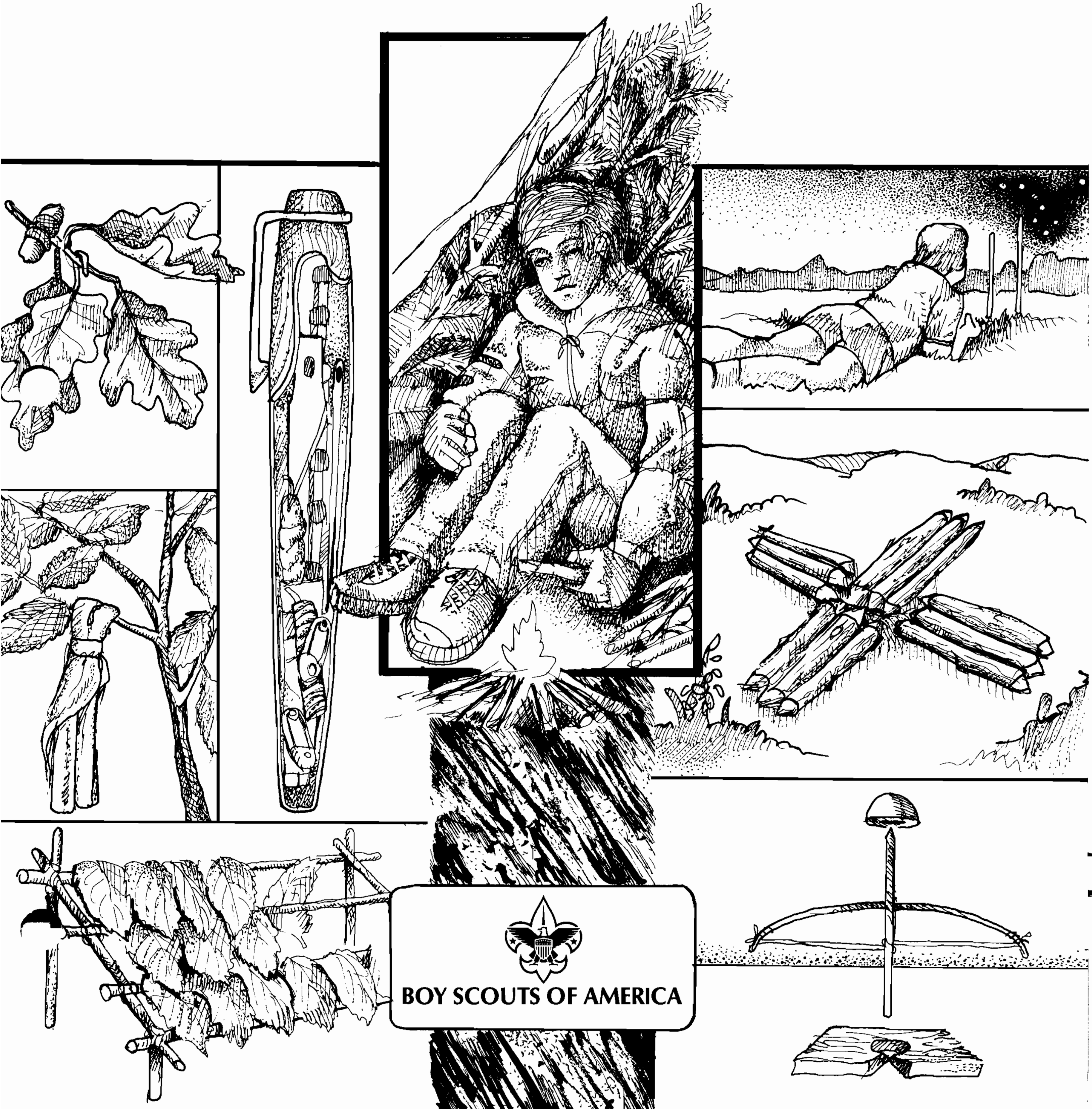
OUTDOOR SKILLS INSTRUCTION
SURVIVAL



Outdoor Skills Instruction
Survival

Boy Scouts of America

Introduction

This outdoor seminar is designed to assist leaders in organizing a quality outdoor experience for their troops. The techniques taught in this seminar are designed to provide the necessary knowledge to survive in emergency situations.

Site selection is very important to the success of this seminar. Some parts of the seminar will be conducted indoors. The majority of the seminar will be hands-on learning and should be done in an area where projects can be completed.

Material in this manual was taken from the *Survival Training* manual of the U.S. Air Force, published in July 1985.

Note to the user of this manual:

This manual is one in a series of skills manuals. Each manual may be used separately, or sessions may be mixed. Each manual covers a broad spectrum of topics. You will note that there are no time schedules listed. The training should be conducted according to the ability of the participants to complete the topics. These sessions may be conducted by any qualified Scouter. You are encouraged to recruit experts to assist in instructing. Use the outlines as guides to create a hands-on learning experience.

Outdoor Skills Instruction Manuals

Aquatics, No. 33026
Backpacking, No. 33035
Camping, No. 33003
Cooking, No. 33567
Rappelling/Rock Climbing, No. 33027
Survival, No. 33029
Team Building, No. 33004

Special note: Keep in mind that the goal of this outdoor skills instruction is to help instill in participants the self-confidence that will assist them in solving problems in life. They will learn how to work with the environment and to see how nature can help us live in better harmony with each other.

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SESSION 1
KNOWING WHAT TO DO

DECISION MAKING: INITIATIVE GAMES

One of the most important things to remember in any situation is keeping your senses and making the right decisions. Making the right decision takes practice. One way to get practice is to participate in initiative games. These activities help build teamwork and problem-solving skills. The games vary in length of time to complete. Depending on the size of your group, you should do at least two, preferably more.

Learning Objectives

As a result of this session participants should be able to make decisions.

A-Frame

Challenge

This problem requires six people. The object is to move the A-frame apparatus, with one person on board, from point A to point B (30 feet), using the five available 18-foot sling ropes.

Materials

The A-frame can be built from lashed saplings, or more uniformly from sections of 2″ × 3″ lumber, bolted together with three ⅜″ × 3½″ carriage bolts.

Rules

1. The A-frame must maintain at least one point of contact with the ground at all times, but never more than two points of contact.
2. Only the person on the A-frame may make body contact with the A-frame apparatus, and he or she must avoid contact with the ground.
3. The ropes may not touch the ground at any time during the passage over the restricted area.

4. No one can be closer than 5 feet to the A-frame while the frame is being moved. Tie a knot in the rope at 5 feet to help the crew maintain this distance.

Solution

One solution is to tie the five sling ropes to the apex of the A-frame, using a series of knots you feel comfortable with. Stand the frame vertically (two points of contact at the base) and ask one of the six participants to stand on the horizontal crossbar. As this individual rocks from side to side (each left/right rocking motion is coupled with a thrust forward) the other five participants support the A-frame with the sling ropes. There is little chance of the A-frame and the rider falling over if the rope holders remain alert.

The Diminishing Load Problem

Challenge

The object is to move all members of a group across an open field as quickly as possible; all but the last person must be carried across. The distance may vary according to the estimated strength of the group. The width of a football field will provide quite a physically challenging distance.

Rules

1. To be counted as having crossed the open area, a person must be carried.
2. The carrier must return and be carried across.
3. The only person allowed to walk or run across the open area (except when carrying a person or returning) is the last person.
4. If the person being carried touches the ground while being transported, both members must return to the start.
5. The number of people being carried and carrying others may vary with the strength and imagination of the group; one-to-one is not the only way.

Variations

The object can be to move the entire group across the distance in as few trips as possible (this changes the emphasis from speed to efficiency). To emphasize trust, require that everyone wear blindfolds. Have at least three people available to act as spotters.

Jelly Roll

Challenge

The object is to transport an entire group over a 20- to 25-foot area smeared with an imaginary poisonous jelly, the touching of which has dire consequences, using only the props provided. Physical success is measured by getting the whole group through the task, not just the most capable members.

Materials

Four "jelly-resistant" paper cores (large, durable, and surprisingly strong cardboard tubes). The cores measure about 24 inches long by 12 inches in diameter. These cores, which can be obtained inexpensively (usually free) from industrial paper manufacturers, provide the basis for a number of initiative games and problems. If you have trouble locating these handy props, substitute smooth-sided log sections of about the same dimensions. It's certainly more work to fashion the logs, but they will last a lot longer.

A stout pole measuring about 8 feet long, and a 30-foot rope. Both of these items are considered resistant to the jelly.

A 2″ × 10″ × 12′ board. This board should be unwarped and relatively free of knots. Rasp and sand the edges and corners of the board for safety reasons. The board is *not* considered resistant to the jelly.

Location

Do not set up this problem on a smooth gym floor. The paper cores will move too quickly and eventually someone will take a punishing fall. A wrestling mat or gymnastic floor exercise mat is okay for an attempt, but get permission from the coaches before you use their expensive mats.

Rules

1. The cores are jelly-resistant and may be freely rolled about.
2. The board will dissolve if any part of it touches the jelly, and the group either loses this prop or suffers some other unsavory consequence (your choice).
3. Two short lengths of rope delineate the area to be crossed.
4. The jelly substance extends indefinitely in a lateral direction within the measured area, so no one can walk around this obstacle.
5. If a participant touches the jelly (even slightly—this stuff is devastating) she or he must quickly return to the starting point and begin again.
6. Walking purposefully into the jelly in order to advance the group's effort is not allowed, and is obviously unhealthy.
7. Instructors, because of their specially imported jelly-resistant shoes, may cavort freely within the confines of whatever nasty substance your imagination placed there.

The Amazon

Challenge

Using a plank, a pole, a length of rope, and a stick, the group must retrieve a container placed in the "river" some distance from a simulated riverbank.

Materials

A ⅜-inch diameter multiline rope or sash line.

A pole at least 1½ inches in diameter. The pole does not have to be perfectly straight; a tree limb will suffice.

A plank that is at least 6 inches wide, 2 inches thick, and preferably of hardwood.

A reaching stick can be constructed of any available material.

The container can be a no. 10 can with a wire handle attached.

Rules

1. The crew members may use only the props and themselves.
2. Touching the ground (water) between the bank and the container is perilous; anyone who does so must go back to the bank and begin again.
3. Time penalties may be assigned every time the plank, the stick, or an individual touches the ground (water).

Log Cabin Push-up

This cooperative activity can be used as a simple four-person stunt, or you may continue to add people for a large group initiative problem.

Challenge

Four people lie prone in a square; each person's feet are on the lower back of another. On signal, everyone does a push-up. If done simultaneously, there will be four raised bodies with eight hands touching the ground: simple but impressive.

Setup

To set up the initial four-person attempt, ask for four volunteers who can do at least one push-up. Ask one person to lie facedown on the ground, as if preparing to do a push-up. The second person lies facedown at a right angle to the first person, so that the tops of his or her feet are on top of the first person's lower back. The third person repeats the procedure, using the second person as a footrest. The fourth person completes the square. All four should be facedown with their insteps on someone's back.

Foot pressure on the back might cause a problem: If one of the participants has trouble getting up, tell him or her that you will give a 1-2-go count, and that the "permanently prone" individual should attempt a push-up on the count of two, offering the advantage of a head start.

After your groups of four have had some fun with this push-up, ask the group to continue to add people to one of the quad arrangements in an attempt to include the whole group (from four to any number) in a mass log cabin push-up. There is more than one solution.

Discussion

This problem is time-consuming—not from the standpoint of discovering a workable solution, but because it takes a long time for a group to decide on a technique and implement it. This group attempt needs a leader.

Note: People who cannot do a push-up or who have back problems can be official photographers or officials for this "world's record attempt."

Bottoms Up

This one-on-one warm-up exercise combines strength, balance, and a very odd position. The group should pair off for this exercise.

Challenge

Sit on the ground facing your partner, and place the bottom of your feet against the bottom of your partner's feet. Legs should be bent, feet held high, and posteriors fairly close to one another. Then attempt to push against your partner's feet (while putting all of your weight on your arms), until both of your bottoms come off the ground. You will notice a tightening of the triceps muscles in your arms, considerable laughter, and not much movement on the first couple of tries.

If your bottom remains permanently welded to the ground, blame it on your partner and find someone more your size to blame the next time.

Summary

As you can readily see, the use of initiative games helps develop your decision-making skills. You can break the word survival down to the following definition:

S Size up the situation

U Undue haste makes waste

R Remember where you are

V Vanquish fear and panic

I Improvise

V Value living

A Act only after thinking

L Learn basic skills

USING A MAP AND COMPASS

Learning Objectives

As a result of this session participants should be able to determine their location and time of day and demonstrate map and compass techniques.

Resources

- Topographic maps of the area
- Compass for each participant

Introduction

Most of you have probably had some basic exposure to use of map and compass techniques. In this session we are going to learn more about how to use a map and compass, as well as learn techniques for finding directions without a map and compass.

Getting Started

For a map to be used, the map must correspond to the lay of the land and the user must have a knowledge of direction and how the map relates to the cardinal directions. For land navigation, the map must be "oriented" to the lay of the land. This is usually done with a compass. On most maps, either a declination diagram, compass rose, or lines of magnetic variations are provided to inform the user of the difference between magnetic north and true north.

Directions

Directions are usually expressed as right, left, straight ahead, etc., but the question arises, "To the right of what?" Military personnel use a method of expressing direction that is accurate, adaptable for use in any area of the world, and has a common unit of measure. Military directions are expressed as units of angular measure. The most commonly used unit of angular measure is the degree, with subdivisions of minutes and seconds.

Baselines

To measure anything, there must always be a starting point or zero measurement. To express a direction as a unit of angular measure, there must be a starting point or zero measure and a point of reference. These two points designate the baseline. There are three baselines: true north, magnetic north, and grid north. Those most commonly used are magnetic north (when working with a compass), and grid north (when working with a military map).

- **True north** is a line from any position on the Earth's surface to the North Pole. All lines of longitude are true north lines. True north is usually symbolized by a star (figure 1).
- **Magnetic north** is the direction to the north magnetic pole, as indicated by the north-seeking needle of a magnetic compass. Magnetic north is usually symbolized by a half arrowhead (figure 1).
- **Grid north** is the north established by the vertical grid lines on a map. Grid north may be symbolized by the letters GN or the letter Y.

Azimuth

The most common method used for expressing a direction is azimuths. An azimuth is defined as a horizontal angle, measured in a clockwise manner from a north baseline. When the azimuth between two points on a map is desired, the points are joined by a straight line and a protractor is used to measure the angle between north and the drawn line. This measured angle is the azimuth of the drawn line (figure 2). When using an azimuth, the point from which the azimuth originates is imagined to be the center of the azimuth circle (figure 3). Azimuths take their name from the baseline from which they are measured; true azimuths from true north, magnetic azimuths from magnetic north, and grid azimuths from grid north (figure 1). Therefore, any given direction can be expressed in three different ways: a grid azimuth if measured on a map, a magnetic azimuth if measured by a compass, or a true azimuth if measured from a meridian of longitude.

The Compass and Its Uses

The magnetic compass is the most commonly used and simplest instrument for measuring directions and angles in the field. The lensatic compass (figure 4) is the standard magnetic compass for military use today.

The lensatic compass must always be held level and firm when sighting on an object and reading an azimuth (figure 5). There are several techniques for holding the compass and sighting. One way is to align the sighting slot with the hairline on the front sight in the cover and the target. The azimuth can then be read by glancing down at the dial through the lens. This technique provides a reading precise enough to use.

Night Use of the Compass

For night use, special features of the compass include the luminous markings, the bezel ring, and two luminous sighting dots. Turning the bezel ring counterclockwise causes an increase in azimuth, while turning it clockwise causes a decrease. The bezel ring has a stop and spring mechanism that allows turns at 3-degree intervals per click and holds it at any desired position. One accepted method for determining compass directions at night is:

1. Rotate the bezel ring until the luminous line is over the black index line.
2. Hold the compass with one hand and rotate the bezel ring in a counterclockwise direction with the other hand to the number of clicks required. The number of clicks is determined by dividing the value

of the required azimuth by 3. For example, for an azimuth of 51 degrees, the bezel ring would be rotated 17 clicks counterclockwise (figure 6).

3. Turn the compass until the north arrow is directly under the luminous line on the bezel.
4. Hold the compass open and level in the palm of the left hand with the thumb along the side of the compass. In this manner, the compass can be held consistently in the same position. Position the compass approximately halfway between the chin and the belt, pointing to the direct front. (Practice in daylight will help in pointing the compass the same way every time.) Looking directly down into the compass, turn the body until the north arrow is under the luminous line. Then proceed forward in the direction of the luminous sighting dots (figure 4). When the compass is to be used in darkness, an initial azimuth should be set while light is still available. With this initial azimuth as a baseline, any other azimuth which is a multiple of 3 degrees can be established through use of the clicking feature of the bezel ring. The magnetic compass is a delicate instrument, especially the dial balance, and the user should take care. Compass readings should never be taken near visible masses of iron or electrical circuits.

Map Orientation

A map is oriented when it is in a horizontal position with its north and south corresponding to north and south on the ground. The best way to orient a map is with a compass. (*Note:* Caution should be used to ensure that nothing in the area will alter the compass reading, such as metal, mine ore, etc.)

Using the Lensatic Compass

With the map in a horizontal position, the lensatic compass is placed parallel to a north-south grid line with the cover side of the compass pointing toward the top of the map. This will place the black index line on the dial of the compass parallel to grid north. Since the needle on the compass points to magnetic north, a declination diagram is formed on the face of the compass by the index line and the compass needle.

Rotate the map and compass until the directions of the declination diagram formed by the black index line and compass needle match the directions shown on the declination diagram printed in the margin of the map. The map is then oriented (grid north).

If the magnetic north arrow on the map is to the left of grid north, the compass reading will equal the G-M angle given in the declination diagram. If the magnetic north is to the right of grid north, the compass reading will equal 360 degrees minus the G-M angle. In figure 7, the declination diagram illustrates a magnetic north to the right of grid north; the compass reading will be 360 degrees minus 21½ degrees, or 338½ degrees. Remember to point the compass north arrow in the same direction as the magnetic north arrow, and the compass reading (equal to the G-M angle or the 360 degree minus G-M angle) will be quite apparent.

In summary, if the variation is to the east of true north or the magnetic north arrow of the declination diagram is to the east (right) of the grid north line, subtract the degrees of variation from 360 degrees. If it is to the left (west), add to 000 degrees. "East is least and west is best."

If a grid line is not used, a true north-south line can be used. True north-south lines are longitudinal lines or lines formed by the vertical lines on a tick map (assuming the top of the map is north). The same procedure is used if magnetic variation is figured from true north—not grid north.

Using the Floating Needle Compass

A floating needle compass (figure 8) has a needle with a north direction marked on it. The degree and direction marks are stationary on the bottom inside of the compass. The button and wrist compasses may be floating dial or floating needle. To determine the heading, line up the north-seeking arrow over 360 degrees by rotating the compass. Then read the desired heading. Orienting a map with a floating needle compass is similar to the method used with the floating dial. The only exception is with the adjustment for magnetic variation. If magnetic variation is to the east, turn the map and the compass to the left (the north axis of the compass should be aligned with the map north) so that the magnetic north-seeking arrow is pointing at the degree number on the compass that corresponds with the angle of declination.

Orientation by Physical Features

When a compass is not available, map orientation requires a careful examination of the map and the ground to find linear features common to both, such as roads, railroads, fence lines, power lines, etc. By aligning the feature on the map with the same feature on the ground (figure 9), the map is oriented. Orientation by this method must be checked to prevent the reversal of directions that may occur if only one linear feature is used. This reversal may be prevented by aligning two or more map features (terrain or manmade). If no second linear feature is visible, but the map user's position is known, a prominent object may be used. With the prominent object and the user's position connected with a straight line on the map, the map is rotated until the line points toward the feature.

If two prominent objects are visible and plotted on the map and the position is not known, move to one of the plotted and known positions, place the straightedge or protractor on the line between the plotted positions, turn the protractor and the map until the other plotted and visible point is seen along the edge. The map is then oriented.

Determining Direction

Using the Sun and Stars

When a compass is not available and there are no recognizable, prominent landforms or other features, a map may be oriented by any of the expedient field methods we will now discuss.

Shadow-Tip Method

This simple method of determining direction and time by the sun consists of only three basic steps (figure 10).

- **Step 1.** Place a stick or branch into the ground at a fairly level spot where a distinct shadow will be cast. Mark the shadow tip with a stone, twig, or other means.
- **Step 2.** Wait until the shadow tip moves a few inches. If a 4-foot stick is being used, about 10 minutes should be sufficient. Mark the new position of the shadow tip in the same way as the first.
- **Step 3.** Draw a straight line through the two marks to obtain an approximate east-west line. If uncertain which direction is east and which is west, observe this simple rule: The sun rises in the east and sets in the west (but rarely *due* east and *due* west). The shadow tip moves in just the opposite direction. Therefore, the first shadow-tip mark is always in the west direction, and the second mark is always the east direction, anyplace on Earth.

A line drawn at right angles to the east-west line at any point is the approximate north-south line, which will help orient a person to any desired direction of travel. Inclining the stick to obtain a more convenient shadow does not impair the accuracy of the shadow-tip method. Therefore, a traveler on sloping ground or in highly vegetated terrain need not waste valuable time looking for a large level area. A flat spot, the size of the hand, is all that is necessary for shadow-tip markings, and the base of the stick can be either above, below, or to one side of it. Also, any stationary object (the end of a tree limb or the notch where branches are jointed) serves just as well as an implanted stick because only the shadow tip is marked.

The shadow-tip method can also be used to find the approximate time of day (figure 10B). To find the time of day, move the stick to the intersection of the east-west line and the north-south line, and set it vertically in the ground. The west part of the east-west line indicates the time is 0600 and the east part is 1800, *anywhere on Earth.* The north-south line now becomes the noon line. The shadow of the stick is an hour hand in the shadow clock; the time can be estimated using the noon line and 0600 (west) line as the guides. Depending on the location and the season, the shadow may move either clockwise or counterclockwise, but this does not alter the manner of reading the shadow clock.

The shadow clock is not a timepiece in the ordinary sense. It always reads 0600 at sunrise and 1800 at sunset. However, it does provide a satisfactory means of telling time in the absence of properly set watches. Being able to establish the time of day is important for such purposes as keeping a rendezvous, beginning a search for separated persons or groups, and estimating the remaining duration of daylight. Shadow-clock time is closest to conventional clock time at midday, but the spacing of the other hours, compared to conventional time, varies somewhat with the locality and date.

Note: The shadow-tip system is ineffective for use beyond 66½ degrees latitude in either hemisphere due to the position of the sun above the horizon. Whether the sun is north or south of you at midday depends on the latitude. North of 23.4 degrees N, the sun is always due south at local noon and the shadow points north. South of 23.4 degrees S, the sun is always due north at local noon and the shadow points south. In the tropics, the sun can be either north or south at noon, depending on the date and location, but the shadow progresses to the east regardless of the date.

Equal-Shadow Method

The equal-shadow method of determining direction (figure 11) is a variation of the shadow-tip method. It is more accurate and may be used at all latitudes less than 66 degrees at all times of the year.

- **Step 1.** Place a stick or branch into the ground vertically at a level spot where a shadow at least 12 inches long will be cast. Mark the shadow tip with a stone, twig, or other means. This must be done 5 to 10 minutes before noon (when the sun is at its highest point, or zenith).
- **Step 2.** Trace an arc, using the shadow as the radius and the base of the stick as the center. A piece of string, a shoelace, or a second stick may be used to do this.
- **Step 3.** As noon approaches, the shadow becomes shorter. After noon, the shadow lengthens until it crosses the arc. Mark the spot as soon as the shadow tip touches the arc a second time.
- **Step 4.** Draw a straight line through the two marks to obtain an east-west line.

Although this is the most accurate version of the shadow-tip method, it must be performed around noon. It requires the observer to watch the shadow and complete step 3 at the exact time the shadow tip touches the arc.

Using the Stars

At night, the stars can be used to determine the north line in the northern hemisphere or the south line in the southern hemisphere. Figure 12 shows how this is done.

Using a Watch

A watch can be used to determine the approximate true north or south (figure 13). In the northern hemisphere, the hour hand is pointed toward the sun. A south line can be found midway between the hour hand and 1200 standard time. During daylight savings time, the north-south line is midway between the hour hand and 1300. If there is any doubt as to which end of the line is north, remember that the sun is in the east before noon and in the west in the afternoon.

The watch may also be used to determine direction in the southern hemisphere; however, the method is different. The 1200-hour dial is pointed toward the sun, and halfway between 1200 and the hour hand will be a north line. During daylight savings time, the north line lies midway between the hour hand and 1300.

The watch method can be in error, especially in the extreme latitudes, and may cause "circling." To avoid this, make a shadow clock and set the watch to the time indicated. After traveling for a hour, take another shadow-clock reading.

Determining Specific Position

Using a Map and Compass

When using a map and compass, the map must be oriented using the method described earlier in this section. Next, locate two or three known positions on the ground and the map. Using the compass, shoot an azimuth to one of the known positions. Once the azimuth is determined, recheck the orientation of the map and plot the azimuth on the map. To plot the azimuth, place the front corner of the straightedge of the compass on the corresponding point on the map. Rotate the compass until the determined azimuth is directly beneath the stationary index line. Then draw a line along the straightedge of the compass and extend the line past the estimated position on the map. Repeat this procedure for the second point (figure 14A). If only two azimuths are used, the technique is referred to as *biangulation* (figure 14B). If a third azimuth is plotted to check the accuracy of the first two, the technique is called *triangulation* (figure 14C). When using three lines, a triangle of error may be formed. If the triangle is large, the work should be checked. However, if a small triangle is formed, the user should evaluate the terrain to determine the actual position. One azimuth may be used with a linear land feature such as a river, road, railroad, etc., to determine specific position.

Without a Compass

A true north-south line determined by the stick and shadow, sun and watch, or celestial constellation method may be used to orient the map without a compass. However, visible major land features can be used to orient the map to the lay of the land. Once the map is oriented, identify two or three landmarks and mark them on the map. Lay a straightedge on the map with the center of the straightedge at a known position (as a pivot point) and rotate the straightedge until the known position of the map is aligned with present position. Then draw a line. Repeat this for the second and third position. Each time a line of position is plotted, the map must still be aligned with true north and south. If three lines of position are plotted and form a small triangle, use terrain evaluation to determine the present position. If they form a large triangle, recheck calculations for errors.

Dead Reckoning

Dead reckoning is the process of locating your position by plotting the course and distance from the last known location. In areas for which maps exist, even poor ones, travel is simply a matter of knowing your position at all times by associating the map features with the ground features. Yet a great portion of the globe is unmapped, or only small-scale maps are available. You may be required to travel in these areas without a usable map. Although these areas could be anywhere, they are more likely to be found in frozen wastelands and deserts.

For many centuries, mariners used dead reckoning to navigate their ships when they were out of sight of land or during bad weather, and it is just as applicable to navigation on land. Movement on land must be carefully planned. In military movement, the starting location and destination are known. If a map is available, the starting point and destination are carefully plotted, along with any known intermediate features along the route. These intermediate features, if clearly recognizable on the ground, serve as checkpoints.

If a map is not available, the plotting is done on a blank sheet of paper. A scale is selected so the entire route will fit on one sheet. A north direction is clearly established. The starting point and destination are then plotted in relationship to each other. If the terrain and enemy situations permit, the ideal course is a straight line from starting point to destination. This is seldom possible or practical. The route of travel usually consists of several courses, with an azimuth established at the starting point for the first course to be followed. Distance measurement begins with the departure and continues through the first course until a change in direction is made. A new azimuth is established for the second course and the distance is measured until a second change of direction is made, and so on. Records of all data are kept and all positions are plotted.

Measuring Distance by Paces

A pace (for our purposes) is equal to the distance covered every time the same foot touches the ground. To measure distance, count the number of paces in a given course and convert to the map unit. Usually, paces are counted in hundreds, and hundreds can be kept track of in many ways: making notes in a record book; counting individual fingers; placing small objects such as pebbles into an empty pocket; tying knots in a string; or using a mechanical hand counter.

Distances measured this way are only approximate, but with practice they can become very accurate. It is important that each person who uses dead reckoning navigation establish the length of the average pace. This is done by pacing a measured course many times and computing the mean (figure 15). In the field, an average pace must often be adjusted because of the following conditions:

- **Slopes.** The pace lengthens on a downgrade and shortens on an upgrade.
- **Winds.** A head wind shortens the pace while a tail wind increases it.
- **Surfaces.** Sand, gravel, mud, and similar surface materials tend to shorten the pace.
- **Clothing.** Excess weight of clothing shortens the pace, while the type of shoes effects traction and therefore the pace length.

The course of travel may be plotted directly on the face of the map or on a separate piece of paper at the same scale as the map. If the latter method is chosen, the complete plot can be transferred to the map sheet, if at least one point of the plot is also shown on the map. The actual plotting can be done by protractor and scale. The degree of accuracy obtained depends upon the quality of draftsmanship, the environmental conditions, and the care taken in obtaining data while en route. Figure 16 illustrates a paper plot of data obtained from a log. It should be noted that four of the courses from A to H are short and have been plotted as a single course, equal to the sum of the four distances and using a mean azimuth of the four. This is recommended because it saves time without a loss of accuracy. If possible, a plot should be tied into at least one known intermediate point along the route. This is done by directing the route to pass near or over a point. If the plotted position of the intermediate point differs from its known location, discard the previous plot and start a new plot from the true location. The previous plot may be inspected to see if there is a detectable constant error applicable to future plots; otherwise it is of no further use.

Determining Longitude

To find the longitude from local apparent noon, you must know the correct time and the rate at which a watch gains or loses time. If this rate and the time the watch was last set are known, the correct time can be computed by adding or subtracting the gain or loss.

Step 1. Correct the time zone on the watch to Greenwich time; for example, if the watch is on eastern standard time, add 5 hours to get Greenwich time. Longitude can be determined by timing the moment a celestial body passes the meridian. The easiest body to use is the sun. Use one of the following methods:

- **Stick and Shadow.** Put up a stick or rod (figure 17) as nearly vertical as possible in a level place. Check the alignment of the stick by sighting along the line of a makeshift plumb bob. (To make a plumb bob, tie any heavy object to a string and let it hang free. The line of the string indicates the vertical.) Sometime before midday, begin marking the position of the end of the stick's shadow. Note the time for each mark. Continue marking until the shadow definitely lengthens. The time of the shortest shadow is the time when the sun passes the local meridian or local apparent noon. You will probably have to estimate the position of the shortest shadow by finding a line midway between two shadows of equal length, one before noon and one after. If the times of sunrise and sunset are accurately determined on a water horizon, local noon will be midway between these times.
- **Dumb Plumb Bob.** Erect two plumb bobs about 1 foot apart so that both strings line up on Polaris, much the same as a gun sight. Plumb bobs should be set up when Polaris is on the meridian and has no east-west correction. The next day, when the shadows of the two plumb bobs coincide, they will indicate local apparent noon.

Step 2. Compute the Greenwich time of local apparent noon. In this step you correct this observed time of meridian passage for the equation of time; that is, the number of minutes the real sun is ahead of or behind the *mean sun*. (The mean sun was invented by astronomers to simplify the problems of measuring time. It rolls along the equator at a constant rate of 15 degrees per hour. The real sun is not so considerate; it changes its angular rate of travel around the Earth with the seasons). Figure 18 gives the value of time in minutes to be added to or subtracted from mean (watch) time to get apparent (sun) time.

After computing the Greenwich time of local noon, the difference of longitude between your position and Greenwich can be found by converting the interval between 1200 Greenwich and the local noon from time to arc. Remember that 1 hour equals 15 degrees of longitude, 4 minutes equal 1 degree of longitude, 4 seconds equal 1 minute of longitude.

Example: Your watch is on eastern standard time, and it normally loses 30 seconds a day. It hasn't been set for 4 days. The local noon is timed at 15:08 on the watch on 4 February. Watch correction is 4 x 30 seconds, or plus 2 minutes. Zone time correction is plus 5 hours. Greenwich time is 15:08 plus 2 minutes plus 5 hours, or 20:10. The equation of time for 4 February is minus 14 minutes. Local noon is 20:10 minus 14 minutes of 19:56 Greenwich. The difference in time between Greenwich and present position is 19:56 minus 12:00 or 7:56. A time of 7:56 equals 119 degrees of longitude. Since local noon is later than Greenwich noon, you are west of Greenwich, and longitude is 119 degrees west.

Deciding to Stay or Travel

In any survival situation following an emergency, a decision must be made to either move or remain as close as possible to the site. In some areas, the decision to stay or travel is automatic. The best advice is to stay where you are. Most rescues have been made when people remained in one spot. You should only leave the area when you are certain of your location and know that water, shelter, food, and help can be reached; or after having waited several days, you are convinced that rescue is not coming and you are equipped to travel.

Before making any decision, consider your personal physical condition and the condition of others in the party when estimating their ability to sustain travel. If people are injured, try to get help. If travel for help is required, send the people who are in the best physical and mental condition. Send two people if possible. To travel alone is dangerous. Before any decision is made, consider all of the facts.

If the decision is to stay, consider these factors:

- Environmental conditions
- Health and body care; camp sanitation
- Rest and shelter
- Water supplies
- Food

If the decision is to travel, consider the following in addition to the primary survival problems of food, water, and shelter.

- Direction of travel and reason for it
- Travel plan
- Equipment required

Before departing the site, you should leave information at the site stating your departure time, destination, route of travel, personal condition, and available supplies.

Present location must be known to decide intelligently whether to wait for rescue or to determine a destination and route of travel. Try to locate your position by studying maps, landmarks, or celestial bodies. You should try to determine the nearest rescue point, the distance to it, the possible difficulties and hazards of travel, and the probable facilities and supplies en route and at the destination.

There are a number of other factors that should be considered when deciding to travel:

- The equipment and materials required for cross-country travel should be analyzed. Travel is extremely risky unless the necessities for survival are available. You should have sufficient water to reach the next probable water source indicated on a map or chart, and enough food to last until you can procure additional food. To leave shelter and travel in adverse weather conditions is foolhardy.
- In addition to the basic requirements, your physical condition must be considered in any decision to travel. If in good condition, you should be able to move an appreciable distance, but if not, or if you are injured, the ability to travel extended distances may be reduced. Analyze all injuries received during the emergency.
- If possible, you should avoid making any decision immediately after the emergency. You should wait a period of time to allow for recovery from the mental—if not the physical—shock resulting from the emergency. When shock has subsided you can then evaluate the situation, analyze the factors involved, and make valid decisions.

Travel

Once you decide to travel, there are several considerations that apply, regardless of the circumstances. Someone must assume leadership, if you are in a group, and the party must work as a team to ensure that all tasks are done in an equitable manner. The leader is responsible for ensuring that the talents of all people are used, particularly those with survival experience.

You should keep your body's energy output steady to reduce the effects of increased physical demands.

Maintain a realistic pace to save energy. It increases stamina and keeps body temperature stable because it reduces the practice of quick starts and lengthy rests. More importantly, a moderate, realistic pace is essential in high altitudes to avoid the risks of lapse of judgment and hallucinations due to lack of oxygen (hypoxia).

Travel speed should be geared to physical condition and daily needs, and the group pace should be governed by the pace of the slowest group member. Additionally, rhythmic breathing should be practiced to prevent headache, nausea, lack of appetite, and irritability. Rest stops should be short since it requires more energy to begin again after cooling off.

You should wear clothing in layers and make adjustments to provide for climate, temperature, and precipitation. It is better to start with extra clothing and stop and shed a layer when you begin to warm up. Wearing loose clothing provides for air circulation, allows body moisture to evaporate, and retains body heat. Loose clothing also allows freedom of movement.

You should keep in mind when planning travel time and distance that the larger the group, the slower the progress will be. Time must be added for those who must acclimate themselves to the climate, altitude, and the task of backpacking. You should also allow time for unexpected obstacles and problems that might occur.

Proper nutrition and water are essential to building and preserving energy and strength. Several small meals a day are preferred to a couple of large ones, so that calories and fluids are constantly available to keep the body and mind in the best possible condition. You should try to have water and a snack available while trekking, and you should eat and drink often to restore energy and prevent chills in cold temperatures. This also applies at night.

Land Travel Techniques

Land travel techniques are based largely on experience, which is acquired through performance. However, experience can be partially replaced by learning through instruction and observation. For example, travel routes may be established by observing the direction of a bird's flight, the actions of wild animals, the way a tree grows, or even the shape of a snowdrift. Bearings read from the compass, the sun, or the stars will improve on these observations and confirm original headings. All observations are influenced by the location and physical characteristics of the area where they are made and by the season of the year.

Route Finding

The novice should follow a compass line, whereas an experienced person follows lines of least resistance by realizing that a curved route may be faster and easier under certain circumstances. Use game trails when they follow a projected course only. For example, trails made by migrating caribou are frequently extensive and useful. On scree or rock slides, mountain sheep trails may be helpful. Game trails offer varying prospects, such as the chance of securing game or locating water holes.

Successful land travel requires knowledge beyond mere travel techniques. You should have at least a general idea of the location of your starting place and your ultimate destination. You should also have some knowledge of the terrain through which you will travel.

Wilderness Travel

Wilderness travel requires constant awareness. A novice views a landscape from the top of a hill with care and interest, and then says, "Let's go." The experienced person carefully surveys the surrounding countryside. A distant blur may be mist or smoke; a faint, winding line on a far-off hill may be man-made or an animal trail; a blue spot in the lowlands may be a herd of caribou or cattle.

People should plan travel only after carefully surveying the terrain. Study distant landmarks for characteristics that can be recognized from other locations or angles. Careful and intelligent observation will help you to correctly interpret the things you see, such as distant landmarks, or a broken twig at your feet. Before leaving a place, travelers should study their back trail carefully. You should know the route forward and backward. An error in route planning may make it necessary to backtrack in order to take a new course. For this reason, all trails should be marked (figure 19).

Travel in Mountains

Mountain ranges frequently affect the climate of a region. The climate, in turn, influences the vegetation, wildlife, and the character and number of people living in the region. For example, the ocean side of mountains has more fog, rain, and snow than the inland side of a range. Forests may grow on the ocean side, while inland, it may be semidry. Therefore, a complete change of survival techniques may be necessary when crossing a mountain range.

Travel in mountainous country is simplified by conspicuous drainage landmarks, but it is complicated by the roughness of the terrain. A mountain traveler can readily determine the direction in which rivers or streams flow; however, surveying is necessary to determine if a river is safe for rafting, or if a snowfield or mountainside can be traversed safely.

Mountain travel differs from travel through rolling or level country, and certain cardinal rules govern climbing methods. A group descending into a valley, where descent becomes increasingly steep and walls progressively more perpendicular, may have to climb up again in order to follow a ridge until an easier descent is possible. In such a situation, rappeling may save many weary miles of travel. In mountains, travelers must avoid possible avalanches of earth, rock, and snow, as well as crevasses (deep cracks in the ice) in ice fields.

In mountainous country, it may be better to travel on ridges—the snow surface is probably firmer and there is a better view of the route from above. Watch for snow and ice overhanging steep slopes. Avalanches are a hazard on steep snow-covered slopes, especially on warm days and after heavy snowfalls. Snow avalanches occur most commonly and frequently in mountainous country during winter, but they also occur with the warm temperatures and rainfall of spring. Both small and large avalanches are a serious threat to you as they have tremendous force.

The natural phenomenon of the snow avalanche is complex. It is difficult to definitely predict impending avalanches, but knowing general characteristics of avalanches and how to identify them can help people avoid avalanche hazard areas. Consult a local expert regarding characteristics of avalanches in your area.

SESSION 2
SHELTER

Learning Objectives

As a result of this session, participants should be able to construct simple shelters.

Introduction

Shelter is anything that protects you from the environmental hazards. This describes how the environment influences shelter site selection and other factors you must consider before constructing an adequate shelter. The techniques and procedures for constructing shelters for various types of protection are also presented.

Choosing a Site

The location and type of shelter to be built vary with each survival situation. There are many things to consider when picking a site. You should consider the time and energy required to establish an adequate camp, weather conditions, life forms (human, plant, and animal), terrain, and time of day. Every effort should be made to use as little energy as possible and yet attain maximum protection from the environment.

Time

Late afternoon is not the best time to look for a site to meet that day's shelter requirements. If you wait until the last minute, you may be forced to use poor materials in unfavorable conditions. You must constantly be thinking of ways to satisfy your needs for protection from environmental hazards.

Weather

Weather conditions are a key consideration when selecting a shelter site. Failure to consider the weather could have disastrous results. Some major weather factors that can influence your choice of shelter type and site selection are temperature, wind, and precipitation.

Temperatures can vary considerably within a given area. Situating a campsite in low areas such as a valley in cold regions can expose you to low night temperatures and windchill factors. Colder temperatures are found along valley floors, which are sometimes referred to as "cold air sumps." It may be better to situate campsites to take advantage of the sun. You could place shelters in open areas during the colder months for added warmth, and in shaded area for protection from the sun during periods of hot weather. In some areas a compromise may have to be made. For example, in many deserts the daytime temperatures can be very high while low temperatures at night can turn water to ice. Protection from both heat and cold are needed in these areas. Shelter type and location should be chosen to provide protection from all the existing temperature and weather conditions.

Wind can be either an advantage or a disadvantage depending upon the temperature of the area and the velocity of the wind. During the summer or on warm days, you can take advantage of the cool breezes and protection the wind provides from insects by locating your camp on a knoll or spit of land. Conversely, wind can become an annoyance or even a hazard as blowing sand, dust, or snow can cause skin and eye irritation and damage to clothing and equipment. On cold days or during winter months, you should seek shelter sites that are protected from the effects of windchill and drifting snow.

The many forms of precipitation (rain, sleet, hail, or snow) can also present problems. Shelter sites should be out of major drainages and other low areas to provide protection from flash floods or mud slides resulting from heavy rains. Snow can also be a great danger if shelters are placed in potential avalanche areas.

Life Forms

All life forms (plant, human, and animal) must be considered when selecting the campsite and the type of shelter that will be used. For a shelter to be adequate, certain factors must be considered, especially if extended survival is expected.

- Insect life can cause personal discomfort, disease, and injury. By locating shelters on knolls, ridges, or any other area that has a breeze or steady wind, you can reduce the number of flying insects in your immediate area. Staying away from standing water sources will help to avoid mosquitoes, bees, wasps, and hornets. Ants can be a major problem; some species will vigorously defend their territories with painful stings or bites or particularly distressing pungent odors.
- Large and small animals can also be a problem, especially if the camp is situated near their trails or water holes.
- Dead trees that are standing and trees with dead branches should be avoided. Wind may cause them to fall, causing injuries or death. Poisonous plants, such as poison oak or poison ivy, must also be avoided when locating a shelter.

Terrain

Terrain hazards may not be as apparent as weather and animal life hazards, but they can be many times more dangerous. Avalanche, rock, dry streambeds, or mudslide areas should be avoided. These areas can be recognized by either a clear path or a path of secondary vegetation, such as one- to fifteen-foot-tall vegetation or other new growth that extends from the top to the bottom of a hill or mountain. You should not choose shelter sites at the bottom of steep slopes that may be prone to slides. Likewise, there is a danger in camping at the bottom of steep scree or talus slopes. Additionally, a rock overhang must be checked for safety before using it as a shelter.

Site Requirements

Four prerequisites must be satisfied when selecting a shelter location.

1. The site must be near water, food, fuel, and a signal or recovery site.
2. The area should be safe, providing natural protection from environmental hazards.
3. The site must have sufficient materials available to construct the shelter. In some cases, the "shelter" may already be present. You seriously limit yourself if you assume shelters must be a fabricated framework having predetermined dimensions and a cover of materials. You should consider using sheltered places already in existence in the immediate area and adding materials as needed to create a survival shelter.
4. Finally, the area chosen must be both large enough and level enough for you to lie down. Personal comfort is an important fundamental for you to consider. An adequate shelter provides physical and mental well-being for sound rest. Rest is extremely vital if you are to make sound decisions. Your need for rest becomes more critical as time passes and rescue or return is delayed.

Before actually constructing a shelter, you must determine the specific purpose of the shelter. The following factors influence the type of shelter to be built.

- Rain or other precipitation
- Cold
- Heat
- Insects
- Available materials (manufactured or natural)
- Expected length of stay
- Your physical condition

If possible, you should try to find a shelter that needs little work to be adequate. Using what is already there saves time and energy. For example, rock overhangs, caves, large crevices, fallen logs, root buttresses, or snowbanks can all be modified to provide adequate shelter. Modifications may include adding snow blocks to finish off an existing tree well shelter, increasing the insulation of the shelter by using vegetation, or building a reflector fire in front of a rock overhang or cave. You must consider the amount of energy required to build the shelter. It is not wise to spend time and energy constructing a shelter if nature has provided a natural shelter nearby that will satisfy your needs. See figure 20 for examples of natural shelters.

The size limitations of a shelter are important only if there is either a lack of material on hand or if it is cold. Otherwise, the shelter should be large enough to be comfortable yet not so large as to cause an excessive amount of work. Any shelter, natural or otherwise, in which a fire is to be built must have a ventilation system to provide fresh air and allow smoke and carbon monoxide to escape. Even if a fire does not produce visible smoke (such as a heat tab fire), the shelter must still be vented. See figure 21 for placement of ventilation holes in a snow cave. If a fire is to be placed outside the shelter, the opening of the shelter should be 90 degrees to the prevailing wind. This will reduce the chances of sparks and smoke being blown into the shelter if the wind should reverse direction in the morning and evening. This frequently occurs in mountainous areas. The best fire-to-shelter distance is approximately 3 feet.

Immediate Action Shelters

The first type of shelter that you may consider using, or the first type you may be forced to use, is an immediate action shelter. An immediate action shelter is one that can be erected quickly and with minimum effort; for example, a raft, canoe, tarpaulin, or plastic bag. Natural formations, including overhanging ledges, fallen logs, caves, and tree wells, can also shield you from the elements immediately (figure 22). It isn't necessary to be concerned with exact shelter dimensions. You should remember that when shelter is needed, use an existing shelter if at all possible. You should improvise on natural shelters or construct new shelters only if necessary. Regardless of type, the shelter must provide whatever protection is needed and, with a little ingenuity, it should be possible for you to protect yourselves and do so quickly.

Improvised Shelters

Shelters of this type should be easy to construct and dismantle in a short period of time. However, these shelters usually require more time to construct than an immediate action shelter, and should only be considered when you aren't immediately concerned with getting out of the elements. Shelters of this type include the following:

- The "A-frame" design, which is adaptable to all environments as it can be easily modified
- Simple shade shelter, which is useful in dry areas
- Tepees
- Snow shelters, including tree-pit shelters
- All other variations of the above shelter types; sod shelters, etc.

Building the Shelter

The first step is deciding the type of shelter required. No matter which shelter is selected, the building or improvising process should be planned and orderly, following proven procedures and techniques. The second step is to select, collect, and prepare all materials needed before the actual construction; this includes framework, covering, bedding or insulation, and implements used to secure the shelter ("dead-men," lines, stakes, etc.)

For shelters that use a wooden framework, the poles or wood selected should have all the rough edges and stubs removed. Not only will this reduce the chances of the fabric being ripped, but it will eliminate the chances of injury to you.

On the outer side of a tree selected as a natural shelter, some or all of the branches may be left in place as they will make a good support structure for the rest of the shelter.

There are many materials that can be used as framework coverings. Some of the following are both framework and covering all in one:

- Bark peeled off dead trees
- Boughs cut off trees
- Bamboo, palm, grasses, and other vegetation cut or woven into desired patterns

The next step in the process of shelter construction is site preparation. This includes brushing away rocks and twigs from the sleeping area and cutting back overhanging vegetation.

Now you can actually construct the shelter, beginning with the framework. The framework is very important. It must be strong enough to support the weight of the covering and possible buildup of snow. It must also be sturdy enough to resist strong wind gusts.

The pitch of the shelter is determined by the framework. A 60-degree pitch is optimum for shedding precipitation and providing shelter room.

The size of the shelter is determined by the framework. The shelter should be large enough for you to sit up, with adequate room to lie down and to store all personal equipment.

After the basic framework has been completed, you can apply and secure the framework covering. The care and techniques used to apply the covering will determine the effectiveness of the shelter in shedding precipitation.

If you are going to use manufactured fabric for a survival shelter, you should remember that pitch and tightness apply to shelters designed to shed rain or snow. Nylon is porous and will not shed moisture unless it is stretched tightly at an angle of sufficient pitch to encourage runoff instead of penetration. An angle of 40 to 60 degrees is recommended for the pitch of the shelter. The fabric stretched over the framework should be wrinkle-free and tight. You should not touch the fabric when water is running over it, as this will break the surface tension at that point and allow water to drip into the shelter. Even during a hard rain, the outer layer only lets a mist penetrate if it is pulled tight. The inner layer will then channel off any moisture that may penetrate. This layering of fabric also creates a dead-air space that covers the shelter. This is especially beneficial in cold areas when the shelter is enclosed. Adequate insulation can also be provided by boughs, snow, etc. A double layering of fabric helps to trap body heat, radiating heat from the Earth's surface, and other heating sources.

If natural materials are to be used for the covering, the shingle method should be used. Starting at the bottom and working toward the top of the shelter, the bottom of each piece should overlap the top of the preceding piece. This will allow water to drain off. The material should be placed on the shelter in sufficient quantity so that those in the shelter cannot see through it.

Maintenance and Improvements

Once a shelter is constructed, it must be maintained. Additional modifications may make the shelter more effective and comfortable. Indian lacing (lacing the front of the shelter to the bipod) will tighten the shelter. A door may help block the wind and keep insects out. Other modifications may include a fire reflector, work area, or another addition such as an opposing lean-to.

Shelters for Temperate Climates

A-Frame

The following is one way to build an A-frame shelter in a warm or temperate environment, using fabric for the covering. There are as many variations of this shelter as there are builders. If followed carefully, the procedures here will result in a safe shelter that will meet your needs. For an example of this and other A-frame shelters, see figure 23.

Materials

- One 12- to 18-foot sturdy ridge pole with all projections cleaned off
- Two bipod poles, approximately 7 feet long
- Fabric
- Suspension lines
- "Buttons"—small objects placed behind gathers of fabric to provide a secure way of affixing the suspension line to the fabric
- Approximately 14 stakes, 10 inches long

Assembling the Framework

1. Lash the two bipod poles together at eye-level height.
2. Place the ridge pole, with the large end on the ground, into the bipod formed by the poles and secure with a square lash.
3. The bipod structure should be 90 degrees to the ridge pole and the bipod poles should be spread out to an approximate equilateral triangle with a 60-degree pitch. A piece of line can be used to measure this.

Applying the Fabric

1. Tie off about 2 feet of the apex in a knot and tuck this under the butt end of the ridge pole. Use half hitches and clove hitches to secure the fabric to the base of the pole.

2. Place the center radial seam of the suspension line (or the center of the fabric) on the ridge pole. After pulling the fabric taut, use half hitches and clove hitches to secure the fabric to the front of the ridge pole.

3. Draw a line on the ground from the butt of the ridge pole to each of the bipod poles. Stake the fabric down, starting at the rear of the shelter and alternately staking from side to side to the shelter front. Use a sufficient number of stakes to ensure that the fabric is wrinkle-free.

4. Stakes should be slanted or inclined away from the direction of pull. When tying off with a clove hitch, the line should pass in front of the stake first and then pass under itself to allow the button and line to be pulled 90 degrees to the wrinkle.

5. Indian lacing is the sewing or lacing of the lower lateral band to the inner core or line, which is secured to the bipod poles. This will remove the remaining wrinkles and further tighten the fabric.

6. A rain fly, bed, and other refinements can now be added.

Lean-to

Materials

- A sturdy, smooth ridge pole (longer than the builder's body) long enough to span the distance between two sturdy trees
- Support poles, 10 feet long
- Stakes, suspension lines, and buttons
- Fabric

Assembling the Framework

1. Lash the ridge pole between two suitable trees at about chest or shoulder height.

2. Lay the roof support poles on the ridge pole so the roof support poles and the ground are at approximately a 60-degree angle. Lash the roof support poles to the ridge pole.

Applying the Fabric

1. Place the middle seam of the fabric on the middle support pole with the lower lateral band along the ridge pole.

2. Tie off the middle and both sides of the lower lateral band approximately 8 to 10 inches from the ridge pole.

3. Stake the middle of the rear of the shelter first, then alternate from side to side.

4. The stakes that go up the sides to the front should point to the front of the shelter.

5. Pull the lower lateral band closer to the ridge pole by Indian lacing.

6. Add bed and other refinements (reflector fire, bed logs, rain fly, etc.) See figure 24 for lean-to examples.

Tepee

The tepee is an excellent shelter for protection from wind, rain, cold, and insects. Cooking, eating, sleeping, resting, signaling, and washing can all be done without going outdoors. The tepee, whether nine-pole, one-pole, or no-pole, is the only improvised shelter that provides adequate ventilation to build an inside fire. With a small fire inside, the shelter also serves as a signal at night.

Materials

- Suspension line
- Fabric
- Stakes
- Although any number of poles may be used, 11 smooth poles, each about 20 feet long, will normally provide adequate support.

Assembling the Framework

Assume 11 poles are used. Adjust instructions if a different number is used.

1. Lay 3 poles on the ground with the butts even. Stretch the canopy along the poles. The lower lateral band should be 4 to 6 inches from the bottoms of the poles before the stretching takes place. Mark one of the poles at the apex point.
2. Lash the 3 poles together, 5 to 10 inches above the marked area. (A shear lash is effective for this purpose.) These poles will form the tripod (figure 25).
3. Draw a circle approximately 12 feet in diameter in the shelter area and set the tripod so the butts of the poles are evenly spaced on the circle. Five of the remaining 8 poles should be placed so the butts are evenly spaced around the 12-foot circle and the tops are laid in the apex of the tripod to form the smallest apex possible (figure 25).

Applying the Fabric

1. Stretch the fabric along the tie pole. Using the suspension line attached to the middle radial seam, tie the lower lateral band to the tie pole 6 inches from the butt end. Stretch the fabric along the middle radial seam and tie it to the tie pole using the suspension line at the apex. Lay the tie pole onto the shelter frame with the butt along the 12-foot circle and the top in the apex formed by the other poles. The tie pole should be placed directly opposite the proposed door.
2. Move the canopy fabric (both sides of it) from the tie pole around the framework and tie the lower lateral band together and stake it at the door. The front can now be sewn or pegged closed, leaving 3 or 4 feet for a door. A sewing "ladder" can be made by lashing steps up the front of the tepee (figure 25).
3. Enter the shelter and move the butts of the poles outward to form a more perfect circle until the fabric is relatively tight and smooth.
4. Tighten the fabric and remove remaining wrinkles. Start staking directly opposite the door, and alternate from side to side, pulling the fabric down and to the front of the shelter. Use clove hitches or similar knots to secure the fabric to the stakes.

5. Insert the final two poles into the loops on the smoke flaps. The tepee is now finished (figure 25).
6. One improvement that could be made to the tepee is the installation of a liner. This will allow a draft for a fire without making the occupants cold, since there may be a slight gap between the lower lateral band and the ground. A liner can be affixed to the inside of the tepee by taking the remaining fabric and firmly staking the lower lateral band directly to the ground all the way around, leaving room for the door. The area where the liner and door meet may be sewn up. The rest of the fabric is brought up the inside walls and affixed to the poles with buttons (figure 25).

One-Pole Tepee

Materials

- Normally, use a 14-gore section of canopy; strip the shroud lines, leaving 16- to 18-inch lengths at the lower lateral band.
- Stakes
- Inner core and needle

Construction

1. Select a shelter site and draw a circle about 14 feet in diameter on the ground.
2. Stake the material to the ground using the lines attached at the lower lateral band. After deciding where the shelter door will be located, stake the first line (from the lower band) down securely. Proceed around the circle that was drawn and stake down all the lines from the lateral band, making sure the material is stretched taut before the line is staked down.
3. Once all the lines are staked down, loosely attach the center pole, and, through trial and error, determine the point at which the material will be pulled tight once the center pole is placed upright—securely attach the material at this point.
4. Using a suspension line (or inner core), sew the end of the material together leaving 3 or 4 feet for a door (figure 26).

No-Pole Tepee

For this shelter, the 14 gores of material are prepared the same way. A line is attached to the apex and thrown over a tree limb, etc., and tied off. The lower lateral band is then staked down, starting opposite the door, around a 12- to 14-foot circle.

Sod Shelter

A framework covered with sod provides a shelter that is warm in cold weather and one that is easily made waterproof and insect-proof in the summer. The framework for a sod shelter must be strong, and it can be made of driftwood, poles, willow, etc. Sod, with a heavy growth of grass or weeds, should be used since the roots tend to hold soil together. Cutting about two inches of soil along with the grass is sufficient. The size of the blocks are determined by the strength of the individual. A sod house is strong and fireproof.

Shelters for Tropical Areas

In tropical areas, especially moist tropical areas, the major environmental factors influencing both site selection and shelter types are:

- Moisture and dampness
- Rain
- Wet ground
- Heat
- Mud-slide areas
- Dead standing trees and limbs
- Insects

You should establish a campsite on a knoll or high spot in an open area well away from any swamps or marshy areas. The ground in these areas is drier, and there may be a breeze, which will result in fewer insects. Underbrush and dead vegetation should be cleared from the shelter site. Crawling insects will not be able to approach you as easily due to lack of cover. A thick bamboo clump or matted canopy of vines for cover reflects the smoke from the campfire and discourages insects. This cover will also keep the extremely heavy early morning dew off the bedding.

The easiest improvised shelter is made by draping a tarpaulin or poncho over a rope or vine stretched between two trees. One end of the canopy should be kept higher than the other. Insects can be discouraged by few openings in shelters and by smudge fires. A hammock made from fabric will keep you off the ground and discourage ants, spiders, leeches, scorpions, and other pests.

In the wet jungle, you need shelter from dampness. Try to make mosquito-proof coverings with netting or cloth. A good rain shelter can be made by constructing an A-frame and shingling it with a good thickness of palm or other broadleaf plants, pieces of bark, and mats of grass (figure 27).

Nights are cold in some mountainous tropical areas. You should try to stay out of the wind and build a fire. Reflecting the heat off a rock pile or other barrier is a good idea. Some natural materials that can be used for shelters are green wood (dead wood may be too rotten), bamboo, and palm leaves. Vines can be used in place of suspension line for thatching roofs or floors. Banana plant sections can be separated from the banana plant and fashioned to provide a mattress.

Raised Platform Shelter

The raised platform shelter has many variations. One example is four trees or vertical poles in a rectangular pattern that is slightly longer and wider than yourself, keeping in mind you will also need protection for equipment. Two long, sturdy poles are then square-lashed between the trees or vertical poles, one on each side of the intended shelter. Crosspieces can then be secured across the two horizontal poles at 6- to 12-inch intervals. This forms the platform on which a natural mattress can be constructed. Fabric can be used as an insect net, and a roof can be built over the structure using A-frame building techniques. The roof should be waterproofed with thatching laid bottom to top in a thick shingle fashion. See figure 28 for examples of this and other platform shelters. These shelters can also be built using three trees in a triangular pattern. At the foot of the shelter, two poles are joined to one tree.

Paraplatform

A variation of the platform shelter is the paraplatform. A quick and comfortable bed is made by simply wrapping material around the two "frame" poles. Another method is to roll poles in the material in the same manner as for an improvised stretcher (figure 29).

Hammocks

Various hammocks can be made that are more involved than a simple material-wrapped framework and are not quite as comfortable (figure 31).

Hobo Shelter

If a more permanent shelter is desired, as opposed to a simple shade shelter, you should build a "hobo" shelter. To build this shelter:

1. Dig into the lee side of a sand dune to protect the shelter from the wind. Clear a level area large enough to lie down in and store equipment.
2. After the area has been cleared, build a heavy driftwood framework that will support the sand.
3. Wall the sides and top with strong material (boards, driftwood, etc.) that will support the sand; leave a door opening.
4. Slope the roof to equal the slope of the sand dune. Cover the entire shelter with material to keep sand from sifting through small holes in the walls and roof.
5. Cover with 6 to 12 inches of sand to provide protection from wind and moisture.
6. Construct a door for the shelter (figure 30).

Shelters for Dry Climates

Natives of hot, dry areas make use of lightproof shelters with sides rolled up to take advantage of any breeze. The extremes of heat and cold must be considered in hot areas, as many of these areas can become very cold during the night. The major problem for you will be escaping the heat and sun rays.

Natural shelters in these areas are often limited to the shade of cliffs and the lee sides of hills, dunes, or rock formations. In some desert mountains, it is possible to find good rock shelters or cave-like protection under tumbled blocks of rocks which have fallen from cliffs. Use care to ensure that these blocks are in areas void of future rock falling activity and free from animal hazards.

Vegetation, if any exists, is usually stunted and armed with thorns. It may be possible to stay in the shade by moving around the vegetation as the sun moves. The hottest part of the day may offer few shadows because the sun is directly overhead. Material draped over bushes or rocks will provide some shade.

Principles of Desert Shelters

Materials that can be used to build desert shelters include the following:

- Sand, though difficult to work with when loose, may be made into pillars by using sandbags made from any available cloth.
- Rock can be used in shelter construction.
- Vegetation such as sagebrush, creosote bushes, juniper trees, and desert gourd vines are valuable building materials.
- Canopy and suspension lines are perhaps the most versatile building materials available. When used in layers, fabric protects you from the sun's rays.

The shelter should be made of dense material or have numerous layers to reduce dangerous ultraviolet rays. The color of the materials used make a difference as to how much protection is provided from ultraviolet radiation. As a general rule, the order of preference should be to use as many layers as practical in the order of orange, green, tan, and white.

The roof of a desert shelter should be multilayered so the resulting airspace reduces the inside temperature of the shelter. The layers should be 12 to 18 inches apart (figure 32). You should place the floor of the shelter about 18 inches above or below the desert surface to increase the cooling effect.

In warmer deserts, white material should be used as an outer layer. Orange or sage green material should be used as an inner layer for protection from ultraviolet rays. In cooler areas, multiple layers of material should be used, with sage green or orange material as the outer layer to absorb heat. The sides of shelters should be movable in order to protect you during cold and windy periods, and to allow for ventilation during hot periods.

In a hot desert, shelters should be built away from large rocks, which store heat during the day. You may need to move to the rocky areas during the evening to take advantage of the warmth that heated rocks radiate.

Build desert shelters on the windward sides of dunes for cooling breezes. It is best to build shelters during early morning, late evening, or at night. However, if you have an emergency in a desert area during daylight hours, you must be immediately concerned with protection from the sun and loss of water. In this case, canopy material can be draped over a life raft, vegetation, or a natural terrain feature for quick shelter.

SESSION 3
FOOD

Learning Objectives

As a result of this session participants should be able to construct simple traps, plan nutrition, and know what to eat and what not to eat.

Introduction

Except for the water you drink and the oxygen you breathe, you must meet your body's needs through the intake of food. This chapter will explore the relationship of proper nutrition to physical and mental efficiency. It is extremely important that you maintain a proper diet at all times. A nutritionally sound body stands a much better chance of surviving. Improper diet over a long period of time may lead to a lack of stamina, slower reactions, less resistance to illness, and reduced mental alertness, all of which can cost you your life in a survival situation. A knowledge of the body's nutritional requirements will help you select foods to supplement your rations.

Nutrition

You expend much more energy in survival situations than you would in the course of your everyday life. Basal metabolism is the amount of energy expended by the body when it is in a resting state. The rate of basal metabolism will vary slightly with regard to the sex, age, weight, height, and race of a person. The basic energy will change as a person's activity level changes. A person who is simply sitting in a warm shelter, for example, may consume anywhere from 20 to 100 calories an hour, while that same person, wading through thick undergrowth with a heavy pack, would expend a greater amount of energy. In a survival situation, proper food can make the difference between success and failure.

The three major constituents of food are carbohydrates, fats, and proteins. Vitamins and minerals are also important as they keep certain essential body processes in good working order. It is also necessary to maintain proper water and salt levels in your body, as they aid in preventing certain heat disorders.

Carbohydrates

Carbohydrates are composed of very simple molecules that are easily digested. Carbohydrates lose little of their energy to the process of digestion and are therefore efficient energy suppliers. Because carbohydrates supply easily used energy, many nutritionists recommend that, if possible, emergency survivors try to use them for up to half of their caloric intake. Examples of carbohydrates are starches, sugars, and cellulose. These can be found in fruits, vegetables, candy, milk, cereals, legumes, and baked goods. Cellulose cannot be digested by humans, but it does provide needed roughage for the diet.

Fats

Fats are more complex than carbohydrates. The energy contained in fats is more slowly released than the energy in carbohydrates. Because of this it is a longer-lasting form of energy. Dietary fats supply certain fat-soluble vitamins. Sources of these fats and vitamins are butter, cheese, oils, nuts, egg yolks, margarine, and animal fats. If you eat fats before sleeping, you will sleep warmer. If fats aren't included in the diet, you can become rundown and irritable. This can lead to both physical and psychological breakdown.

Proteins

The digestive process breaks protein down into various amino acids. These amino acids are formed into new body tissue, such as muscles. Some proteins give the body the exact amino acids required to rebuild itself. These proteins are referred to as "complete." Proteins that lack one or more of these essential amino acids are referred to as "incomplete." Foods containing incomplete proteins include cheese, milk, cereal grains, and legumes. Incomplete protein, when eaten in the right combination or with complete proteins (grain with milk and beans, for example) can supply the assortment of amino acids needed by the body. Complete protein is found in fish, meat, poultry, eggs, and blood. No matter which type of protein is consumed, it will contain the most complex molecules of any food type.

If possible, the recommended daily allowance of 2½ to 3 ounces of complete protein should be consumed each day. If only incomplete proteins are available, two, three, or even four types of foods may need to be eaten in combination so that enough amino acids are combined to form complete protein.

If amino acids are introduced into the body in great numbers and some of them are not used for the rebuilding of muscle, they are changed into fuel or stored in the body as fat. Because protein contains the more complex molecules, compared to fats and carbohydrates, they supply energy after those forms of energy have been used up. A lack of protein causes malnutrition, skin and hair disorders, and muscle atrophy.

Vitamins

Vitamins are found in small quantities in many foods, and are essential for normal growth and health. Their chief function is to regulate the body processes. Vitamins can generally be placed into two groups: fat-soluble and water-soluble. The body only stores slight amounts of the water-soluble type. In a long survival episode where a routinely balanced diet is not available, you must overcome food aversions and eat as much of a variety of vitamin-rich foods as possible. Often one or more of the four basic food groups (meat, fish, poultry; vegetables and fruits; grain and cereal; milk and milk products) are not available in the form of familiar foods, and vitamin deficiencies such as beri-beri or scurvy result. If you can overcome aversions to local foods high in vitamins, these diseases—as well as signs and symptoms such as depression and irritability—can be warded off.

Minerals

Adequate minerals can also be provided by a balanced diet. Minerals build or repair the skeletal system and regulate normal body functions. Minerals needed by the body include iodine, calcium, iron, and salt, to name but a few. A lack of minerals can cause problems with muscle coordination, nerves, water retention, and the ability to form or maintain healthy red blood cells.

Caloric Requirements

For you to maintain your efficiency, the following number of calories per day is recommended. These figures will change because of individual differences in basal metabolism, weight, etc. During warm weather you should consume anywhere from 3,000 to 5,000 calories per day. In cold weather the calorie intake should rise to 4,000 to 6,000 calories per day. Being familiar with the calorie and fat amounts in foods is important. For example, it would take quite a few mussels and dandelion greens to meet your nutritional requirements. You should try to be familiar enough with foods that you can select or find foods that provide a high calorie intake (figure 33). You should also be familiar with the number of calories supplied by the food you take on expeditions. In most situations, these will have to be supplemented with other foods you can procure. If possible, you should limit your activities to save energy. Rationing food is a good idea since you never know when your ordeal will end. You should eat when you can, keeping in mind that you should maintain at least a minimum calorie intake to satisfy your basic activity needs.

Caloric and fat values of selected foods are shown in the chart and, unless otherwise specified, the foods listed are raw. Depending on how you cook the food, the usable food value can be increased or decreased.

Finding Food

You should be able to find something to eat wherever you are. One of the best places to find food is along the seacoast, between the high and low watermarks. Other likely spots are the areas between the beach and a coral reef; the marshes, mud flats, or mangrove swamps where a river flows into the ocean or into a larger river; riverbanks, inland water holes, shores of ponds and lakes, margins of forests, natural meadows, protected mountain slopes, and abandoned cultivated fields.

Rationing Food and Water

Consideration must be given to available food and water and how long the survival episode may last. Environmental conditions must also be considered. If you are in a cold environment, more of the proper food will be required to provide necessary body heat. Rescue may vary from a few hours to several months, depending on the environment, operational commitments, and availability of rescue resources in that area. Available food must be rationed based on the estimated time that will elapse before being able to supplement issued rations with natural foods. If you decide that some of the group should go for help, each traveler should be given twice as much food as those remaining behind. In this way, those resting at the encampment and those walking out will stay in about the same physical condition for about the same length of time.

If available water is less than a quart a day, avoid dry, starchy, and highly seasoned foods and meat. Keep in mind that eating increases thirst. For water conservation, the best foods to eat are those with high carbohydrate content, such as hard candy and fruit. All work requires additional food and water. When work is being performed, you must increase food and water consumption to maintain physical efficiency.

Meals and Cooking

If food is available, it is all right to nibble throughout the day. It is preferable, though, to have at least two meals a day, with one being hot. Cooking usually makes food safer, more digestible, and palatable. The time spent cooking will provide a good rest period. On the other hand, some foods, such as sapodilla, star apple, and soursop, are not palatable unless eaten raw.

Wild or Native Foods

Learn to overcome food prejudices. Foods that may not look good to you are often a part of other people's regular diet. Wild foods are high in mineral and vitamin content. With a few exceptions, all animals are edible when freshly killed. Avoid strange looking fish and fish with flesh that remains indented when depressed, as it is probably becoming spoiled and should not be eaten. With knowledge and the ability to overcome food prejudices, a person can eat and sustain life in strange or hostile environments.

Insects

If there ever is a time when food aversions must be overcome, it is when you must turn to insects as a food source.

People in many cultures eat insects and consider them great delicacies. When food is limited and insects are available, they can become a valuable food source. In some places, locusts, grasshoppers, cicadas, and crickets are eaten regularly; occasionally termites, ants, and a few species of stonefly larvae are consumed. Big beetles such as the Goliath beetle of Africa, the giant water beetles, and the big long-horned beetles are relished the world over.

Termites and white ants are also an important food source. They occur in enormous numbers and are easily collected both from their nests and during flight. They are sometimes attracted to light in unbelievable numbers. Many Native American tribes made a habit of eating the large carpenter ants that are sometimes pests in houses. These were eaten both raw and cooked.

Today it is known that insects have nutritional or medicinal value. The praying mantis, for example, contains fifty-eight percent protein, twelve percent fat, three percent ash, vitamin B complex, and vitamin A. The insect's outer skeleton is an interesting compound of sugar and amino acids. Stinging insects are edible, but their stinging apparatus should be removed before they are eaten.

Insects have been used as a food source for thousands of years and will undoubtedly continue to be used. If you cannot overcome your aversion to insects as a food source, you will miss out on a valuable and plentiful supply of emergency food.

Fish and Shellfish

Fishing is one way to get food throughout the year wherever water is found. There are many ways to catch fish, including hook and line, gill nets, traps, and spearing.

Hook-and-Line Fishing

If an emergency fishing kit is available, there will be a hook and line in it, but if a kit is not available a hook and line will have to be found elsewhere or improvised. Hooks can be made from wire or carved from bone or wood. The line can be made by unraveling or twisting threads from clothing or plant fibers. A piece of wire between the fishing line and the hook will help prevent the fish from biting through the line.

This type of fishing on a rocky coast requires a lot of care to keep the line from becoming entangled or cut on sharp edges. Most shallow-water fish are nibblers. Unless the bait is well placed and hooked and the barb of the hook offset by bending, the bait may be lost without catching a fish. Use hermit crabs, snails, or the tough muscle of a shellfish as bait. Take the cracked shells and any other animal remains and drop them into the area to be fished. This brings the fish to the area. Examine stomach contents of the first fish caught to determine what the fish are feeding on.

Bait and Lures. Insects, smaller fish, shellfish, worms, or meat can be used as bait. Bait can be selected by observing what the fish are eating. Even an open coconut can be used for bait. Artificial lures can be made from pieces of brightly colored cloth, feathers, or bits of bright metal or foil tied to a hook. If the fish will not take the bait, try to snag or hook them in any part of the body as they swim by.

Jigging

A baited or spooned hook dipped repeatedly beneath the surface of the water is sometimes effective. This method may be used at night.

Spearing

This method is difficult, except when the stream is small and the fish are large and numerous during the spawning season, or when the fish congregate in pools. Make a spear by sharpening a long piece of wood, lashing two long thorns on a stick, or fashioning a bone spear point, and take a position on a rock over a fish run. Wait patiently and quietly for a fish to swim by.

Net Fishing

The most effective fishing method is a net because it will catch fish without having to be attended (figures 34 and 35). If a gill net is used, stones can be used for anchors and wood for floats. The net should be set at a slight angle to the current to clear itself of any floating refuse that comes down the stream. The net should be checked at least twice daily (figure 36). A net with poles attached to each end works effectively if moved up or down a stream as rapidly as possible while moving stones and threshing the bottom or edges of the stream banks. The net should be checked every few moments so the fish cannot escape.

Fish Traps

Fish traps (figure 37) are very useful for catching both freshwater and saltwater fish, especially those that move in schools. In lakes or large streams fish tend to approach the banks and shallows in the morning and evening. Sea fish, traveling in large schools, regularly approach the shore with the incoming tide, often moving parallel to the shore, guided by obstruction in the water.

A fish trap is basically an enclosure with a blind opening where two fence-like walls extend out, like a funnel, from the entrance. The time and effort put into building a fish trap should depend on the need for food and the length of time you survivors plan to stay in one spot.

The trap location should be selected at high tide and the trap built at low tide. One to two hours of work should do the job. Consider the location, and try to adapt natural features to reduce the labor. Natural rock pools should be used on rocky shores. Natural pools on the surface of reefs should be used on coral islands by blocking the opening as the tide recedes. Sandbars, and the ditches they enclose, can be used on sandy shores. The best fishing off sandy beaches is the lee side of offshore sandbars. By watching the swimming habits of fish, a simple dam can be built that extends out into the water, forming an angle with the shore. This will trap fish as they swim in their natural path. When planning a more complex brush dam, select protected bays or inlets, using the narrowest area and extending one arm almost to the shore.

In small, shallow streams, the fish traps can be made with stakes or brush set into the stream bottom or weighted down with stones so that the stream is blocked except for a small narrow opening into a stone or brush pen or shallow water. Wade into the stream, herding the fish into the trap, and catch or club them when they get in shallow water. Mud-bottom streams can be trampled until cloudy and then netted. The fish are blinded and cannot avoid the nets. Freshwater crawfish and snails can be found under rocks, logs, overhanging bushes, or in mud bottoms.

Tickling

Tickling can be effective in small streams with undercut banks or in shallow ponds left by receding flood waters. Place your hands in the water and reach under the bank slowly, keeping your hands close to the bottom, if possible. Move your fingers slightly until they make contact with a fish. Then work your hands gently along its belly until reaching its gills. Grasp the fish firmly just behind the gills and scoop it onto land.

Where to Fish

Freshwater Fishing

In fresh water, the deepest water is usually the best place to fish. In shallow streams, the best places are pools below falls, at the foot of rapids, or behind rocks. The best time to fish is usually early morning or late evening (figure 38). Sometimes fishing is best at night, especially in moonlight or if a light is available to attract the fish. You should be patient and fish at different depths in all kinds of water. Fishing at different times of the day and changing bait often are rewarding.

Freshwater Shellfish

Mangrove swamps are often good fishing grounds. At low tide, clusters of oysters and mussels are exposed on the mangrove "knees" or lower branches. Clams can be found in the mud at the base of trees. Crabs are very active among branches or roots and in the mud. Freshwater crawfish and snails can be found under rocks, logs, overhanging bushes, or in mud bottoms. Snails are found on mud and clinging to roots. Shellfish that are not covered at high tide or those from a colony containing diseased members should not be eaten. Some indications of diseased shellfish are shells gaping open at low tide, foul odor, or milky juice.

Ocean Fishing

At the ocean, fish, crabs, lobsters, crayfish, and small octopi can be poked out of holes, crevices, or rock pools. You should be ready to spear them before they move off into deep water. If they are in deeper water, they can be teased shoreward with a baited hook or a stick. Snails and limpets cling to rocks and seaweed from the low-water mark up. Large snails called chitons adhere tightly to rocks just above the surf line. Mussels usually form dense colonies in rock pools, on logs, or at the bases of boulders. Mussels are poisonous in tropical zones during the summer, especially when seas are highly phosphorescent or reddish.

Shrimp (prawns) live on or near the sea bottom and may be scraped up. They may be lured to the surface with light at night. A handmade net is excellent for catching shrimp. Lobsters are creeping crustaceans found on or near the sea bottom. A lobster trap, jig, baited hook, or dip net can be used to catch lobsters. Crabs will creep, climb, and burrow and are easily caught in shallow water with a dip net or in traps baited with fish heads or animal viscera.

Sluggish sea cucumbers and conchs (large snails) live in deep water. The sea cucumber will shoot out its stomach when excited. The stomach is not edible. The skin and the five strips of muscle can be eaten after boiling. Conches can be boiled out of their shells and have very firm flesh. Use care when picking conches up. The bottom of their "foot" has a bony covering, which can severely cut anyone who touches it.

The safest ocean fish to eat are those from the open sea or deep water beyond the reef. Silvery fishes, river eels, butterfly fishes, and flounders from bays and rivers are good to eat. Land crabs are common on tropical islands and are often found in coconut groves.

Plant Food

The thought of having a diet consisting only of plant food is often distressing to stranded hikers. If you know what to look for, can identify it, and know how to prepare it properly for eating, there is no reason why you can't find adequate sustenance.

Plants provide carbohydrates, which provide body energy and calories. Carbohydrates keep weight and energy up, and include important starches and sugars.

Finding Plants to Eat

Another advantage of a plant diet is availability. In many instances, procuring animal food may be out of the question because of injury, exhaustion, or being in an area that lacks wildlife. Experts estimate there are about three hundred thousand classified plants growing on the surface of the Earth, including many that thrive on mountaintops and on the floors of the oceans. There are two considerations that you must keep in mind when looking for plant foods. The first consideration, of course, is that the plant be edible and, preferably, palatable. Next, it must be fairly abundant in the area in which it is found. If its family includes an inedible or poisonous variety, the edible plant must be distinguishable to the average eye from the poisonous one. Usually a plant is selected because one special part, such as the stalk, the fruit, or the nut, is edible.

General Edibility Rules

To aid in determining plant edibility, there are general rules that should be observed and an edibility test that should be performed. Select plants resembling those cultivated by people. It is risky to rely upon a plant (or parts thereof) being edible for human consumption simply because animals have been seen eating it (for example, horses eat leaves from poison ivy; some rodents eat poisonous mushrooms). When selecting an unknown plant as a possible food source, apply the following general rules:

- Do not select mushrooms and fungi. Fungi have toxic peptides, a protein-based poison that has no taste. There is no field test other than eating to determine whether an unknown mushroom is edible. Anyone gathering wild mushrooms for eating must be absolutely certain of the identity of every specimen picked. Some species of wild mushrooms are difficult for an expert to identify. Because of the potential for poisoning, relying on mushrooms as a viable food source is not worth the risk.
- Plants with umbrella-shaped flowers are to be completely avoided, although carrots, celery, dill, and parsley are members of this family. One of the most poisonous plants, poison water hemlock, is also a member of this family (figure 39).
- All of the (wild) legume family (beans and peas) should be avoided. They absorb certain minerals from the soil that can cause problems. The common mineral absorbed is selenium; it is what has given locoweed its fame.
- As a general rule, avoid all bulbs. Examples of poisonous bulbs are tulips and death camas.

- Avoid white and yellow berries, as they are almost always poisonous. Blue or black berries are generally safe for consumption.
- Aggregated fruits and berries are always edible (for example, thimbleberry, raspberry, salmonberry, and blackberry).
- Single fruits on a stem are generally considered safe to eat.
- Plants with shiny leaves are considered to be poisonous and caution should be used.
- A milky sap indicates a poisonous plant.
- Plants that are irritants to the skin, such as poison ivy, should not be eaten.
- Plants growing in the water or moist soil are often the most palatable.
- Plants are less bitter when growing in shaded areas.

This information concerning plants is general. There are exceptions to every rule.

Plant Edibility Test

When selecting unknown plants for consumption, plants with the characteristics described in this test should be avoided. Plants that do not have these characteristics should be considered as possible food sources. Apply the edibility test to only one plant at a time so that if some abnormality does occur, it will be obvious which plant caused the problem.

Once a plant has been selected for the edibility test, proceed as follows:

1. Crush or break part of the plant to determine the color of its sap. If the sap is clear, proceed to the next step.
2. Touch the plant's sap or juice to the inner forearm or tip of the tongue. (A small taste of a poisonous plant will not do serious harm.) If there are no ill effects, such as a rash or burning sensation to the skin, bitterness to the taste, or numbing sensation of the tongue or lips, then proceed with the rest of the steps. *Note:* Sometimes heavy smokers are unable to taste various poisons, such as alkaloids.
3. Prepare the plant or plant part for consumption by boiling in two changes of water. The toxic properties of many plants are water soluble or destroyed by heat; cooking and discarding in two changes of water lessens the amount of poisonous material or removes it completely. Parboiling is a process of boiling the individual plant parts in repeated changes of water to remove bitter elements. This boiling period should last about 5 minutes.
4. Place about 1 teaspoon of the prepared plant food in the mouth for 5 minutes and chew but do not swallow it. A burning, nauseating, or bitter taste is a warning of possible danger. If any of these ill effects occur, remove the material from the mouth at once and discard that plant as a food source. However, if no burning sensation or other unpleasant effect occurs, swallow the plant material and wait 8 hours.
5. If after 8 hours there are no ill effects, such as nausea, cramps, or diarrhea, eat about 2 tablespoonfuls and wait an additional 8 hours.
6. If no ill effects occur at the end of this 8-hour period, the plant may be considered edible.

7. Keep in mind that any new or strange food should be eaten with restraint until the body system has become accustomed to it. The plant may be slightly toxic and harmful when large quantities are eaten.

If cooking facilities are not available, you will not be able to boil the plant before consumption. In this case, plant food may be prepared as follows:

- Leach the plant by crushing the plant material and placing it in a container. Pour large quantities of cold water over it (rinse the plant parts). Leaching removes some of the bitter elements of nontoxic plants.
- If leaching is not possible, you should follow the steps you can in the edibility test.

You will find some plants that are completely edible, but many plants will have only one or a few identifiable parts with food and thirst-quenching value. The variety of plant component parts that might contain substances of food value is shown in figure 40.

Edible Plant Parts

Tubers

The potato is an example of an edible tuber. Many other kinds of plants produce tubers, such as the tropical yam, the Eskimo potato, and tropical water lilies. Tubers are usually found below the ground. Tubers are rich in starch and should be cooked by roasting in an earth oven or by boiling to break down the starch for ease in digestion. The following are some of the plants with edible tubers:

- East Indian arrowroot
- Taro
- Cassava (tapioca)
- Chufa (nut grass)
- Water lily (tropical)
- Sweet potato (kamote)
- Tropical yam

Roots and Rootstocks

Many plants produce roots that may be eaten. Edible roots are often several feet in length. In comparison, edible rootstocks are underground portions of the plant which have become thickened, and are relatively short and jointed. Both true roots and rootstocks are storage organs rich in starch. The following are some of the plants with edible roots or rootstocks (rhizomes):

- Baobab
- Screw pine
- Goa bean
- Water plantain
- Bracken
- Reindeer moss
- Wild calla (water arum)
- Rock tripe
- Polypody
- Canna
- Flowering rush
- Cattail
- Ceylon spinach
- Chicory
- Horseradish
- Tree fern
- Water lily (temperate zone)
- Manioc

Bulbs

The most common edible bulb is the wild onion, which can easily be detected by its characteristic odor. Wild onions may be eaten uncooked, but other kinds of bulbs are more palatable if cooked. All bulbs contain a high percentage of starch. (Some bulbs are poisonous, such as death camas, which have white or yellow flowers.) The following are some of the plants with edible bulbs:

- Wild lily
- Wild tulip
- Wild onion
- Blue camas

Shoots (Stems)

All edible shoots grow in much the same fashion as asparagus. The young shoots of ferns (fiddleheads) and especially those of bamboo and numerous kinds of palms are desirable for food. Some kinds of shoots may be eaten raw, but most are better if first boiled for 5 to 10 minutes, the water drained off, and the shoots reboiled until they are sufficiently cooked for eating (parboiled). (See figure 41.)

- Agave (century plant)
- Coconut palm
- Purslane
- Reindeer moss
- Bamboo
- Fishtail palm
- Goa bean
- Nipa palm
- Bracken
- Rattan palm
- Wild rhubarb
- Cattail
- Sago palm
- Ceylon spinach
- Rock tripe
- Colocynth
- Sugar palm
- Papaya
- Sugar cane
- Lotus lily
- Pokeweed (poisonous roots)
- Sweet potato (kamote)
- Loofah sponge
- Water lily (tropical)
- Polypody
- Buri palm
- Arctic willow

Leaves

The leaves of spinach-type plants (potherbs), such as wild mustard, wild lettuce, and lamb's-quarters, may be eaten either raw or cooked. Prolonged cooking, however, destroys most of the vitamins. Plants that produce edible leaves are perhaps the most numerous of all edible plants. The young tender leaves of nearly all nonpoisonous plants are edible. The following are only some of the plants with edible leaves:

- Amaranth
- Loofah sponge
- Rock tripe
- Avocado
- Mango
- Wild sorrel
- Baobab
- Sea orach
- Goa bean
- Papaya
- Ceylon spinach
- Cassava
- Chickory
- Screw pine

- Spreading wood fern
- Dock
- Plantain
- Pokeweed (poisonous roots)
- Sweet potato (kamote)
- Tamarind
- Horseradish
- Prickly pear
- Taro (only after cooking)
- Water lettuce
- Purslane
- Ti plant
- Arctic willow
- Lotus lily
- Reindeer moss

Bark
The inner bark of a tree—the layer next to the wood—may be eaten raw or cooked. It is possible in northern areas to make flour from the inner bark of such trees as the cottonwood, aspen, birch, willow, and pine. The outer bark should be avoided in all cases because this part contains large amounts of bitter tannin. Pine bark is high in vitamin C. The outer bark of pines can be cut away and the inner bark stripped from the trunk and eaten fresh, dried, or cooked, or it may be pulverized into flour. Bark is most palatable when newly formed in spring. As food, bark is most useful in arctic regions, where plant food is scarce.

Fruits
Edible fruits can be divided into sweet and nonsweet (vegetable) types. Both are the seed bearing parts of the plant. Sweet fruits are often plentiful in all areas of the world where plants grow. For instance, in the far north, there are blueberries and crowberries; in the temperate zones, cherries, plums, and apples; and in the American deserts, fleshy cactus fruits. Tropical areas have more kinds of edible fruit than other areas, and a list would be endless. Sweet fruits may be cooked or, for maximum vitamin content, left uncooked. Common vegetable fruits include the tomato, cucumber, and pepper.

Fleshy Fruits (Sweet). The following are plants with edible fruits:

- Wild apple
- Banana
- Wild blueberry
- Bullocks heart
- Cloudberry
- Crabapple
- Cranberry
- Wild fig
- Wild grape
- Huckleberry
- Jackfruit
- Jujube
- Mango
- Mulberry
- Papaya
- Plum
- Pokeberry
- Prickly pear
- Rose apple
- Soursop
- Sweetsop

Fleshy Fruits (Vegetables). The following are plants with edible fruits:

- Breadfruit
- Horseradish
- Plantain
- Wild caper
- Loofah sponge

Seeds and Grains

Seeds of many plants, such as buckwheat, ragweed, amaranth, and goosefoot, contain oils and are rich in protein. The grains of all cereals and many other grasses, including millet, are also extremely valuable sources of plant protein. They may either be ground between stones, mixed with water, and cooked to make porridge; or parched or roasted over hot stones. In this state, they are still wholesome and may be kept for long periods without further preparation (figure 42). The following are some of the plants with edible seeds and grains:

- Amaranth
- Italian millet
- Rice
- Bamboo
- Pearl millet
- Nipa palm
- Tamarind
- Screw pine
- Colocynth
- Water lily (tropical)
- Sterculia
- Baobab
- St. John's bread
- Goa bean
- Lotus lily
- Purslane
- Water lily (temperate)
- Loofah sponge

Nuts

Nuts are among the most nutritious of all raw plant foods and contain an abundance of valuable protein. Plants bearing edible nuts occur in all the climatic zones of the world and in all continents except in the arctic regions. Inhabitants of the temperate zones are familiar with walnuts, filberts, almonds, hickory nuts, acorns, hazelnuts, beechnuts, and pine nuts, to mention just a few. Tropical zones produce coconuts and other palm nuts, brazil nuts, cashew nuts, and macadamia nuts (figure 43). Most nuts can be eaten raw, but some—such as acorns—are better when cooked. The following are some of the plants with edible nuts:

- Almond
- Water chestnut
- Buri palm
- Mountain chestnut
- Coconut palm
- Beechnut
- Filbert (hazelnut)
- Fishtail palm
- Jackfruit seeds
- English oak (acorn)
- Sago palm
- Sugar palm
- Pine
- Wild pistachio
- Walnut

Gums and Resins

Gums and resins are sap that collects and hardens on the outside surface of the plant. It is called gum if it is soft and soluble, and resin if it is hard and not soluble. Most people are familiar with the gum that exudes from cherry trees and the resin that seeps from pine trees. These plant byproducts are edible and are a good source of nutritious food.

Saps

Vines or other plant parts may be tapped as potential sources of usable liquid. The liquid is obtained by cutting the flower stalk and letting the fluid drain into some sort of container. Palm sap, with its high sugar content, is highly nutritious. The following are some plants that yield edible sap or drinking water:

- Sweet acacia (water)
- Colocynth (water)
- Coconut palm (sap)
- Fishtail palm (sap)
- Agave (water)
- Saxual (water)
- Nipa palm (sap)
- Rattan palm (water)
- Cactus (water)
- Grape (water)
- Banana (water)
- Sago palm (sap)
- Sugar palm (sap)
- Buri palm (sap)

Appendix

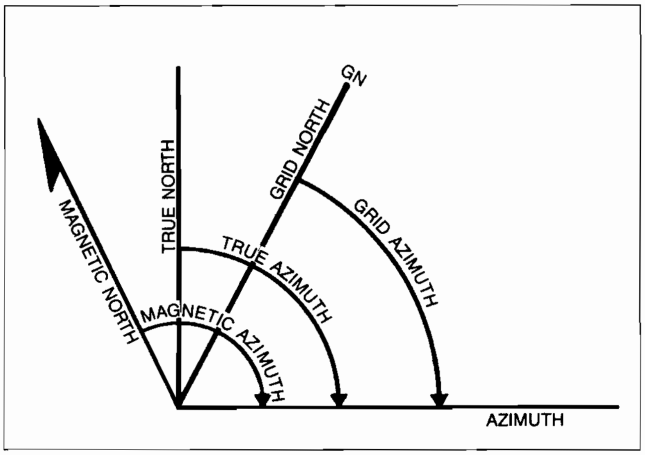


Figure 1. True, Grid, and Magnetic Azimuths

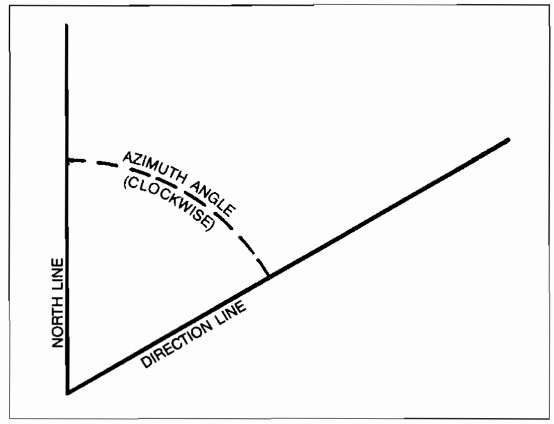


Figure 2. Azimuth Angle

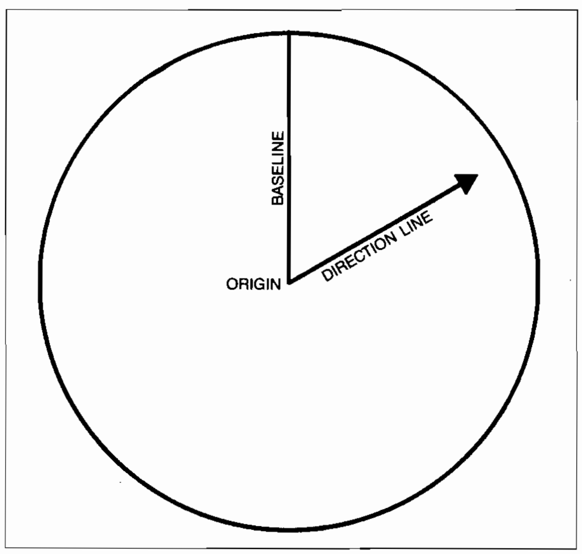


Figure 3. Origin of Azimuth Circle

Figure 4. Lensatic Compass

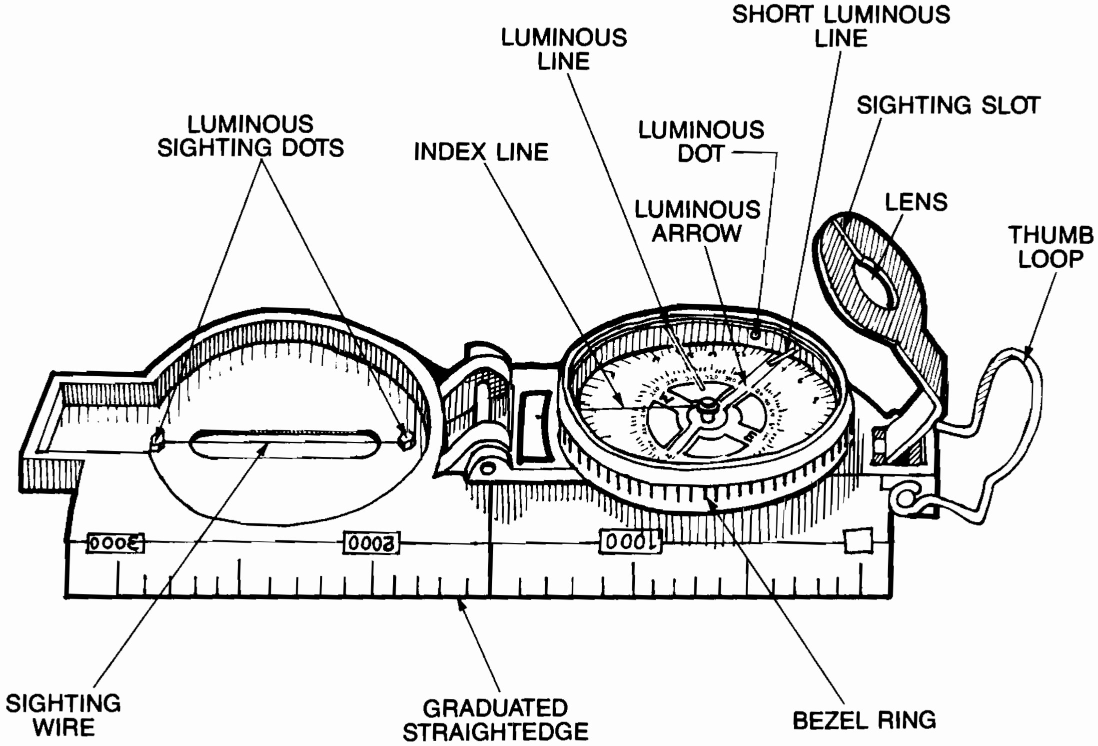
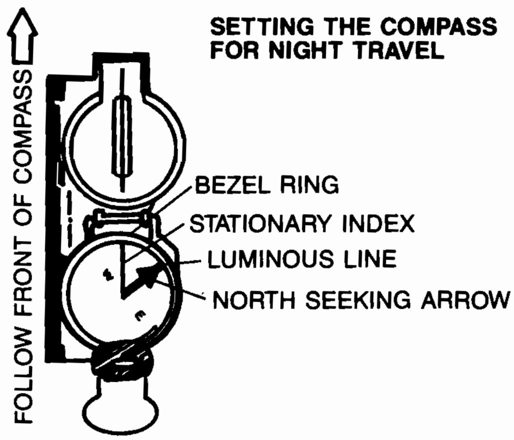


Figure 5. Holding the Compass

Figure 6. Setting Compass for Night Travel



Each click of the bezel ring equals 3 degrees.

Heading between 0 and 180 degrees is divided by 3. Sum is number of clicks to the left of stationary index line. Heading between 180 and 360 degrees, subtract heading from 360 then divide sum by 3. New sum is the number of clicks to the right from stationary index line.

Examples
Heading of 027° = 9 clicks left
Heading of 300° = 20 clicks right

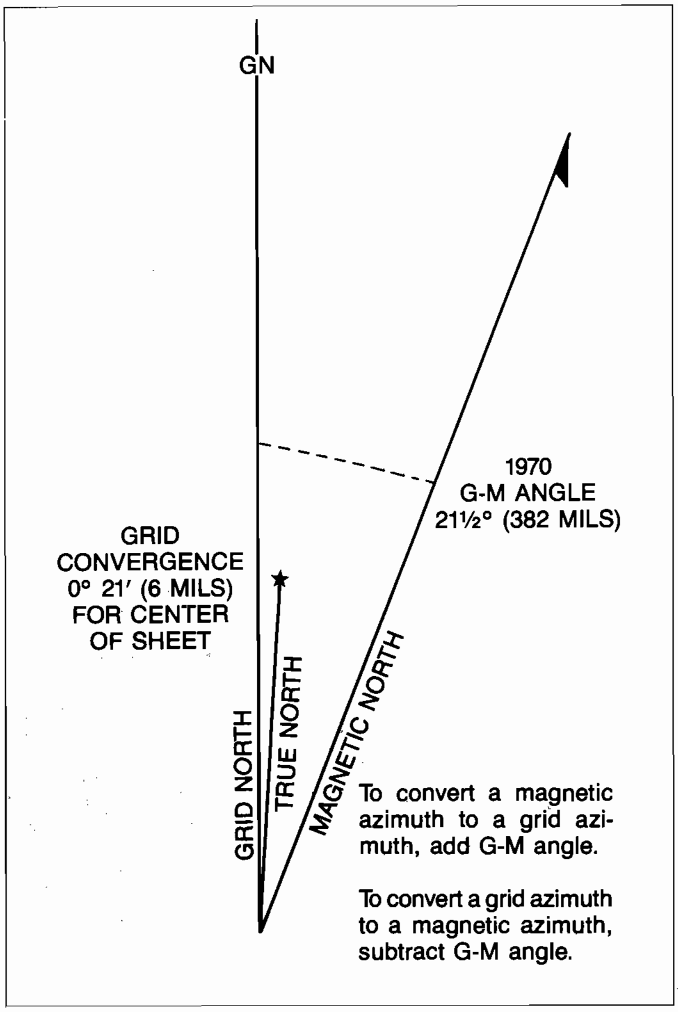


Figure 7. Magnetic North

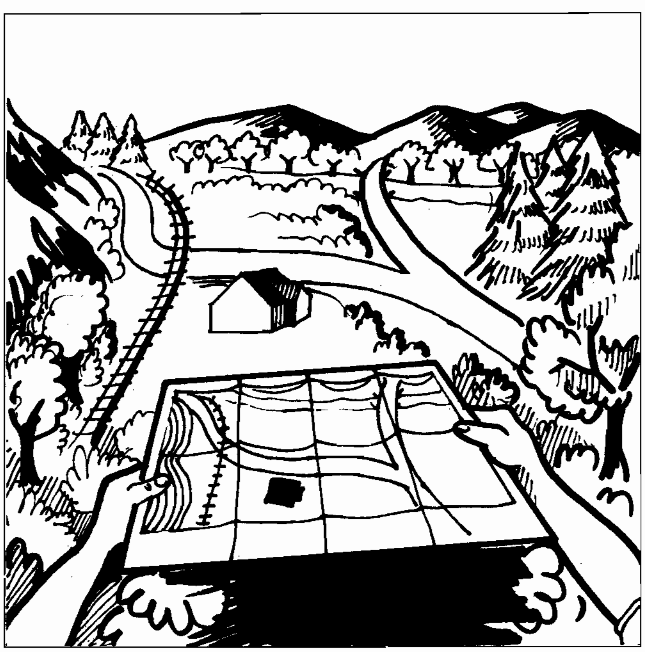


Figure 9. Orienting a Map

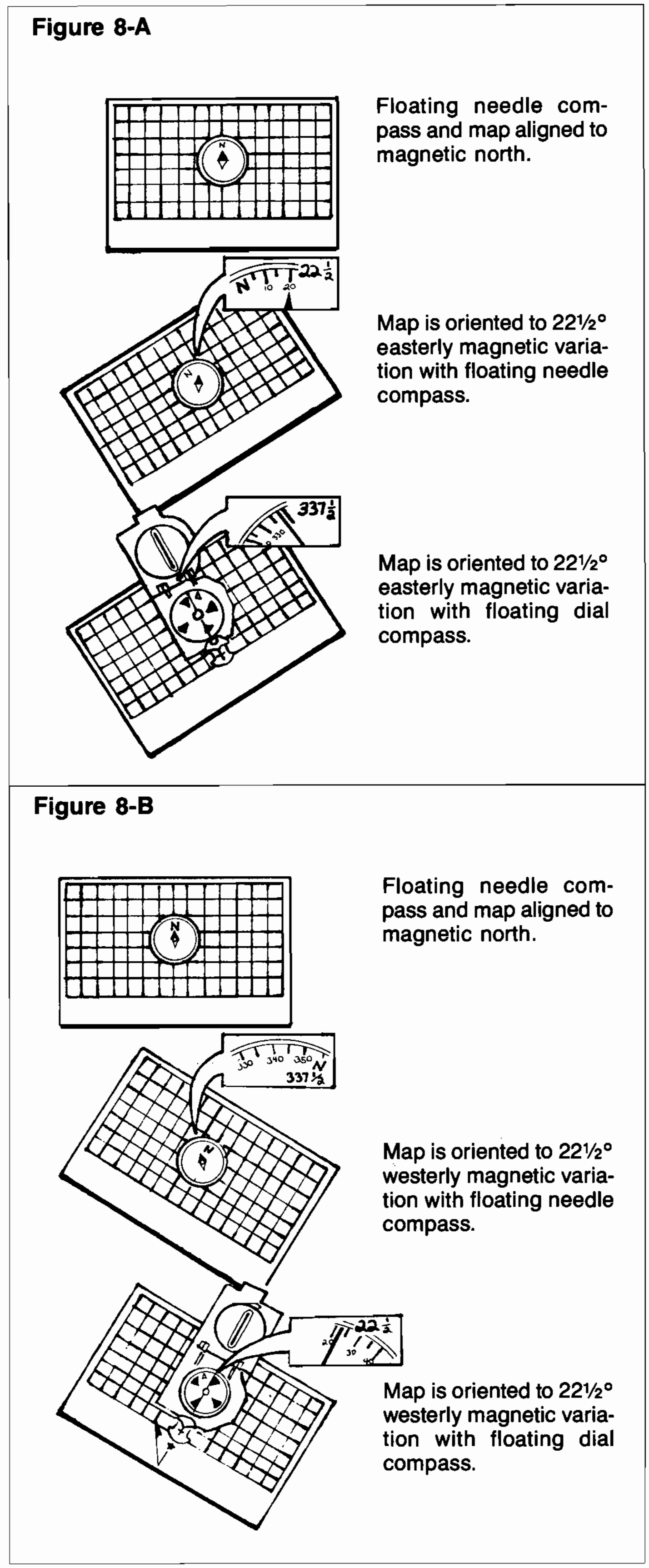


Figure 8. Floating Needle Compass

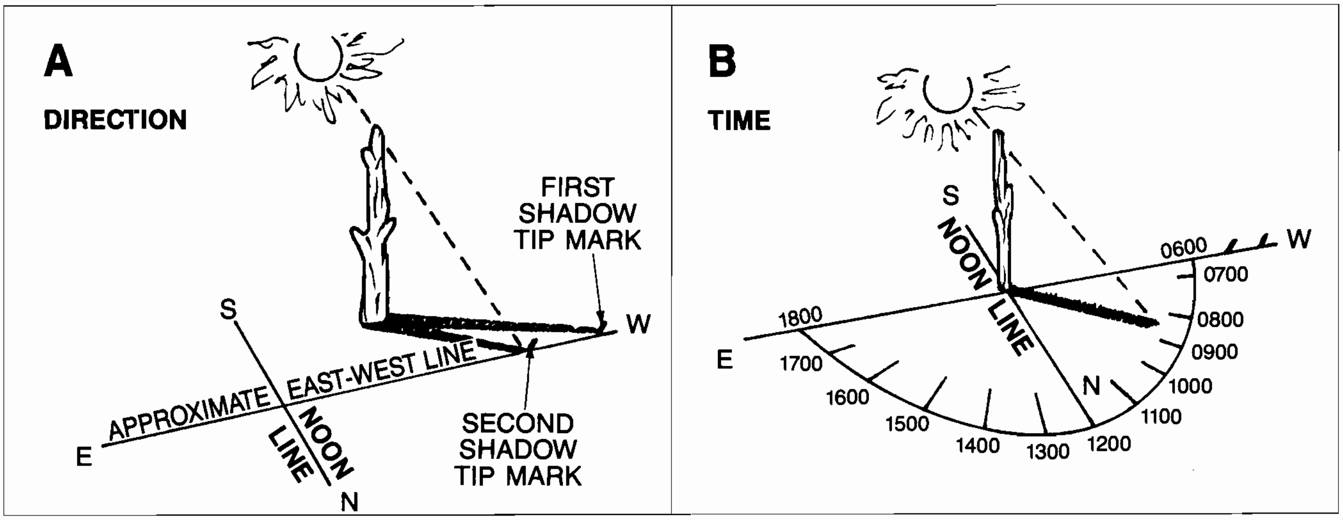


Figure 10. Determining Direction and Time by the Sun

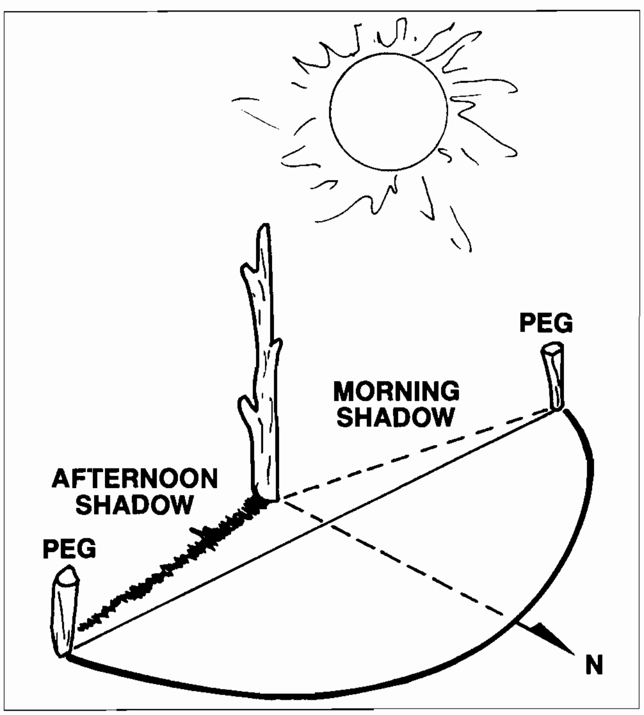


Figure 11. Equal-Shadow Method of Determining Direction

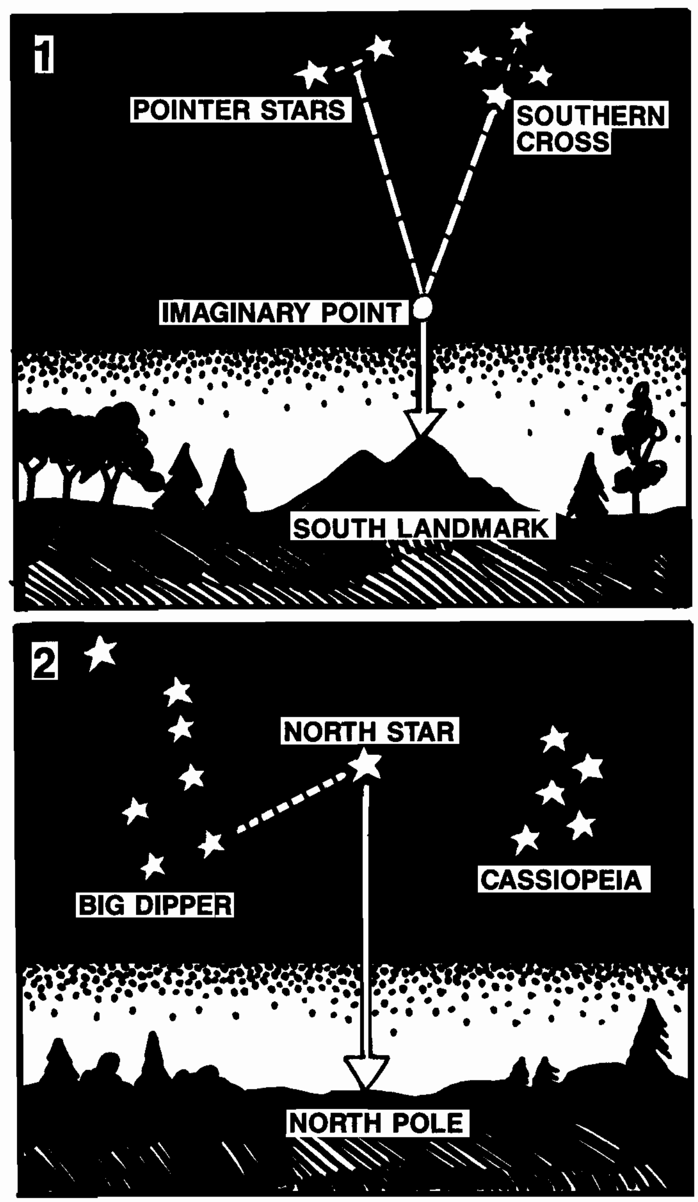


Figure 12. Using the Stars

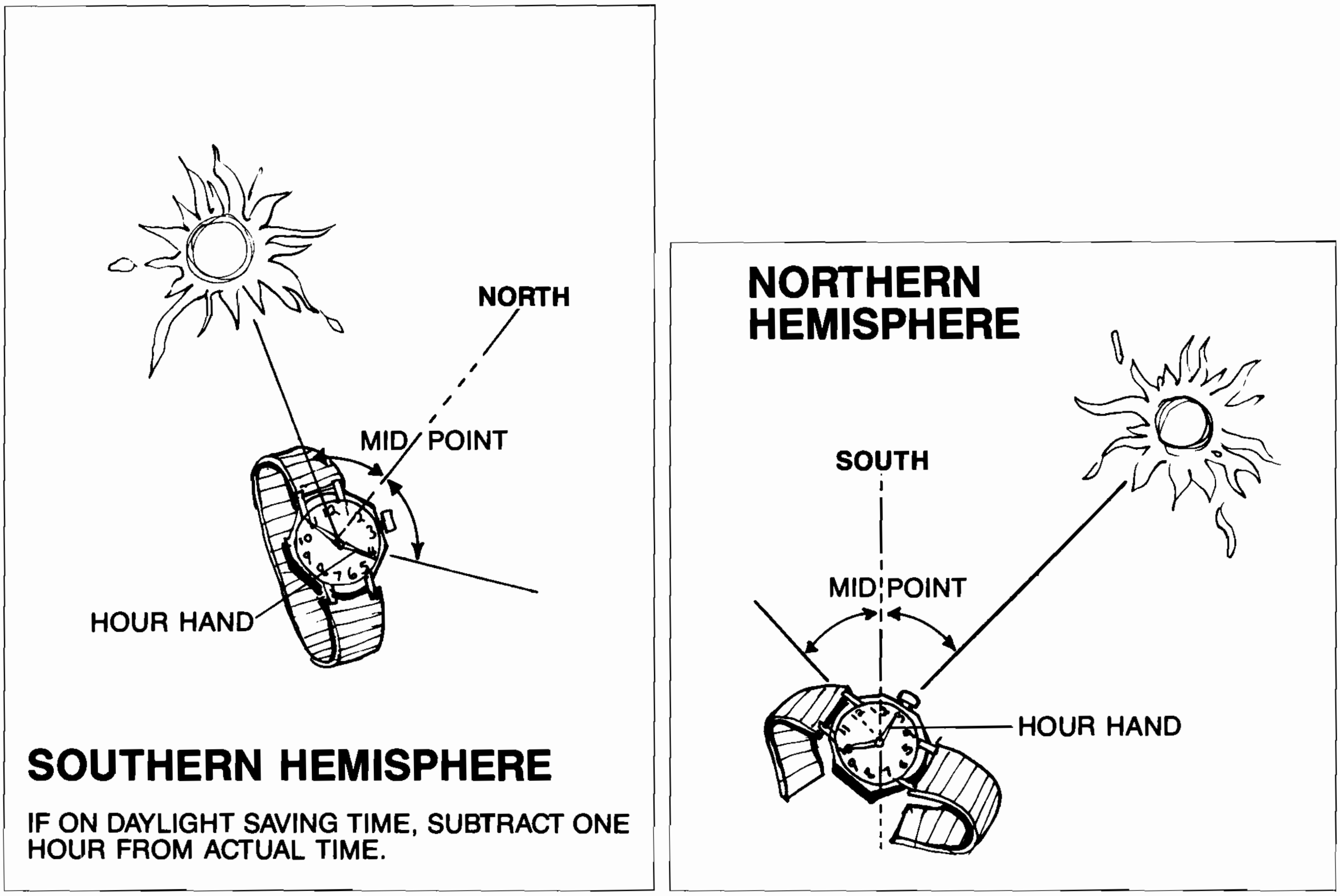


Figure 13. Using a Watch to Determine Direction

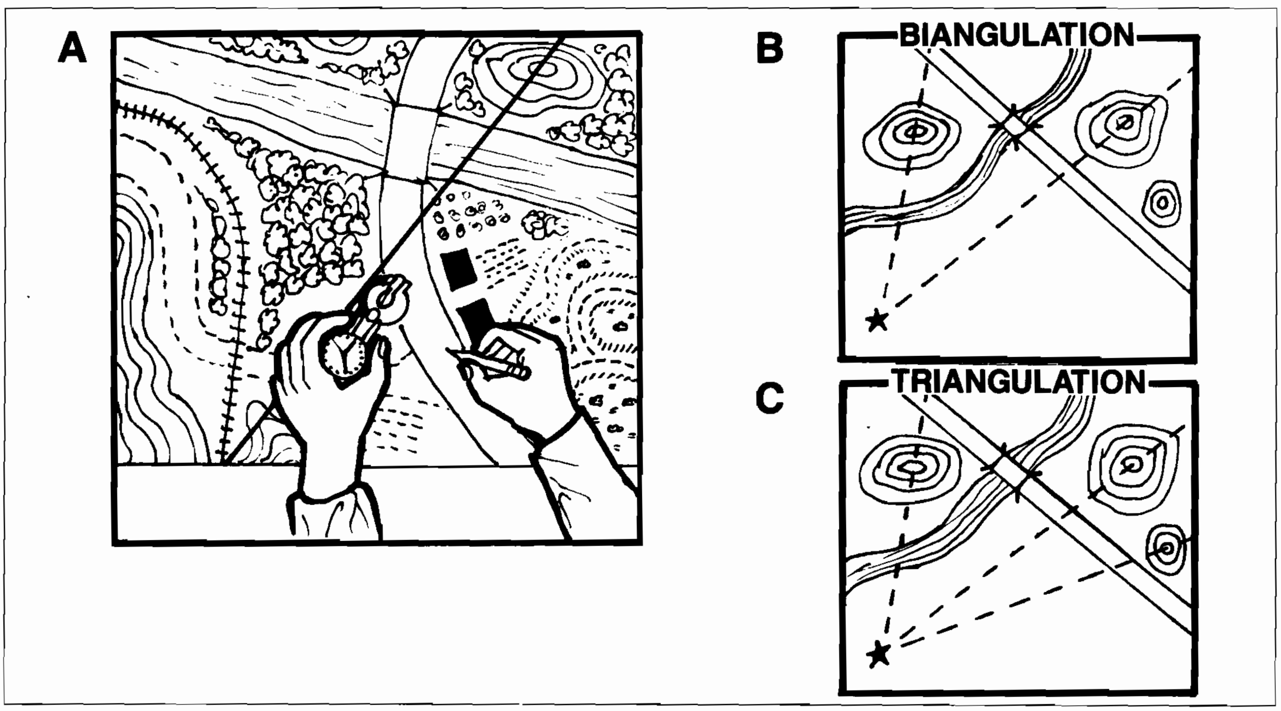


Figure 14. Using Map and Compass

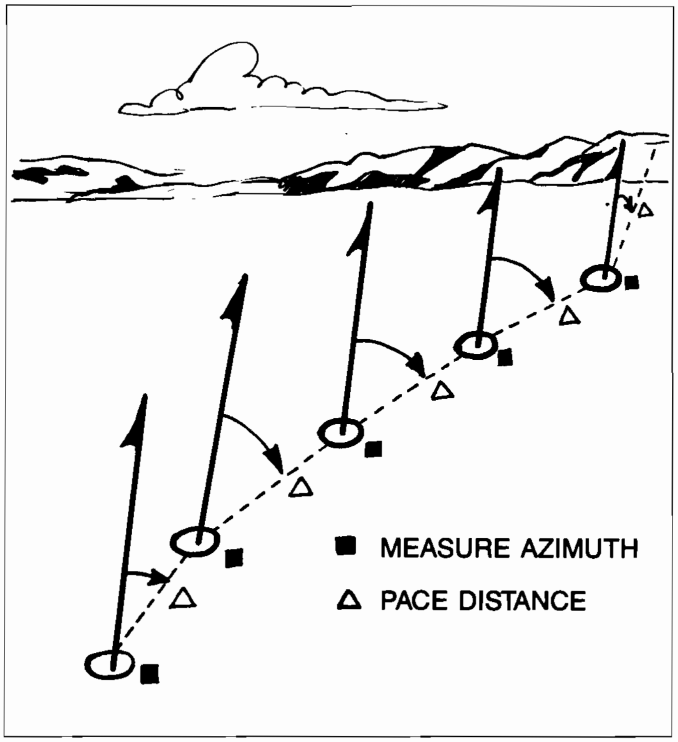


Figure 15. Measuring Distance by Paces

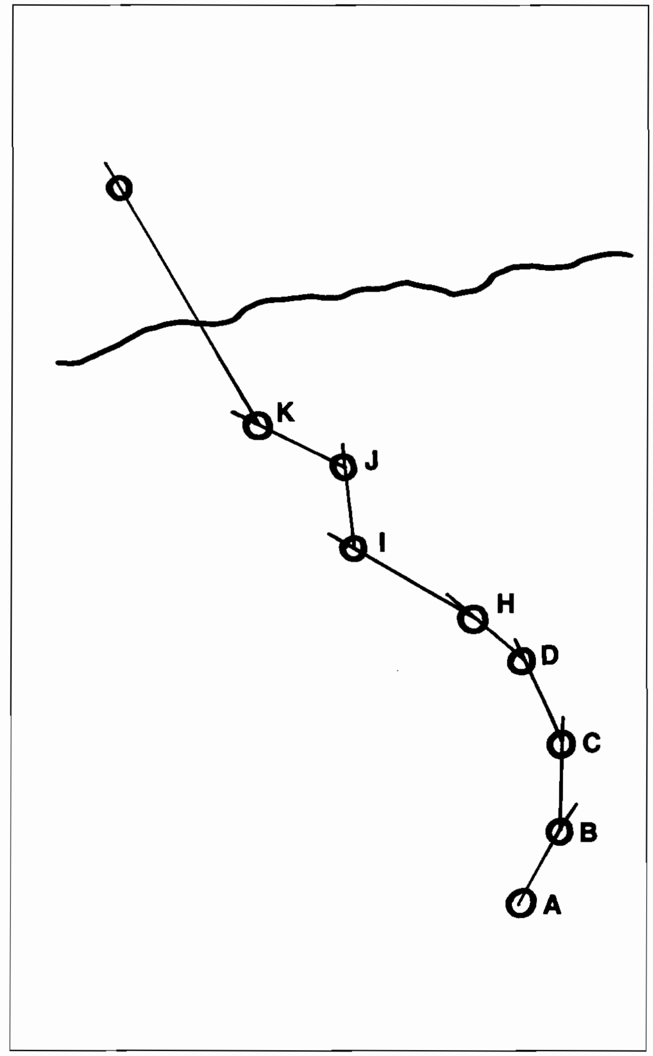


Figure 16. Plotting Data from a Log

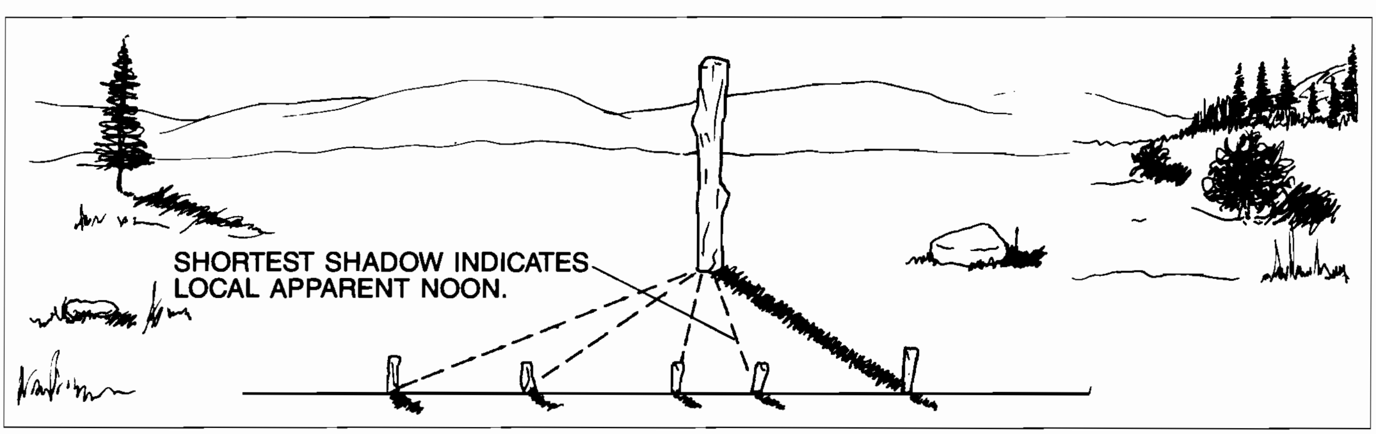


Figure 17. Using Stick and Shadow

DATE	EQ. OF TIME*	DATE	EQ. OF TIME*	DATE	EQ. OF TIME*	DATE	EQ. OF TIME*	DATE	EQ. OF TIME*	DATE	EQ. OF TIME*
JAN. 1	- 3.5 MIN.	MAR. 4	-12.0 MIN.	MAY 2	+3.0 MIN.	AUG. 4	-6.0 MIN.	OCT. 1	+10.0 MIN.	DEC. 1	+11.0 MIN.
2	- 4.0	8	-11.0	14	+3.8	12	-5.0	4	+11.0	4	+10.0
4	- 5.0	12	-10.0	MAY 28	+3.0	17	-4.0	7	+12.0	6	+ 9.0
7	- 6.0	16	- 9.0			22	-3.0	11	+13.0	9	+ 8.0
9	- 7.0	19	- 8.0	JUNE 4	+2.0	26	-2.0	15	+14.0	11	+ 7.0
						AUG. 29	-1.0				
12	- 8.0	22	- 7.0	9	+1.0	SEPT. 1	0.0	20	+15.0	13	+ 6.0
14	- 9.0	26	- 6.0	14	0.0	5	+1.0	OCT. 27	+16.0	15	+ 5.0
17	-10.0	MAR. 29	- 5.0	19	-1.0	8	+2.0			17	+ 4.0
20	-11.0	APR. 1	- 4.0	23	-2.0	10	+3.0			19	+ 3.0
24	-12.0	5	- 3.0	JUNE 28	-3.0	13	+4.0	NOV. 4	+16.4	21	+ 2.0
JAN. 28	-13.0	8	- 2.0			16	+5.0	11	+16.0	23	+ 1.0
FEB. 4	-14.0	12	- 1.0	JULY 3	-4.0	19	+6.0	17	+15.0	25	0.0
13	-14.3	16	0.0	9	-5.0	22	+7.0	22	+14.0	27	- 1.0
19	-14.0	20	+ 1.0	18	-6.0	25	+8.0	25	+13.0	29	- 2.0
FEB. 28	-13.0	APR. 25	+ 2.0	JULY 27	-6.6	SEPT. 28	+9.0	NOV. 28	+12.0	DEC. 31	- 3.0

*ADD PLUS VALUES TO MEAN TIME AND SUBTRACT MINUS VALUES FROM MEAN TIME TO GET APPARENT TIME.

Figure 18. Computing Apparent Time

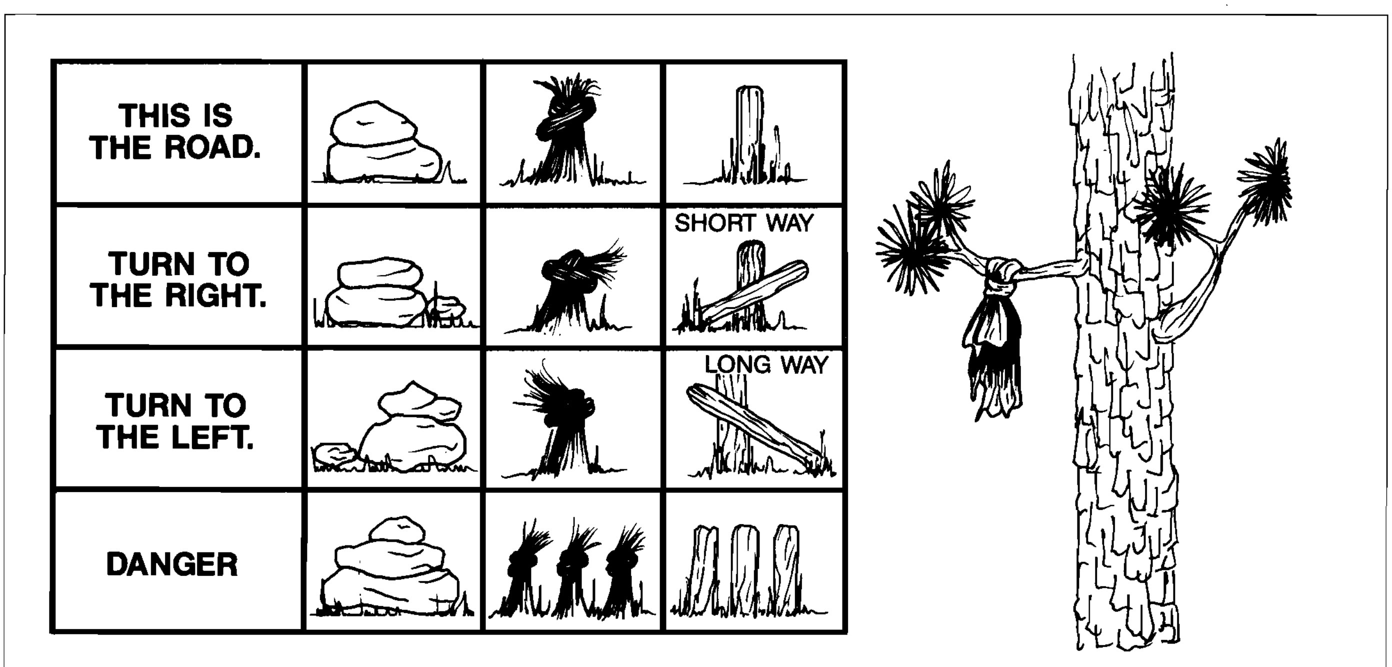


Figure 19. Marking a Trail

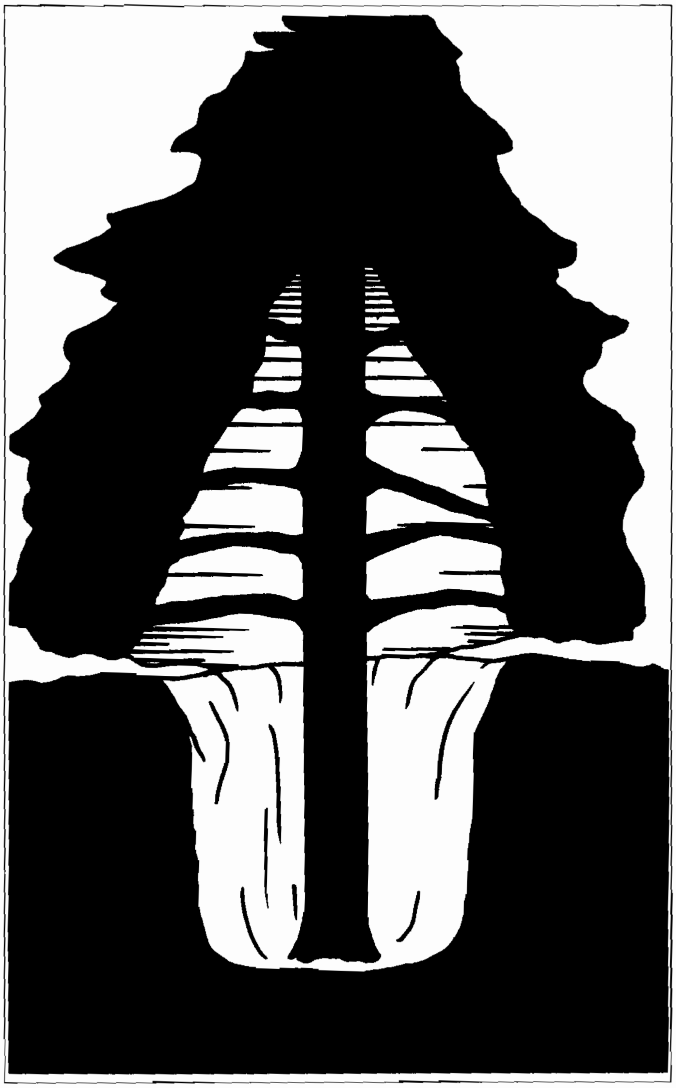


Figure 20. Natural Shelters

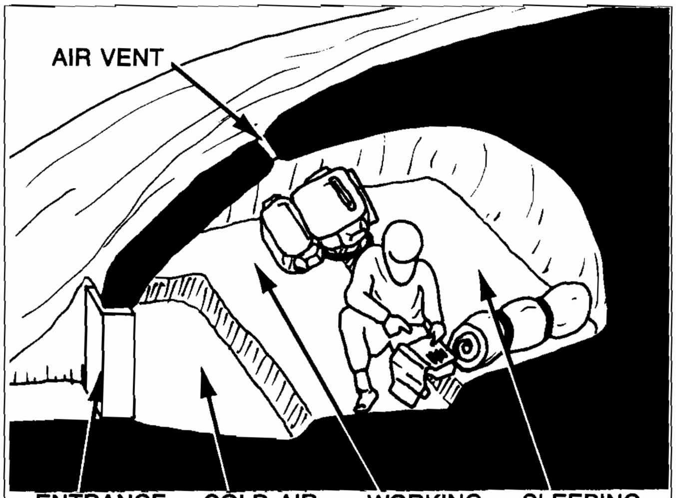


Figure 21. Ventilating a Snow Cave

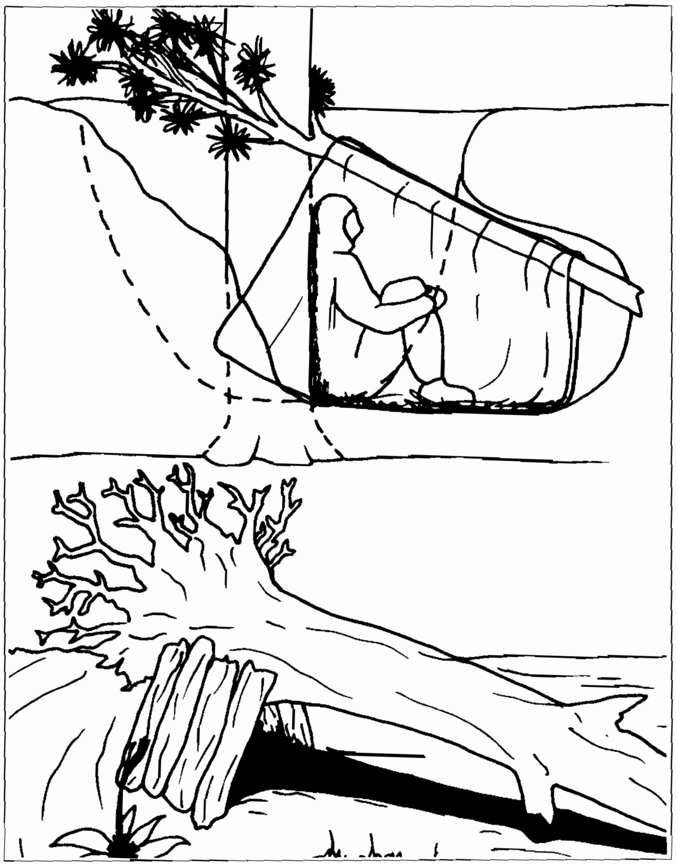


Figure 22. Natural Shelter Formations

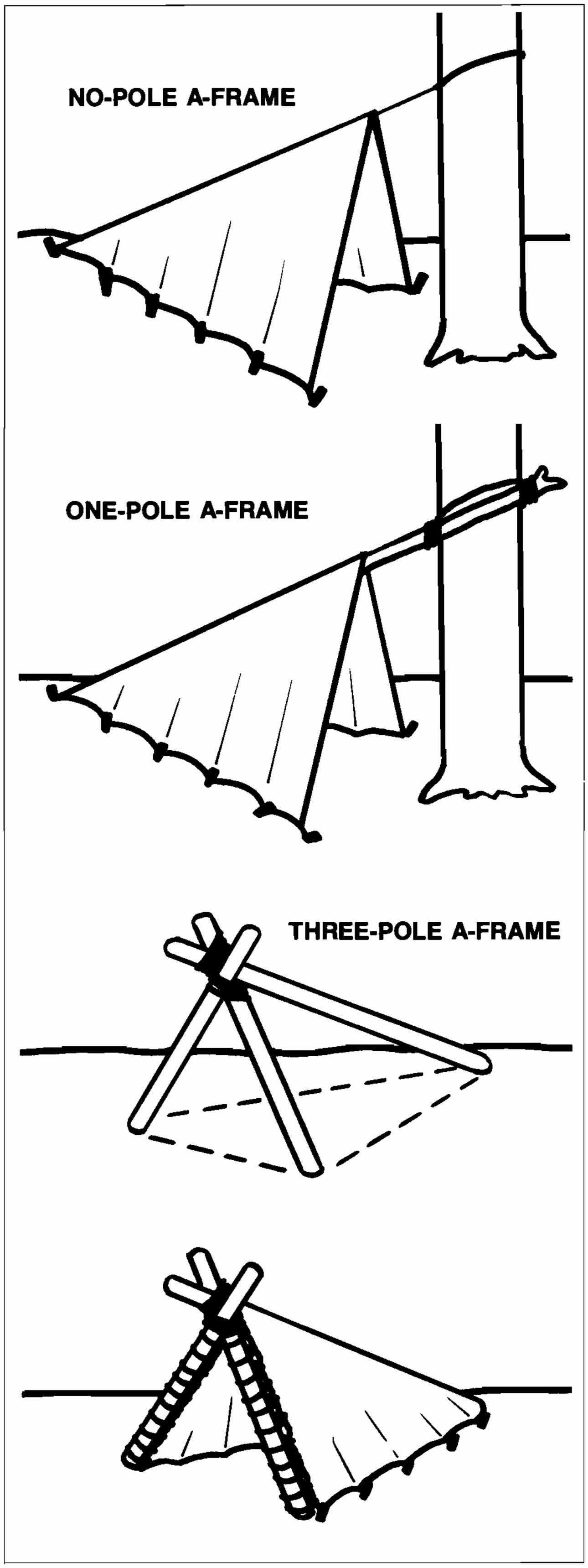


Figure 23. A-Frame Shelters

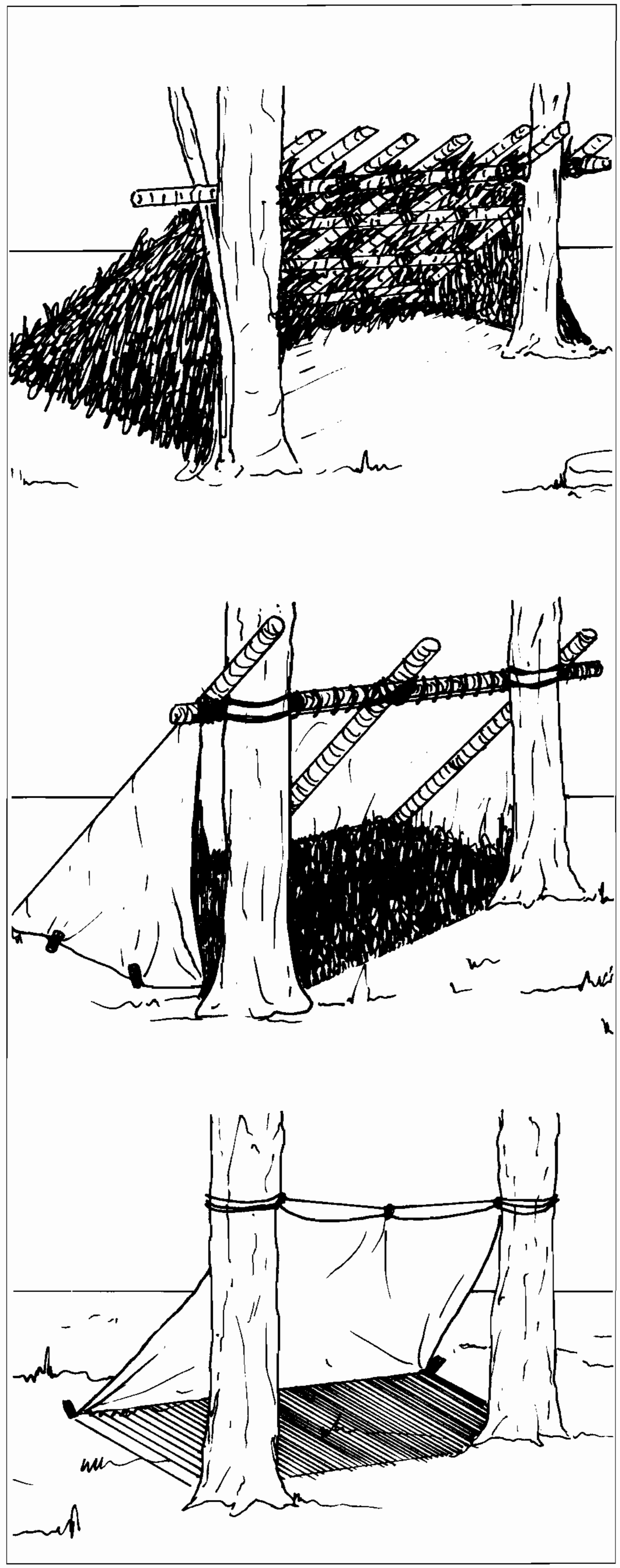


Figure 24. Lean-to Shelters

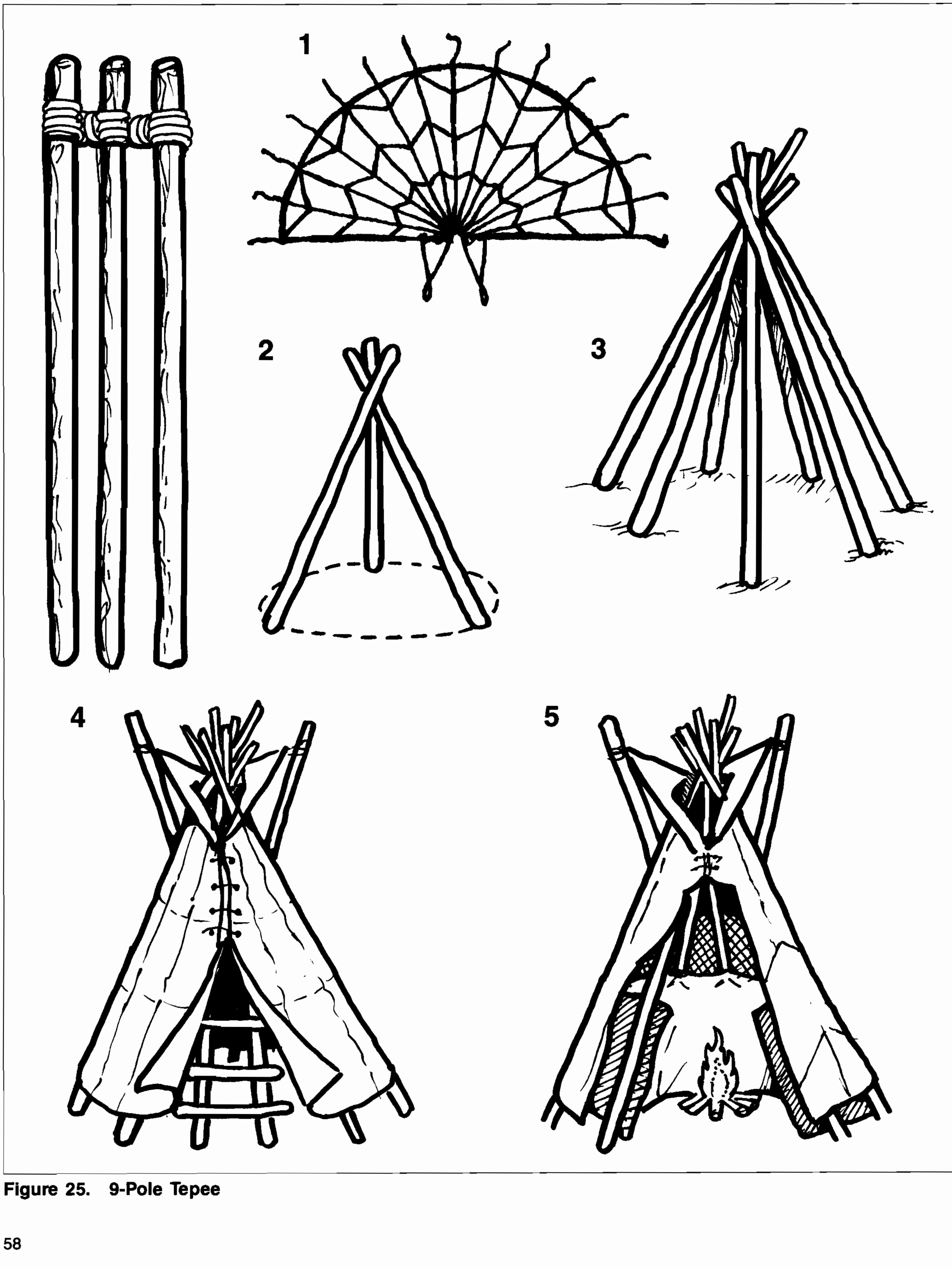


Figure 25. 9-Pole Tepee

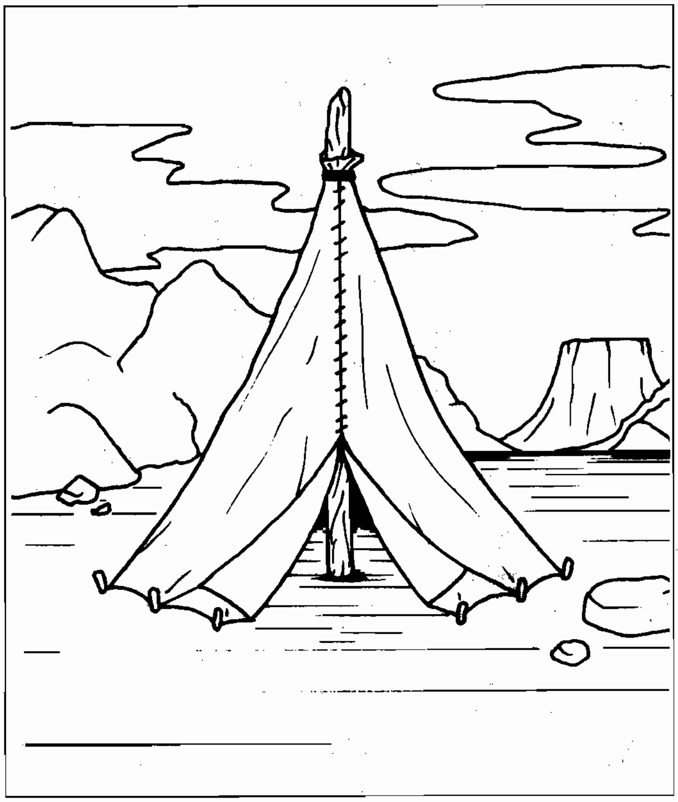


Figure 26. Making a Door

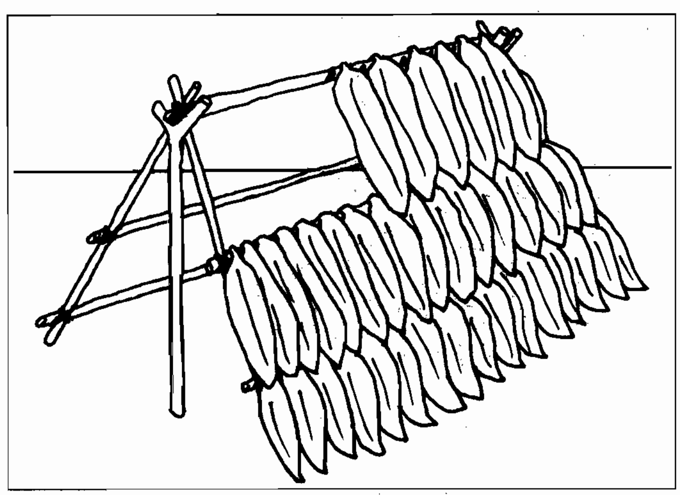


Figure 27. Rain Shelter

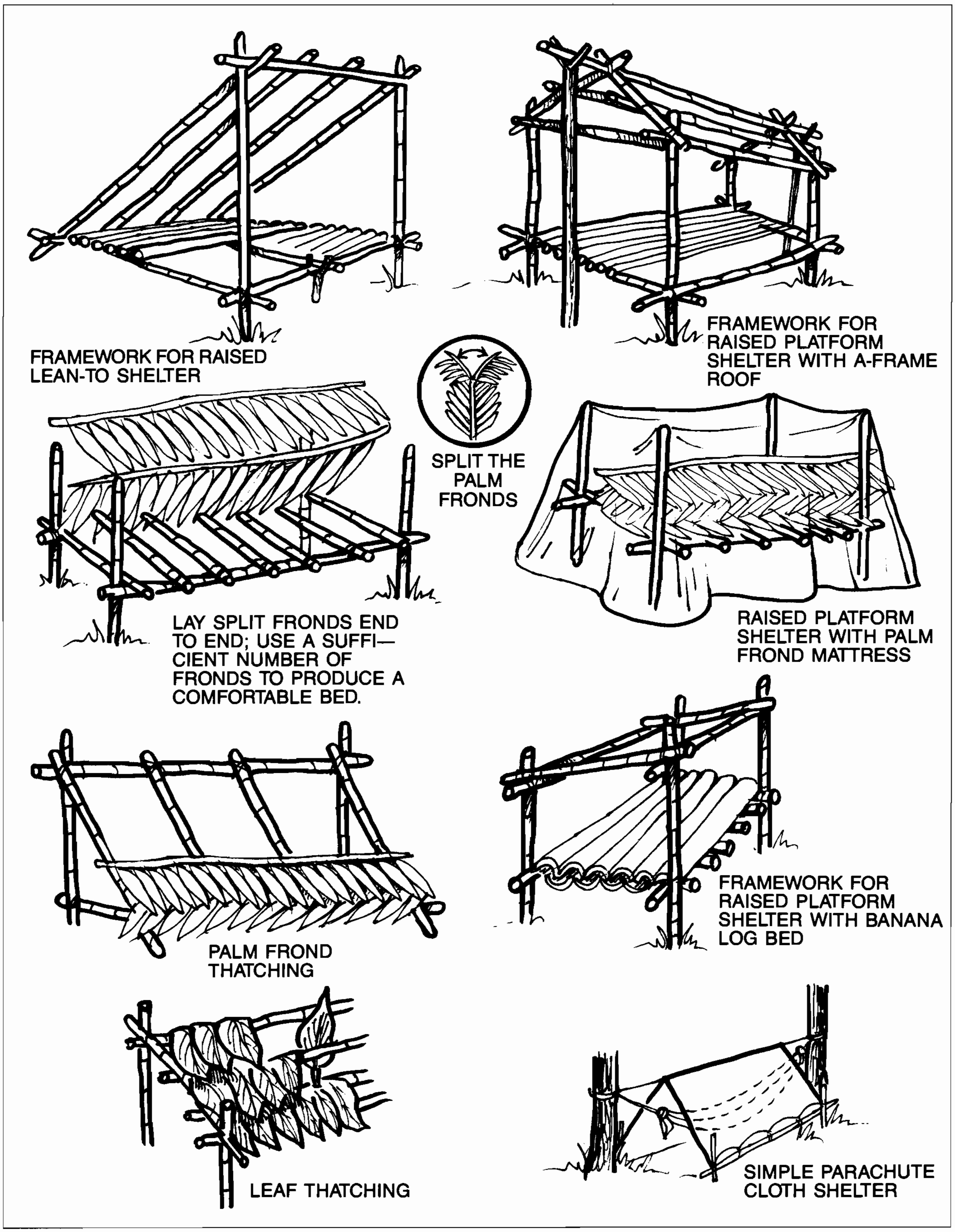


Figure 28. Raised Platform Shelter

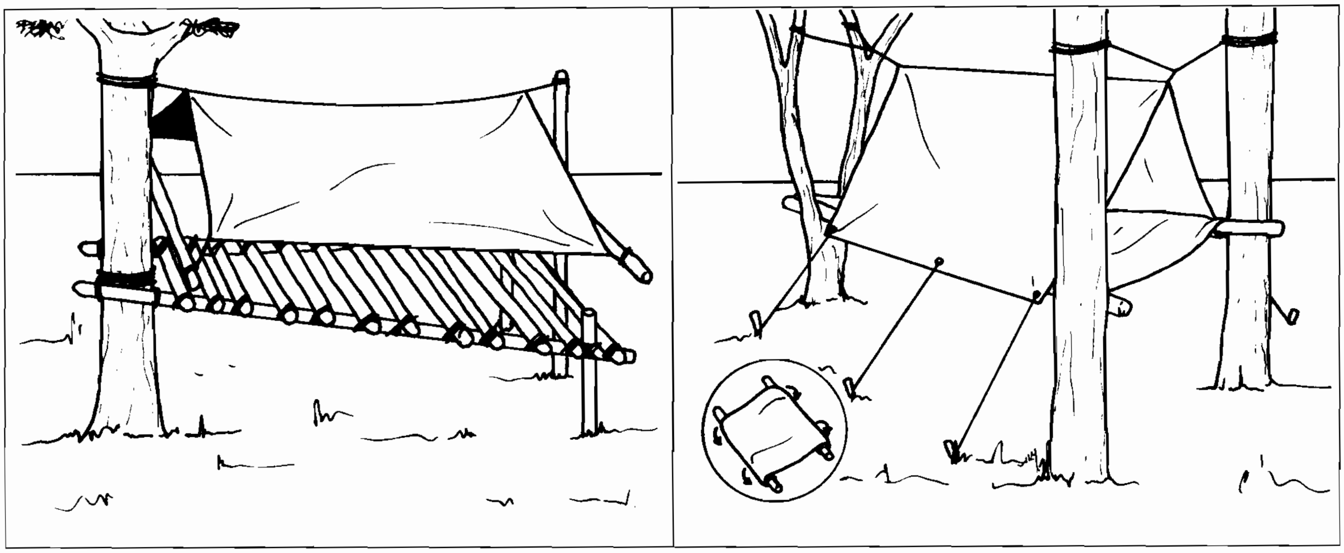


Figure 29. Paraplatform Shelters

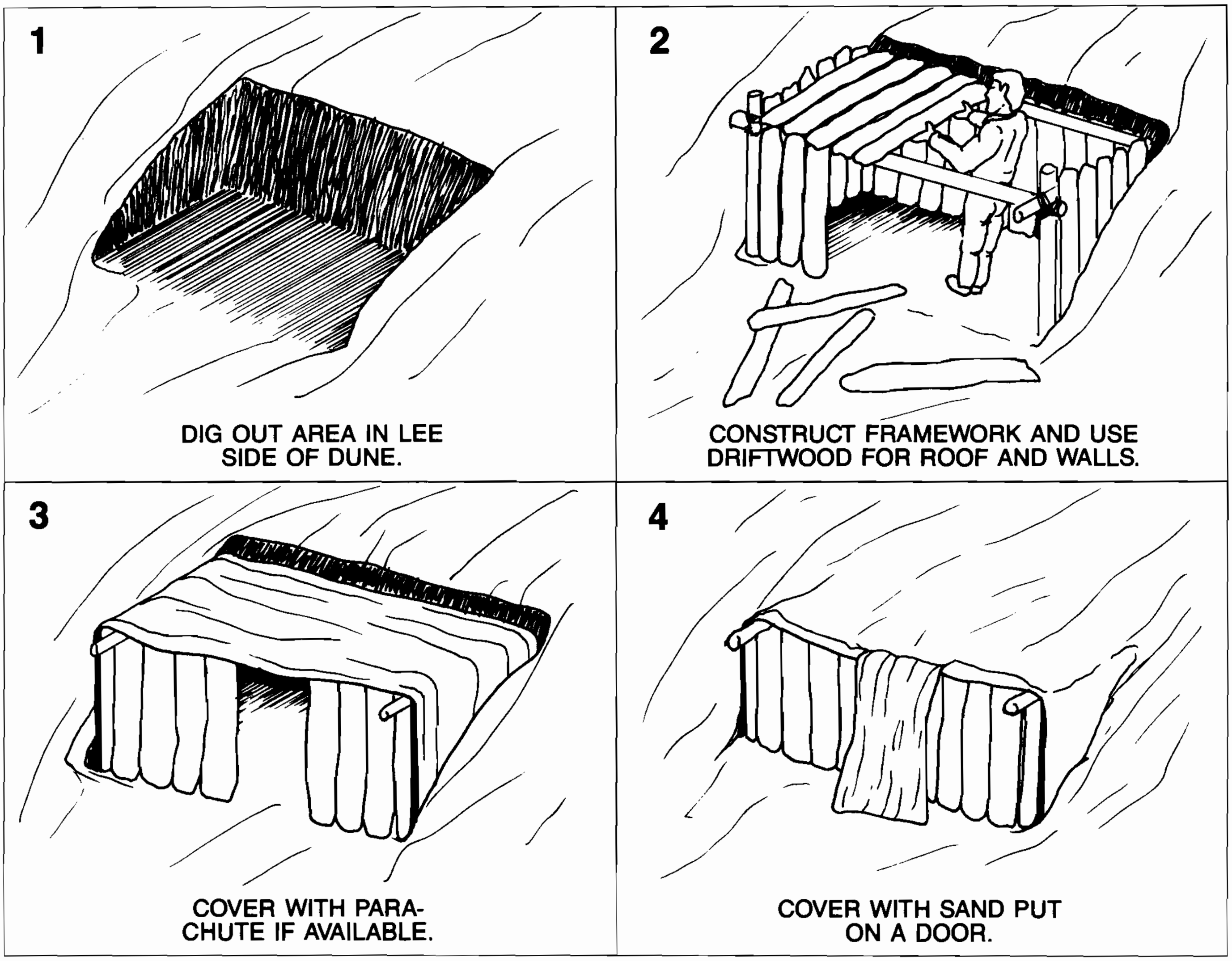


Figure 30. Constructing a Door

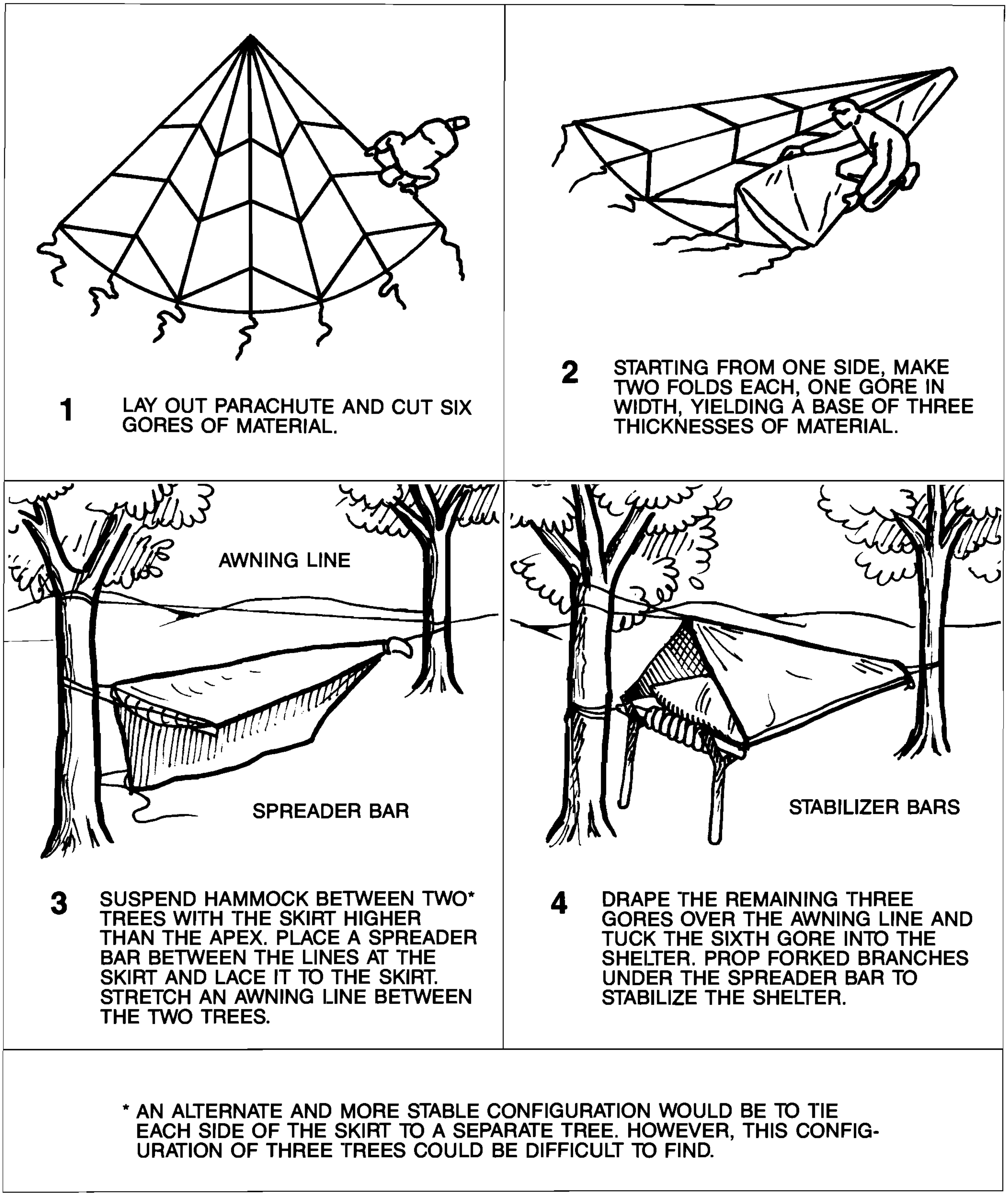


Figure 31. Hammocks

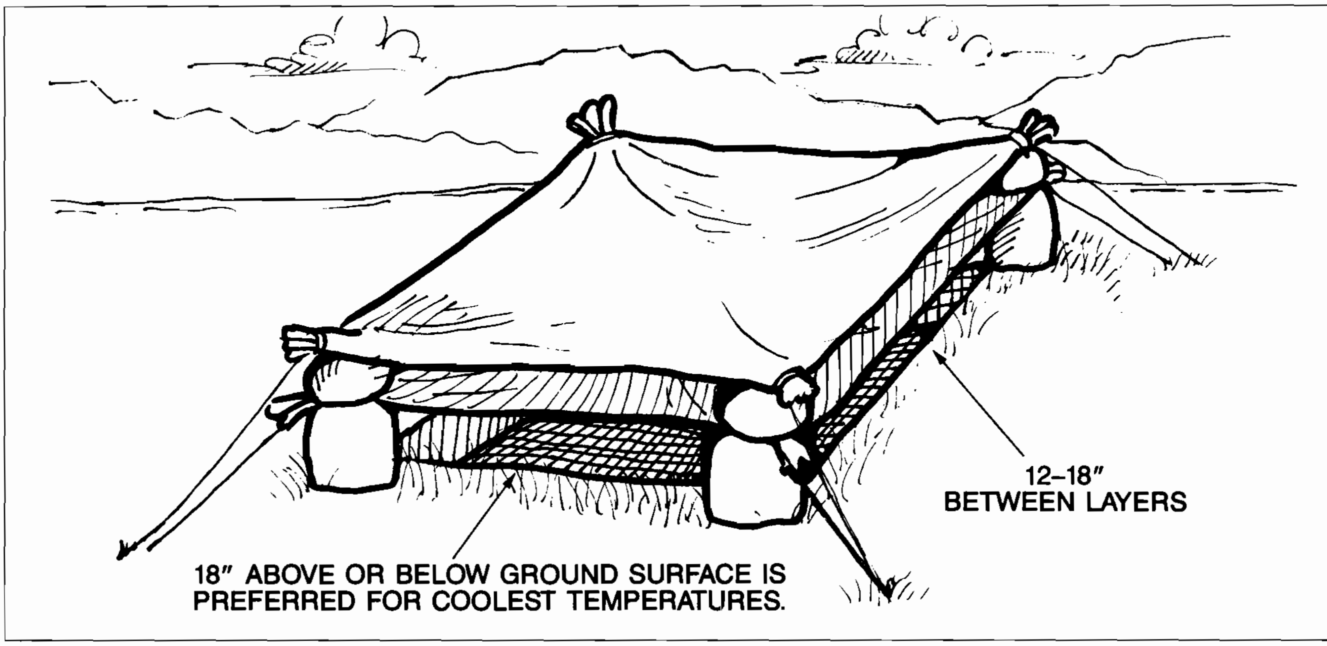


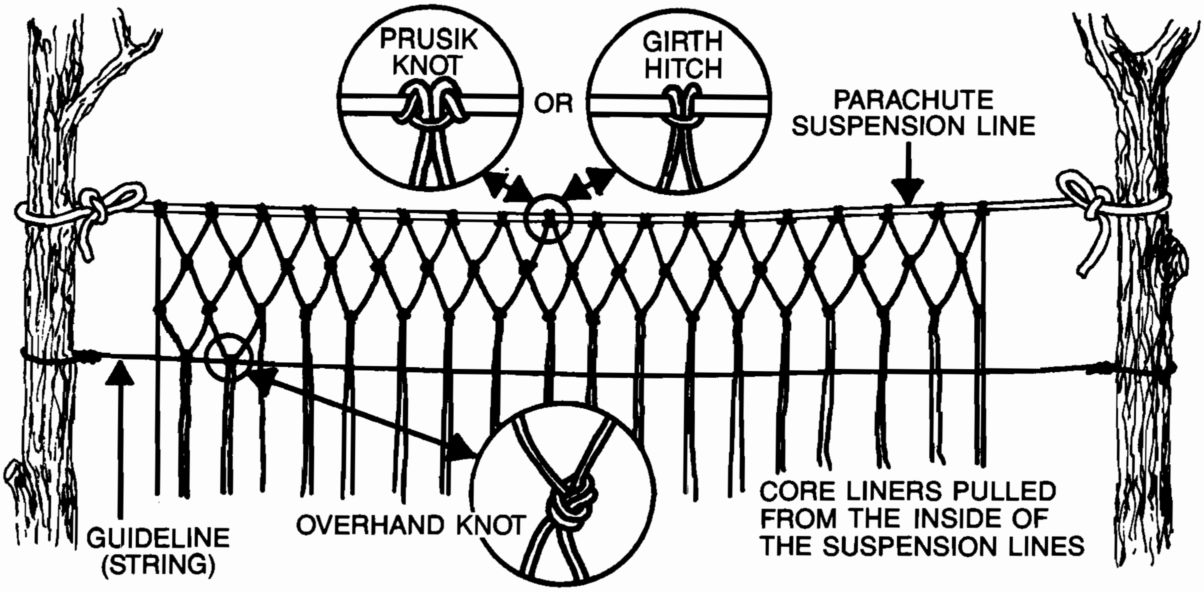
Figure 32. Desert Shelter

Food and Calorie Chart

Food	Calories	Fat
Whole large duck egg	177	12.0
Small or large mouth bass—3 to 4 oz.	109	3.6
Clams—4 to 5 large	88	.2
Freshwater crayfish—3 to 4 oz.	75	.6
Eel—3 to 5 oz.	240	20.0
Octopus—3 to 4 oz.	76	.9
Atlantic salmon—4 oz.	220	14.0
Rainbow trout—4 oz.	200	11.8
Banana—one small	87	.3

Food	Calories	Fat
Breadfruit—3 to 4 oz.	105	.5
Guava—one medium	64	.7
Mango—one small	68	.5
Wild duck—4 oz.	230	16.0
Baked opossum—4 oz.	235	10.6
Wild rabbit—4 oz.	124	4.0
Venison—4 oz.	128	3.1
Dandelion greens—1 cup cooked	70	1.4
Potato—medium	78	.2
Prickly pear—4 oz.	43	.2

Figure 33. Food and Calorie Chart



1. Suspend a suspension line casing (from which the core liners have been pulled) between two uprights, approximately at eye level.
2. Hang core liners (an even number) from the line suspended as in 1, above. These lines should be attached with a Prusik knot or girth hitch and spaced in accordance with the mesh you desire. One-inch spacing will result in a 1-inch mesh, etc. The number of lines used will be in accord with the width of the net desired. If more than one man is going to work on the net, the length of the net should be stretched between the uprights, thus providing room for more than one man to work. If only one man is to make up the net, the depth of the net should be stretched between the uprights and step 8, below, followed.
3. Start at left or right. Skip the first line and tie the second and third lines together with an overhand knot. Space according to mesh desired. Then tie fourth and fifth, sixth and seventh, etc. One line will remain at the end.
4. On the second row, tie the first and second, third and fourth, fifth and sixth, etc. to the end.
5. Third row, skip the first line and repeat step 3 above.
6. Repeat step 4, and so on.
7. You may want to use a guide line which can be moved down for each row of knots to ensure equal mesh. Guide line should run across the net on the side opposite the one you are working from so that it will be out of your way.
8. When you have stretched the depth between the uprights and get close to ground level, move the net up by rolling it on a stick and continue until the net is the desired length.
9. String suspension line casing along the sides when net is completed to strengthen it and make the net easier to set.

Figure 34. Fishing with a Net

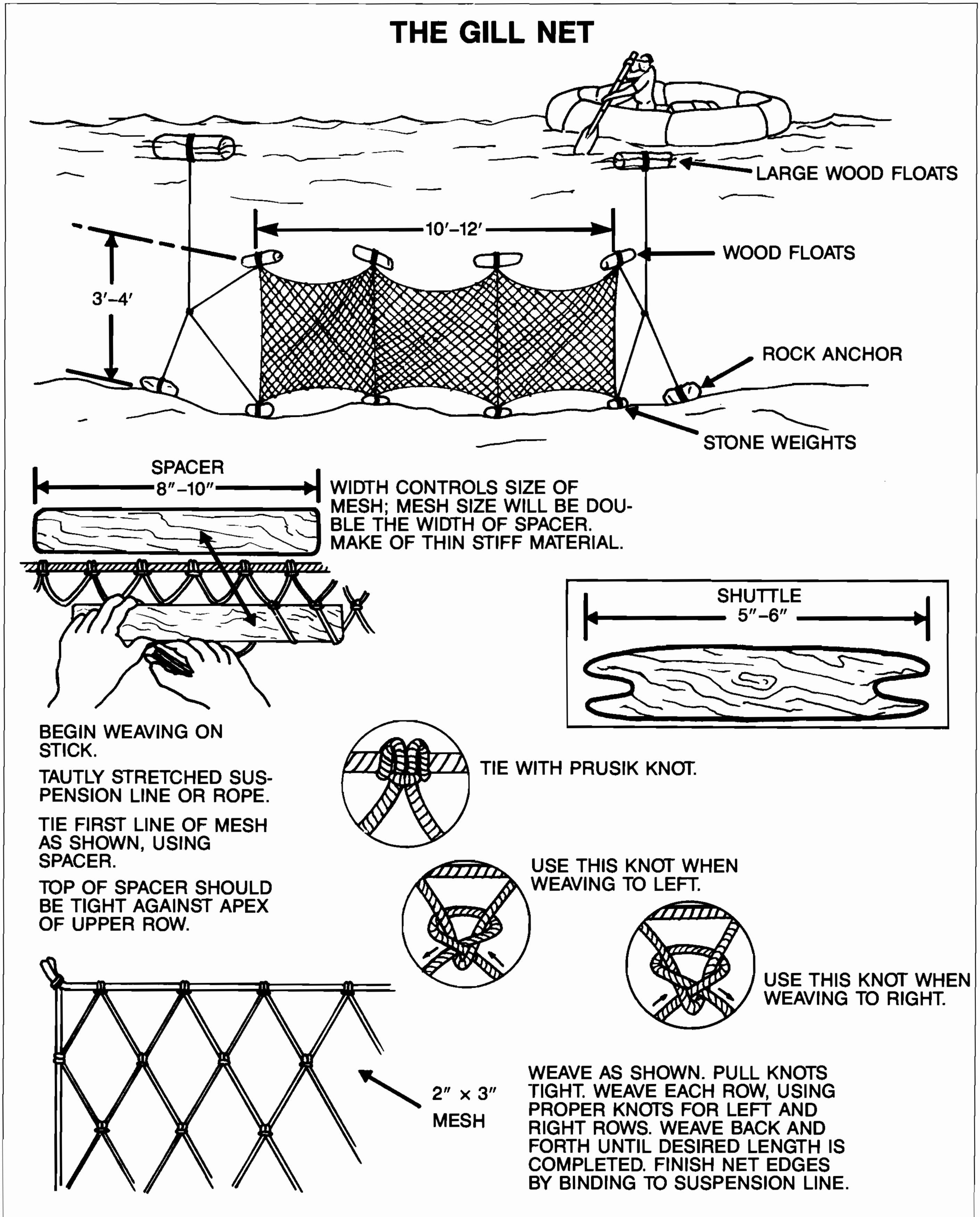


Figure 35. Making a Gill Net with Shuttle and Spacer

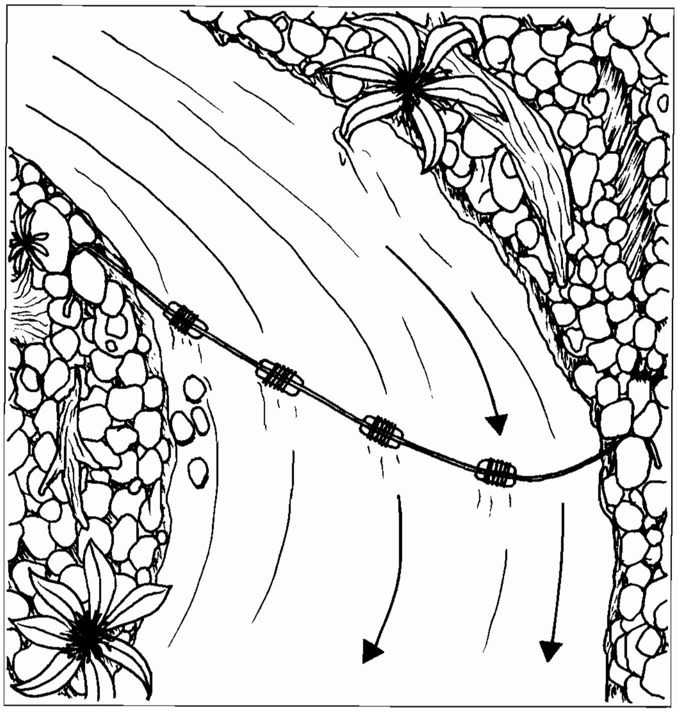


Figure 36. Setting the Gill Net

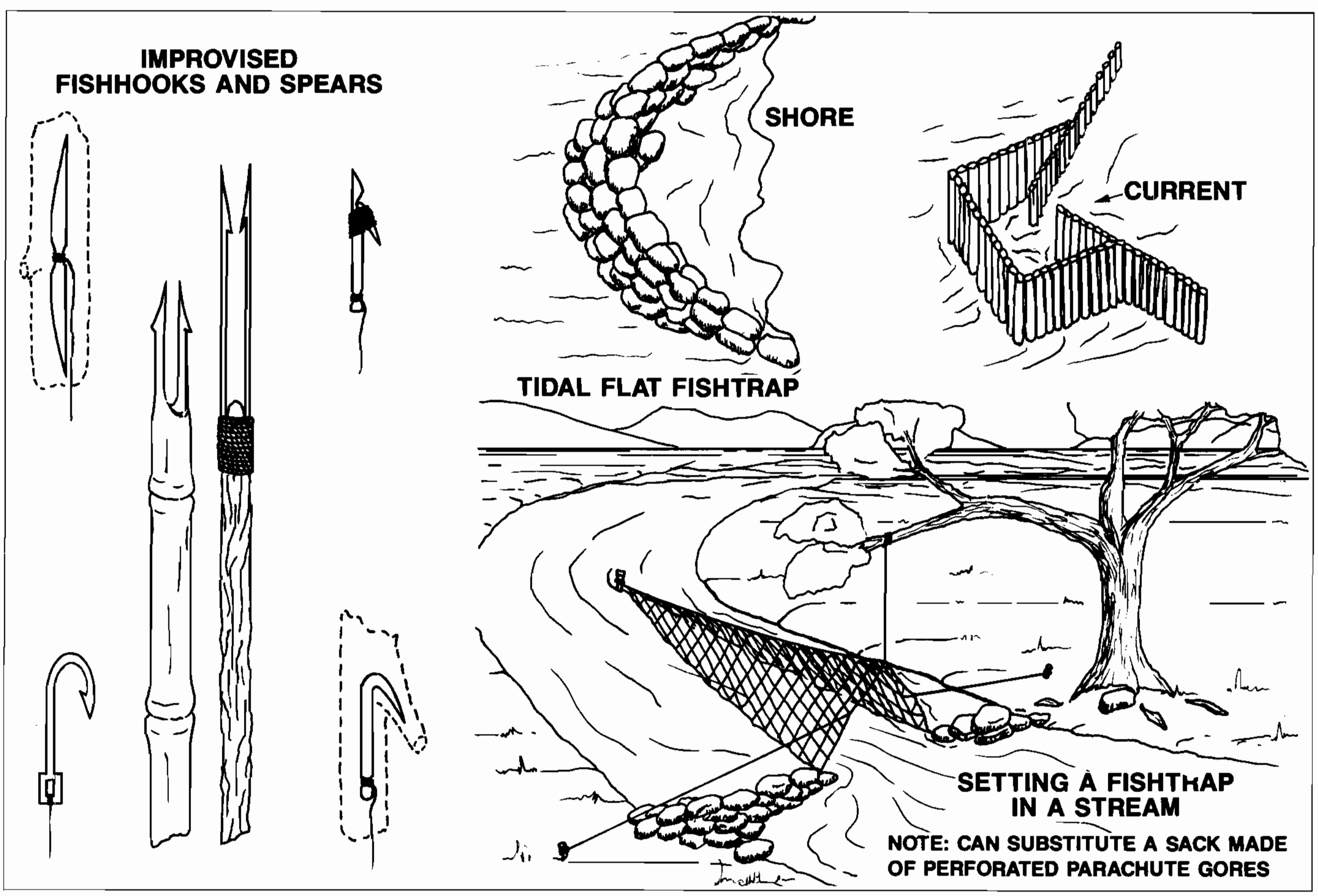


Figure 37. Fish Traps

Figure 38. Freshwater Fishing

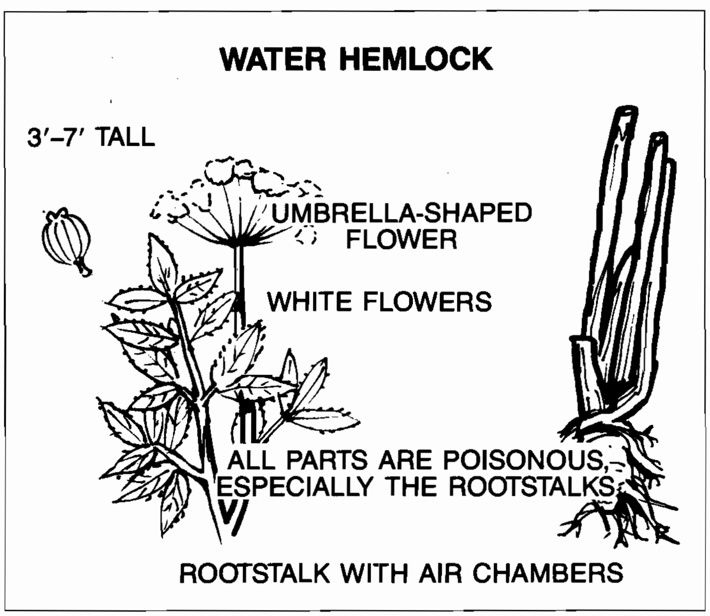


Figure 39. Water Hemlock

EDIBLE PARTS OF PLANTS	
Underground Parts	Tubers Roots and Rootstalks Bulbs
Stems and Leaves (potherbs)	Shoots and Stems Leaves Pith Bark
Flower Parts	Flowers Pollen
Fruits	Fleshy Fruits (dessert and vegetable) Seeds and Grains Nuts Seed Pods Pulps
Gums and Resins	
Saps	

Figure 40. Edible Parts of Plants

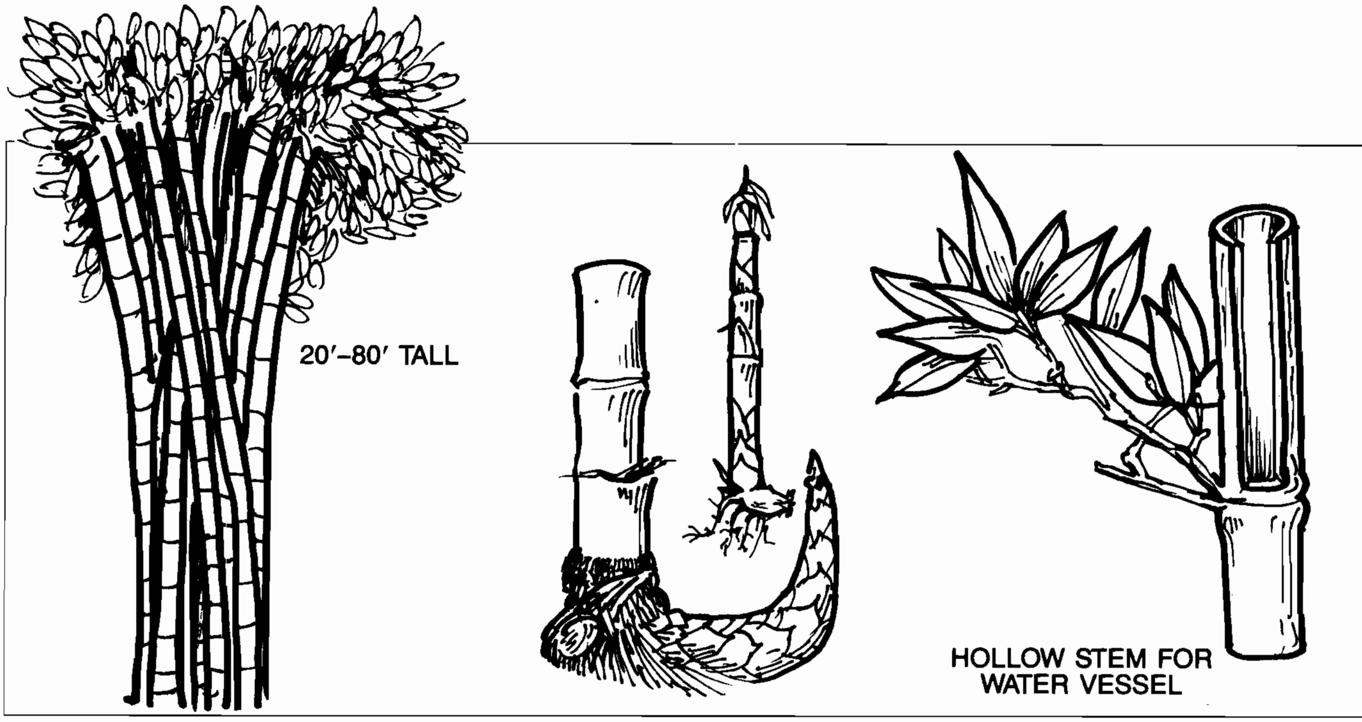


Figure 41. Edible Shoots

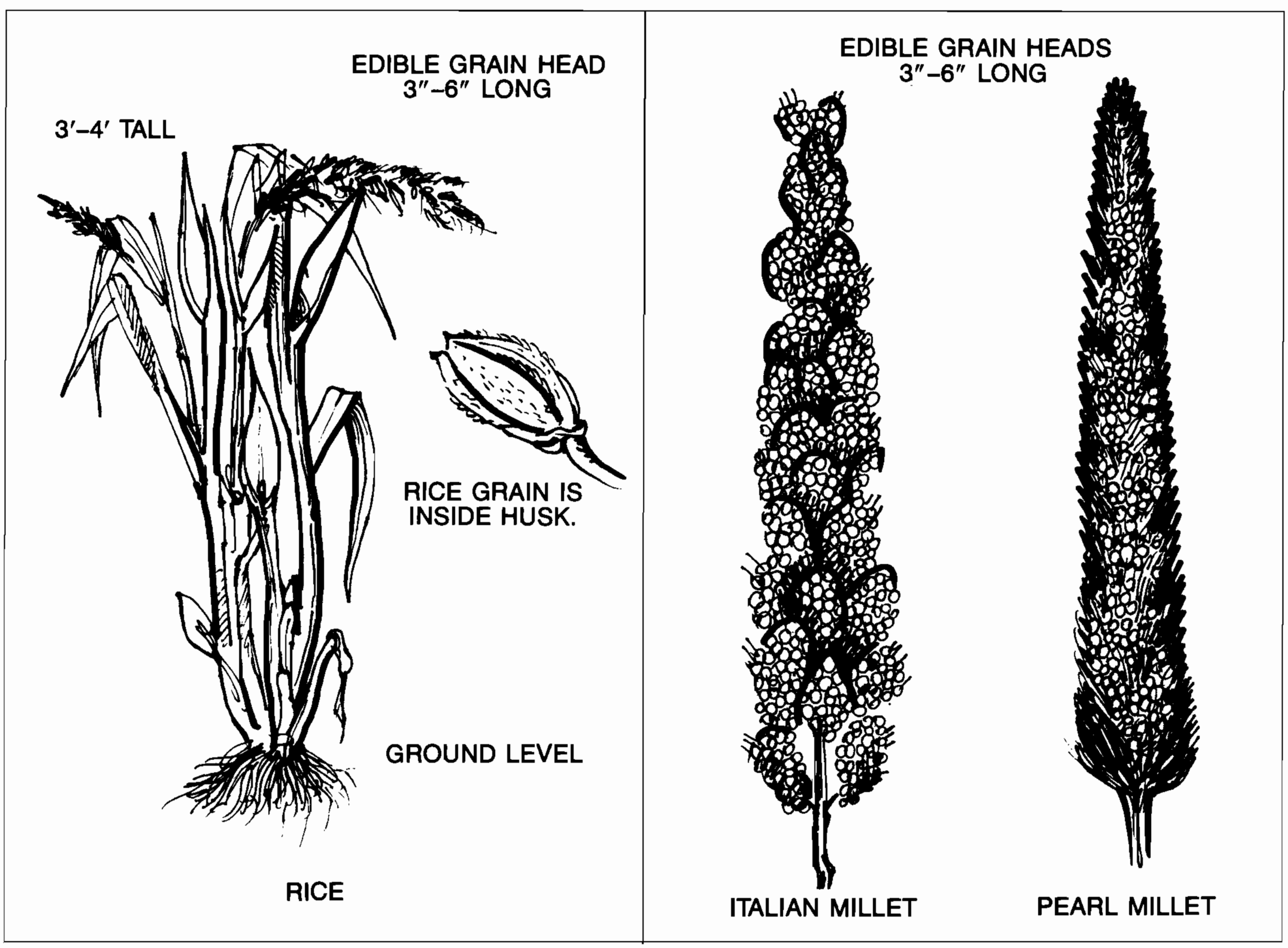


Figure 42. Edible Seeds and Grains

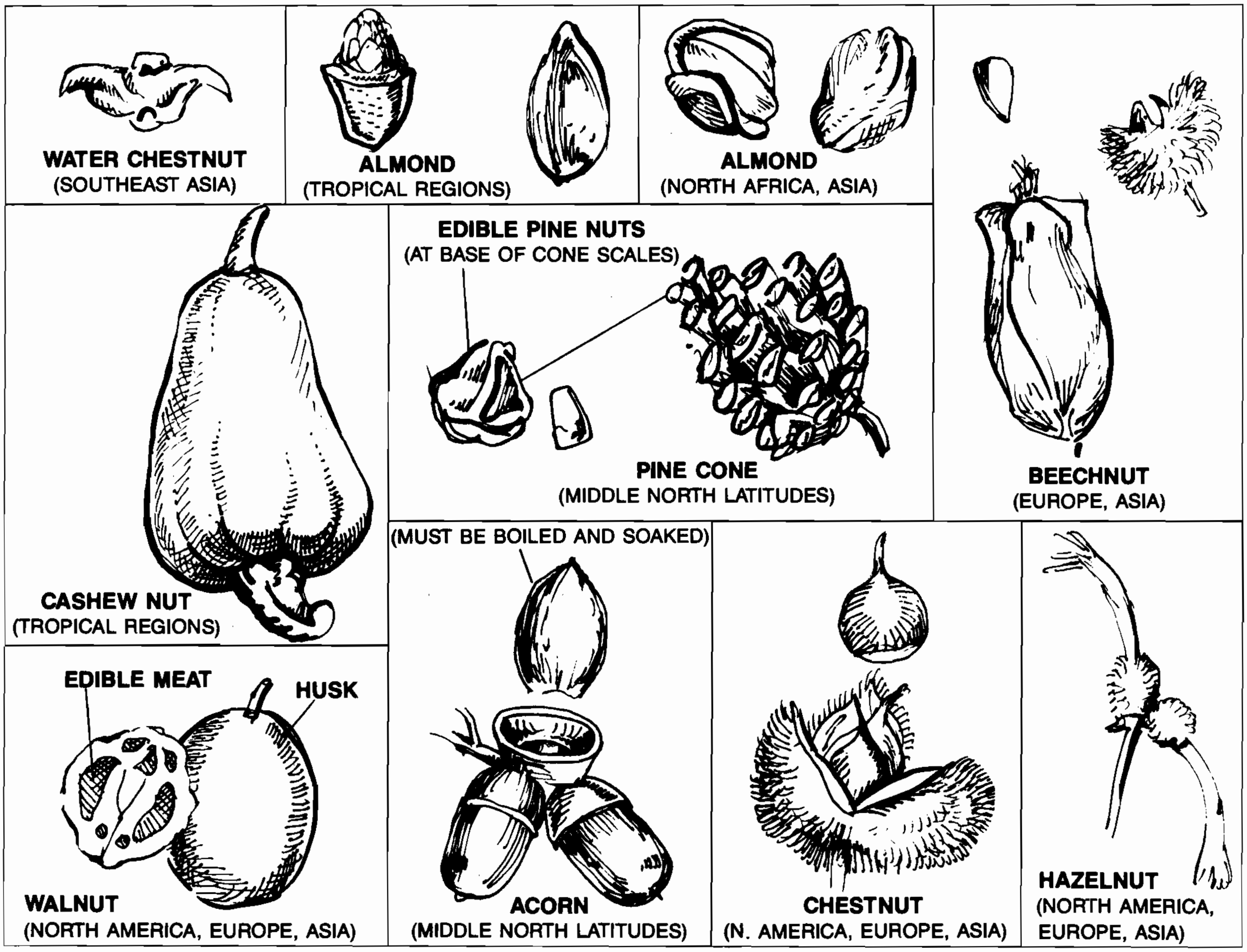


Figure 43. Edible Nuts

Figure 44. Snares