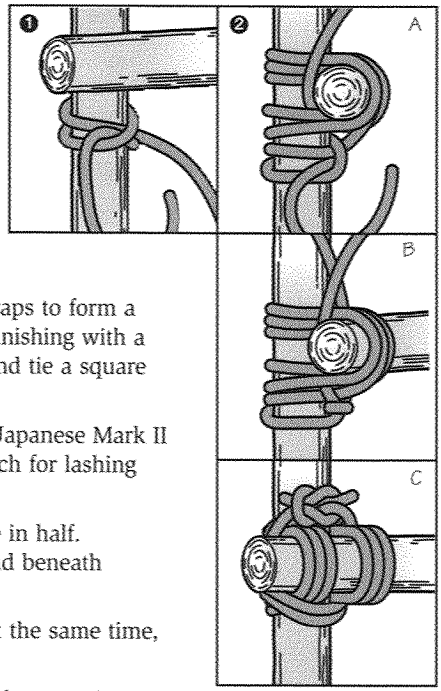
Step 5—Finish with a clove hitch around the top spar.

Rope for Lashing

In most cases, ¼-inch-diameter manila rope is fine for lashing together two spars when the combined diameter of both spars is 6 inches or less. When the combined diameter exceeds 6 inches, use rope that is ⅜ inch in diameter. To ensure the full strength of a lashing, use enough rope to make the required number of wraps and fraps. Dress the lashing after completing it by wrapping any extra rope around a spar and securing it with an additional clove hitch.

VARIATIONS OF THE SQUARE LASHING

Here are two variations on the basic square lashing.



Modified Square Lashing. Tying a clove hitch to complete a square lashing can be difficult. The modified square lashing eliminates the ending clove hitch.

Step 1—Begin with a clove hitch, but leave a tail of about 12 inches and let it hang free.

Step 2—Complete three wraps and two fraps to form a traditional square lashing, but instead of finishing with a clove hitch, bring up the tail of the rope and tie a square knot in the standing part of the rope.

Japanese Mark II Square Lashing. The Japanese Mark II square lashing is a straightforward approach for lashing two spars together.

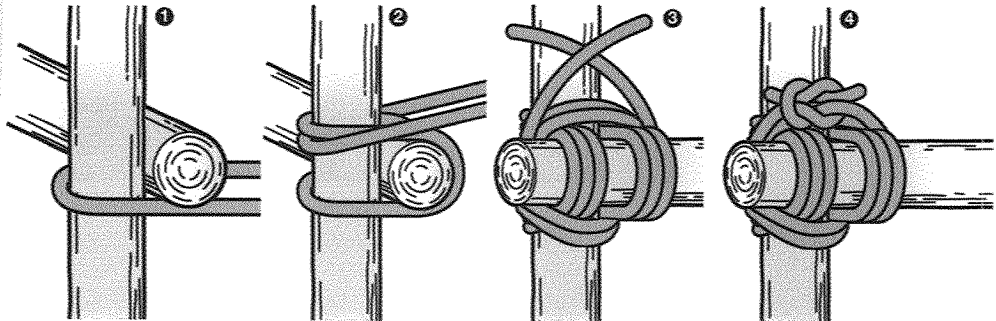
Step 1—Begin by folding the lashing rope in half. Place the bend around the vertical spar and beneath the horizontal spar.

Step 2—Working both ends of the rope at the same time, make three wraps around the spars.

Step 3—Bring the rope ends up between the spars in opposite directions to make the frapping turns around the wraps.

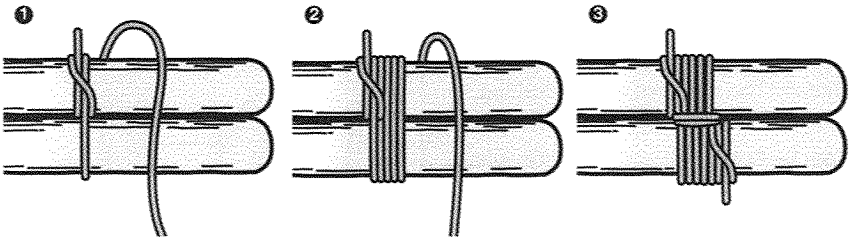
Step 4—Pull the frapping turns tight, and complete the lashing by tying the two ends with a square knot.

The advantage of this variation is that you work both ends of the rope at the same time. That can make forming the lashing quicker since each hand has less rope to pull through. This lashing has the same holding effect as both the traditional and modified square lashings.



Shear Lashing

Spars secured with a shear lashing can be raised as an A-frame.



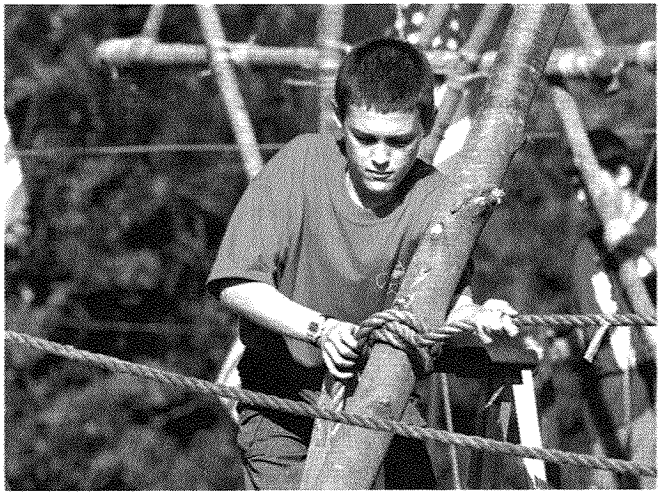
Step 1—Lay two spars side by side. Tie a clove hitch around one of them. Wrap the short end (the tail) around the running end to secure the clove hitch.

Step 2—Make five to 10 wrapping turns around both spars. The more wraps and the tighter the wraps, the stiffer the lashing will be.

Step 3—Take two tight frapping turns between the spars, around the wraps.

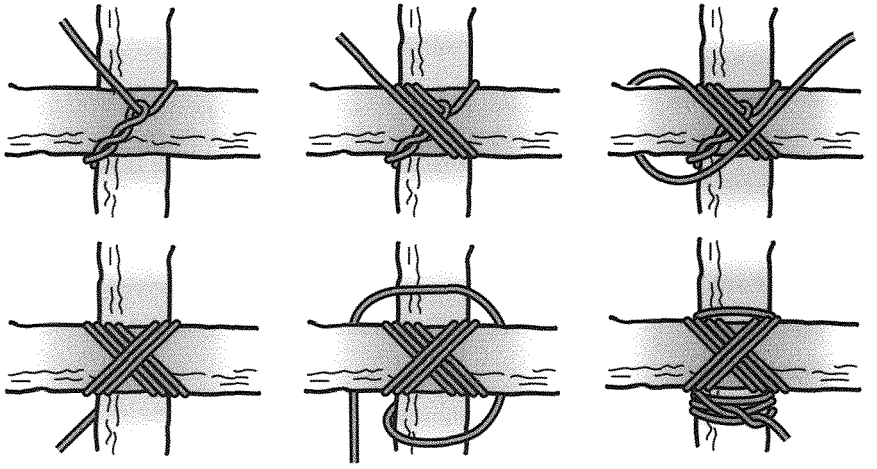
Step 4—Finish with a clove hitch on the opposite spar, being sure to lock the clove hitch tight against the wraps and fraps.

Step 5—Spread the ends of the spars (the legs) as needed.



Diagonal Lashing

The diagonal lashing gets its name from the fact that the wrapping turns cross the spars diagonally. A diagonal lashing is used to close a gap between two spars where they cross but do not touch.



Step 1—Tie a timber hitch around the spars where they cross. Pull it snug to bring the spars together.

Step 2—Make three wrapping turns on the opposite diagonal to the timber hitch. Keep the wraps parallel to one another and pull them tight.

Step 3—Make three more tight wraps across the first three (on the original diagonal), again keeping them parallel.

Step 4—Take two frapping turns between the spars, tightly around both sets of wraps.

Step 5—Complete the lashing with a clove hitch around one of the spars.

Round Lashing

Round lashings bind two spars side by side.

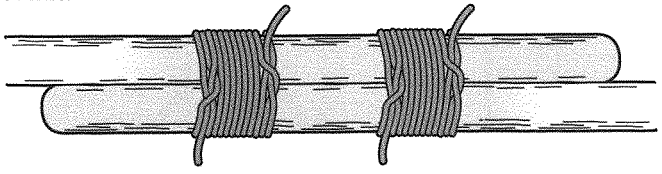
Step 1—Position the spars alongside each other and tie them together with a clove hitch.

Step 2—Make seven or eight very tight, neat wraps around the spars.

Step 3—Finish the lashing with another clove hitch around both spars.

A round lashing has no fraps. The wraps must do all the work, so pull them as tight as you can. Make a second round lashing farther along the spars to keep them from twisting out of line.

When very smooth synthetic rope or very smooth spars are used, the round lashing can be made more secure by adding several additional half hitches to each of the clove hitches.



Other Lashings

A few additional lashings will allow you to build special structures or put the finishing touches on a table, tower, or other project.

Tripod Lashing (With Plain Turns). The tripod lashing is used to join three poles together to form a tripod.

Step 1—Lay three poles alongside each other, making sure the bottom ends are lined up evenly.

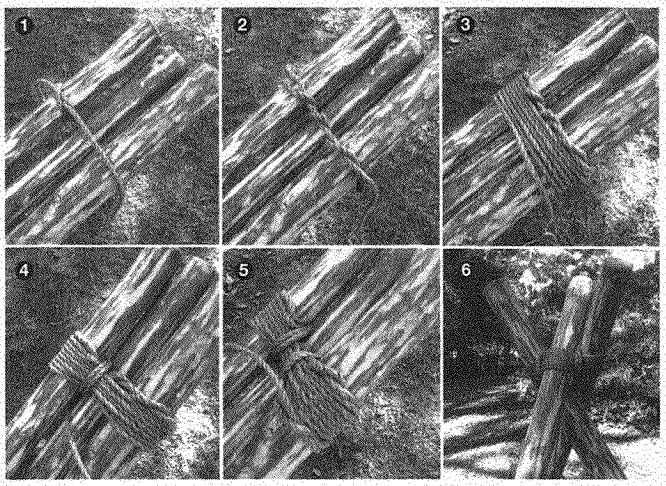
Step 2—Tie a clove hitch around one of the outside poles. Wrap the short tail around the long end of the rope.

Step 3—Wrap the rope around all three poles six to eight times, laying the turns of rope neatly alongside one another. (How stiff the tripod legs will be when they are separated depends on the number and the tightness of these wrapping turns.)

Step 4—Carry the end of the rope between the middle pole and the pole with the clove hitch, and take two tight frapping turns around the wraps. Then pull the rope straight across the center pole (not diagonally over the wraps), and take another two tight frapping turns around the wraps between the middle pole and the other outside pole.

Step 5—End with a clove hitch around the outside pole, being sure to snug the clove hitch tight against the wraps and the fraps.

Step 6—Stand the tripod up and spread the legs into position. crossing the outside legs under the middle pole.



Floor Lashing. The floor lashing will secure the top of a table, the deck of a raft, the floor of a signal tower, or the walkway of a bridge.

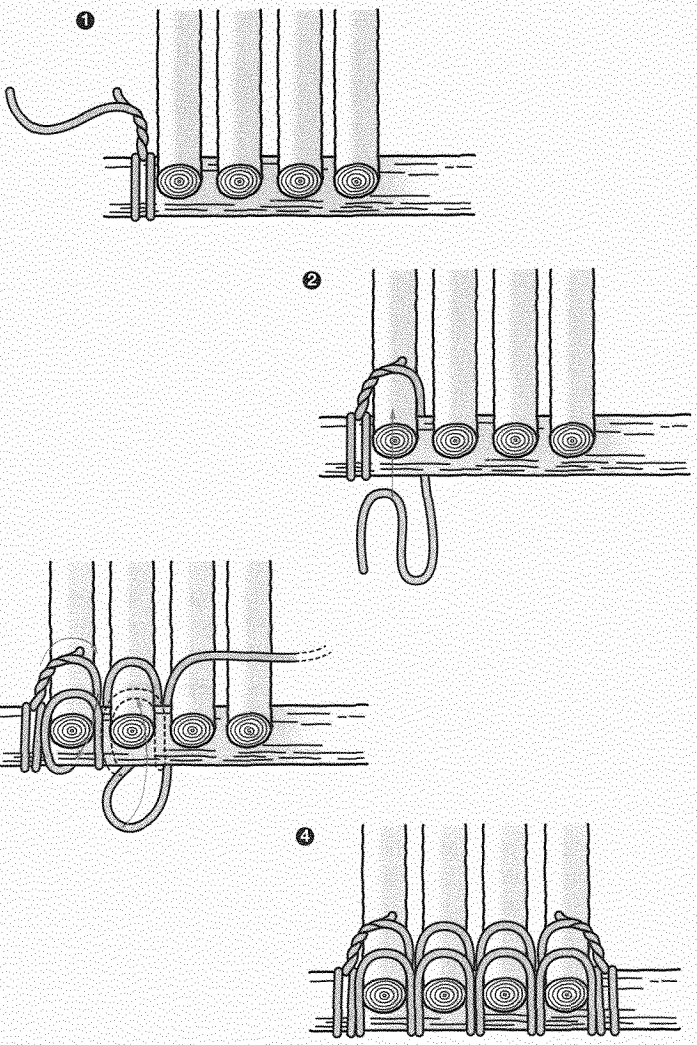
Step 1—Lay the floor spars side by side on top of the *stringers*—the logs or poles on which your platform will rest. Tie a clove hitch around one stringer, wrapping the rope's short tail around the rope's long part.

Step 2—Starting on the *inside* of the stringer, bring the rope *over* the first floor spar. Form a bight in the standing part of the rope, pull the bight under the stringer, and cast the bight *over* the first floor spar on the *outside* of the stringer.

Step 3—Pull the rope tight, then place a new bight *over* the next floor spar on the inside, repeating step 2. Throughout the process, you are always working with a bight in the rope, passing it over the floor spar on the inside, pulling it under the stringer, looping the bight around the floor spar on the outside, and pulling it tight as you go. The long end of the rope always remains on the inside of the stringer. Continue until all the floor spars are tightly bound to the stringer.

Step 4—After attaching the last floor spar, finish the lashing with a clove hitch around the stringer. Lock the clove hitch tightly against the last floor spar.

Step 5—Repeat the procedure to lash the other ends of the floor spars to the other stringer.

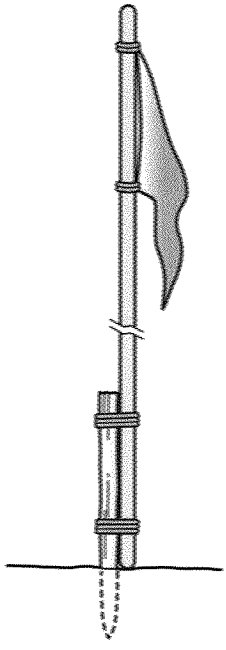


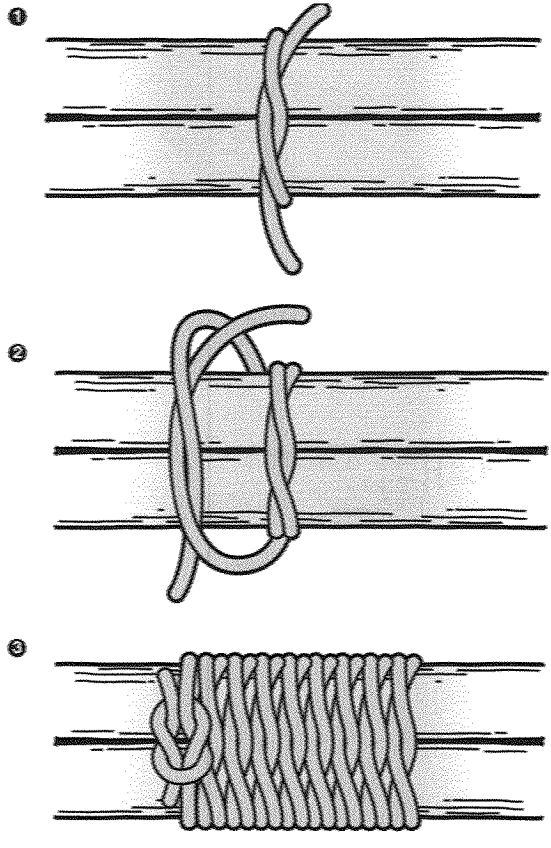
West Country Shear Lashing. Use this lashing in pairs to hold together two spars. The steps for forming it are similar to those for a West Country whipping. The primary difference is that the whipping is used to prevent a rope end from unraveling, while the lashing is used to hold spars together.

Step 1—Lay the spars side by side. Tie the midpoint of the lashing rope around the spars with an overhand knot.

Step 2—Take the two ends of the lashing rope behind the spars and tie another overhand knot.

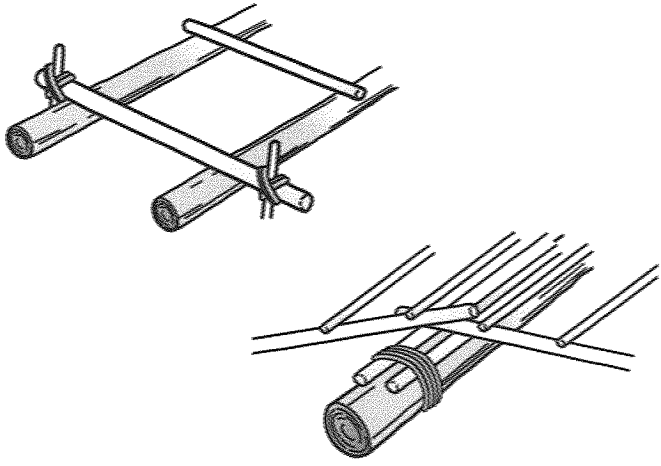
Step 3—Continue to tie overhand knots, alternating them between the front and back of the spars, until the lashing has been formed.





Always tie each overhand knot the same way ("right over left" or "left over right") so the knots lie together neatly. Finish the West Country shear lashing with a tight square knot.

Strop Lashing. When a quick job is desired with light spars, a simple strop lashing will often suffice. Find the middle of the length of binder twine or lashing rope and tightly wrap both ends simultaneously in opposite directions around the poles, finishing with a square knot.



Strop lashings can be used to secure a short stave to a stake, to join walkway sections to a rustic bridge, or to lash the ends of bridge walkways to stakes.

Lashing Together a Trestle

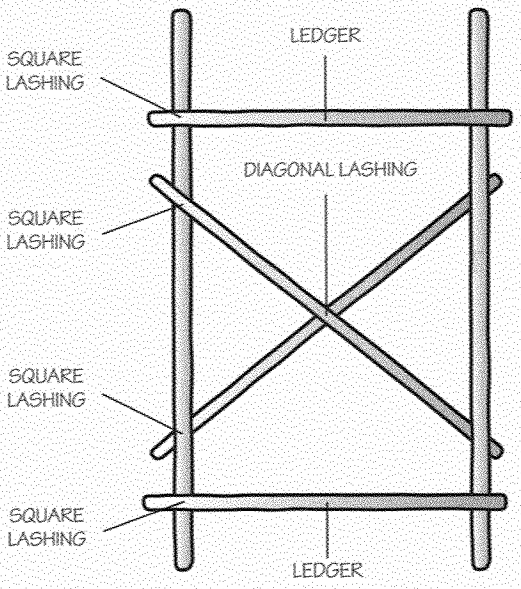
Trestles are used in many pioneering projects to provide support.

Step 1—Lay the two legs on the ground with the butt ends (the larger-diameter ends) of the spars at the same end and even with one another. Secure the horizontal ledgers in place with square lashings.

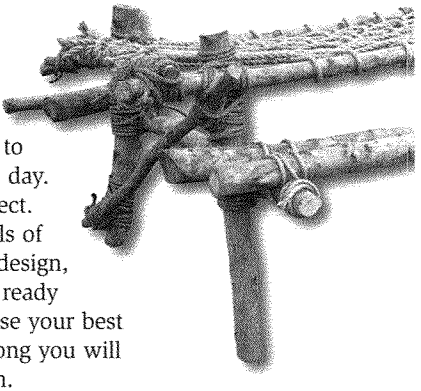
Step 2—Add the cross braces. The cross braces (spars usually 2 inches in diameter) are lashed to the legs in a particular sequence.

- Position one cross brace so that it is on the side of the spars opposite the ledgers. (It might help to flip the trestle over.) Lash the cross brace to the spars with square lashings.
- Position the second cross brace so that one end is on the same side of the spars as the ledgers, but the other end is on the opposite side. Lash the second cross brace to the spars with square lashings. There will be a slight gap between the cross braces where they cross one another.

Step 3—Stand the trestle up. Make sure the legs, ledgers, and cross braces are all properly positioned and secure. If everything looks good, use a diagonal lashing to pull together the two cross braces where they are closest to each other. That will add tremendous stability to the trestle and complete the structure. If adjustments must be made, lay the trestle down and get everything in order before making the diagonal lashing.



Pioneering Projects



Build a signal tower? You bet. Rig a monkey bridge to cross a stream? There is no better way to spend the day. Lash together a table for your patrol campsite? Perfect.

Project construction brings together all the skills of pioneering. You will need to make a plan, create a design, and develop a list of materials. When everything is ready and you have your counselor's approval, you can use your best skills for making lashings and tying knots. Before long you will have a structure that you'll be glad to call your own.

Pioneering Kit

A troop, a district, or a council camp might want to assemble a pioneering kit that contains the ropes and spars needed for a variety of pioneering projects. The materials in the kit can be used at Scouting events, reused and replaced as necessary, then neatly stored until the next time they are needed.

Rope can be purchased in spools of 600 feet or more. Manila rope ¼ inch in diameter is ideal for most pioneering projects. Cut the rope into lengths of 10, 15, 20, 30, and 50 feet. Whip the ends of each length to help prevent fraying or unraveling. For easy identification, color code the rope lengths by dipping the ends in paint of various colors.

Spars are available from various sources including lumberyards and farm supply stores. Sometimes they can be harvested during timber-thinning operations at Scout camps or on private tree farms. Remove the bark to limit damage from insects and to provide a good surface for securing lashings. As with ropes, spars can be painted on the ends to color-code their lengths.

Treat spars with care so they can be reused and will last a long time. When spars are not in use, store them in a dry, sheltered, and well-ventilated area. Keep the spars off the ground by stacking them on top of several perpendicular logs or timbers.

Steps in Building Your Pioneering Project

The pioneering basics—tying knots, making lashings, constructing anchors, and using rope tackle—can be learned and practiced at home and at troop meetings. The projects and structures shown in this pamphlet can usually be constructed with materials available at summer camp or at council camping events.

Step 1—Decide on the type of project you want to build. Consider the equipment, the number of people needed, and the time required to build it.

Step 2—Check the project site. Are there natural anchors (mature trees, large rocks) for securing guylines? If a bridge will cross a stream, how long must the span be, and how high? What safety issues and Leave No Trace considerations must be addressed before pioneering work can begin?

Step 3—Make a rough sketch of the project. Develop a list of materials that includes all the spars, ropes, and other items you will need.

Step 4—Gather the materials.

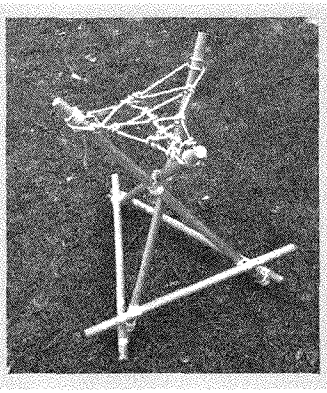
Step 5—Review the plans with your crew members and counselor. Perhaps the project can be built as several trestles that can then be lashed together. Several Scouts can be assigned to build each trestle or other subassembly of the project.

As you build, monitor the progress of the work to make sure everyone involved keeps safety in mind at all times.

Remember, whether you build a project with a group of Scouts or on your own, you will need your counselor's approval before you begin. Your counselor can help you create a rough sketch of the project and make a list of the materials you will need.

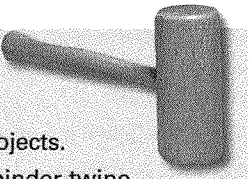
When you are ready to begin building, be sure you do so only under the supervision of a Pioneering merit badge counselor.

It is not necessary for your project to be picture perfect, but make it structurally sound. If one or two spars are a bit longer than required, that is fine as long as the lashings are in the proper location for strength and the diameter of the spars will carry the load.



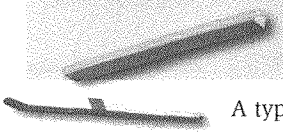
With your parent's permission and counselor's approval, search the internet for more pioneering projects, such as a camp stool.

Other Equipment

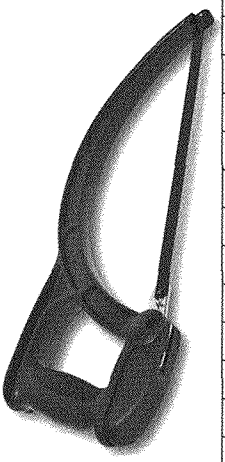


Besides spars and ropes, your pioneering kit should contain some basic equipment needed for building projects.

- 2 shovels
- 2 wooden mallets
- 1 hand ax
- 1 bow saw
- 4 spools of parachute cord
- 4 boxes of binder twine
- 10 wooden cleats and nails (for use with masthead knot)
- 50 anchor stakes
- Carabiners, steel rings, and/or screw pin shackles
- Tape measure



A typical pioneering kit contains the following spars:



Quantity	Butt Diameter	Length
50	2 to 2½ inches	2 feet
30	2 to 2½ inches	3 feet
20	2 to 2½ inches	3½ feet
15	2 inches	4 feet
10	3 inches	4 feet
10	2 to 2½ inches	6 feet
8	3 inches	6 feet
15	2½ inches	8 feet
10	3 inches	8 feet
10	2½ inches	10 feet
20	3½ inches	10 feet
8	4 inches	10 feet
10	3½ inches	12 feet
6	4 inches	12 feet
6	4 inches	14 feet
4	5 inches	14 feet
Rope for bridge handrails:		
8	1½ inches	12 feet

TOWERS

The four-by-four square climbing tower, the traditional signal tower, and the hourglass tower (pyramid tower) present interesting challenges. Each can be constructed as several trestles and then assembled and lifted into position.

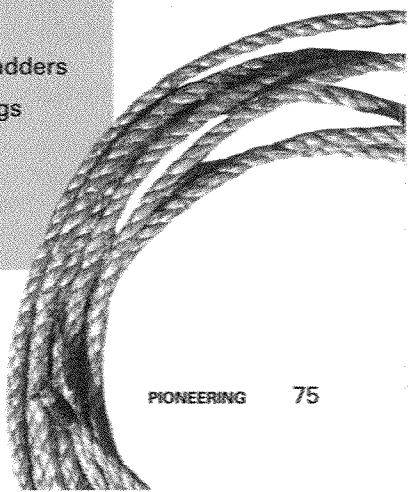
As stated in the *Guide to Safe Scouting,* completed pioneering projects related to requirement 10 cannot expose participants to a height greater than 6 feet off the ground. Your project must comply with these requirements as explained in the *Guide to Safe Scouting.*

FOUR-BY-FOUR SQUARE CLIMBING TOWER

This sturdy climbing tower sees plenty of action wherever it's built. Its a simple tower design, but very solid. It's formed by building two trestles with top handrails, and joining them together on each side with three spreaders and a diagonal support. A rope ladder is used to climb up to the platform.

Materials Needed

- 4 8-foot by 4-inch spars for the legs
- 12 4-foot by 3-inch spars for the spreaders
- 6 5-foot by 2-to-3-inch spars for the diagonal supports and X-braces
- 9 to 13 floor spars, 4-foot by 2-to-3-inch
- 4 2-foot by 2-inch ladder rungs
- 38 20-foot by ¼-inch lashing ropes
- 6 25-foot by ⅜-inch ropes for guy lines and ladders
- 2 35-foot by ¼-inch ropes for the floor lashings
- 8 pioneering stakes
- 4 sticks
- binder twine



Build the trestles:

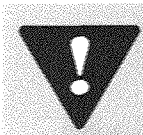
Step 1—For each of two trestles, lay two 8-foot spars next to one another on the ground, making sure the butt end of each is on the bottom.

Step 2—With tight square lashings, connect the legs about 3 inches from the bottom with a 4-foot spreader (ledger), and about 6 inches from the top with a 4-foot spreader (handrail).

Step 3—Select one of the stoutest 4-foot spreaders and lash it securely to the legs, so the underside of the spar is 5 feet from the bottom. This leg will serve as the trestle's transom and act as a platform support for the floor. Make sure the ends of all the 4-foot spreaders extend out from the legs about 4 inches on each side.

Step 4—To add the cross braces (X-braces), lay one end of one of the 5-foot spars on top of one 8-foot leg, about a foot up from the bottom, and place the other end underneath the other 8-foot leg, about a foot down from the 4-foot transom. Lash this 5-foot spar in place with square lashings.

Step 5—Now take a second 5-foot spar and cross it on top of the first to form an "X," then lash it in place. Where these cross braces intersect, string them together with a tight diagonal lashing.



All pioneering projects are temporary in nature. Towers, bridges, and other structures that have been lashed together must be dismantled when they are no longer being used. This is both a matter of safety and a part of BSA's Leave No Trace ethic.

Connect the trestles:

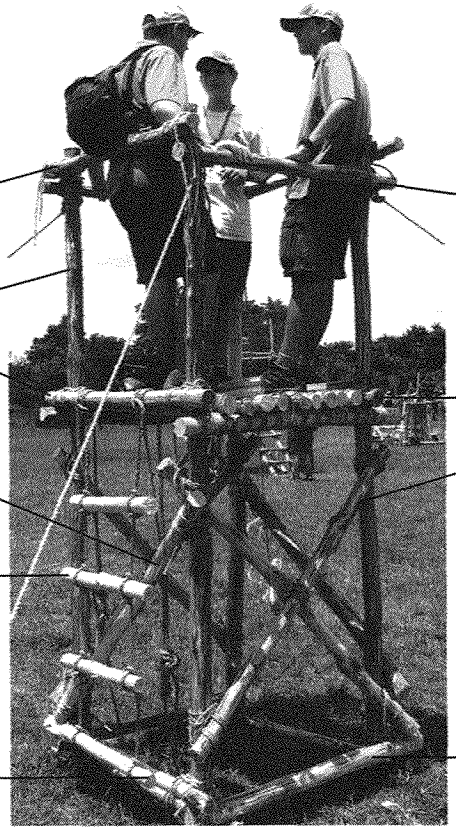
Step 6—When both trestles are complete, stand them up parallel to one another and join them together by lashing a 4-foot (bottom) spreader tightly on the inside of each trestle's 4-foot ledger.

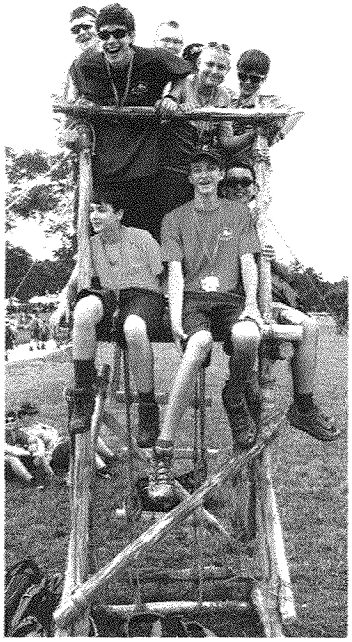
Step 7—Lash a 4-foot top spreader just over the handrails, and a 4-foot middle spreader just over each platform support (trestle transoms).

Step 8—Tightly lash on a 5-foot diagonal support from the bottom of one leg to just under the X-brace on the other leg.

Step 9—With all hands on deck, carefully flip over the tower and, in the same fashion, join the trestles on the other side. (When it comes time to lash on the 5-foot diagonal support on the other side, make sure the bottoms of the diagonals are lashed on opposite trestles.)

Step 10—When the trestles are connected on all four sides, with the whole crew pitching in, carefully stand up the tower and place it in position.





Anchor the tower:

Tie one end of a 25-foot rope to each 8-foot leg, 2 feet from the top, using a roundturn with two half hitches. Construct a 1-1 anchor, 12 feet out at 45 degrees from each corner. With rope tackles, secure the guy lines to the 1-1 anchors.

Lash on the floor:

Lay out the floor spars on top of the platform supports (trestle transoms). Then, using the 35-foot ropes, lash them securely in place with good floor lashings.

Build and attach the rope ladder:

Step 1—Make the rope ladder by tying marlin spike hitches to the four 2-foot ladder rungs using the two other 25-foot ropes. Refer to making a rope ladder. Start by tying one end of each rope to the middle spreader on the side of the tower where you want the ladder, using a clove hitch or a roundturn with two half hitches. Leave enough tail in the rope so that you can tie a bowline with a small loop in the end. Let this bowline dangle down 1 to 2 feet toward the ground.

Step 2—Space the rungs about 15 inches apart. When all the rungs have been added and are evened out on each side, carry the end of each rope under the 4-foot bottom spreader and thread them through the bowline's loop.

Step 3—Tighten each side of the ladder by pulling on the end of each side, using the bowlines' loops like rope tackles.

Step 4—Finish off with a couple of half hitches.

Test the tower:

Before opening the tower to general use, make a test climb while the safety officer and the whole crew observe all lashings and anchors to ensure they are secure.

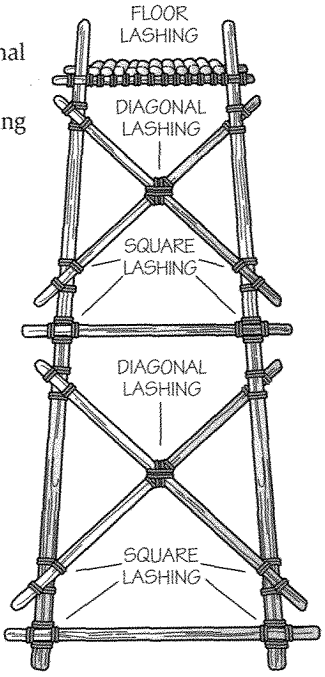
For more on anchors, see the "Anchors and Rope Tackle" chapter.

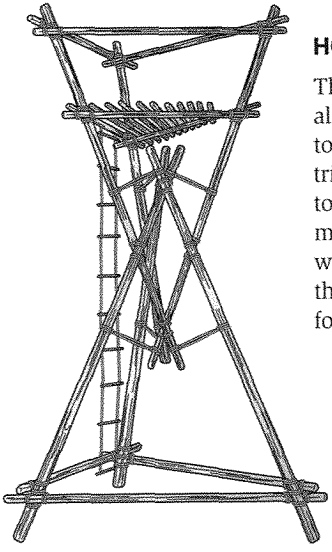
TRADITIONAL SIGNAL TOWER

The square base and narrowing top of a traditional signal tower is a highly stable design.

Construct the tower. Build two identical trestles, joining together the long spars (the tower legs) with three evenly spaced horizontal spars and two X-braces. Position the trestles on their sides, spaced apart and parallel to each other, and use horizontal spars and X-braces to join the trestles together into a four-sided structure. Lash the floor spars in place.

Raise the tower. Use guylines both for pulling the tower upright and for controlling its motion so that it does not go too far over. It may be necessary to dig in the butt ends of the vertical spars to keep them in place while the tower is being lifted.





HOURGLASS TOWER

The hourglass tower, also known as a pyramid tower, uses spars to form triangles that are then lashed together. Building a scale model of the pyramid tower will help you understand how the triangles fit together to form an hourglass shape.

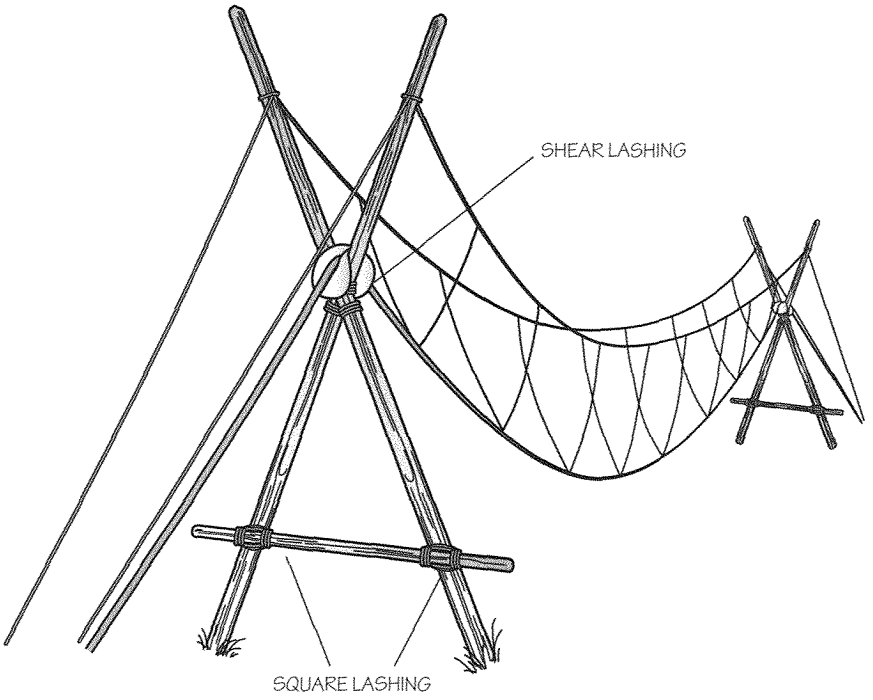
For stability, anchor all towers with guylines. When heeling in vertical spars, use a spade to cut out any grass, save the clump of turf, and replace it after dismantling and removing the pioneering project.

Bridges

Pioneering bridges can be constructed to cross small streams or gullies. Building a bridge for fun and for practice on flat, dry ground can be just as satisfying.

MONKEY BRIDGE

Solid bridges can be built with trestles and walkways. Rope bridges include the monkey bridge.

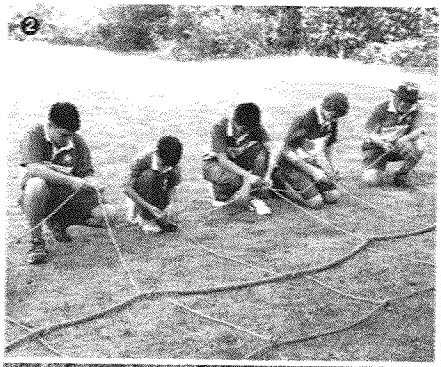


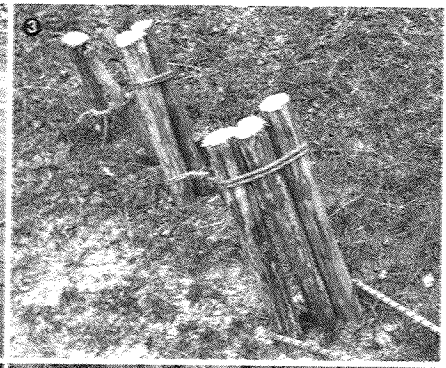
Using 50-foot hand and foot ropes, the maximum span for a bridge is 20 feet. The extra 30 feet of rope allows 15 feet at each end for the proper distance from the A-frames to the anchors (10 feet), and for making the knots at the anchors (5 feet).

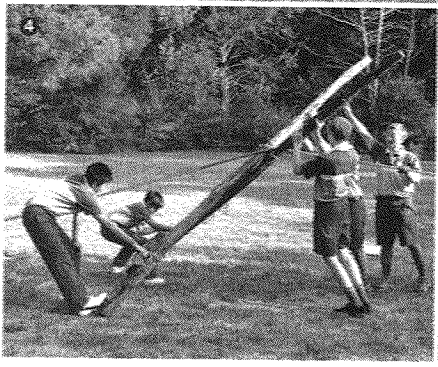
Materials Needed

- 4 8-foot spars, 4 inches diameter at the butt end
- 2 2-inch-by-4-foot crosspieces
- 1 ¾-inch- or 1-inch-diameter foot rope (length of span, plus 30 feet for anchoring)
- 2 ½-inch-diameter hand ropes (length of span, plus 30 feet for anchoring)
- ¼-inch-by-9-foot stringer ropes (divide the length of the bridge span by three to get the number of stringer ropes needed; for example, a 20-foot span will take seven stringer ropes)
- 4 guylines
- 16 stakes (six for each 3-2-1 anchor, four for guylines)
- 2 burlap pads
- 4 lengths of 18-foot rope (for trestle lashings)

Step 1—Begin building two identical A-frames by tightly securing two spars, 3 feet from the top, with a shear lashing. Spread the legs apart and place a 4-foot crosspiece on each A-frames, 2 feet from the butt ends of the long spars. Tightly secure the crosspiece to the spars using square lashings.







Step 2—Lay out the foot rope and the two hand ropes parallel to each other and about 4 feet apart. Tie a 9-foot-long stringer rope to one hand rope using a clove hitch. Make a roundturn with the stringer rope around the foot rope, then tie the running end to the other hand rope. Repeat with the other stringer ropes at 3-foot intervals along the hand and foot ropes.

Step 3—Make a 3-2-1 anchor at each end of the bridge. Drive the stakes in line with the bridge.

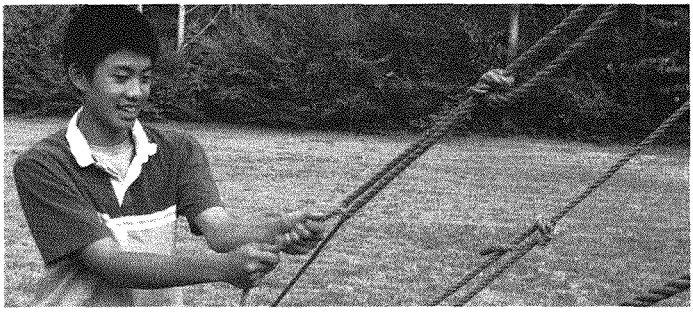
Step 4—Put the rope assembly in place and secure it temporarily to the anchors. Raise the A-frames straight up and into position, with the butt ends in shallow holes to help prevent shifting. Increase the stability of the A-frames by tying them to guylines and anchoring the lines at a 45-degree angle from the direction of the foot rope.

Step 5—Make a pad by folding over a piece of burlap. Place it above the shear lashing of one A-frame and position the foot rope on the pad. Do the same for the second A-frame.

Step 6—Retie each end of the foot rope to its anchor with a roundturn and two half hitches. Tighten the rope to lift the foot rope into position.

Step 7—Secure the hand ropes by forming clove hitches and tightening them to the tops of the A-frame legs. Anchor the running ends of the hand ropes to stakes driven into the ground in line with the hand ropes or attached to the 3-2-1 anchor also used to tie the foot rope. Using a rope tackle will let you adjust tension on the hand ropes. Tighten all the ropes as much as possible and check the knots and lashings to ensure that everything is in order.

Step 8—Tighten all the ropes as much as possible and check the knots and lashings to ensure that everything is in order.



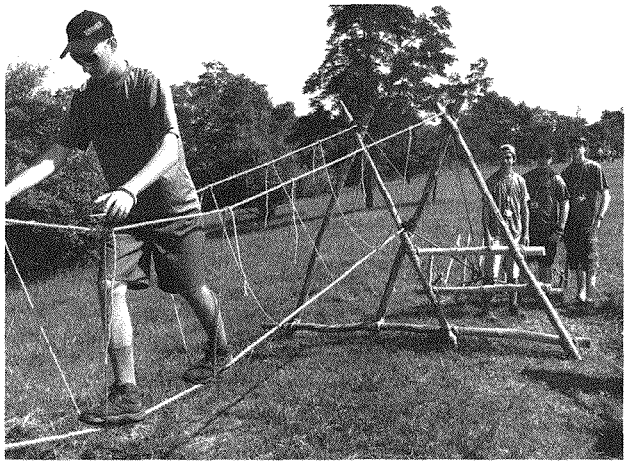
When constructing monkey bridges, observe these safety rules.

- Construct monkey bridges no higher than 5 feet above flat-surfaced ground and no longer than 25 feet.
- Check every rope, especially those carrying a load, each day before using.
- Station Scouts at each end to control access to the bridge. Allow only one person at a time on the bridge. Never allow unaccompanied children on the bridge.
- Shut down the bridge when any repairs are being made. Do not reopen the bridge until the adult leader has approved the repairs.

Any activity on monkey bridges, rope swings, slide-for-life, or similar devices that are located over water must comply with Safe Swim Defense. See the *Guide to Safe Scouting* for more information.

DOUBLE A-FRAME MONKEY BRIDGE

The double A-frame monkey bridge has two distinct advantages over the X-frame version. First, the double A-frame provides a wider base, making it less likely to tip over. The second advantage is that the positions of the A-frames can be adjusted. This allows you to narrow the span between the hand ropes for better balance as you make the crossing.



SINGLE-TRESTLE BRIDGE

This bridge uses only a single trestle and two walkways. Building the bridge requires lashing together several subassemblies: the trestle, the walkways, and the handrails.

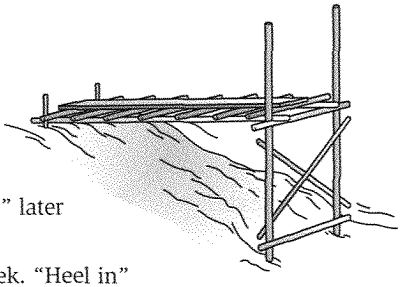
The spars for the walkways and trestle (as listed under "Materials Needed") will be long enough to span a creek or ravine up to 4 feet deep and 18 feet across. The legs for the trestle should be spars about 3 inches in diameter and 8 to 10 feet long. When choosing these spars, take into account the depth of the creek you are crossing. The distance from the base of the legs to the top ledger (transom) on the trestle should be about a foot higher than the level of the banks of the creek. This will allow the walkways to slant upward. For attaching the handrail, allow an additional 4 feet from the top ledger to the top of the legs.

See the "Lashings" section for detailed instructions on how to make a trestle. You will find instructions for making a walkway later in this chapter.

Make the top ledger of the trestle about 3 inches in diameter since it will carry the weight of the walkways and the person using it. The bottom ledger can be about 2 inches in diameter.

Materials Needed

- 2 3-inch-by-8-foot or -10-foot trestle legs
- 1 3-inch-by-4-foot trestle top ledger (transom)
- 1 2-inch-by-4-foot trestle bottom ledger
- 2 2-inch-by-6-foot cross braces
- 4 3-inch-by-10-foot walkway lateral spars
- 12 2-inch-by-3-foot walkway cross spars
- 4 2-inch-by-3½-foot walkway cross spars
- 2 2-inch-by-10-inch-by-10-foot walkway planks
- 4 1½-inch-by-12-foot handrails
- 4 stakes

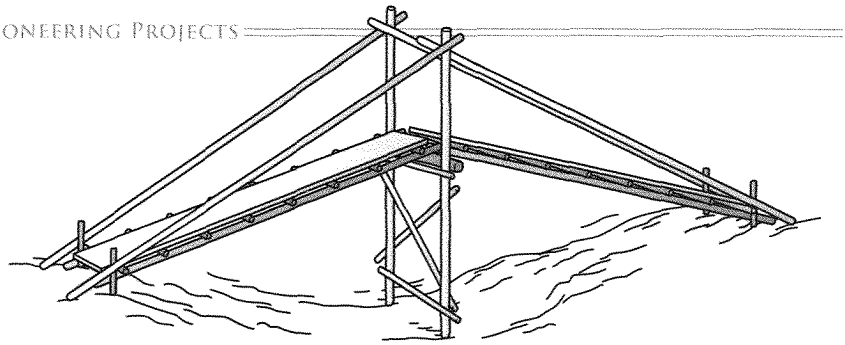


Step 1—Assemble the H-trestle with square lashings to hold the ledgers and the ends of the cross braces to the legs. Use a diagonal lashing to draw together and secure the center of the cross braces.

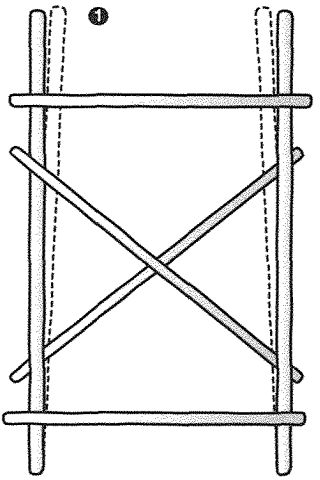
Step 2—Build two walkways. (See "Walkways" later in this chapter.)

Step 3—Set the trestle in the center of the creek. "Heel in" the bottoms of the trestle legs by setting them in holes approximately 4 to 6 inches deep. This will help prevent the trestle from shifting and will also help level the transom spar.

Step 4—Put the walkways in position from both sides and lash each walkway's underspars to the transom (top ledger) of the trestle. Then drive stakes at the other end of the walkways. Lash the ends of the cross spars on the walkways to the stakes.



Step 5—To strengthen the structure and as an aid in crossing the bridge, install handrails. The handrails form triangles with the walkway and the trestle leg, increasing the structure's stability. Use strop lashings to lash the handrails to the top of the trestle legs and to the stakes.



SINGLE-LOCK BRIDGE

The single-lock bridge consists of two H-trestles locked together.

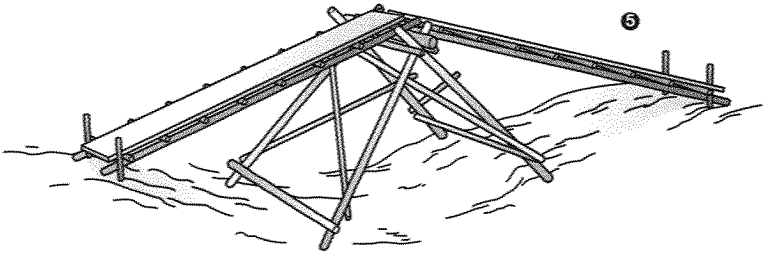
Step 1—Construct the two trestles, making sure that the legs of the second trestle are spaced at the top to fit between and "lock" into the legs of the first.

Step 2—Construct the two walkways. (See "Walkways" later in this chapter.)

Step 3—Place the trestles over the center of the creek so that the tops of the trestles are interlocked. Lay a 3-inch-diameter transom spar on top of the interlocked trestle legs.

Step 4—Stabilize the structure. Place the bases of the legs in holes 4 to 6 inches deep, leveling the transom spar so that the walkways won't tilt sideways.

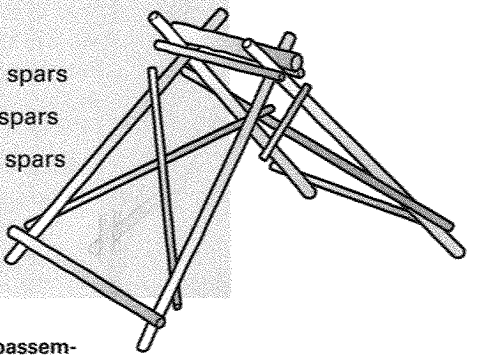
Step 5—Position the walkways. Use strop lashings to lash the underspars on the walkways to the transom spar and to lash the cross spars at the ends of the walkways to the stakes.



Materials Needed

The list of spars shown for this project should build a bridge to span a creek or ravine approximately 4 feet deep and 18 feet from bank to bank.

- 4 3-inch-by-6-foot trestle legs
- 4 2½-inch-by-4-foot trestle ledgers
- 1 3-inch-by-4-foot trestle transom
- 4 2-inch-by-6-foot cross braces
- 4 3-inch-by-10-foot walkway lateral spars
- 12 2-inch-by-3-foot walkway cross spars
- 4 2-inch-by-3½-foot walkway cross spars
- 2 2-inch-by-10-inch-by-10-foot walkway planks
- 4 stakes



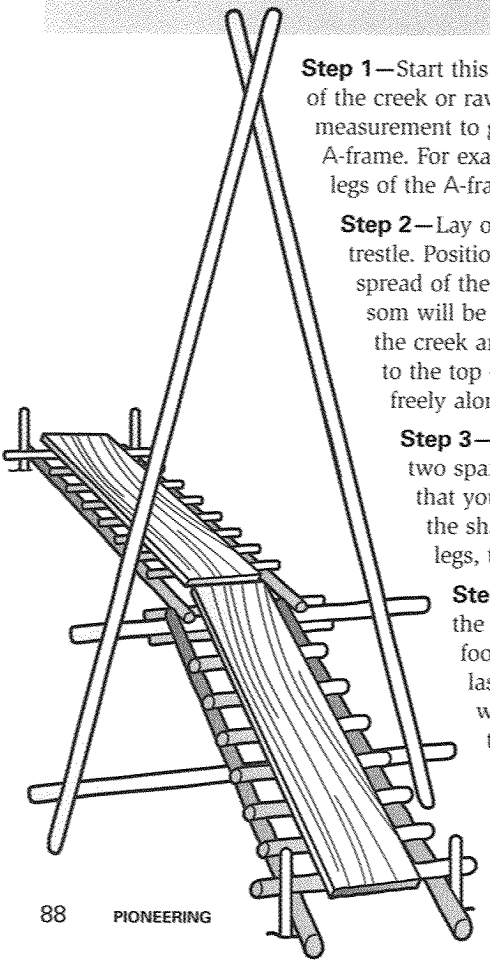
Begin by building the two H-trestles as subassemblies. Adjust the length of the spars for the trestles so that when they are placed in the creek, the tops of the ledgers will be about 1 foot above the level of the creek's banks. This will give a comfortable slant to the walkways.

SINGLE A-FRAME BRIDGE

The simple design of an A-frame bridge makes it a good choice when time and building materials are in short supply.

Materials Needed

- 2 3-inch-by-12-foot A-frame legs
- 1 2-inch-by-6-foot bottom ledger
- 1 3-inch-by-6-foot transom
- 4 3-inch-by-10-foot walkway lateral spars
- 12 2-inch-by-3-foot walkway cross spars
- 4 2-inch-by-3½-foot walkway cross spars
- 2 2-inch-by-10-inch-by-10-foot walkway planks
- 4 stakes



Step 1—Start this project by measuring the depth of the creek or ravine to be spanned. Add 8 feet to that measurement to get the total height of the legs for the A-frame. For example, to span a creek 4 feet deep, the legs of the A-frame should be 12 feet or longer.

Step 2—Lay out the spars and ledgers for the A-frame trestle. Position the transom (the top ledger) and the spread of the spars so that when completed, the transom will be about a foot higher than the banks of the creek and there will be room from the transom to the top of the A-frame for a person to pass freely along the walkways.

Step 3—Use a shear lashing to lash together the two spars. Make the lashing somewhat loose so that you can spread the spar legs apart to form the shape of an A. As you spread the spar legs, the shear lashing will tighten.

Step 4—Complete the A-frame by lashing the bottom ledger across the legs about a foot from the butt ends of the spars. Then lash the transom spar to support the walkways at the proper height in relation to the banks of the creek.

Step 5—Build two 10-foot walkways. (See "Walkways" later in this chapter.)

Step 6—Place the A-frame in the center of the creek and heel in the legs in holes about 4 to 6 inches deep. As the legs are being heeled in, level the transom.

Step 7—When the A-frame is upright, position the ends of the walkways on the transom and lash them in place with strop lashings. Lastly, use strop lashings to secure the cross spars at the ends of the walkways to stakes driven into the banks of the creek.

Step 8—To ensure that the A-frame won't tip over, use guylines extending from the top of the A-frame to anchors on each bank of the stream.

If you have no planking material, you can create a travel surface by adding enough cross spars to the basic walkway design to provide travelers with sure footing along the full width of the bridge.

Walkways

Many bridge designs have one or more trestles supporting a walkway. The walkway of a monkey bridge is a rope suspended between the trestles. For most other bridges, you build a solid walkway from spars.

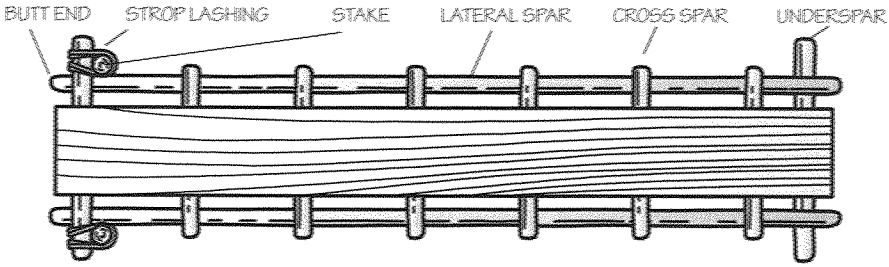
Three of the bridges shown in this pamphlet use walkways constructed from two lateral spars and several cross spars. Planks laid atop the walkways provide easy footing for travelers. In most cases, each bridge has at least two walkways.

Materials Needed

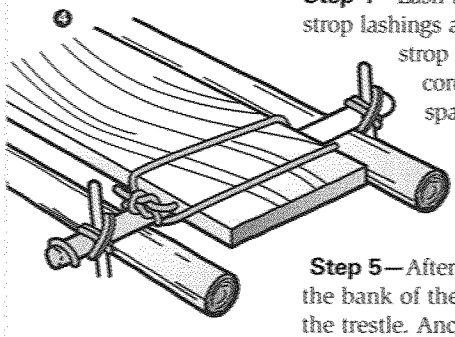
- 2 3½-inch-by-10-foot lateral spars
- 6 2½-inch-by-3-foot cross spars
- 2 2½-inch-by-3½-foot cross spars
- 1 2-inch-by-10-inch-by-10-foot walkway plank

Step 1—To make a 10-foot section of walkway, select two spars with a butt diameter of about 3½ inches. Be sure the spars sag equally under stress, when you stand on them with the ends supported above the ground. If one spar sags more than the other, it will cause the walkway to slant or twist sideways, making walking difficult.

Step 2—Place one of the longer (3½ feet) cross spars *on top* of the butt ends of the lateral spars and use a square lashing to secure it. Fit the other longer cross spar *beneath* the other end of the lateral spars and lash it where it will serve as the *underspar.*

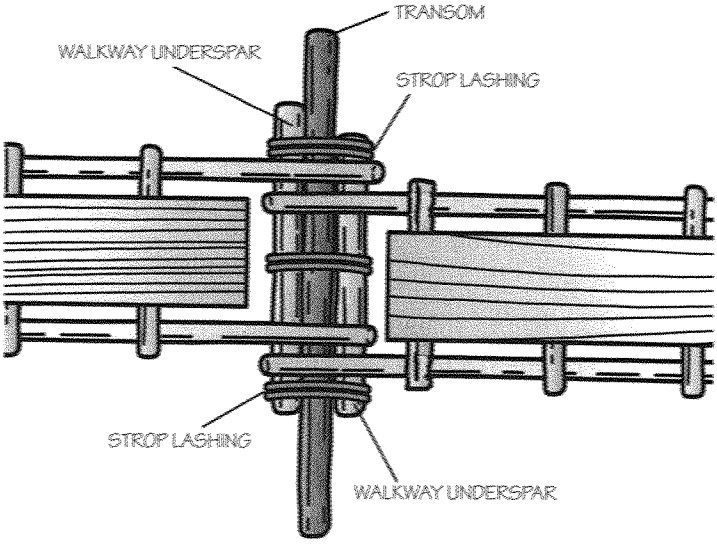


Step 3—Place the shorter (3-foot) cross spars on top of the lateral spars. Space them evenly between the ends of the walkway and use square lashings to attach them to the lateral spars. Since the lashings are intended only to hold the cross spars in position and not to support weight, you can make the lashings with either ¼-inch rope or parachute cord.



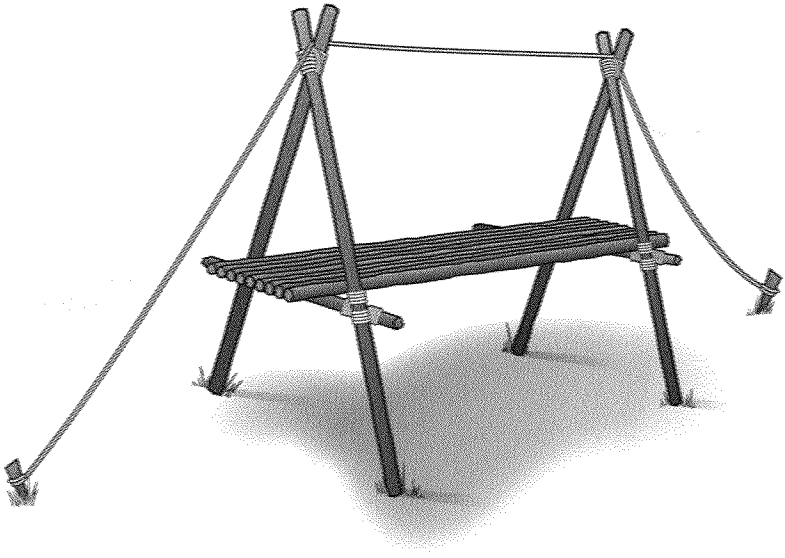
Step 4—Lash the plank for the walking surface in place using strop lashings around the plank and the cross spars. To make a strop lashing, tuck the end of a length of parachute cord or doubled-over binder twine under the cross spar and, pulling out the slack, even up the ends. Bring the ends over the plank and cross them under the cross spar. Wrap them back over the plank and around the cross spar several more times, finishing the lashing with a square knot.

Step 5—After assembling the walkway, place the butt end on the bank of the creek or ravine and position the other end on the trestle. Anchor the butt end by driving stakes next to the first cross spar and using strop lashings to secure the lateral spars to them. The other end of the walkway will rest on the transom spar of the trestle. Use strop lashings to fasten the underspar of each walkway section to the transom.



Camp Table

This camp table provides a convenient raised surface for personal, patrol, or general use. Its design is simple and functional, and it sets up quickly.



Materials Needed

4 strong sticks about 6 feet long for the A-frame legs

2 sticks (crosspieces) about 4 feet long to join the legs and support the tabletop

6 1/4-inch-by-10-foot lashing ropes

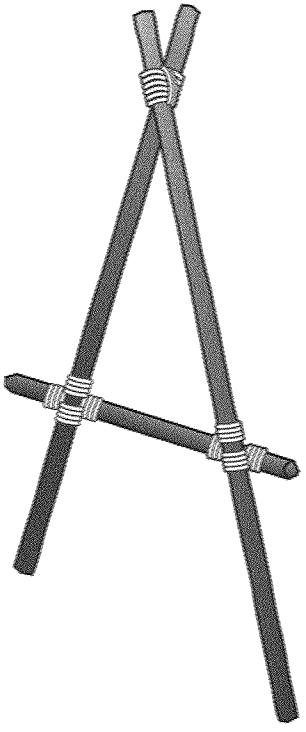
1 1/4-inch-by-20-foot rope to secure the table

2 strong stakes

1 mallet

Scout staves (12 work well) or similar 5-foot poles for the tabletop

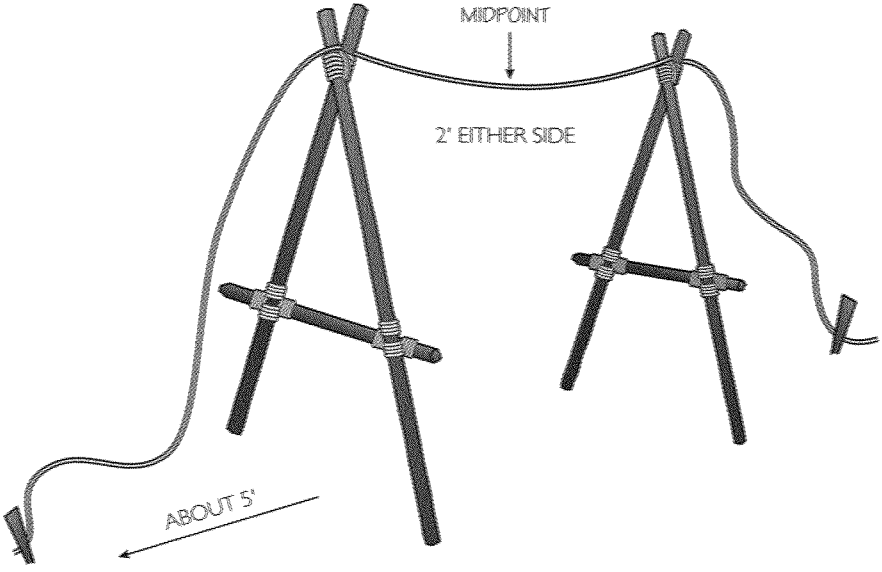
Binder twine

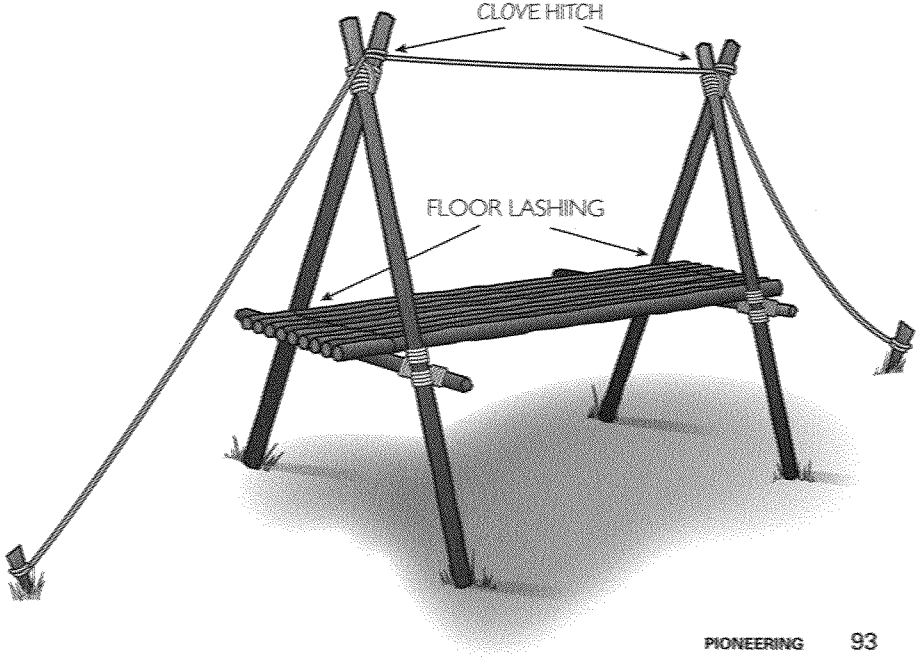


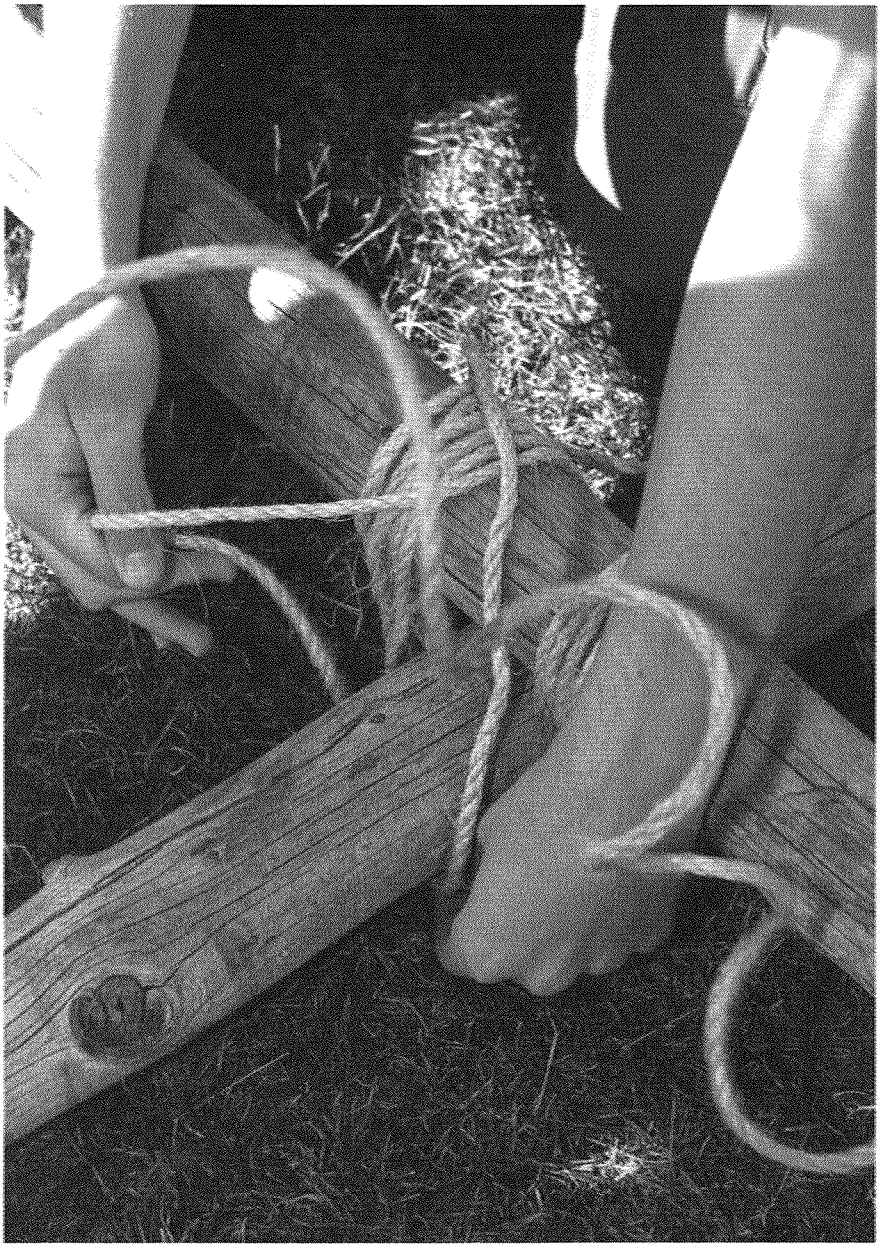
Step 1—Make the two A-frame Lash together the top of each pair of legs with a shear lashing, then lash on the 4-foot crosspiece with tight square lashings. Make sure each crosspiece is lashed on at the same place on each of the legs, about 2½ feet up from the bottom.

Step 2—Stand up the A-frames. Halve the 20-foot rope (that is, determine its midpoint). About 2 feet on either side of the middle of the rope, tie a clove hitch to the top of each A-frame. (The A-frames will thus stand about 4 feet apart.) Using a roundturn with two half hitches, attach each end of the rope to a stake hammered into the ground about 5 feet away from the A-frames.

Step 3—Lash on the tabletop. To make the top, lay the Scout staves or similar 5-foot poles on the crosspieces and attach them on each end with a floor lashing, using binder twine.


MIDPOINT
2' EITHER SIDE
ABOUT 5'


CLOVE HITCH
FLOOR LASHING



Pioneering Resources

Scouting Literature

Boy Scout Handbook; Guide to Safe Scouting; Deck of First Aid; Emergency First Aid pocket guide; *Wilderness First Aid Manual; Wilderness First Aid Field Guide; Knots* pocket guide; *Deck of Knots; Knots and How to Tie Them; Camping, Climbing, First Aid, Model Design and Building, Textile,* and *Woodwork* merit badge pamphlets

With your parent's permission, visit the Boy Scouts of America's official retail website, www.scoutshop.org, for a complete listing of all merit badge pamphlets and other helpful Scouting materials and supplies.

Books

Ashley, Clifford W. *The Ashley Book of Knots.* Doubleday, 1993.

Bigon, Mario, and Guido Regazzoni. *The Morrow Guide to Knots.* William Morrow, 1982.

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Toghill, Jeff. *Knots & Splices.* Sheridan House, 1998.

Toss, Brion. *The Complete Rigger's Apprentice: Tools and Techniques for Modern and Traditional Rigging.* International Marine/Ragged Mountain Press, 2016.

Online Resources

First Aid merit badge pamphlet, http://boyslife.org/merit-badges/first aid-merit-badge/

Guide to Safe Scouting, http://www.scouting.org/HealthandSafety/GSS.aspx

Acknowledgments

The Boy Scouts of America thanks Larry Green and Dr. James Roberts for their assistance in updating this pamphlet.

We are grateful to pioneering legend Adolph Peschke, West Des Moines, Iowa, for writing the 1993 edition of the *Pioneering* merit badge pamphlet. Mr. Peschke's son, Donald Peschke, also was instrumental in developing the 1993 edition. Many of the techniques shown in that edition have been adapted for subsequent printings.

Over the years, many Scouters and pioneering experts have assisted with revising the merit badge requirements, pamphlet text, and illustrations, and we are grateful for their input. Among these individuals have been Ken Hammond, Richard Jahn, Mike Kleckner, Ken Knowles, R. G. Kruger, Brian Nulle, Paul Oliphant, Clarence Olson, Bill Schrichte, Dan and Gretchen Walters, and Elaine Waraczynski.

The Boy Scouts of America is also grateful to the men and women serving on the National Merit Badge Subcommittee for the improvements and updates to this pamphlet.

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Christian Michaels—page 14

MERIT BADGE LIBRARY

Though intended as an aid to Boy Scouts, and qualified Venturers and Sea Scouts in meeting merit badge requirements, these pamphlets are of general interest and are made available by many schools and public libraries. The latest revision date of each pamphlet might not correspond with the copyright date shown below, because this list is corrected only once a year, in January. Any number of merit badge pamphlets may be revised throughout the year; others are simply reprinted until a revision becomes necessary.

If a Scout has already started working on a merit badge when a new edition for that pamphlet is introduced, *they may continue to use the same merit badge pamphlet to earn the badge and fulfill the requirements therein.* In other words, the Scout need not start over again with the new pamphlet and possibly revised requirements.

Merit Badge Pamphlet	Year
American Business	2013
American Cultures	2013
American Heritage	2013
American Labor	2018
Animal Science	2014
Animation	2015
Archaeology	2017
Archery	2015
Architecture and Landscape Architecture	2014
Art	2013
Astronomy	2016
Athletics	2016
Automotive Maintenance	2017
Aviation	2014
Backpacking	2016
Basketry	2017
Bird Study	2017
Bugling (see Music)	
Camping	2018
Canoeing	2014
Chemistry	2018
Chess	2016
Citizenship in the Community	2015
Citizenship in the Nation	2014
Citizenship in the World	2015
Climbing	2011
Coin Collecting	2017
Collections	2013
Communication	2013
Composite Materials	2012
Cooking	2014
Crime Prevention	2012
Cycling	2017
Dentistry	2016
Digital Technology	2014
Disabilities Awareness	2016
Dog Care	2016
Drafting	2013
Electricity	2013
Electronics	2014
Emergency Preparedness	2015
Energy	2014
Engineering	2016
Entrepreneurship	2013
Environmental Science	2015
Exploration	2016
Family Life	2016
Farm Mechanics	2017
Fingerprinting	2014
Fire Safety	2016
First Aid	2015
Fish and Wildlife Management	2014
Fishing	2013
Fly-Fishing	2014
Forestry	2015
Game Design	2013
Gardening	2013
Genealogy	2013
Geocaching	2016
Geology	2016
Golf	2012
Graphic Arts	2013
Hiking	2016
Home Repairs	2012
Horsemanship	2013
Indian Lore	2008
Insect Study	2018
Inventing	2016
Journalism	2017
Kayaking	2016
Landscape Architecture (see Architecture)	
Law	2011
Leatherwork	2017
Lifesaving	2017
Mammal Study	2014
Medicine	2012
Metalwork	2012
Mining in Society	2014
Model Design and Building	2010
Motorboating	2015
Moviemaking	2013
Music and Bugling	2013
Nature	2014
Nuclear Science	2017
Oceanography	2012
Orienteering	2016
Painting	2016
Personal Fitness	2016
Personal Management	2015
Pets	2013
Photography	2016
Pioneering	2017
Plant Science	2018
Plumbing	2012
Pottery	2008
Programming	2013
Public Health	2017
Public Speaking	2013
Pulp and Paper	2013
Radio	2017
Railroading	2015
Reading	2013
Reptile and Amphibian Study	2018
Rifle Shooting	2012
Robotics	2016
Rowing	2014
Safety	2016
Salesmanship	2013
Scholarship	2014
Scouting Heritage	2017
Scuba Diving	2009
Sculpture	2014
Search and Rescue	2018
Shotgun Shooting	2013
Signs, Signals, and Codes	2015
Skating	2015
Small-Boat Sailing	2016
Snow Sports	2017
Soil and Water Conservation	2016
Space Exploration	2016
Sports	2012
Stamp Collecting	2013
Surveying	2004
Sustainability	2013
Swimming	2014
Textile	2014
Theater	2014
Traffic Safety	2016
Truck Transportation	2013
Veterinary Medicine	2015
Water Sports	2015
Weather	2013
Welding	2016
Whitewater	2005
Wilderness Survival	2012
Wood Carving	2016
Woodwork	2011

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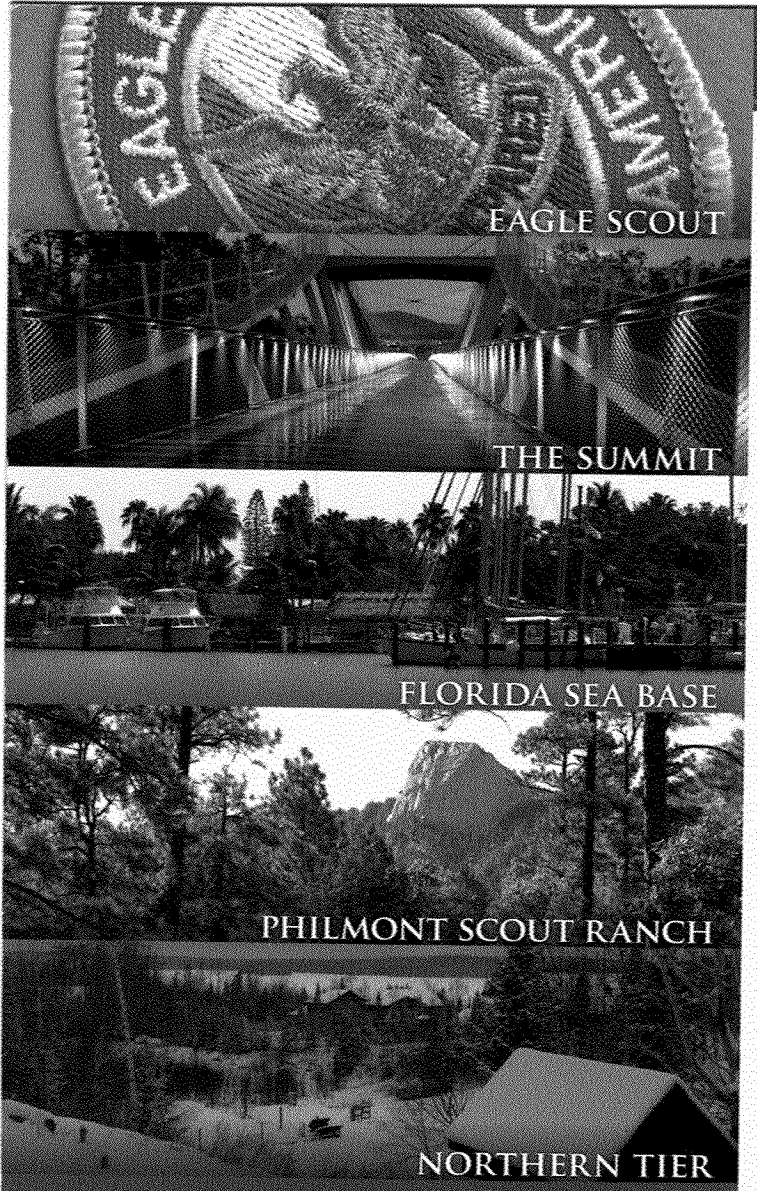

ON THE ROAD TO HIGH ADVENTURE

THE SUPPLY GROUP IS READY TO BE A PARTN ON YOUR TRAIL TO EAGLE THROUGH HIGI ADVENTURE. THE ADVENTURE IS YOURS AND WE ARE READY WITH THE GEAR YOU WILL NEED. YOU CAN DEPEND ON THE LATES IN LIGHTWEIGHT, DURABLE, QUALITY GEAR THAT WILL MEET AND SURPASS YOUR TOUGHEST REQUIREMENTS.

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