THE SLEEPING SYSTEM • SELECTING A CAMPSITE • SNOW AND WINTER CAMPING • STOVES • WATER • FOOD • "IT'S JUST CAMPING"

CHAPTER 3

CAMPING, FOOD, AND WATER

The art of alpine camping under the "starry firmament" allows us to pass through primeval mountain locations. Camp offers the restoration of warm food, shelter, and sleep, and the best campers go stealthily through wild spaces, leaving no trace of their passing. In the words of John Muir, founder of the Sierra Club, ". . . standing alone on the mountain-top it is easy to realize that whatever special nests we make . . . we all dwell in a house of one room—the world with the firmament for its roof—and are sailing the celestial spaces without leaving any track."

THE SLEEPING SYSTEM

The sleeping system is what gets you through the night in the wilderness in safety and comfort. The system has four components: sleeping clothes, a sleeping bag, ground insulation, and shelter.

SLEEPING CLOTHES AND ACCESSORIES

Experienced climbers carefully guard a dry set of clothes to wear at camp and in their sleeping bags, typically a spare base layer, warm hat, gloves, and dry socks. Upon arriving at the evening's camp, they'll ditch the damp clothes from the climb and don the dry, warding off the evening chill. Sleeping clothes, a puffy coat, camp shoes, and a hot drink boost the revitalization process. In addition, this reduces the moisture introduced into the sleeping bag and keeps the bag clean. Since climbers cannot afford the weight of multiple sets of clothes, while wearing their dry evening set they use any final sunshine to attempt to dry out what will be tomorrow's climbing clothes. Precipitation, of course, complicates the evening procedure.

A few accessories can help climbers get a good night's sleep. A small inflatable pillow is especially useful for side sleepers. A conveniently placed (and well-marked!) pee bottle can minimize the chill and hazard of nocturnal excursions.

SLEEPING BAGS

A good sleeping bag fits your body, retains body heat, and is light and compressible. For cold conditions, nothing beats the efficient mummy bag (fig. 3-1). A sleeping bag's fill material traps an insulating layer of air between the climber's warm body and the external cooler air. A bag's thermal efficiency depends on each climber's unique physiology; fit of the bag to the body; and the type, amount, and loft (thickness) of the insulation.

Physiological factors. A sleeping bag only slows body heat's inevitable escape. Individuals vary considerably in their ability to generate heat and tolerate cold, depending on muscle mass, age, and gender. Young, fit men typically produce more body heat than older men and much more heat than women. Experienced mountaineers and people who work outside may feel more comfortable in cold environments than people who work in offices. Heavier people often run warmer than slim people.

Fit. A sleeping bag that is too long or wide creates excess interior volume that needs heating and adds unnecessary weight. Being too tight in any dimension forces your body to compress the insulation, making the bag colder. Choose a design that fits you well. Size the bag a little larger for winter camping or expedition use; the extra room together with your convective body heat helps dry small items such as wet gloves, socks, and boot liners. Use caution, however, when trying to use your sleeping bag as a dryer: the excess moisture can collect in the insulation, particularly on longer trips.

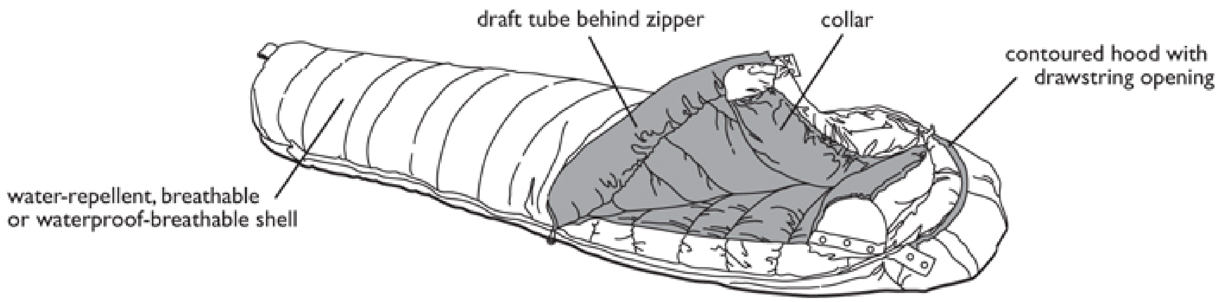


Fig. 3-1. Mountaineering mummy bag features and components.

THIEVES IN THE NIGHT

A sleeping bag and mattress or pad are used to prevent excessive heat loss. As the night gets progressively colder, insulation is needed to balance heat generation against thermal theft, which happens in all of the following ways:

- **Warm air (convection).** The body continually warms the air around it. Clothes and sleeping bags trap this warm air, slowing its escape to the atmosphere.
- **Breathing and sweat (respiration and evaporation).** People lose about a liter of water through breath and sweat every night. In colder environments, the warm, moist air you breathe out can be a significant form of heat loss.
- **Cold ground (conduction).** Direct contact with cold ground also sucks heat away from the body. Rock and snow are the most conductive surfaces encountered in the wilderness; grass, dry dirt, and forest duff are the least. Camping mattresses or pads help to insulate you from cold ground; look for higher R-values for colder surfaces.
- **Radiant heat (infrared radiation).** The night vision goggles of the movies remind us that every living body has a heat signature from the direct loss of heat through infrared radiation. Radiant heat represents up to 10 percent of our heat loss, and recent innovations that use reflective materials in insulating air mattresses and clothes capture and return some of this heat.

Bag Rating Systems

Historically, a sleeping bag rating gave only rough guidance of the coldest temperature at which an average person would stay warm through the night, assuming use of long underwear, a hat, and an insulated pad. Now, many sleeping bags—though not all, including some high-quality bags—are independently rated under international standard ISO 23537 or EN13537. These new standards do not apply to use by children or military personnel or in extremely cold conditions.

Under the standard, each bag is assigned four temperature ratings:

1. **Upper Limit:** The highest temperature for a “standard man” to sleep without sweating.
2. **Comfort:** The lowest temperature for a “standard woman” to have a comfortable night’s sleep.
3. **Lower Limit:** The lowest temperature for a standard man to have a comfortable night’s sleep.
4. **Extreme:** The survival rating for a standard woman.

Women and men should use the Comfort and Lower Limit ratings, respectively, for choosing a sleeping bag. Table 3-1 offers rough seasonal guidelines. For a three-season camping example, Table 3-1 gives a rough low temperature of 15 degrees Fahrenheit; the average woman would want a bag with a Comfort rating of 15 degrees Fahrenheit, and the average man would want a bag with a Lower Limit rating of 15 degrees Fahrenheit.

Most of us are not “standard”; climbers must consider their personal metabolism, body composition, and particularly any additional insulation that they may wear in the sleeping bag. Other factors that affect warmth are the level of hydration or fatigue, and the quality of shelter and ground insulation (see the “Tips on Staying Warm in a Sleeping Bag” sidebar).

TABLE 3-1. SEASONAL GUIDELINES FOR SLEEPING BAGS

SEASON	TEMPERATURE RANGE
Summer	Above 40°F (above 4°C)
Three-season (spring, fall, and high altitudes in summer)	15° to 40°F (-9° to 4°C)
Winter camping	-10° to 15°F (-23° to -9°C)

Polar and extreme alpine	Below -10°F (below -23°C)

Insulation, Fabric, and Environmental Factors

The two types of insulation for mountaineering sleeping bags are natural down (goose or duck) and polyester fibers, each with advantages and disadvantages. Both types can now be treated with durable water repellent (DWR) chemicals to increase their hydrophobic properties. (See Chapter 2, Clothing and Equipment, for a discussion of insulating fills and DWR.)

The nylon or polyester fabrics used in mountaineering sleeping bags are tightly woven to keep the insulation in place. Waterproof-breathable fabrics are expensive but advantageous in damp environments such as a snow cave or wet tent; they are especially desirable with a down bag. Shell materials are treated with DWR, giving the same advantages and limitations as when used in clothing (see "Waterproof Fabrics" in Chapter 2 for details).

Any attempts to waterproof a sleeping bag, including using waterproof-breathable materials, will decrease the bag's ability to pass body moisture through to the atmosphere. The trade-off is between the risk of external water—rain, snow, tent condensation, dew—and the risk of significant perspiration and damp clothing. In wet environments most climbers will want to use a bag with synthetic insulation or waterproof-breathable fabrics.

Condensation dampness or dew is particularly insidious. As the evening's air cools, it releases moisture, condensing as dew, especially on cold objects. In humid environments, avoiding dew in the evening as the temperature falls toward the dew point is critical for sleeping bags and clothes. As the night air cools, keep tents zipped (and thus slightly warmer), sleeping bags stuffed, and clothes stowed away until bedtime to minimize dampness.

Features and Components

The features and components of a sleeping bag affect efficiency and ventilation (see Figure 3-1). A close-fitting hood surrounds your head, retaining precious heat while leaving your face uncovered for respiration. Collars that seal around the neck and draft tubes along the length of the zipper further retain heat inside the main body of the bag. Long zippers make it easy to get in and out of the bag and help ventilate excess heat if the bag gets too warm. Some designs offer complementary left- and right-hand zippers so that two bags can be zipped together. Using a half- or three-quarter-length zipper saves weight and bulk but sacrifices flexibility in ventilation.

Accessories

Washable sleeping bag liners add a few degrees of warmth and keep body oils from soiling the bag's interior and insulation. But bag liners add weight and bulk, and the same objective can be accomplished with a clean, dry set of multipurpose sleeping clothes.

Vapor-barrier liners (VBLs) are either a sleeping bag liner or a full multipiece suit constructed of a waterproof-nonbreathable material. In frigid conditions and especially on longer trips, VBLs can be used to protect clothing and sleeping bag insulation from the degradation caused by perspiration condensing *inside* the insulation. You sleep inside the VBL (typically wearing a base layer), inside the sleeping bag. These liners reduce evaporative heat loss and the amount of moisture (in arctic environments: ice) buildup within the sleeping bag's insulation. Clothing insulation, especially that worn on the hands and feet, can be similarly protected. Test out a VBL before using it on an expedition; many climbers find them awkward and clammy.

TIPS ON STAYING WARM IN A SLEEPING BAG

- **Eat well and stay hydrated.** If you wake up cold, increase your metabolism by drinking and eating.
- **Use proper ground insulation.** A fully inflated pad or insulating air mattress will maximize the insulation potential.
- **Wear dry clothes,** including a base layer, hat or balaclava, gloves, and dry socks.
- **Augment loft** by wearing insulated clothes inside, or placing an insulated jacket on top of the sleeping bag.
- **Place a leakproof bottle of hot liquid in the bag.**
- **Use a pee bottle** when nature calls to avoid getting cooled down from stepping outside.
- **Change clothes inside the sleeping bag.**

Most sleeping bags come with a semi-waterproof stuff sack for storage during trips and a larger, breathable storage sack for storage between trips. In possibly wet conditions, use a waterproof stuff sack or plastic bag. Use a compression stuff sack to save pack space, especially with typically hard-to-compress synthetic bags. Fleece-lined stuff sacks double as a pillow.

Specialty Bags

Some climbers prefer to go as light as possible, sacrificing a little comfort for less weight. Used in conjunction with an insulating jacket, half- or three-quarter-length bags can be adequate to just below freezing. Some ultralight enthusiasts prefer a simple zipperless, hoodless quilt with down or polyester insulation.

Care and Cleaning

With a little care, a sleeping bag will last for many years.

Storage. Always store the bag fully lofted. Only keep the bag in a compression stuff sack for short periods of time, for instance, while traveling or when carrying it in a backpack.

Cleaning down and synthetic bags. Spot-clean soiled areas with soap specified by the manufacturer, then wash in full, when needed. Never dry-clean a down sleeping bag. Before washing, secure all zippers and snaps, and remove detachable pieces. Bags with waterproof-breathable shells should be washed inside out. Wash the bag with mild non-detergent (preferably down-specific) soap on the gentle cycle in a large front-loading washing machine. Run the bag through the rinse cycle several times to remove all soap. Re-treat the DWR finish as required (see "Clothing Care" in Chapter 2, Clothing and Equipment) while still wet, and dry the bag in a large clothes dryer using medium heat. Remove the bag occasionally and break up clumps of down, or throw a few tennis balls into the dryer. Squeeze the insulation to check for moisture. Washing and drying a bag takes several hours. Some outdoor repair shops specialize in laundering sleeping bags.

GROUND INSULATION

The foundation of a comfortable night in the outdoors is good insulation under the sleeping bag. A sleeping pad reduces the amount of heat you lose to cold ground or snow. If you are forced to sleep without a pad, use extra clothing, your pack, climbing rope, or boots for padding and insulation.

Type

There are four common types of pads; for a comparison, see Table 3-2.

Closed-cell foam. Bulkier than pneumatic options, a thin pad of closed-cell foam provides good lightweight insulation that cannot fail from a puncture. Textured designs lend a softer sleeping surface, lower weight, and increased ability to trap air, resulting in greater thermal efficiency. Some molded patterns make for simple and compact storage.

Self-inflating pad. The bulky, water-absorbing open-cell foam pad of long ago evolved into the self-inflating pad, with Therm-a-Rest being the best-known brand. The open-cell foam is enclosed in an airtight, waterproof chamber that compresses well.

TABLE 3-2. CHOOSING GROUND INSULATION

GROUND INSULATION	TYPICAL R-VALUES	TYPICAL USES
Closed-cell foam: 0.38 in., 0.63 in., 0.75 in. (1 cm, 1.5 cm, 2 cm)	R1.5, 2.7, 3.5	Inexpensive and puncture-proof. Multipurpose pads for sitting, dressing, cooking. Frequently combined with three-quarter-length self-inflating pad or insulating air mattress.
Self-inflating pad: 1.5 in.–2 in. (3.8–5 cm)	R2–5	General-purpose insulating pad.
Non-insulating air mattress	R1	Not appropriate for mountaineering except in mild weather.
Insulating air mattress	R2–5	General-purpose insulating mattress.

Non-insulating air mattress. A basic inflatable mattress provides plenty of cushion to cover bumps, rocks, and roots. Non-insulating air mattresses are typically compact, but the air in the mattress convects heat away from the body by internal air circulation. Coupling non-insulating air and closed-cell foam mattresses is an effective and inexpensive solution for colder weather.

Insulating air mattress. Modern versions of the air mattress employ complex internal chambers and insulation to minimize air convection currents, and they use radiant-heat-reflective materials to reflect infrared radiation back to the sleeper. Once inflated, these lightweight, extremely small sleeping pads have high warmth ratings, very useful on snow and ice. However, these mattresses offer no insulation if punctured.

Size and Warmth

Self-inflating pads and insulating air mattresses come in various lengths, but a shorter (4 feet, or 120 centimeters) size is usually adequate for general mountaineering; you can use a smaller closed-cell foam sit pad (or items of gear) to pad and insulate feet and legs. For greater insulation when camping on snow or in winter or arctic environments, use a short, self-inflating pad on top of a full-length closed-cell foam pad.

Pads are rated for warmth by R-value, a measure of thermal resistance. For example, pads with a rating of R2.5 protect well down to about freezing; R4, to about 15 degrees Fahrenheit (minus 10 degrees Celsius); and R5-plus, for colder temperatures. Lower R-values are needed for sleeping on grass or dry forest duff than for sleeping on wet ground, rock, and snow, which have relatively high conductivity. Table 3-2 shows typical R-values and uses of ground insulation.

SHELTER

The seventh of the Ten Essentials, shelter is key to surviving a night in the wilderness and usually means a tent, tarp, or bivy. If you are not carrying shelter on a day trip, or will be away from shelter on the summit attempt, carry emergency shelter that is sufficient for the entire party.

The most common and versatile mountain shelter, tents are relatively easy to set up and provide rainproof privacy and refuge from wind or sun. They are usable in almost any terrain, and are often roomy enough for people and their gear. Tents usually are the first choice above timberline, on glaciers, in winter, and in bear or mosquito country.

A lightweight alternative to tents, tarps can be used in conjunction with bivy sacks to provide effective shelter from rain and sun. Bivy sacks also make great lightweight emergency shelters.

SHELTER FROM THE STORM

Choose sleeping system components to keep you safe through the worst likely conditions while allowing fast and light travel:

- **Sleeping clothes and equipment** include a dry base layer, hat, gloves, socks; pillow, water bottle, and perhaps a pee bottle.
- **Sleeping bag or ultralight quilt.**
- **Ground insulation.**
- **Shelter: tent, tarp, or bivy.** Shelter left behind in base camp is not enough.

When selecting a tent or tarp, climbers must weigh protection (sturdiness and coverage), weight, and space (fig. 3-2). There are trade-offs. Consider how and where you will use the shelter as well as your personal preferences (see the "Choosing a Tent" sidebar). Shelters come in many shapes and sizes (fig. 3-3).

Moisture Strategies

Tents serve two competing functions in managing moisture: keeping out as much moisture as possible from the external environment while venting as much moisture as possible from the interior. A single person exhales and perspires a substantial amount of water overnight. If the tent were waterproof, this water vapor would dampen sleeping bags and clothing. Therefore, the tent must "breathe."

Double-wall tents. Double-wall construction consists of an inner wall, which is breathable, separated from an outer, detachable, waterproof rain fly. Exhaled moisture and perspiration escape from the vented space between these two layers. The fly of a mountaineering tent should come fairly close to the ground, covering the tent and entryway and shedding wind-driven rain. Tent floors are typically coated nylon with a sill, which extends up the sides. A higher sill offers more protection from rain blown in under the fly; yet it also reduces the amount of breathable fabric and can gather condensation. To avoid unnecessary seams, the floor and sill are typically one continuous piece of fabric, commonly known as a bathtub floor. All seams in the rain fly and floor should be factory-taped to keep water out.

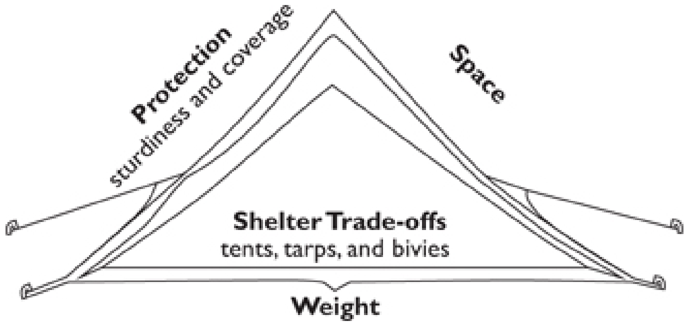


Fig. 3-2. When choosing a shelter, climbers consider weight, space, and protection (sturdiness and coverage).

Fig. 3-3. Shelters come in many shapes and sizes: a, classic four-season dome tent (shown with rain fly and tunnel-style vestibule); b, classic three-season tent (shown with rain fly rolled back); c, four-season single-wall waterproof-breathable tent; d, fly and footprint only, without inner tent; e, ultralight single-wall waterproof-nonbreathable tent using trekking poles for support; f, tarp with trekking poles for support; g, lightweight bivy sack; h, hoop-style bivy sack.

Single-wall waterproof-breathable tents. Lightweight, rugged, and expensive, these tents use just one layer of waterproof-breathable fabric (see Chapter 2, Clothing and Equipment). The inside is a fuzzy, blotter-like facing that holds and distributes excess moisture to assist its passage through the fabric.

The great advantage of a single-wall tent is its light weight. The lightest two-person version currently weighs 3.3 pounds (1.5 kilograms), and typical versions, about 5 pounds (2.3 kilograms). They are also quieter in high winds because there is no outer fly to flap against the tent walls. Their major disadvantages are their price tags and tendency to collect moisture during warm, wet weather.

Ultralight single-wall waterproof-nonbreathable tents. These tents trade efficient breathability for lighter weights. Moisture management is accomplished through vents.

Tarps. Having no walls, tarps easily vent moisture. They are usually paired with ground sheets. Tarp campers in marginal weather will often use an all-weather "splash bivy" for additional protection. (See "Bivy Sacks," below.)

Three- and Four-Season Tents

Tents for mountaineering are either three-season tents (for nonwinter use) or four-season tents (for all situations, including snow camping). All-season climbers often own both types and perhaps a tarp and bivy sack as well.

Three-season tents. The side or top panels of many three-season tents are made with transparent netting, providing ventilation, bug protection, and lower weight. However, blowing snow and condensation can come in through the netting. Adequate for mountaineering in a wide variety of conditions from late spring to early fall, they can be ideal for longer trips where weight is more of a concern.

CHOOSING A TENT

Before purchasing a tent, try it out at the store to check space, protection, and weight:

- **Space:** Tents are rated for the number of sleepers, usually assuming no gear inside and smaller, rather friendly climbers. Is there sufficient head and foot room? How vertical are the walls? The steeper the walls, the greater the interior usable space. Is it easy to go in and out of the door(s)? Does each side have a door? How easy is the tent to set up?
- **Protection:** Summer in the Sierra, autumn in the Alps, or winter in the Cascades? Will the shelter need to withstand above-timberline wind or heavy snowfall? A four-season tent implies more protection.

- **Weight:** What does it really weigh? Break out the scale since manufacturers are notoriously optimistic. With two-person, four-season tents weighing from 3.3 to almost 10 pounds (1.5 to 4.5 kilograms), a tent can be the heaviest piece of gear in the pack. Ultralight two-person tents can weigh as little as 1.3 pounds (600 grams), and tarps, much less. Tents often list a "minimum weight" (excluding stakes, stuff sacks, instructions, et cetera), and a "packaged weight," which includes everything. Use "minimum weight" for comparisons.

Four-season tents. Usually heavier, more expensive, and built to withstand winter conditions of high winds and snow loading, four-season tents have higher-strength aluminum or carbon fiber poles and more-durable reinforcing. The doors, windows, and vents have solid panels that zip, and the fly extends close to the ground. Four-season tents often have more than two poles and a greater emphasis on guylines. Usually, the tent shape is some variation on the dome.

Ultralight tents. Often associated with long-distance hikers and moderate weather, ultralight tents can be used by climbers in moderate conditions. They are made of Dyneema Composite fabric (formerly known as Cuben Fiber) or silnylon and may use trekking poles as tent poles to save weight. These designs are not freestanding and so are less well suited to windy, wet alpine environments.

Tent Design

Designers shape tents to maximize usable interior space, load-bearing strength, and ability to withstand high winds, while at the same time minimizing a tent's weight. A great tent must be easy to pitch and disassemble but tenacious when storms attempt to take it down. Mountaineering tents use a variety of clever crisscrossing pole architectures to form various dome or tunnel shapes. Some are freestanding and need no stakes to hold their shape. These can be picked up and moved but must be secured with stakes and perhaps guylines to prevent being blown away—a real danger in a storm, especially when unoccupied.

The two-person tent is the most popular tent size for mountaineering, offering the greatest flexibility in weight and choice of campsite. For a group, it is generally more versatile to bring two two-person tents rather than one larger tent. Many two-person tents can handle three people in a pinch, yet are light enough to be used by one person. The tent will be warmer, however, with more than one occupant.

Some three- and four-person tents are light enough to be carried by two people who crave luxurious living (or two large people who crave adequate space). Larger tents, especially those high enough to stand in, are big morale boosters during an expedition or long storm but are burdens to carry. Before you set out, distribute the tent parts (tent, fly, poles, and stakes) among the party to share the weight.

Tent Features

A good mountaineering tent keeps out most of the rain and snow as climbers get in and out. Manufacturers offer many different features, such as extra doors, interior pockets, gear loops, tunnels, alcoves, vestibules, and hoods. Of course, most extra features add both weight and cost.

Vestibules. Four-season tents, and some three-season models, commonly include a protruding floorless protected area known as a vestibule. Some expedition rain flies come with their own poles for extending the vestibule area (see Figure 3-3a). Vestibules help shelter the entrance and provide more room for storing gear and boots, dressing, and cooking. In foul weather, cooking in the tent vestibule is an art to be appreciated—carefully (see "Stove Safety" later in this chapter). Some four-season tents provide two vestibules, allowing for specialization (for example, cooking in one, boot storage in the other).

Vents. Vents near the ceiling that allow warm, moist air (which rises) to escape are useful. Mosquito netting allows air to flow freely when the doors are unzipped and will keep out rodents, reptiles, and bugs (see Figure 3-3b and e).

Color. Tent color is a matter of personal taste. Warm tent colors such as yellow, orange, and red are cheerier if the party is stuck inside, and they make it easier to spot camp from afar. On the other hand, subdued hues blend into the landscape.

Go out a few times with a rented or borrowed tent and establish some preferences before you buy.

Anchoring the Tent

Bring stakes designed to handle the terrain. In forest duff, short plastic or wire stakes, such as those that come with most tents, are just fine. In rocky alpine terrain, metal skewer-type stakes (fig. 3-4a) or sturdier plastic T-shaped stakes (fig. 3-4b) may be required. In sand or snow, a broader surface area on the stake will help (fig. 3-4c).

Stakes simply driven into snow in the normal fashion will pull out in heavy wind and melt out during the day. Ice axes, skis, and trekking poles can make solid anchors but cannot be used for anything else while they are securing the tent. For extra security, tie the tent to an available rock or tree.

In snow, the best anchors are deadman anchors (fig. 3-5). These can be stakes, stuff sacks packed with snow, metal plates called flukes made specifically for this purpose, or even rocks or sticks, which you do not have to dig up when breaking camp if the knots for the cords attached to them are above the snow. First, tie the deadman to the tent guyline, or form a loop in the line and slip the deadman into it. Dig a T-shaped trench at least 12 inches (30 centimeters) deep, with the long leg of the T facing the tent. Put the deadman into the trench in the crossbar of the T, then pull the line taut, backfill the trench, and stamp down the snow.

Guylines can be kept taut with small plastic or metal tensioners (fig. 3-6a and b) or with a simple taut-line hitch (fig. 3-6c).

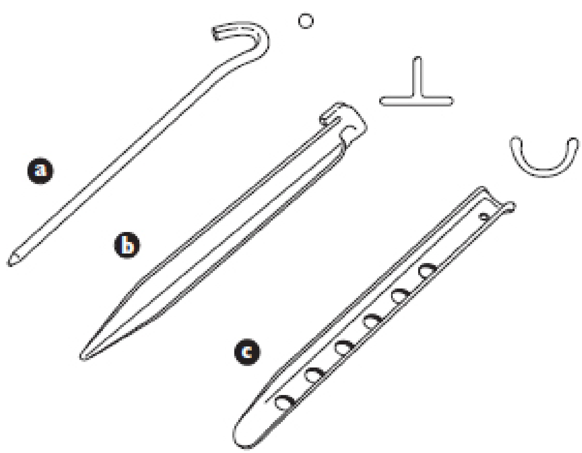


Fig. 3-4. Tent stakes (note profile cross sections at upper right): a, skewer; b, T-shaped; c, snow or sand stake.

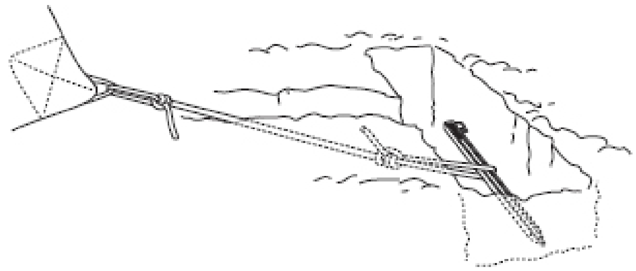


Fig. 3-5. Deadman anchor: Dig a T-shaped trench about 12 inches (30 centimeters) deep, fasten the tent's guylines around the anchor, and place it in the trench's crossbar. Pull the line taut to tension the tent. Backfill the trench and stomp the snow to compact it over the anchor.

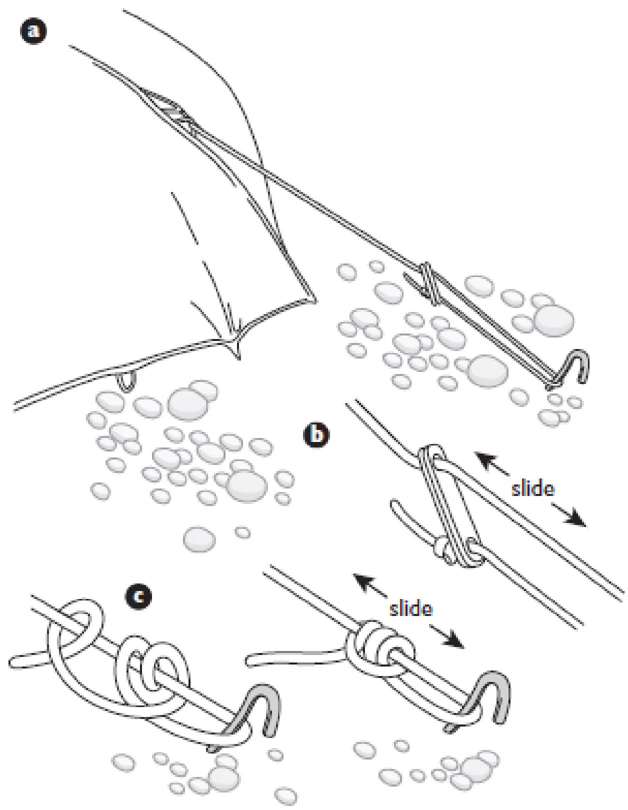


Fig. 3-6. Tensioning guylines: a, guyline with a tensioner device; b, close-up view of a tensioner; c, taut-line hitch.

Tent Setup, Care, and Cleaning

When setting up or taking down a tent, push poles through the tent sleeves rather than pulling them. Pulling can separate the pole sections and risk breakage at the joints. A tent goes up quickly if members of the party are familiar with the tent design.

To protect the tent floor from water, dirt, and abrasion, discourage people from wearing boots inside the tent. Before packing up, turn the tent inside out and shake it to clear out debris and remove condensation or rain. When not on an ultralightweight trip, bring a tarp or ground cloth to protect the tent floor from abrasion (tuck any excess underneath the tarp or cloth to avoid channeling rainwater). Footprints—ground cloths shaped for a specific tent—can be purchased from manufacturers or made from polyethylene fiber fabrics (such as Tyvek) or another Lightweight, durable material. Fabric repair tape is a good idea for the repair kit.

Tents last longer when carefully cleaned and air-dried after each trip. To clean a tent, hose it off or hand wash it with mild soap and water. Scrub stains with a sponge. Spot-clean any tree sap. Hang to dry.

High temperatures and prolonged exposure to sun damage tent material, so do not leave the tent set up for unnecessary periods of time. The damage from ultraviolet light can ruin a rain fly in a single season of prolonged exposure. Do not touch tent fabric just after applying DEET-based insect repellent to yourself; the chemical can ruin fabric coatings.

TARPS

A tarp—lightweight and low cost—may offer adequate shelter from all but extreme weather in lowland forests and among subalpine trees. Compared with a tent, a tarp offers less protection from heat loss and wind and none at all from insects or rodents. A tarp also requires ingenuity and some cooperation from the landscape to set up (fig. 3-7). It may be a poor choice as the main shelter above timberline unless you bring ice axes or trekking poles. A tarp shelter, however, can be very helpful as a cooking and eating area in camp during inclement weather. Avoid wrapping yourself in a tarp as if it were a blanket because perspiration will condense inside the waterproof material.

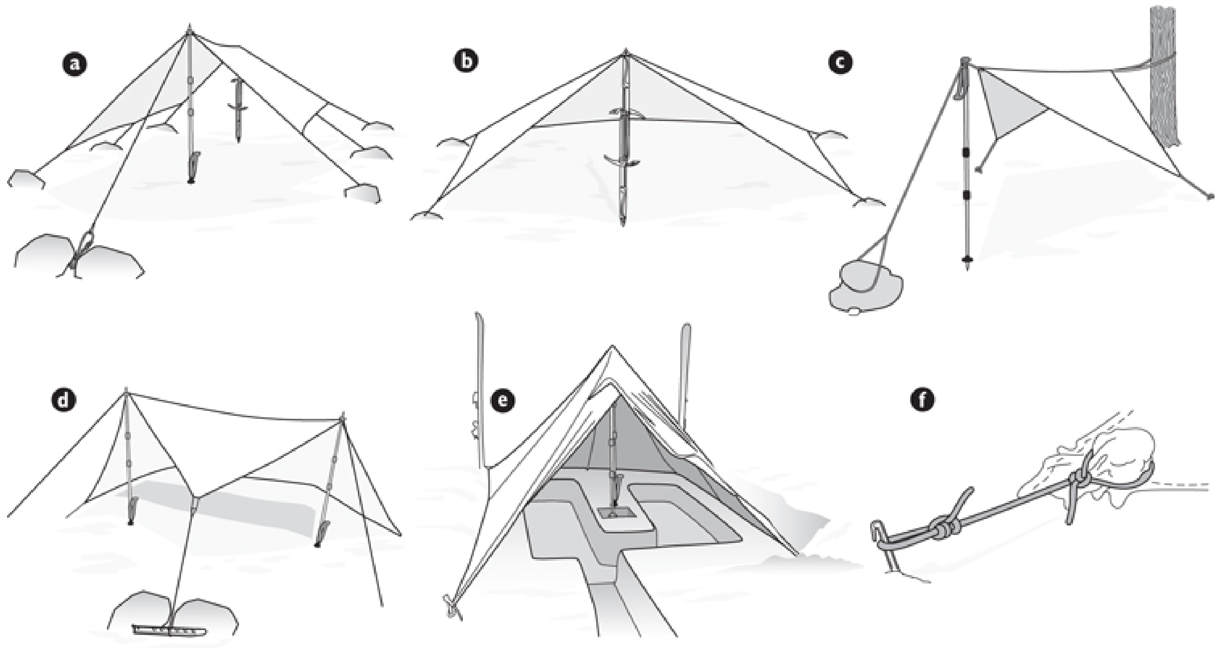


Fig. 3-7. Improvised tarp shelters: a, A-frame using trekking pole and ice axes secured by a chock; b, arrowhead using two lashed ice axes; c, dining fly with tree and trekking pole; d, using two trekking poles and secured by a stake wedged between rocks; e, dining fly for kitchen in snow using skis, a stake, and a trekking pole; f, tying off corners of a tarp that has no grommets or tie-off loops.

Plastic tarps are inexpensive but unsuitable for mountaineering. Coated nylon or silnylon tarps are stronger and usually very lightweight. Tarps made of Dyneema Composite fabric are the lightest available. Many tarps come with reinforced grommets or tie-off loops for easy rigging. Alternatively, create corner tie-in points using a bit of the tarp's fabric wrapped around a small cone or pebble from the campsite (fig. 3-7f). Bring lightweight cord, a few light stakes, and use taut-line hitches (see Figure 3-6c) to string the tarp up.

Some manufacturers offer lightweight, floorless nylon tents and usually at least one pole. Similarly, the rain fly of some double-wall tents can be set up without the tent, serving as a freestanding lightweight shelter.

BIVY SACKS

A lightweight alternative to a tent, a bivy sack is a large fabric envelope with a zipper entrance, typically with zippered mosquito netting. Bivy sacks provide some insulative value and the moisture-management functions of a tent—keeping out external moisture while venting internal water vapor. The bottom is usually waterproof-coated nylon; the upper is either a waterproof-breathable or weather-resistant material. Bivies come in three main types:

1. **All-weather bivies** are able to fully function as a shelter weighing from about 1 to 2.5 pounds (about 0.5 to 1.1 kilograms).
2. **Splash bivies** are weather-resistant on the top, allowing them to be extremely lightweight (as light as 6 ounces/180 grams) and breathable. Intended for mild weather, they protect from splashing rain and snow drift when used with tarps.

WHEN YOU GOTTA GO

Each climber needs to drink plenty of water during the climb to stay hydrated and avoid fatigue. Finding a safe and private place to pee is more difficult for women. Some are comfortable just undoing the quick-release elastic leg loops at the back of their climbing harness and pulling down their pants. Alternatively, commercially developed pee funnels allow women to urinate through their pants fly while standing. Climbing parties should allow climbers the time and opportunity to urinate on a regular basis to avoid dehydration, embarrassment, and dangerous situations. As a reminder for all climbers: do not remove your climbing harness and do not untie from the rope unless you are in a safe situation.

THREE CARDINAL RULES FOR LEAVE NO TRACE CAMPING

1. **Camp gently.** Camp in established campsites or on durable surfaces whenever possible. Research regulations and special issues for the areas you intend to climb. Use a camp stove instead of building a fire. Wash people and dishes well away from campsites and water sources.
2. **Do not disturb.** Leave flowers, rocks, and wildlife undisturbed by "taking only pictures and leaving only footprints." Keeping human food from wildlife minimizes the chance of future unwanted human-animal encounters.
3. **Dispose of waste.** Dispose of human waste properly, at least 200 feet (75 steps) away from water, trails, and campsites. In forest, dig a hole to fully bury your poop. In the alpine, human waste must be packed out in "blue bags" or WAG BAG waste bags (see Chapter 7, Leave No Trace). Go stealthily and pack out all garbage and scraps of food.

3. **Emergency bivies** weigh so little, about 4 to 9 ounces (113 to 255 grams), that each member of the climbing party can always carry one as an emergency shelter.

Styles vary from spartan sacks (see Figure 3-3g) to minitents that may be staked out and have a hoop to keep the fabric off the sleeper's face (see Figure 3-3h). Bivies are typically designed for one person, two in an emergency.

A bivy can be used as primary shelter or carried only as an emergency shelter. Test that the length and circumference can accommodate the sleeper, a fully lofted sleeping bag, and ground insulation inside the bivy, as this is common practice. In mild conditions, a bivy sack, with a tarp set up over it, offers good protection at less weight than most tents. In wet conditions, a bivy sack inside a tent will keep the sleeping bag dry no matter how damp the tent.

SELECTING A CAMPSITE

The ideal campsite has great views, a nearby water source, protection from the elements, and flat space for tents and cooking. Some places have it all, but selecting a campsite usually involves trade-offs. Climbers may deliberately walk past an idyllic spot in the forest in favor of a cramped mountain ledge that puts them closer to the summit.

Wind. Wind is a big consideration in choosing a campsite. In most areas, prevailing winds tend to come from a particular direction. A ridge-top camp is very exposed, and a notch or low point on a ridge is the windiest of all. Alpine breezes can be capricious. An afternoon breeze blowing upslope may reverse at night as heavy, chilled air rolls downslope from snowfields. Cold air flows downward during settled weather, following valleys and collecting in depressions. Thus, there is often a chilly breeze down a creek or dry wash and a pool of cold air in a basin. Night air is often several degrees cooler near a river or lake than on the knolls above.

Consider wind direction when pitching a tent. Pitching camp on the lee (downwind) side of a clump of trees or rocks is often best. Facing the door into the wind in good weather will distend the tent and minimize flapping. In stormy conditions, pitch the tent door away from wind so rain and snow will not be blown inside.

Location. Consider how changes in temperature or weather may affect the campsite. For example, avoid camping in gullies or creek beds, which are susceptible to flash floods during a thunderstorm. Consider that a river or stream may rise if conditions change. The braided rivers in the Alaskan interior, for example, often rise considerably due to increased glacial runoff as the day warms up. In winter or in the high country, make sure the tent is clear of any potential avalanche path or rockfall. If you camp under trees, look up to assess the health of the branches.

Leave No Trace. After safety considerations, environmental impact is critical in campsite selection. The more human traffic there is and the more fragile the setting, the more careful climbers need to be (see "Three Cardinal Rules for Leave No Trace Camping" sidebar). The detailed campsite discussion of Chapter 7, Leave No Trace, can be summarized as follows:

- **Best choices:** Established, fully impacted site; snow; or rock slab
- **Good choices:** Sandy, gravelly, or dirt flat; or duff in deep forest
- **Poor choices:** Grass-covered meadow, or plant-covered meadow above timberline
- **Worst choice:** Waterfront along lakes and streams

Bear country. Many wild areas visited by climbers are also home to bears, and camping in bear country means thinking about how to avoid potential conflict. Bears have powerful noses and can smell food from up to a mile away. Consider this as you are setting up camp and choosing a campsite. In treeless bear country, the target is to set up camp in a triangle configuration (fig. 3-8) that is at least 100 yards (or meters) on each side. That distance is usually impractical, but set the configuration points as far apart as feasible: one point of the triangle that has good visibility in all directions is the cooking and eating area; at another point, put storage of food, camp kitchen items (stove, pots, scrubber, et cetera), and any other items with an aroma (such as toothpaste, deodorant, lotions, and human waste); at the third, upwind point, establish the tent site. Know that large animals such as bears and cougars are not known to attack parties of four or more persons, so this may be a useful minimum group size for extended trips in wilder areas—if everyone stays together. Make sure to sleep in a tent rather than out in the open. Keep in mind that bear and cougar attacks are extremely rare and fatalities much less frequent than fatalities from snakes, lightning, or bees.

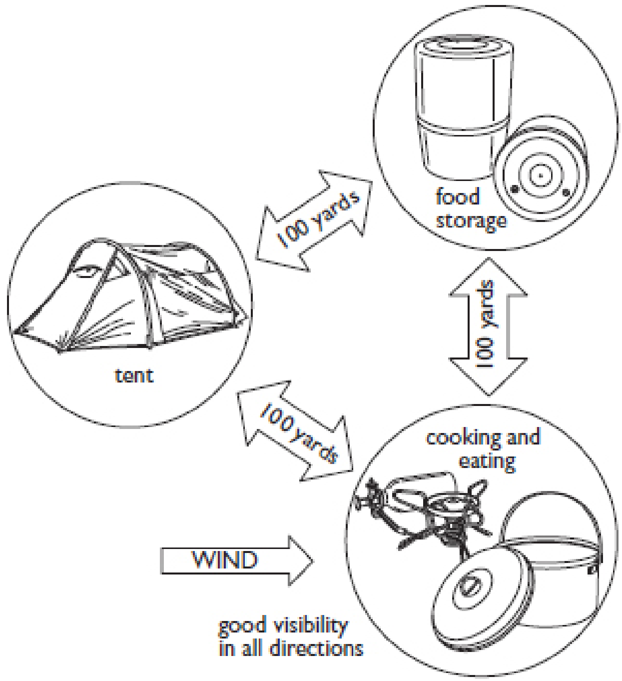


Fig. 3-8. Optimal campsite triangle for camping in bear habitat.

PROTECTING FOOD FROM ANIMALS

Do not leave food inside the tent. Bears, rodents, skunks, raccoons, birds, and other animals can smell food and will tear or gnaw through plastic bags, stuff sacks, and even packs. Ravens, crows, and jays can peck through mesh tent windows; weasels can skillfully fiddle with zippers; other animals simply rip or chew through the fabric, taking food, making a mess, and ruining your shelter. The traditional solution was to suspend a stuff sack or pack from a line strung between two trees. But stout, high branches are in short supply in the alpine, and clever critters, ever fond of a free lunch, can thwart the cleverest of contraptions. If a tree is your only option, try the Pacific Crest Trail (PCT) method (fig. 3-9). Today's land managers may provide steel-wire high lines, poles, or metal food storage cabinets in popular backcountry camping areas, so use them when available.

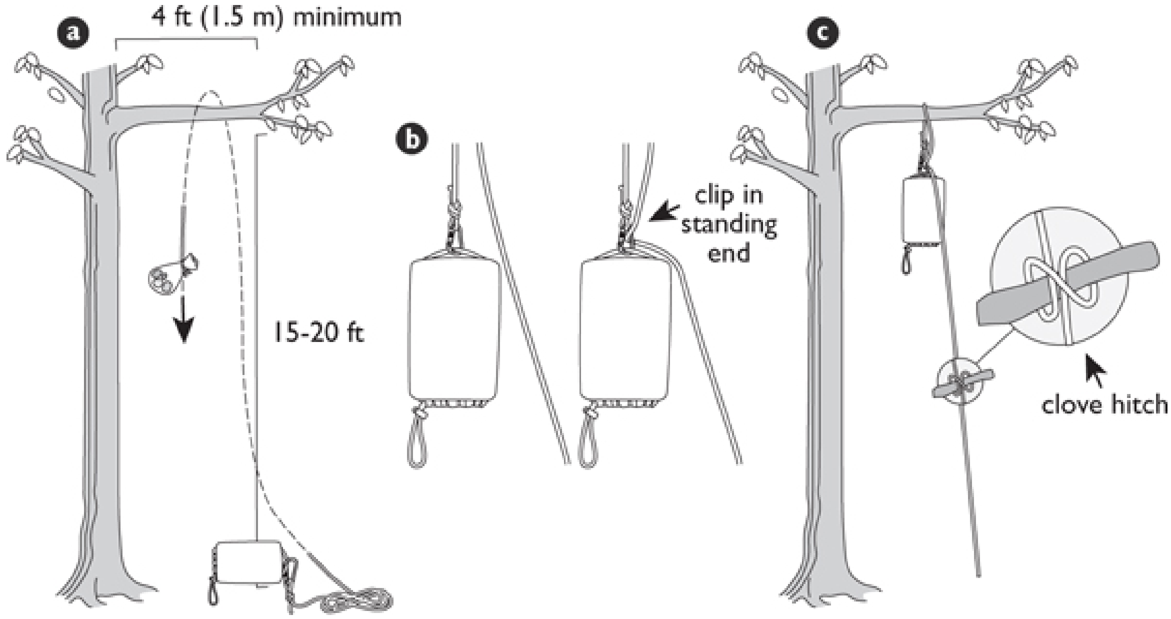


Fig. 3-9. The PCT method for hanging food: a, toss a line over a high, sturdy tree limb; b, attach food bag, clipping the standing end of the rope back through the attachment carabiner; c, hoist the bag all the way up, then, as high as you can reach, clove-hitch a stick to the lower line. Then lower the food bag, which will move the stick upward until it jams against the carabiner.

Bear-resistant canisters and bags. Managers of numerous wilderness areas in the western United States find that special bear-resistant, unbreakable plastic food canisters (fig. 3-10a) are more effective than the traditional hanging food bag. Canisters are bulky, however, and are heavier than nylon or plastic sacks. In places with significant bear populations, land managers often loan or rent these containers. Some areas require them and may assess significant fines on the containerless. Lightweight collapsible bear bags such as the Ursack (fig. 3-10b) are allowed in many areas as an alternative to rigid bear canisters. These are made of "bulletproof" Spectra fabric advertised as being impervious to bears; optional aluminum inserts help keep the food from being mashed.

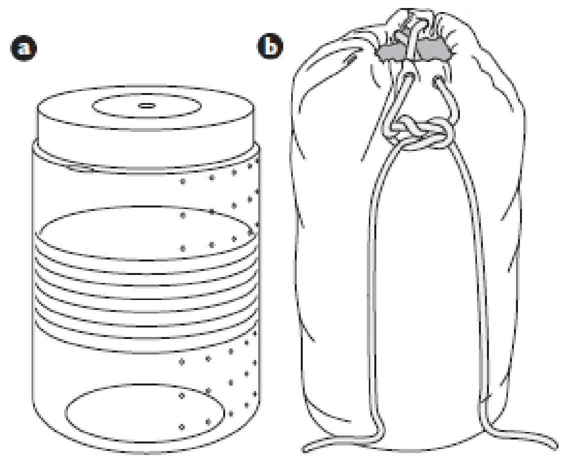


Fig. 3-10. Bear-resistant containers: a, bear canister; b, Ursack. For the latter, cinch the bag tight, leaving no gaps, and secure the cord with a surgeon's knot (shown loose here for clarity).

Hiding a food cache in the wilderness is generally a poor practice that is prohibited in some areas. Where allowed, use a bear-resistant container. When animals get into an improperly protected cache they get in the habit of seeking out people for food. If a bear or cougar becomes habituated to people's campsites as a food source, the animal may become a "problem animal" that must be relocated or killed. Remember, a fed bear is a dead bear.

PREPARING A MEAL IN BEAR COUNTRY

When you prepare a meal, remove only the items for that meal, and bring them to the cooking and eating site. Maintain a lookout during cooking and eating. If a bear is ambling toward the group, quickly pack up the food.

At the end of the meal, wash up well with unscented soap to remove food odors from people, clothes, and equipment. Dispose of cleaning water downwind from the campsite and well away from water sources (see Chapter 7, Leave No Trace). Return all the cooking equipment and leftover food to the food storage site. Do not keep any food in the tent, and avoid bringing clothes with food stains or cooking odors into the tent. When storing food to protect it from animals, include such odorous objects as tooth-brushes, toothpaste, lotions, used feminine-hygiene products, the garbage bag, and even Esbit fuel.

SNOW AND WINTER CAMPING

For successful winter camping, a good shelter, proper insulation, and the skills to stay dry are essential. Tents are the preferred choice when weather conditions are changing, with temperatures near the freezing point, as well as in terrain with little snow, on short trips, or when camp must be set up quickly. If the sun is out at midday, the inside of a tent can be 40 degrees Fahrenheit (20 degrees Celsius) warmer than the outside air, allowing climbers to dry clothes or sleeping bags. More exotic snow shelters such as snow caves and igloos require more time, effort, and skill but may be stronger, more spacious, and even warmer in very cold weather.

TOOLS

A mountaineering snow shovel is essential for preparing tent platforms, building wind-blocking walls, digging emergency shelters, excavating climbers from avalanche debris, and sometimes even for clearing climbing routes. In winter, each party member should carry a shovel. For summer snow camping, take one shovel per tent or rope team, with a minimum of two shovels per party.

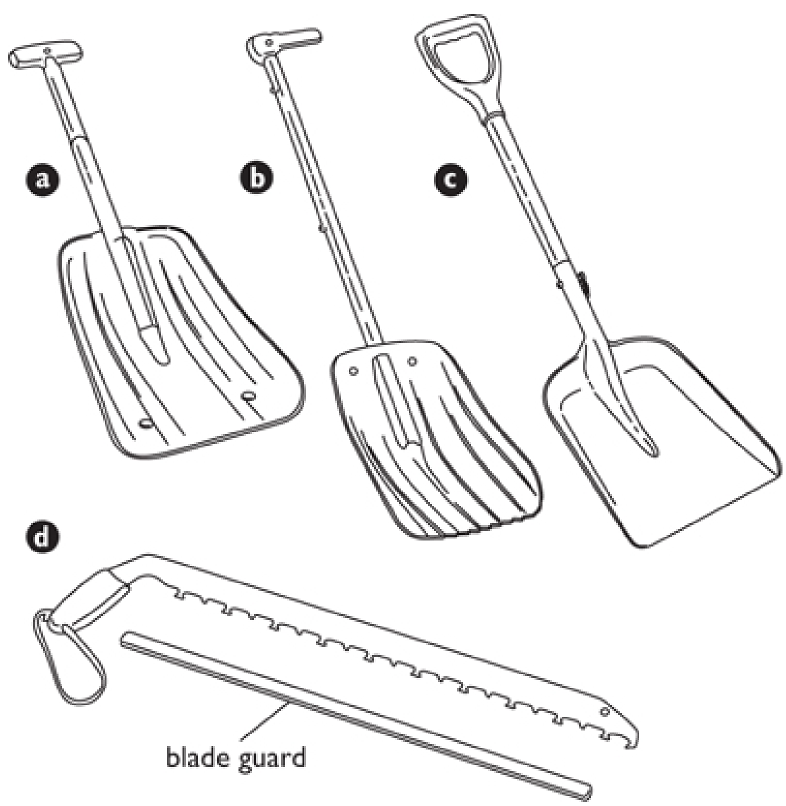


Fig. 3-11. Snow tools: a, scoop-style shovel with T-shaped handle; b, scoop-style with L-shaped handle; c, straight-bladed shovel with D-shaped handle; d, snow saw with blade guard.

Look for a lightweight shovel with a compact sectional or telescoping handle and a sturdy aluminum blade for chopping into icy snow. The blade may be scoop-shaped (fig. 3-11a and b), which makes it easier to move large volumes of snow, or relatively straight-bladed (fig. 3-11c), which makes cutting snow blocks easier. A D-shaped handle (see Figure 3-11c) or L- or T-shaped handles (see Figure 3-11a and b) can provide leverage and a firm grip.

A snow saw (fig. 3-11d) is the best tool for cutting blocks to make an igloo, a snow trench, or a wind-blocking snow wall around your tent (see Figure 3-12).

TENTS IN WINTER

Locate a winter camp away from hazards such as crevasses, avalanche paths, and cornices. Observe the local wind patterns: A rock-hard or sculpted snow surface indicates frequent wind, whereas an area with loose, powdery snow indicates a lee slope where wind-transported snow is deposited. An area deep in powdery snow may be protected from wind, but the tent may frequently have to be cleared of snow. (For more, see Chapters 17, Avalanche Safety; 18, Glacier Travel and Crevasse Rescue; and 27, The Cycle of Snow.)

Select a flat spot. Establish a tent platform by compacting an area large enough to hold the tent and to allow for movement around it to check guylines or clear snow. A straight-bladed shovel works well to flatten the tent site. Tromping around on it with snowshoes will compact the surface. A ski does a great job of grading it. Flatten and smooth the tent platform thoroughly to keep occupants from sliding downslope and to avoid uncomfortable bumps that will be cast in ice during the night. If the site is unlevel, sleep with your head toward the high side. See "Anchoring the Tent" above for securing a tent in snow.

After pitching the tent, dig a pit about 1 foot (30 centimeters) deep in front of the tent door (fig. 3-12). Climbers can then sit comfortably in the doorway to put on boots and gaiters. In bad weather, the vestibule-protected pit is a convenient, wind-protected location for the stove.

Stormy weather may require a snow wall around most mountaineering tents to protect them from the wind and to avoid tent collapse (see Figure 3-12). Don't dig the floor of the tent down but stake it at snow level; a tent in a pit will be buried faster by falling snow. Unless necessary, avoid fully surrounding the tent or tents as this tends to trap drifting and falling snow. Build the wall in an arc on the windward side with walls 3 to 6 feet (1 to 2 meters) high. Blocks cut by a snow saw or straight-bladed snow shovel make the easiest, quickest walls and cut the wind more effectively than a rounded pile. Keep snow walls at least as far from the tent as they are high: for example, a 3-foot-high wall should be at least 3 feet away from the tent, because wind will quickly deposit snow on the wall's leeward side. Piling snow against the windward side of the wall strengthens the blocks and helps minimize drifting on the leeward sides.

Fig. 3-12. Typical winter camp: snow walls and a tent placed with its door downwind, with a vestibule-protected pit as a kitchen area.

During a storm, party members will periodically have to clear snow away from the tops and sides of the tent. In most storms, the problem is drifting snow not falling snow. Snow deposits develop on the leeward side of tents and snow walls. Even a partially buried tent poses a risk of asphyxiation, especially if stoves are used inside. Snow can load the tent enough to break poles and collapse the tent. Shake the walls regularly and shovel out around the tent, taking care to remove snow from below the lower edge of the fly so air can flow. Be careful not to cut the tent with the shovel; nylon slices easily when tensioned. In a severe or prolonged storm, a tent may begin to disappear between neighboring snowdrifts, making it necessary to reestablish the tent on top of the drifted snow.

Useful items for winter camping. These include a small whisk broom to sweep snow from boots, packs, clothing, and the tent; a sponge for cleaning up food and water spills, and removing interior condensation; an LED lantern for cheer during long winter nights. For a larger community tent, a gas lantern can repay its price in weight and bother by adding tremendous brightness and warmth.

House rules for tent-bound hours. Having a few house rules in place makes time spent tent-bound more pleasant. It often helps to have one person enter the tent first to lay out sleeping pads and organize gear. Packs may have to be stored outside a small tent; if your tent has vestibules, brush off all snow before bringing packs inside. House rules may also dictate that boots be taken off outside, brushed free of snow, and placed in a waterproof boot bag inside the tent. Boots can tear holes in the tent floor. Mountaineering boots with removable liners are a real advantage—leave the shells outside or in the vestibule and bring the liners inside. Use stuff sacks to reduce clutter and protect personal gear. Put dry clothing inside your sleeping bag or a waterproof sack so it does not get wet from condensation.

Sleeping bags also offer an opportunity to dry out gear. Add small items, such as boot liners, gloves, and socks, to your bag before you go to sleep, and they will be dry and warm in the morning. Do not attempt to dry large items of clothing by wearing them to bed; they will just make you and the bag wet and cold. In extreme cold, put boots inside an oversized stuff sack and place them inside or next to the sleeping bag to keep them from freezing. To prevent a water bottle from freezing or a compressed gas fuel canister from getting chilled (and performing poorly at breakfast), place them inside the sleeping bag overnight.

SNOW SHELTERS

When the temperature drops or winter storms bring strong winds and heavy snowfall, seasoned mountaineers may prefer to sleep in a snow shelter rather than a tent. A snow cave or an igloo takes more time to build, but either is more secure than a tent and warmer in cold weather.

Construction time, effort, and the near certainty of getting wet during construction are the major drawbacks of snow shelters. Among the different types of snow shelters, snow trenches are relatively quick to complete, snow caves take more time to build, and igloos are typically too complex and time intensive to construct. Snow shelters require no special equipment other than a snow shovel and perhaps a snow saw to cut blocks—but they do require skill. Practice before committing to a trip that may need to rely on them.

Dripping water is a potential problem in any snow shelter. Body heat warms the air, which rises to the ceiling, resulting in some melting. If the ceiling is smooth, most of the meltwater will absorb into the snow. But little spikes and bumps will become dripping points, so take the time to smooth the inner walls. Finally, do not cook inside the snow shelter; inadequate ventilation may lead to carbon monoxide poisoning.

IMPROVISE WITH NATURAL FEATURES

The best shelter in a snow environment is a four-season tent, and setting one up is certainly quicker and easier than building a snow shelter. However, knowing how to construct a snow shelter could prevent an unplanned bivouac from becoming fatal. With a little improvisation, natural features can convert into snow hideaways. Such shelters occur under logs, along riverbanks, or in the pits or wells formed when the limbs of large conifer trees deflect snow from the tree trunks. For a tree-well shelter, enlarge the natural hole around the trunk and make a roof from any available covering, such as ice blocks, tree limbs, an emergency space blanket, or a tarp.

Blocking the wind is often essential for survival. Boughs and bark can insulate and support, but only cut live trees in an emergency. Make sure your chosen location is not in the path of a potential avalanche (see Chapter 17, Avalanche Safety).

Snow Trench

A snow trench can take only a half hour to build, making it suitable for bivouac use as well as for spartan one- or two-person quarters. It is the simplest structure to build out of snow blocks. Unlike a snow cave, a trench does not require particular terrain features; it is appropriate for the flats or on an avalanche-safe slope. However, the snow must be deep enough that the completed trench floor still sits in snow.

To build a snow trench, establish an initial cut line 6 to 7 feet (about 2 meters) long with either a straight-bladed shovel or a snow saw (fig. 3-13a). Dig a narrow trench along this cut line by using the snow saw or shovel to quarry snow blocks about 1 to 1.5 feet (40 centimeters) wide by 2 feet (60 centimeters) long by 3 feet (90 centimeters) tall (fig. 3-13b). The blocks can be created as part of the process of removing snow for the trench, or they can be quarried nearby. Set each snow block aside carefully when it is removed from the quarry—they will form the roof of the trench.

Once the trench area is large enough—2 feet (60 centimeters) wide by 6.5 feet (2 meters) long by 3 feet (90 centimeters) deep for one person—roof the trench, A-frame style, with the snow blocks (fig. 3-13c). Close off the back with another snow block. When the A-frame roof is in place, crawl underneath it into the trench and enlarge the interior down and out to accommodate the intended number of occupants. Build steps leading down into the trench. Provide a ventilation hole in the roof. Use loose snow to caulk any gaps between roof blocks and around the back. Smooth out any bumps or irregularities in the ceiling so meltwater will run down the blocks to the sides rather than dripping on the occupants. Cover most of the entrance with a pack wrapped inside a plastic bag, but leave some space for ventilation. Cook outside of the trench.

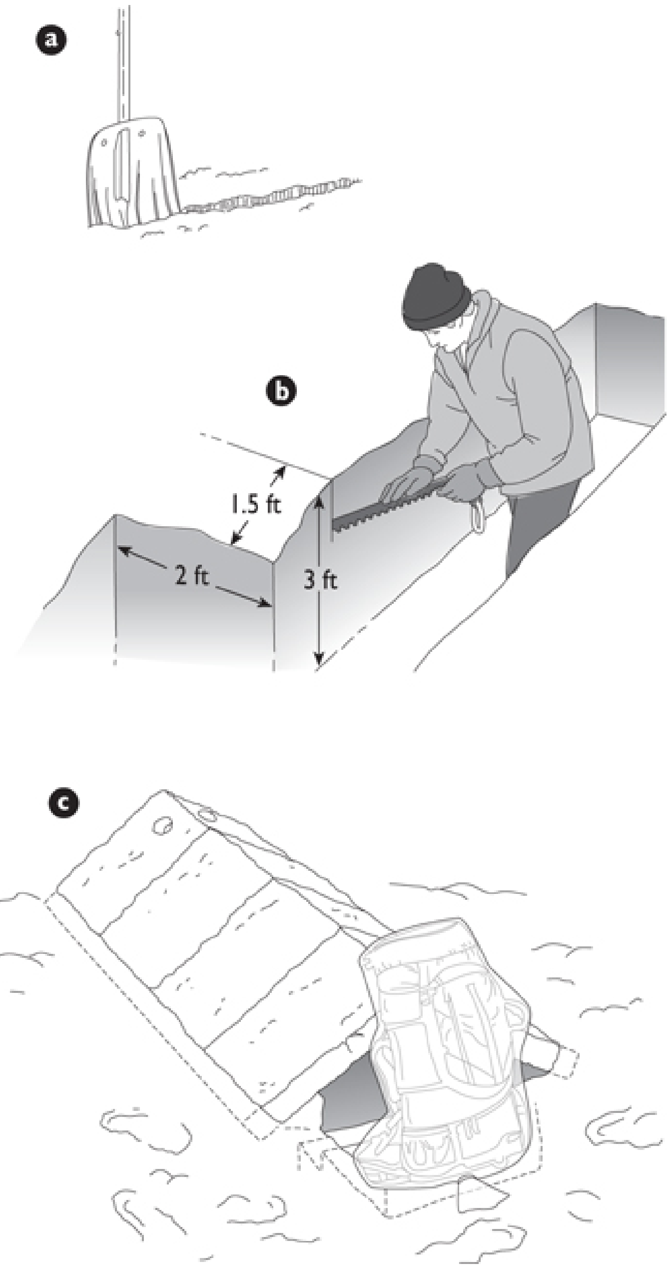


Fig. 3-13. Building a snow trench: a, establish an initial cut line with straight-bladed shovel; b, quarry snow blocks 1.5 feet wide by 2 feet long by 3 feet tall (40 by 60 by 90 centimeters); c, build an A-frame roof with snow blocks, enlarge interior, provide ventilation hole in roof, and shield the door opening with a large backpack.

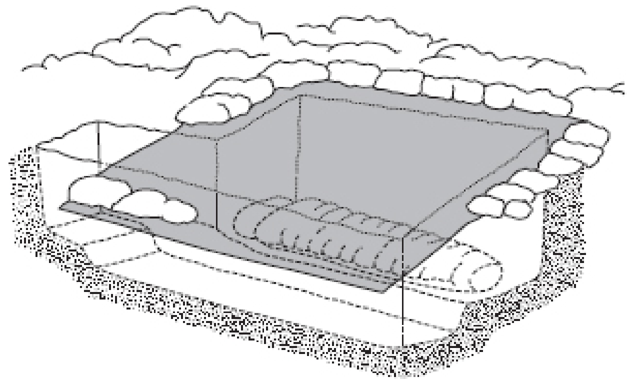


Fig. 3-14. Basic snow trench roofed with a tarp.

A more basic, emergency snow trench shelter can be built by digging a trench some 4 to 6 feet (1.2 to 2 meters) deep and large enough for the party to sleep in. Stretch a tarp over the top and weigh the edges down with snow (fig. 3-14). On a flat site, provide some slope to the tarp by building up the snow on one side of the trench. This quick shelter works moderately well in wind or rain, but a heavy snowfall can collapse the roof. As with all snow shelters, the smaller the trench, the easier it is to keep warm.

Snow Cave

Snow caves are most suitable in locations where climbers can burrow into a substantially snow-covered hillside. The snow must be deep enough to leave about 2 feet (60 centimeters) of ceiling thickness. A strong and stable cave also requires somewhat firm (consolidated) snow. Several people can shelter in one snow cave. A well-built cave dug in firm snow is a very secure structure. However, if the outside temperature is warming toward freezing, a tent or tree well shelter may be a better choice. The collapse of a snow cave roof can cause serious injury.

Find a short—7 feet (2 meters) tall at minimum—snow-drift or 30- to 40-degree slope that is clear of any potential avalanche hazard (fig. 3-15a). It is easier to dig the cave into a steep slope than a gentle slope. The snow must be deep enough that you will not hit ground before you finish excavating the entire cave. Dig an entry that is 1.5 feet (0.5 meter) wide and 5 feet (1.5 meters) high (fig. 3-15b), and dig it into the slope about 3 feet (1 meter) deep. Then create a temporary construction-debris exit slot by digging a waist-high platform centered on the entryway, forming a T that is 4 feet (1.2 meters) wide by 1.5 feet (0.5 meter) high (fig. 3-15c). Develop this platform so that it forms a horizontal slot extending into the slope, allowing for easy snow removal.

Shovel snow out through the horizontal slot; a second person, working outside, can clear the snow away.

Create the main room by digging inward and expanding the room to the front, sides, and upward—all directions except down (fig. 3-15d). Keep digging until all the snow within easy reach has been excavated. Extend the original entry hallway another 2 feet (60 centimeters) into the slope, permitting the person excavating to get farther into the cave to continue excavating outward and upward (fig. 3-15e). Now it should be nearly possible to stand inside. Continue to excavate, now out of the wind; when enough snow has been cleared to allow the excavator to sit up on the floor, another person can enter and help continue to expand the cave in all directions except downward.

Excavate until the inside dimensions are about 5 feet (1.5 meters) from front to back by 7 feet (2 meters) wide and 3.5 feet (1 meter) high, a comfortable minimum for two people. Make the cave larger for more occupants, but remember that a small cave is warmer than a large one. Keep a minimum of 2 feet (60 centimeters) of firm snow on the slope above the cave ceiling (see Figure 3-15g) to provide enough strength to keep the roof from collapsing. Avoid building a flat ceiling. The more dome-shaped the contour, the stronger the ceiling.

Fill in the temporary horizontal slot with snow blocks (fig. 3-15f); one large block or two smaller blocks leaning against each other may be sufficient. Caulk any spaces around the blocks with snow. The top of the completed entrance tunnel should be at least 6 inches (15 centimeters) lower than the cave floor, keeping warm air in the cave and cold drafts out (fig. 3-15g). Use snow blocks to build a wind-screening wall on either side of the entry path.

Poke a pair of ski-pole-basket-sized ventilation holes through the cave ceiling from the inside out (fig. 3-15h) to prevent asphyxiation. If it gets too warm inside, enlarge these holes. Do not use a camp stove inside the cave—cook outside in open air.

Smooth the domed ceiling so that it is free of any bumps or protrusions (fig. 3-15i); this way, melting water will flow down the walls of the cave instead of dripping from bumps onto the occupants. Scratch a small ditch all around the base of the wall to channel meltwater away from the floor. Place a ground sheet on the floor—clear of the meltwater ditch—to help keep things dry and to prevent equipment loss. Keep stormy weather out by putting a small tarp or a pack (inside a plastic bag) over the entrance, but leave an opening for ventilation. Mark the outside area around the cave with bamboo wands (fig. 3-15j), so that someone does not inadvertently walk onto the roof.

Customize the inside by digging small alcoves into the walls to store boots, stoves, and cooking utensils or to hold candles for illuminating the cave at night (fig. 3-15k). Digging the entrance tunnel deeper under the wind-screening snow blocks will make entry easier. Entrance area seats, a cooking platform, and other personal touches make the cave a snow home. Collapse the snow cave when you leave the area so that it is not hazardous for others.

Igloo

If conditions are right, igloos are undeniably fun to build and use, but their complex and time-intensive construction makes them impractical on most mountaineering trips or in an emergency. A possible exception might be a long-term base camp in a flat, remote area.

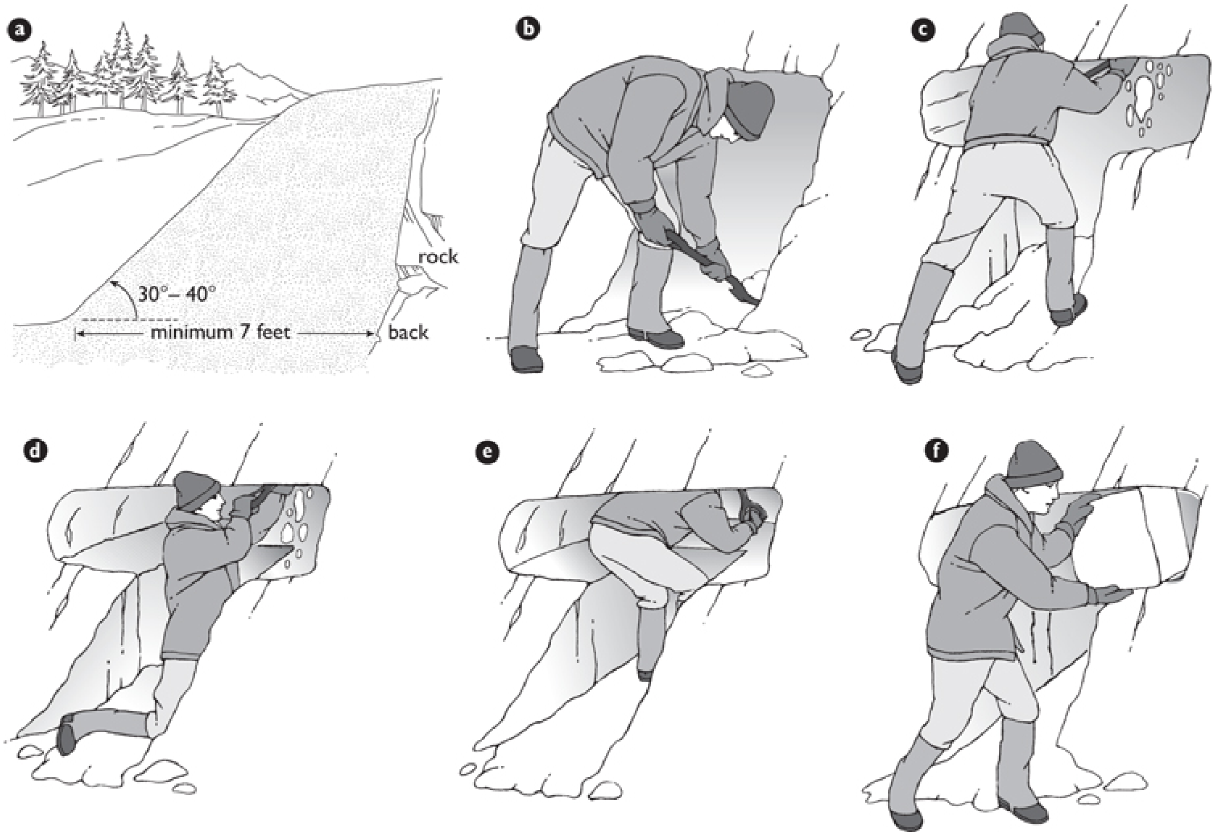
STOVES

Fire is the sixth Ten Essential, and for fire, mountaineers rely on stoves. Stoves are faster, cleaner, and more convenient than campfires for backcountry travel. They will operate under almost any conditions with minimal environmental impact. Whatever stove and fuel you choose, practice using your stove at home first. When choosing the right stove (fig. 3-16) for the next trip, consider four key questions:

Petrol preference. Choose a fuel and then a stove for each adventure. Canister fuel dominates today's outdoor industry, but in some countries liquid or alternative fuels (see Table 3-3) are sometimes easier to find or more suitable for cold weather, high altitudes, or ultra lightweight travel.

Boil or simmer. Some stoves are tiny infernos optimized to boil water and melt snow, while others are appropriate for more complex cooking. Consider your cooking preferences when choosing your stove.

Windy weather. A wind of merely 5 miles per hour (8 kilometers per hour) can double to triple the fuel consumption of an unprotected stove-on-top canister stove. On all but short trips, there is little excess fuel. If you anticipate windy conditions, consider a windproof canister stove system or a remote-fuel stove. Remote-fuel stoves allow a full windscreen to protect the burner from the heat-stealing wind while keeping the fuel reservoir safely away from the inferno. If you are using a stove-on-top canister stove or personal cooking canister system stove, shield the windward side with rocks or gear, but *do not* encircle the stove with a windscreen or the trapped heat will have you serving a Molotov cocktail.


a
30°– 40°
minimum 7 feet
rock
back
b
c
d
e
f

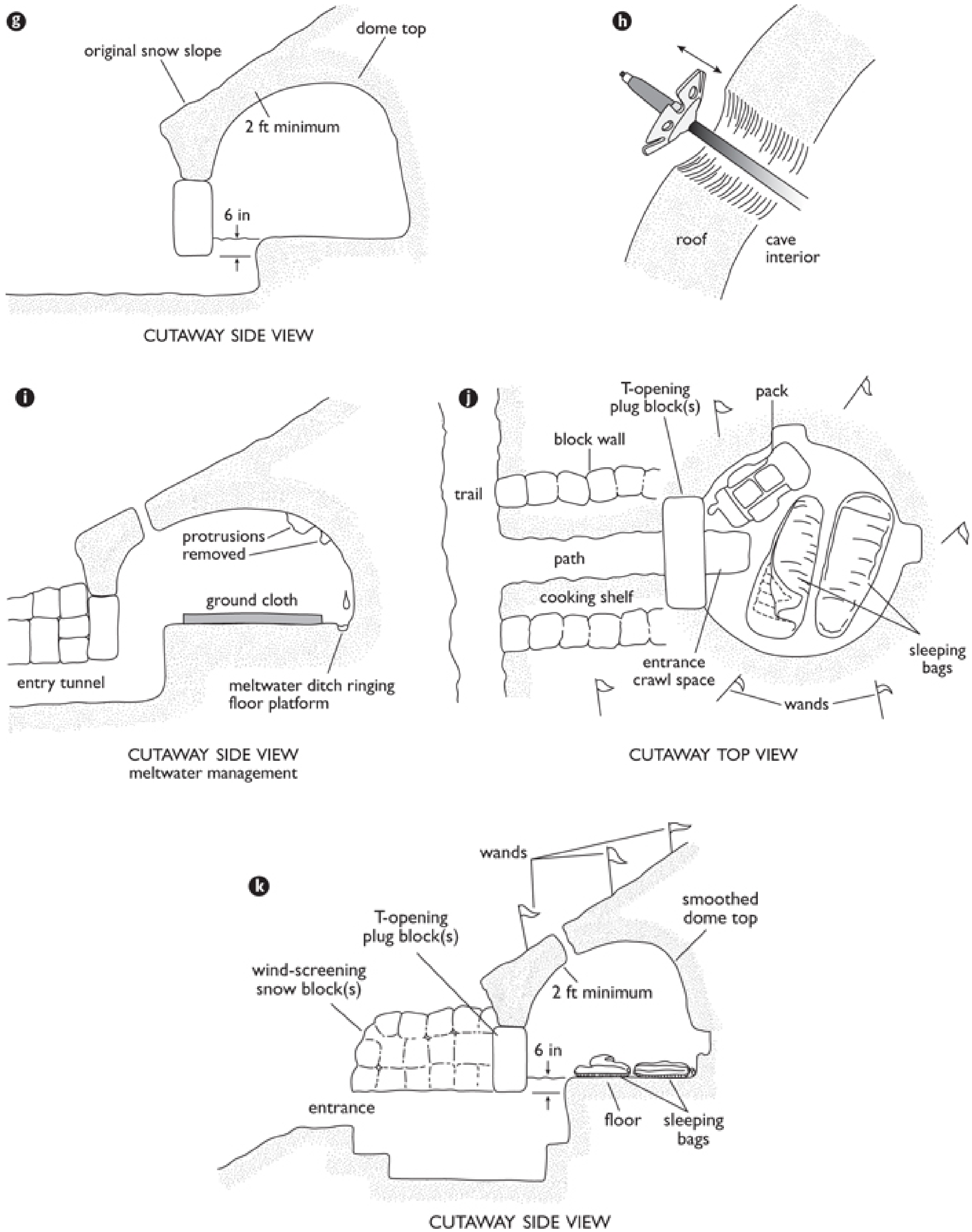


Fig. 3-15. Building a snow cave:
a, choose location;
b, dig entry;
c, dig T-shaped slot;

d, dig inward, expanding up, left, and right;
e, expand to desired size;
f, fill in T-shaped slot;
g, consider the snow cave cross section;
h, create ventilation holes;
i, smooth ceiling and dig meltwater ditch;
j, mark cave perimeter and erect wind blocks;
k, create storage alcoves and deepen entryway.

Cooking for a crowd. For one or two climbers sharing a pot up to about 1.5 liters, stove-on-top and canister system stoves are best. Groups of four or more, or those with substantial snow to melt, need a 2- to 5-liter pot paired with a remote-fuel stove. These are low profile and therefore sufficiently stable for larger pots. Canister system stoves currently can accommodate their specially designed pots of up to 2.5 liters.

STOVE FUELS

Because the type of fuel drives the design and functionality of the stove, it is helpful to learn about fuels before diving fully into stoves. Fuel for camp stoves comes in several varieties, each with advantages and disadvantages. See Table 3-3 for a full comparison of fuel type advantages and disadvantages.

Canister fuel. These convenient canisters of liquefied petroleum gas (LPG) are blends of isobutane, propane, and butane. As the self-sealing valve opens, the pressure in the canister forces fuel out, eliminating both priming and pumping. This makes the stoves they power popular and convenient—easy to light, good flame control, immediate maximum heat output, and no chance of fuel spills. But because the fuel is liquefied, cold and high altitude often hinder stove performance. Butane canisters are the cheapest and work best in warm weather. Purchase blends of isobutane and propane for reasonable performance at high altitude and cold temperatures. Virtually all brands of threaded LPG canisters are interchangeable but contain different gas blends.

CALCULATING CANISTER CONTENTS

To calculate the fuel remaining in a canister, do one of the following:

- Shake and guess.
- Float the canister in water (first burping the bottom concavity) and compare the float line against a full canister (some have an index).
- At home, weigh the canister on a kitchen scale and subtract the weight of an empty canister to determine the remaining fuel. Write the percent of

fuel remaining on the side.

Liquid fuels. White gas and kerosene used to be the most popular mountaineering stove fuels in North America and Europe, respectively. These fuels pack about the same heat output per ounce or gram as LPG and so are still favored for expeditions due to their low cost, availability, ability to refill fuel bottles, and performance in cold, high-altitude locations. Some stoves run only a single type of liquid fuel. Multifuel stoves, with their ability to burn white gas, kerosene, diesel, and others, are a good choice for international trips where fuel availability is uncertain. Unleaded automobile gas can be used, but fuel additives are prone to clogging stoves.

Alternative fuels. Suitable for ultralightweight cooking, solid fuels (Esbit or hexamine fuel tablets) and alcohol are options when their slow heat output is not hindered by bad weather or a need to melt snow or ice. These fuels' lower heat output makes for slow boil times but can be a good trade-off for the weight savings in fuel and stove. Biofuel (used in small woodstoves) is a new category that can make sense in places where it is responsible to burn small amounts of available dry wood.

STOVE TYPES

Once climbers have chosen their preferred petroleum, they can choose from among canister, liquid fuel, and alternative-fuel stove types.

Canister stoves. Simple LPG canister stoves come in two types. *Stove-on-top canister stoves* (fig. 3-16a) simply screw onto the canister, which forms the base. The Snow Peak GigaPower stove is an example. Very lightweight and compact, they are susceptible to wind and prone to tipping over. Do not use a full windscreen since that risks an explosion from superheating the canister. *Remote-fuel canister stoves* are low-profile stoves that attach the canister to the burner via a flexible hose (fig. 3-16b). They accommodate larger pots and are compatible with full windscreens. Some remote-fuel canister stoves permit the canister to be inverted to supply liquid fuel to the burner, improving performance in cold weather.

Canister system stoves. These stoves also use compressed gas canisters, but they up the ante with specially integrated pots with built-in heat exchangers to capture as much of the stove's heat as possible. These stoves are medium-weight and compact, with the stove and fuel stowable within the pot. System stoves come in two types. *Windproof systems* (fig. 3-16c) are extremely efficient in calm air and remain almost as efficient in windy conditions. They do not need a windscreen. If you can see the flame, the stove is not windproof. *Personal cooking systems* (fig. 3-16d) are designed to allow cooking and eating from a single pot but are susceptible to wind and incompatible with windscreens.

TABLE 3-3. COMPARISON OF STOVE FUELS

FUEL	ADVANTAGES	DISADVANTAGES	BEST FOR
CANISTER FUELS			
Blends of isobutane, propane, and butane	No priming or pumping required. Near zero maintenance. Immediate maximum heat output. Ability to simmer on some models. Readily available in North America, Patagonia, the Himalaya, Pakistan, Europe, and South Africa.	Spent canisters must be carried out. Not available everywhere. Tricky to judge fuel level. Less efficient in cold temperatures.	Short, light trips under any conditions. Good at high altitudes if temperatures are above freezing or somewhat colder (with a pressure-regulated stove).
LIQUID (PETROLEUM) FUELS			
White gas or naphtha (for example, Coleman	Widely available and inexpensive. Stable stove	Stoves require priming and are a bit heavier. Require separate fuel bottle.	Winter (very cold) or high-elevation use. International

fuel, MSR fuel), kerosene, diesel, jet fuel, aviation gas, unleaded automobile gas	designs. Simple to judge fuel level and pack exact amounts. No spent canisters.	Fuel spills possible. Stoves require periodic maintenance, tinkering (for example, matching jets to fuel).	expeditions where fuel availability is unknown. Large groups.
ALTERNATIVE FUELS			
Esbit or hexamine fuel tablets	Simple, ultralight, inexpensive stoves. Fuel output not affected by altitude. Titanium versions are compatiblewith burning wood.	Leaves a sticky residue on the bottom of pots. Smelly, expensive fuel. Lower heat output.	Ultralightweight cooking on long trips where melting snow or ice is not required.
Alcohol (grain alcohol 95%, pure or denatured alcohol, marine stove fuel, liquid fondue or chafing dish fuel, methyl alcohol [for example, HEET	Simple ultralight, inexpensive stoves. Widely available inexpensive fuel.	Lowest heat output.	Ultralightweight cooking on long trips where melting snow or ice is not required.

gasline antifreezein yellow bottle])			
Biofuel (used in small woodstoves)	Free fuel that does not have to be carried. Uses minimal fuel.	Dry wood is often not available in alpine environments. Burning wood is prohibited in many areas.	Woodland approaches in dry weather.

Liquid fuel stoves. The classic Primus and Svea 123 stoves had refillable liquid fuel reservoirs under the burner, but they have been replaced by a *remote-fuel* design featuring a refillable fuel bottle connected to the burner by a flexible hose (fig. 3-16e). The liquid fuel bottle must be pumped up to operating pressure by hand each time the stove is lit, and periodically during use for full heat output. Consequently, hand pumping a liquid fuel stove to full operating pressure allows the user to compensate for cold and elevation, the curse of canister-based stoves. Liquid fuel stoves are currently less efficient than canister system stoves even though the two fuels pack about the same BTUs (kilojoules).

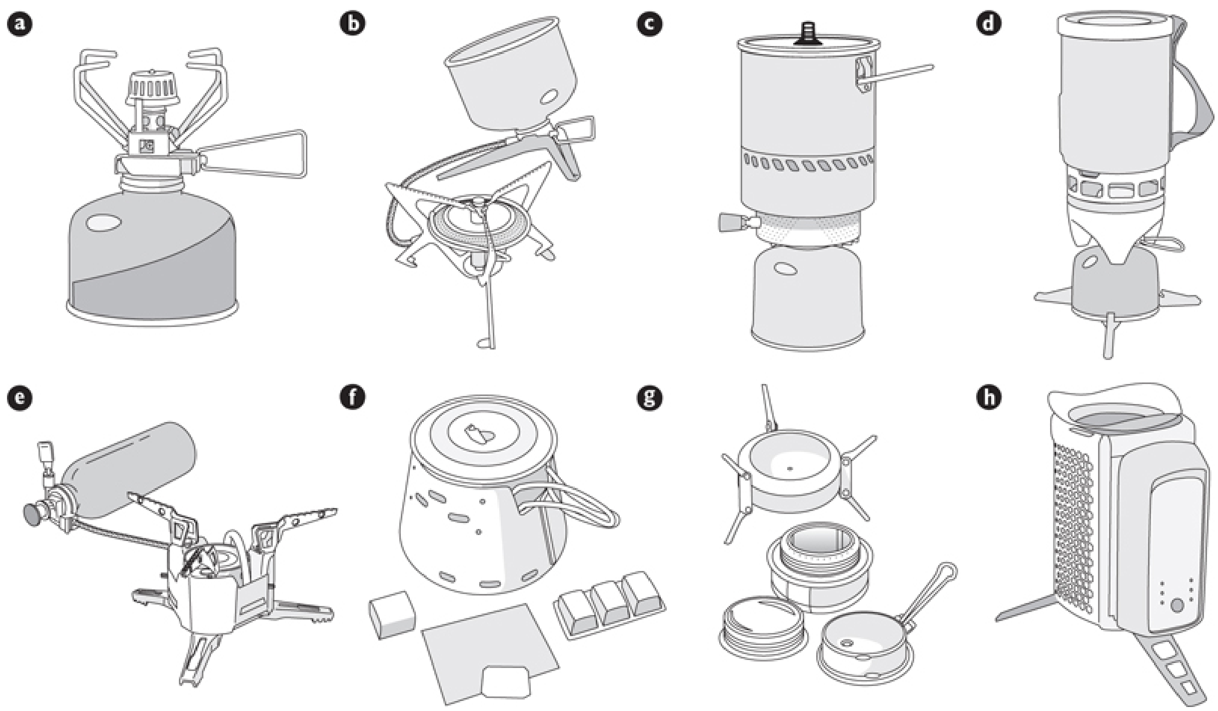


Fig. 3-16. Types of mountaineering stoves: a, stove-on-top canister stove; b, remote-fuel canister stove; c, windproof canister system stove; d, personal cooking canister system stove; e, multifuel liquid fuel stove; f, ultralight Esbit (solid fuel) stove; g, two alcohol stoves; h, biofuel stove.

Since liquid fuel bottles are refillable, there is no spent canister waste to take back down the mountain. Some models run only on one type of fuel, white gas (naphtha). *Multifuel* models, however, burn a wide variety of "petrol" found around the world including white gas, kerosene, diesel, and even, in a pinch, unleaded auto gas. Note that automobile gas has additives that can clog jets and destroy rubber seals, and diesel fuels generally only work well in stoves specifically engineered to run on diesel and fitted with the proper jets.

Hybrid-fuel stoves run off either liquid fuel or compressed gas canisters, delivering the ease of canister fuels but switching easily over to liquid fuels for longer trips, cold weather, and international use.

Alternative-fuel stoves. For ultralightweight cooking, Esbit (solid fuel) stoves and alcohol stoves (fig. 3-16f and g), often constructed from bits of aluminum, titanium, and beer cans, barely register on the weight scale. These featherweights are sufficient for heating water for drinks and freeze-dried meals; they are the standard for long-distance hikers, for example, on the Pacific Crest Trail. They are not, however, powerful enough to efficiently melt snow and ice. In their own category are the *biofuel stoves* (fig. 3-16h) that efficiently burn available dry forest litter and small pieces of dead wood. Freedom from buying or carrying fuel, combined with the ambience of a flickering flame, gives these stoves a unique appeal. Some create electricity from the heat to recharge electronics and run a fan on the flames.

Accessories

A few stove accessories can be quite helpful.

Windscreens. A full wraparound aluminum windscreen (fig. 3-17a) is necessary for many stoves to be efficient. Never wrap a windscreen around any canister stove unless you can exclude the canister from the windscreen, such as with a remote-fuel stove. Using a windscreen incorrectly may superheat the canister and cause it to explode.

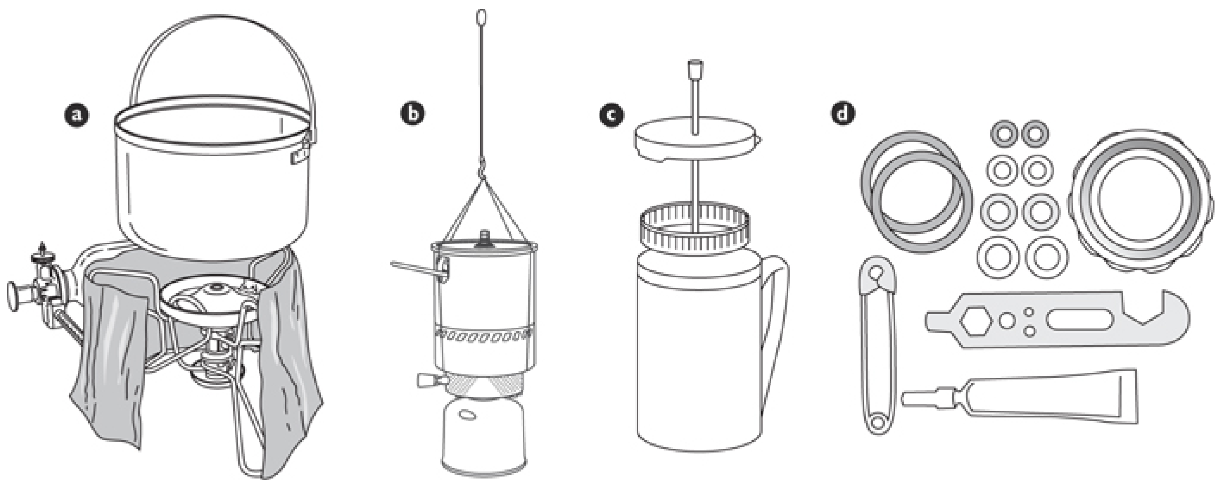


Fig. 3-17. Stove accessories: a, windscreen; b, hanging kit; c, coffee press; d, liquid fuel stove maintenance kit.

Hanging kits. Stove-on-top canister stoves and canister system stoves are somewhat prone to tipping. Hanging kits allow the entire stove and pot to hang as an integral unit from a chain or wire (fig. 3-17b). They are primarily used for big wall climbing and at high camp on expeditions.

Coffee press. Climbers who enjoy caffeine may consider a coffee press (fig. 3-7c), which is offered as an accesssory for some canister stoves.

STOVE OPERATION

A stove ignites when a spark or flame is applied to vaporized fuel at the burner. While some stoves have integrated piezo ignitors, they are notoriously unreliable. With most stoves, you must use matches or a lighter. In stormy conditions, you may need waterproof or stormproof matches and/or several disposable lighters. Keep matches and lighters dry; they may be the only path to ignition.

Stoves can fail, often at inconvenient times. With more than two climbers, bring a backup stove. Modern stoves are compact and lightweight, making the added burden a reasonable trade-off and integral to having the eighth and ninth Ten Essentials, “extra food” and “extra water.” In windy, dusty conditions, debris can clog the jet and cause a stove to fail. Liquid fuel stoves are finicky. Clean them regularly and rebuild them periodically, replacing seals and pump cups and using a maintenance kit as necessary (fig. 3-17d). Read the manufacturer’s instructions to learn what tools are needed and practice repairing the stove at home.

TIPS FOR IMPROVING THE PERFORMANCE OF CANISTER STOVES

- Use a windproof stove system.
- Alternatively, use a remote-fuel stove that allows a liquid feed (upside-down cartridge) mode. Wrap the windscreen around the pot, allowing about a 1/2-inch (1- to 2-centimeter) gap.
- Use a pressure-regulated stove.
- Use isobutane fuel mixes and keep them warm in a sleeping bag or puffy coat prior to use.
- Insulate canisters from cold ground.
- Keep a lid on the cook pot and don’t bother boiling unless necessary.
- During use, the evaporating liquid chills the canister exterior, even causing frost to form. To minimize a loss of pressure and performance, swap out cold canisters for warm ones or sit the canister in a bowl of tepid (even warm) water during use.
- Run the stove a bit below maximum for increased efficiency.

With canister stoves running in upright mode, the fuel is already vaporized, so starting the stove is a simple matter of turning the regulating valve and lighting the released fuel. In contrast, a liquid fuel stove must be “primed” by preheating the generator tube. Using the stove’s valve, release a small amount of fuel (or alcohol carried for the purpose) into the priming cup and light it, with the stove off, thus preheating the generator tube. When the flame from the priming process wanes, open the fuel regulator valve. The liquid fuel vaporizes as it passes through the now hot generator tube toward the jet, and ignites from the residual priming cup flame. Be aware of these pitfalls: Using too much fuel prolongs the process and wastes fuel. Opening the regulator valve too soon may cause a dangerous flare-up. Wait for the flame to subside but not go out. Opening the regulator valve after the priming fuel has extinguished requires quick, careful action with a match or lighter.

HOW MUCH FUEL?

To compute how much fuel is needed for a wilderness trip, consider the needs of the party, type of stove, and type of fuel to compute the baseline. Fuel, like water, is heavy, so it might be tempting to go light. Yet running short when an open fire is not an option means cold food, and running short when snow is the only source for drinking water puts the climb and climbers at risk. Taking sufficient fuel is key to the success of any wilderness trip. Longer trips require careful computation tempered by experience, as well as factoring in a cushion for the unexpected.

For amounts of water needed per person, a good estimate is between 0.75 and 1 liter of hot water per meal and 3 liters of drinking water per day per climber. Dividing the liters that need to be boiled by your type of stove's efficiency factor (Table 3-4) gives the baseline number of ounces of fuel required. Remember that where snow and ice are the only sources of water, additional fuel will be needed to melt water for normal drinking needs. This water will not need to be brought to boiling unless boiling is needed for purification. However, if it is not boiled, and the snow is anything other than newly fallen, it is prudent to purify the water as you would using any other source (see "Water Treatment," later in this chapter).

TIPS FOR MELTING SNOW

Increasing the temperature of snow or ice from the frozen state at 32 degrees Fahrenheit (0 degrees Celsius) requires a surprising amount of energy (fuel) to cause a "phase change" from solid to liquid. In fact, it takes almost the same amount of energy to melt ice as it does to increase the temperature from there all the way to boiling. Always start with some liquid water in the pot to prevent overheating and improve heat transfer. To save fuel, use liquid water for your boil whenever possible.

Adverse factors. Preparing for the trip, it's critical to do the math, adding into the equation adverse environmental factors. Baseline calculations assume that you are starting with room temperature water (70 degrees Fahrenheit, 21 degrees Celsius) and heating that water to boiling in still air. Yet real-world climbing conditions typically require heating cold water, or perhaps even snow, at high elevations and often in windy weather. These adverse factors can increase fuel consumption by many times the baseline For details, see Table 3-5, Calculating Fuel for a Sample Trip.

TABLE 3-4. BASELINE STOVE PERFORMANCE, NO WIND, 70°F (21°C)				
TYPE	WEIGHT	TIME TO BOIL 1 LITER OF WATER	EFFICIENCY FACTOR (liters boiled per ounce of fuel)	WIND PROTECTION OPTIONS
CANISTER STOVES				
Stove-on-top	Light	3–4 minutes	1.8	None
Remote-fuel	Medium	3–4 minutes	1.8	Windscreen
CANISTER SYSTEM STOVES				
Windproof	Medium	3–4 minutes	2.5	Built-in
Personal cooking	Medium	3–4 minutes	2.5	None
LIQUID FUEL STOVE				
Single-fuel or multifuel	Medium	3–4 minutes	1.6	Windscreen
ALTERNATIVE-FUEL STOVES				
Esbit (solid fuel)	Very light	10 minutes or longer	1.0	Built-in or windscreen
Alcohol	Very light	10 minutes or longer	0.7	Built-in or windscreen
Biofuel	Heavy	10 minutes or longer	NA	Built-in

Note: Under efficiency factor: for canisters, 1 ounce (28 grams) is by fuel weight; for liquid fuels, 1 ounce is a fluid ounce, which weighs 0.66 to 0.8 ounce depending on the specific gravity of the fuel used.

TABLE 3-5. CALCULATING FUEL FOR A SAMPLE TRIP

WATER REQUIREMENTS FOR FOUR CLIMBERS FOR FIVE DAYS

A = Cooking water: boiling 2 liters per day = **40 liters**

B = Drinking water: warming 3 liters per day to 70°F (21°C) = **60 liters**

C = Total water = 100 liters

D = Stove efficiency factors: For each of the three stoves below, this figure is **1.8**, **2.5**, and **1.6**, respectively (as in Table 3-4).

FUEL NEEDED TO HEAT WATER	CANISTER STOVE-ON-TOP	WINDPROOF CANISTER SYSTEM	LIQUID FUEL (white gas and a windscreen)
Baseline: Calculate as A ÷ D	22 oz.	16 oz.	25 fl. oz.
Cold water: Calculate as C ÷ D x 25%	14 oz.	10 oz.	16 fl. oz.
Snow or ice: Calculate as C ÷ D x 100%	56 oz.	40 oz.	63 fl. oz.
Subtotal	**92 oz.**	**66 oz.**	**104 fl. oz.**
Windy conditions: Add 100%, 10%, 20%	92 oz.	7 oz.	21 fl. oz.
TOTAL	**184 oz. (5.2 kg)**	**73 oz. (2.1 kg)**	**125 fl. oz. (2.6 kg)**

FUEL SHORTCUT			
To calculate one climber's fuel needs per day, divide the baseline and adverse conditions by 20 person-days (four climbers for five days).			
Baseline conditions	1.1 oz./day	0.8 oz./day	1.3 fl. oz./day
Adverse conditions above	9.2 oz./day	3.7 oz./day	6.3 fl. oz./day

Notes: Totals exclude the weight of canisters or fuel bottles. Example assumes conditions are just below freezing. Conditions significantly below freezing would require additional fuel to heat the ice or snow up to freezing before it can be melted. To convert ounces to grams, multiply by 28.3. To convert fluid ounces to milliliters, multiply by 29.6. To convert milliliters to grams, multiply by 66%–80% depending on the specific gravity of the type of fuel used (fuels are lighter than water). The specific gravity of white gas

(70%) is used in this example. The fuel shortcut assumes a single climber is starting with room temperature water for the baseline conditions, and snow and wind as in the example above for adverse conditions.

The impact of wind on fuel consumption is highly stove dependent. Breezy conditions can double or triple the fuel consumption of an unprotected stove-on-top canister stove or a personal cooking system, and additional wind can prevent boiling altogether. Stoves that allow a windscreen do much better, and windproof stoves are almost unaffected. Temperatures substantially below freezing require additional fuel to heat the snow or ice up to freezing.

Example fuel calculation. Table 3-5 details a step-by-step example calculation for fuel needs for four climbers on a five-day trip. First, they will be melting snow or ice and then boiling it to create 2 liters of cooking water each per day (two meals at 0.75 to 1 liter per meal). “Cooking” is assumed to require simply boiling water without simmering. They will also be melting snow or ice for an additional 3 liters of drinking water each per day to “room temperature” 70 degrees Fahrenheit (21 degrees Celsius). These water requirements may be insufficient, depending on conditions (see “Hydration” in Chapter 21, Expedition Climbing).

The baseline calculation assumes “room temperature” water is heated to boiling in windless conditions. Next, “adverse factors” will require additional fuel on our example trip: snow or ice will be the water source and the stoves will be exposed to an 8 mile-per-hour (13 kilometer-per-hour) wind. Heating cold water (33 degrees Fahrenheit, 1 degree Celsius) to room temperature requires an additional 25 percent fuel beyond the baseline. Melting snow or ice to liquid, but still cold, requires an additional 100 percent fuel beyond the baseline. The effect of wind on stoves can be dramatic but is highly stove dependent. Following along with the math in Table 3-5 demonstrates that, depending on stove type, this sample wilderness trip will require from 2.1 to 5.2 kilograms of fuel to sustain our climbers, before factoring in a cushion for the unexpected.

LIQUID FUEL STORAGE

Carry extra white gas or kerosene in a metal bottle designed specifically for fuel storage, with a screw top and rubber gasket. Plainly mark the fuel container to distinguish it from other containers, such as water bottles, and stow it in a place where any leaks will not contaminate food.

Leave about 1 inch (2–3 centimeters) of air space in the stove's fuel reservoir, rather than filling it to the brim, to prevent excessive pressure buildup. At the end of the season, empty stoves of any fuel. Date any leftover fuel to be sure to use it by the end of the next season. Aging fuel becomes gummy and prone to clogging.

CONTAINER RECYCLING

Canister stove fuel containers are not refillable. But because they are made of steel, when empty they are recyclable in many places after first punching obvious holes in and flattening the container walls.

STOVE SAFETY

Tents have been blown up, equipment burned, and people injured by careless stove use. Before lighting a stove, check fuel lines, valves, and connections for leaks. Let stove cool completely before changing canisters or adding liquid fuel. Change pressurized fuel canisters, and fill and start liquid fuel stoves, outside the tent and away from other open flames.

Do not cook inside the tent unless it is so windy that the stove will not operate outside or so cold that the cook risks hypothermia. The risks range from the relatively minor one of spilling pots onto sleeping bags to the deadly dangers of tent fires or carbon monoxide poisoning.

If it is absolutely necessary to cook inside a tent, follow these safety rules:

1. Light a liquid gas stove outside or near a tent opening so you can toss it away if it flares; wait until it is running smoothly before putting a pot on top.
2. Cook near the tent door or in the vestibule, for better ventilation and so you can throw the stove outside quickly in an emergency.
3. Run stoves at a high setting to make sure as much of the fuel combusts as possible. Colorless and odorless carbon monoxide is undetectable by humans and is absorbed into the blood faster at high altitudes—provide plenty of ventilation.
4. In subfreezing weather liquid petroleum fuel or alcohol can quickly freeze skin. Avoid spilling fuel on yourself.
5. Never use a full wraparound windscreen with any canister stove unless you can exclude the canister from the windscreen, such as with a remote-fuel stove. An incorrectly used windscreen risks an explosion from superheating the canister.

WATER

Replenishing your water supply from wild sources requires tools and knowledge. With the sustained exertion of mountaineering, dehydration can cause fatigue, disorientation, and headaches. It becomes debilitating more quickly than you might expect. Dehydration is a factor in several mountain maladies, including acute mountain sickness (see "Hydration" in Chapter 21, Expedition Climbing and "Dehydration" in Chapter 24, First Aid). Always make plans so there is more than sufficient water on mountaineering adventures. "Extra water" is ninth in the list of Ten Essentials.

To combat dehydration, drink more water than usual, perhaps 1 to 2 extra liters, during the 24-hour period before a climb. Additionally, it is wise to drink a cup or two of water immediately before beginning a climb. Skin and lungs release large amounts of moisture into cold, dry, high-altitude mountain air. Don't ignore thirst, the body's fine-tuned notification system. Monitor the color of your urine: darker-than-normal color means dehydration. At high elevations, dehydration can contribute to nausea that, ironically, reduces the desire to take in fluids.

Keep water handy. Have a bottle within easy reach inside your pack or in a pouch on the hip belt. Some climbers use a hydration bladder carried in their pack, with a tube clipped to the shoulder strap for convenient sipping. Purify drinking water to stay healthy and hydrated. Table 3-6 compares the advantages and disadvantages of various water treatment methods.

TABLE 3-6. WATER TREATMENT SUMMARY

METHOD	PURIFIES	ADVANTAGES	DISADVANTAGES
BOIL			
Boiling	Yes	Simple method.	Slow and inconvenient. Requires additional fuel, which adds weight to pack.
FILTER			

Purifier-Filter	Yes	Same advantages as microfilter, plus effective against viruses	Same advantages as microfilter, except with regard to viruses. Possible cross-contamination from hoses.
Microfilter	No	Quick. Clarifies water making it more palatable. Very effective against parasites, protozoa, and bacteria.	May be bulky or heavy. May clog or break. River water carrying dirt and sediment will clog filter. Filter must be protected from freezing. Ineffective against viruses but may be combined with any chemical or UV method to purify. Possible cross-contamination from hoses.
CHEMICAL			
Chlorine Dioxide Drops or Tablets	Yes	Taste of water not altered significantly. Lightweight and compact. Inexpensive.	Waiting time: drops require letting the two chemicals mix for 5 minutes plus 15 to 30 minutes in the water; killing cryptosporidium in worst-case water takes 4 hours. Tablets may be difficult to dissolve in cold water.

Electrochlorinators	Yes	Taste of water not altered significantly. Lightweight and compact.	Requires device, batteries, and salt. Waiting time: 15 to 30 minutes in the water; killing cryptosporidium in worst-case water takes 4 hours.
Chlorine or Iodine (halogens)	No	Effective against all bacteria and viruses. Lightweight and compact. Inexpensive.	Ineffective against cryptosporidium and only somewhat effective against giardia. Slow (1 hour for cold or cloudy water). Disagreeable taste unless cleared afterward with vitamin C. Persons with active thyroid disease should not use iodine.
ULTRAVIOLET (UV) LIGHT			
UV Light and Microfilter	Yes	Taste of water not altered.	Requires clear water from a microfilter with pores no larger than 0.2 microns. Users cannot reliably assess if water is sufficiently clear that a microfilter is not needed (see “Water Treatment,” below). Battery-

operated, fragile UV lamp. The microfilter also prevents some bottle-thread and stirring contamination risks that may otherwise exist.

Notes: None of the above treatment methods are effective against chemicals, heavy metals, or toxins. "Yes" in the "Purifies" column means effective against all three classes of pathogens: parasites (including protozoa), bacteria, and viruses.

SOURCES OF EXTRA WATER

Some climbs have abundant streams and snowfields to replenish water supplies, but often the high peaks are bone dry or frozen solid, and the only water available is what climbers carry with them or obtain by melting snow or ice. On one-day climbs, the usual source is simply the tap at home. For most people, 1.5 to 3 liters of water per day is enough. Take more than you think is necessary. During a tough three-day climb, each person might drink 6 quarts while hiking and climbing, plus another 5 quarts in camp. At 2 pounds per US quart (or 1 kilogram per liter) that is too much to carry, so supplies must be replenished from lakes, streams, and snow. Melt enough snow in the evening to fill all water bottles and cooking pots.

TABLE 3-7. WATER PATHOGEN SUMMARY

PURIFICATION METHOD	PATHOGENS TREATED			
	Parasites & Protozoa (large)	Bacteria (medium)	Viruses (small)	Purifies?
Boiling	Yes	Yes	Yes	YES
Purifier-Filter	Yes	Yes	Yes	YES
Microfilter	Yes	Yes	No	NO
Chlorine Dioxide Drops or Tablets	Yes	Yes	Yes	YES
Electrochlorinators	Yes	Yes	Yes	YES
Chlorine or Iodine (halogens)	Unreliable	Yes	Yes	NO
UV Light and Microfilter	Yes	Yes	Yes	YES

When the only water source along the trail is snow, pack it inside a water bottle and place the bottle on the outside of your pack to melt the snow and prevent any condensation from getting your pack's contents wet. Start with a bit of water in the bottle to hasten the melting time.

Try catching the drips from overhanging eaves of melting snow. Or find a tongue of snow that is slowly melting into a trickle, dredge a depression below, let the silt settle, and channel the resulting puddle into a container.

If you have sufficient sun and time, set out pots of snow to melt. Otherwise, use the stove. Either way, get the snow from a "drinking snow" pit, well away from the designated toilet and cleaning areas. The snow need not be boiled if it will be otherwise purified, and with care, can be filtered directly from the pot as it melts. A pot can burn if it contains only dry snow—add a little water to it. If you are cooking in the tent vestibule, collect snow in a stuff sack before bringing it inside.

PATHOGENS IN WATER

In the old days, there were few joys as supreme as naïvely drinking refreshing alpine water right from the source. We still lack much data on water quality in remote areas and although most of it may be pure, we purify it anyway. Animal and human waste can contaminate water and older snow, and microscopic organisms can survive freezing temperatures. Tainted snow melts, trickling and percolating its way to cross-contaminate other snow a long distance away. Purify melted snow just as if it were any other water source. Treat water to guard against the three types of waterborne pathogens: parasites, bacteria, and viruses.

Parasites. Larger parasites include amoebas, tapeworms, and flatworms. Smaller parasites include single-cell protozoa such as *Giardia lamblia* ("giardia") and *Cryptosporidium parvum* ("crypto"), which are between 1 and 20 microns in size. (The period at the end of this sentence is roughly 500 microns.) Exposure to giardia and crypto are major health concerns for alpine travelers. Both are found in backcountry waters worldwide, including all of North America, but there is insufficient data to accurately assess frequency and risk. The illnesses giardiasis and cryptosporidiosis take 2 to 20 days to manifest themselves, with symptoms that include intense nausea, diarrhea, stomach cramps, fever, headaches, flatulence, and belches that reek like rotten eggs. Some parasites have tough cell walls that are resistant to chemical treatment. But because of their larger size, they are easily filtered, and boiling kills them.

Another protozoa, cyclospora, which commonly contaminates water in Nepal during spring and summer, is increasingly found in other areas, including North America. About the same size as crypto and susceptible to the same chemicals, it can be treated in the same way.

Bacteria. Mountain waters contain a wide range of bacteria, tiny living organisms between 0.1 and 10 microns in size. Common harmful waterborne bacteria include *salmonella* (incubation period 12–36 hours), *Campylobacter jejuni* (incubation 3–5 days), and *Escherichia coli*, or *E. coli*, (incubation, 24–72 hours). In some parts of the world, water may contain bacteria that cause severe illnesses such as cholera, dysentery, and typhoid. Like viruses, most bacteria can be effectively killed with chemicals. Bacteria are larger than viruses, and so they can be removed more easily with the proper filters. Boiling kills all bacteria.

Viruses. Viruses such as hepatitis A, rotavirus, enterovirus, and norovirus are exceptionally tiny specks of DNA that cause diseases that can be contracted by drinking contaminated water. Viruses are narrowly species-specific, and therefore human viruses are spread by human waste. Although wilderness waters in North America are usually free of human viruses, the risk comes from human traffic and waste handling, so it never hurts to treat against them. Every year people get sick from viruses in heavily used lakes. Viruses are easily killed with chemical treatment but are too tiny to be removed by most filters. Boiling kills viruses.

Table 3-7 summarizes the ability of the major water purification methods to eliminate human pathogens from water sources in the wilderness.

WATER TREATMENT

The principal methods of backcountry water treatment are boiling, filtering, and chemical treatment. No single method is best for every situation. Before using any of these treatment methods, strain water containing sediment or debris through a cloth, paper coffee filter, or paper towel to remove the bulk of the organics. Filtering, chemical disinfecting, and even UV light work more efficiently if the water source has been prefiltered in this way. (See “Additional Water Treatment Considerations,” below.)

Boiling

Boiling, the surefire method of water purification, kills all waterborne pathogens. The US Centers for Disease Control and Prevention (CDC) recommends bringing water to a rolling boil and maintaining the boil for 1 minute, or 3 minutes above 6,500 feet (2,000 meters). Other reliable sources state that simply bringing water to a boil is sufficient, even at elevations as high as Everest Base Camp.

Filtering

Water filters (fig. 3-18) are relatively quick and easy to use and create clear, palatable water. Look for a model that is compact and lightweight and is easy to use, clean, and maintain in the field. Filters come in many gravity-fed and pump formats. Water passes through a hollow-fiber membrane or porous ceramic filter to separate parasites, bacteria, and sometimes viruses. This microscopic strainer collects the pathogens, still alive, on its surface. There is a risk of cross-contamination from the two hoses; be careful handling them. Follow the manufacturer's instructions to periodically clean the filter by backflushing, scrubbing, boiling, and/or chemical disinfection.

ESSENTIAL WATER TIPS

- **Always carry some method to treat water for 3 drinking.** Chlorine dioxide is reliable, lightweight, cheap, and compact.
- **There is no strong evidence that North American wilderness waters unsafe for consumption are pervasive.** This is especially true in remote high-elevation areas without signs of human or animal activity.
- **Maintain good hand hygiene** to avoid the common "fecal-oral" route to illness.

Microfilters. The effectiveness of microfilters to remove parasites and bacteria depends on the filter's pore size. Manufacturers describe filter pore size in various ways, so look for an "absolute" pore size that is 0.2 microns or less. However, even at the smallest pore size, *microfilters do not remove viruses*. To guard against viruses, use a purifier-filter instead, or post-treat the water with UV light or any of the chemical disinfectants below. Tannins, dissolved sticky tea-colored solids, clog filters and can be impossible to remove so backflush often.

Purifier-filters. Purifier-filters are also effective against the exceedingly tiny virus. Purifier-filters work either by physical filtration or by the process of "adsorption." Physical filtration is the method currently used by only a few filters on the market, which use hollow-fiber membrane technology. This filter needs to be replaced when it becomes difficult to pump, a sign that the filter is clogged. Adsorption-based purifier-filters force viruses to cleave to a special material. However, they are difficult to monitor for ongoing effectiveness. Depending on how much water and how dirty the water passing through is, the useful life of this material is often very short, silently ending when the cleaving sites are full, with no indication to the consumer.

Chemical Disinfecting

After adding chemical disinfectants to water, loosen the bottle lid and slosh a bit of the treated water onto the threads around the bottle's top and the cap to eliminate any bugs lurking there. Note that microfilters with a carbon element will eliminate most of the chemical taste from chemically treated water, but you must wait the full time before filtering.

Chlorine dioxide. Water treatment using chlorine dioxide (not to be confused with chlorine) is the most effective of the chemical treatments. Chlorine dioxide is available in tablet or two-part liquid formats. The tablets are simply added to the water. Liquid chlorine dioxide is mixed with phosphoric acid 5 minutes before use, turning from clear to bright yellow. The treated water is ready after a wait period.

Electrochlorinators. These battery-driven devices (e.g., MIOX) use a salt solution to create mixed oxidants, primarily chlorine. These systems can purify water with a 15-to 30-minute wait; for crypto, wait four hours. Follow the manufacturer's instructions carefully.

Chlorine and iodine. These two chemicals are equally effective against all bacteria and all viruses but unreliable against parasites and protozoa (see Table 3-7). They are somewhat effective against giardia but not effective against crypto. Both are halogens; another halogen, bromine, is used on navy ships but impractical for backcountry travel. Chlorine (not to be confused with the fundamentally different chlorine dioxide above) is available as house-hold bleach, sodium dichloroisocyanurate, or troclosene sodium tablets. Iodine is available as tablets, drops, or crystals. Adding vitamin C will help eliminate any bad taste, but wait until the disinfection process is complete.

UV Light

Municipal water systems widely use UV light, but backcountry versions are fragile, battery-operated UV lamps. Even clear-looking water can contain enough particles ("turbidity") to shield pathogens from UV light. Users cannot reliably assess turbidity. If water is marginal or dirty, one manufacturer recommends prefiltering with a third-party 0.2-micron filter—not a coarse prefilter with a pore size of well more than 0.2 microns. A microfilter combined with a chemical treatment costs less.

Additional Water Treatment Considerations

For water treatment, consider these conditions.

Cold water, freezing temperatures, snow, and ice. Cold water slows the processes of chemical treatment so longer contact time is needed. Other methods are not affected. Freezing temperatures can destroy water filters in a manner difficult to detect, especially hollow fiber membranes. Pump filters dry and place in a sleeping bag at night. Freshly fallen snow can be considered pure but deciding whether to purify melted snow or ice requires a judgment call, since giardia, crypto, and many bacteria can survive freezing. Avoid drinking the pinkish "water-melon snow" found in older snow banks (from an algae). It can be a laxative.

Turbidity. Organic turbidity (suspended organic solids) creates a "demand," which depletes chemical disinfectants faster than in clear water. Use additional chemical. Organic turbidity can also clog filters. Inorganic turbidity (for example, glacial silt) creates "hiding places" for pathogens from UV light. It can also clog filters. If not removed by filtering, glacial silt acts as a laxative. Reduce turbidity significantly by prefiltering with a coffee filter, using a chemical flocculant, or waiting for the solids to settle.

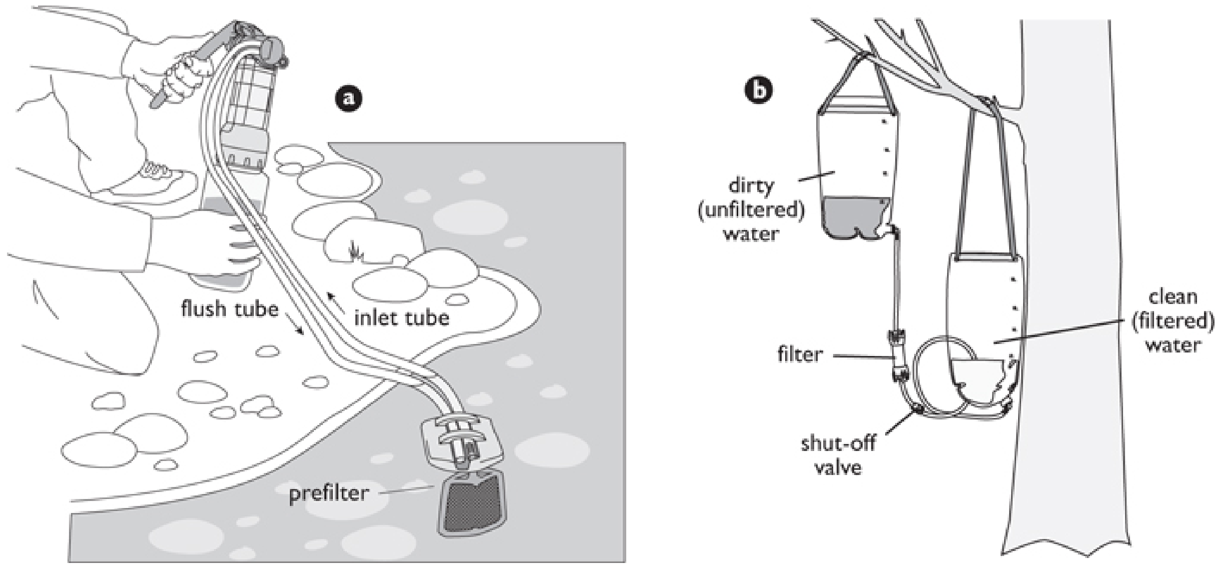


Fig. 3-18. Water filter: a, pump water filter attached directly to water bottle, with prefilter at hose intake end (this particular model offers two-hose continuous self-cleaning); b, gravity-fed water filter hanging from a tree limb. Speed up filtration by keeping the dirty water bag as high as possible and the clean bag as low as possible.

Water storage and dirty hands. Water storage bottles, bags, and hydration devices can easily become contaminated from dirty water or hands. Disinfect with any of the above chemical water treatment methods, bleach, or very hot water. Use only purified water for dishwashing and brushing teeth.

Thoroughly wash hands before handling food. If hand washing is impractical, scrub hand grime with river or lake sand and then clean with hand sanitizer gel or wipes. Backcountry health issues attributed to drinking wilderness water are often caused by fecal-oral contamination from poor hand sanitation.

Chemicals and toxins. None of the treatment methods described above are effective against chemicals or toxins including agricultural runoff (pesticides, herbicides) and industrial runoff (mine tailings, heavy metals). Filters with an activated carbon element offer limited protection. If you're suspicious, move on.

FOOD

Your body needs a variety of foods to tackle a strenuous, demanding activity like mountaineering. With planning, it is possible to choose foods that keep well, are lightweight, and meet all nutritional needs. The longer the trip, the more variable and complex the menu must be. And if the food does not taste good, no one will eat it. If fueling your body quickly and simply is the first aim of alpine cuisine, enjoying your meals is a worthy secondary goal.

Most climbing expeditions plan on providing roughly 4,000 to 5,000 calories a day for each climber. Energy expenditure on a climb can reach as high as 6,000 calories per day, possibly even higher for larger folks. In comparison, most people require only about 1,500 to 2,500 calories per day when living a sedentary life. Adequate caloric intake is essential for climbers. Determine what food intake plan is best, depending on the demands of the trip and your own size, weight, metabolic rate, and level of conditioning. Never engage in calorie restriction (dieting) during a mountaineering trip, for this will interfere with performance and stamina, possibly putting extra demands on others.

COMPOSITION OF FOODS

For the human body to function well, the mountaineer should eat from all three basic food components—carbohydrates (sugars and starch), protein, and fats. The proper proportions are widely debated.

Carbohydrates. The easiest food for the body to convert into energy, carbohydrates should constitute most of the calories. Think of carbohydrates as the main “fuel food” to keep your body functioning most efficiently. Good sources of carbohydrate starch include whole grains, rice, potatoes, cereals, pasta, bread, crackers, and granola bars. Sugars can be supplied not only by honey or granulated sugar but also by fruit (fresh or dried), jam, hot cocoa, energy gels, and drink mixes.

Protein. The daily requirement for proteins is nearly constant regardless of type or level of activity. The body cannot store protein, so once it has met its protein requirement, the excess is either converted to energy or stored as fat. High-protein foods include cheese, peanut butter, nuts, dried meat, canned or vacuum-packed meats and fish, beans, tofu, powdered milk and eggs, and foil-packaged meals containing meat or cheese.

Fats. Because fats pack more than twice as many calories per gram as protein or carbohydrates, they are an important energy source. Fats are digested more slowly than carbohydrates or protein, so they help keep you satisfied longer. This is useful, for example, for staying warm on cold nights. Fats occur naturally in small amounts in vegetables, grains, and beans, and when these are combined with fish, meat, or poultry, the body’s requirements for fat are easily met. High-fat foods include butter, margarine, nut butters, nuts, salami, beef jerky, sardines, oils, eggs, seeds, and cheese.

The better a climber's condition, the more efficiently food and water will provide energy during heavy exercise. Many people find that foods high in fat are more difficult to digest during strenuous exercise. One reliable approach is to eat mainly carbohydrates during the day and replenish calorie stores by adding fats and protein to the evening meal. A bedtime snack high in slower-burning food fuel may help keep you warm.

To fuel working muscles, steadily consume carbohydrates and water beginning one to two hours into the climb. The carbohydrate source can be solid food or a prepared beverage. A well-balanced diet replaces most electrolytes that are lost during heavy sweating. Nevertheless, some climbers like to use "high-performance" sports drinks (often diluted) to replace water, carbohydrates, and electrolytes simultaneously. Try these preparations at home, however, before relying on them in the mountains.

FOOD PLANNING AND PACKAGING

As a rough guideline, provide 1.5 to 2.5 pounds (0.7 to 1.1 kilograms) or 2,500 to 4,500 calories of food per person per day. This will vary based on conditions, exertion, and metabolism. Keep in mind that "extra food" is the eighth Ten Essential, but don't get weighed down by excess provisions.

On very short trips, climbers can carry sandwiches, fresh fruit and vegetables, and just about anything else. Taking only cold, ready-to-eat food saves the weight of stove, fuel, and cook pots, a good idea for lightweight bivouacs. In nasty weather, this approach allows you to retreat directly to the tent without the hassle of cooking. Use firm bread, rolls, or bagels for a sandwich that will stand up to packing. Leave out mayonnaise and other ingredients that spoil easily.

For trips of two or three days—or longer, if base camp is close to the road—any food from the grocery store is fair game. For longer trips, food planning becomes more complicated and food weight more critical. Freeze-dried food is compact, lightweight, and easy to prepare but is relatively expensive. Outdoor stores carry a large selection of freeze-dried foods, including main courses, vegetables, soups, breakfasts, and desserts. Some require little or no cooking; just add hot water, let it soak for a while, and eat from the package. Others require cooking in a pot.

With access to a food dehydrator, climbers can enjoy a more varied menu at substantial savings. Simple and nutritious mountaineering foods can be made from dried fruit, vegetables, and meat. Dehydrated produce can be eaten as is or added as an ingredient to a cooked dish. Fruit leather is easy to prepare with a dehydrator. Sauces are too: dry spaghetti sauce to serve with angel-hair pasta (which is thin and cooks quickly). Many dehydrated foods simply require rehydration.

Vacuum sealing provides even more variety. Dehydrate the food first, then seal it. This process removes all air from the food package, reducing spoilage.

A small kitchen scale is useful for precise planning and packaging of food. Transfer food from bulky packaging into resealable plastic bags or other lightweight containers. Enclose identifying labels and cooking instructions, or write this information on the outside of the bag with a permanent marker. Ingredient or meal packages can be placed inside larger bags labeled in broad categories, such as "breakfast," "dinner," or "drinks."

Groups

Because meals are social events, climbing groups often plan food together. A good menu boosts morale. A carefully planned, shared menu can reduce the overall food weight carried by each person. Another common arrangement is to approach only dinner as a group effort.

TABLE 3-8. BOILING POINT

ELEVATION IN FEET (METERS)	TEMPERATURE AT WHICH WATER BOILS °F (°C)
Sea level (0)	212° (100°)
5,000 (1,525)	202° (95°)
10,000 (3,050)	193° (90°)
15,000 (4,575)	184° (85°)
20,000 (6,100)	176° (80°)
25,000 (7,625)	168° (75°)
29,029 (8,848)	162° (72°)

Group meals can be planned by the group or by a chosen individual. Canvass the group members for food preferences, needs, and allergies; one person may be a vegetarian, another may refuse to eat freeze-dried entrées. Writing down a menu and discussing it with the group can go a long way toward group harmony.

The ideal number of people in a cooking group is two to three per stove, four maximum. Beyond that, group efficiency is outweighed by the complexities of large pots, small stoves, and increased cooking times.

High-Elevation Cooking

Cooking raw foods becomes impractical above about 10,000 feet (3,050 meters). The boiling point of water decreases with altitude as shown in Table 3-8, which increases the time to cook raw food by two to four times at 10,000 feet (3,050 meters) and by four to seven times at 15,000 feet (4,575 meters). The practical answer is to bring foods that require only warming, such as meat or fish in a foil pouch; precooked food that requires only hot water, such as instant rice or quick oats; or simply freeze-dried meals. For the dedicated high-altitude chef, lightweight pressure cookers are available.

The rigors of rapid ascent to higher altitudes also require special attention to the choice of food. Many climbers fall victim to symptoms of mountain sickness, ranging from a slight malaise to vomiting and severe headaches. Under these conditions, food becomes more difficult to digest. Climbers must continue to eat and drink; keeping well hydrated is particularly essential. To cope with this aversion to food, eat light and eat often; also, emphasize carbohydrate foods, which are easiest to digest. Trial and error will determine what foods your body can tolerate.

MENU SUGGESTIONS

Try out various food combinations before taking them on an extended trip in the mountains.

Breakfasts

For a fast start, prepackage a standard meal before the trip. A single bag can contain oatmeal, cold cereal, or granola with dried or dehydrated fruit, plus powdered milk or sweet spices such as nutmeg or cinnamon. Stir in water—cold or hot—and breakfast is ready. Other quick breakfast options include bakery items; dried fruit and meat; nuts; energy bars; dehydrated applesauce; and freeze-dried breakfasts that combine eggs, meat, and potatoes. Common hot drink choices are instant cocoa, instant cider, coffee, powdered milk, tea, and instant breakfast drinks. To many, caffeine is a civilized way to start the day, and many studies show it brings a measurable increase in endurance and delays exhaustion.

Lunches and Snacks

During a climb, lunch begins shortly after breakfast and continues throughout the day. Eat small amounts, and eat often. At least half of a climber's daily food allotment should be for lunch and snacks. A good munching staple is GORP (originally, "good old raisins and peanuts"), a mixture that can contain nuts, small candies such as chocolate chips, and dried fruit or ginger. One handful makes a snack; several make a meal. Granola is another option, with its mixture of grains, honey or sugar, and bits of fruit and nuts. Other popular snack items are fruit leather, candy bars, energy bars, and dried fruit. A basic lunch can include any of the following:

Protein. Sources include vacuum-sealed meats and fish, beef jerky, salami, powdered hummus, hard cheese, nuts, and seeds.

Starch. Carbohydrates include whole-grain breads, bagels, pita bread, granola, firm crackers, tortillas, rice cakes, chips, pretzels, and energy bars.

Sweets. Some treats are cookies, candy bars, hard candy, muffins, pastries, and jam. Chocolate always gets eaten.

Fruit. Sources include fresh fruit, fruit leather, and dried fruit such as raisins, figs, and apples, or freeze-dried strawberries, blueberries, or mango.

Vegetables. Some vegetables that travel well are fresh carrot or celery sticks, sliced sweet peppers, or dehydrated vegetables.

To encourage rehydration, mix up a flavored beverage such as lemonade or fruit punch at lunch. In cold weather, fill a light thermos with hot water at breakfast, and enjoy a cup of instant soup or miso at lunch.

Dinners

The evening meal should be nourishing and delicious, yet easy and quick to prepare. To supplement liquid intake, include some items that take a lot of water, such as soup, hot cider, herbal tea, fruit drink, or cocoa. A cup of soup makes a quick and satisfying first course. A hearty soup can also serve as the main course. Good choices include miso, minestrone, bean, beef barley, lentil, chili, or chicken. Add to the menu instant potatoes, dehydrated vegetables, rice, crackers, tortilla shells, cheese, or bread, and the meal is complete.

One-pot meals with a carbohydrate base of pasta, rice, beans, potatoes, or grains are easy and nutritious. To ensure that you get adequate protein, fat, and flavor, add other ingredients such as chicken, beef, or fish that has been dried or packaged in a foil pouch; sausage; freeze-dried vegetables or fruit; margarine; or a dehydrated soup or sauce mix. Outdoor retail and online stores carry a variety of freeze-dried entrées that are nutritionally balanced and easy to prepare, though expensive. Prepackaged dishes from the grocery store—such as spaghetti, noodle dishes, and rice mixes—are also good, easy, and less expensive. Freeze-dried or dehydrated vegetables add variety. Prepare them as side dishes, or add to soups or stews. Freeze-dried cooked beans or processed soy products in powdered or textured forms are excellent, low-cost protein additions. Natural-food stores often have a wide selection of these ingredients. Climbers can also prepare and dehydrate sauces and many other ingredients at home.

Margarine, which keeps better than butter, and oils, such as olive oil, improve the flavor of many foods and add significant calories with minimum weight. For seasonings, try salt, pepper, herbs, garlic, chili powder, bacon bits, curry powder, dehydrated onions, grated Parmesan cheese, hot sauce, or soy sauce (just not all together). Dessert choices include dates, cookies, candy, chocolate, no-bake cheese-cake, applesauce, cooked dried fruit, instant pudding, and freeze-dried ice cream. Dessert time, accompanied by a cup of hot herbal tea, can provide a pleasant backdrop to group talk about the next day's itinerary and a decision on who will provide the morning wake-up call.

Boiled water cooking. "Cooking" dinner for many alpine chefs simply means boiling water. Packing food that requires no cooking is simple, fast, easy to clean up, and can be delicious. Most freeze-dried entrées are designed to be reconstituted in their packaging. Dinner can also be prepared directly in a bowl or cup. Start with some instant soup. The main course could be a starchy food (instant mashed potatoes, instant rice, or couscous) with added protein, vegetables, and condiments. Follow with a dessert of instant applesauce or instant pudding, and end with a rehydrating hot drink of noncaffeinated tea or cider. The only items to wash up are the spoon, cup, and maybe bowl.

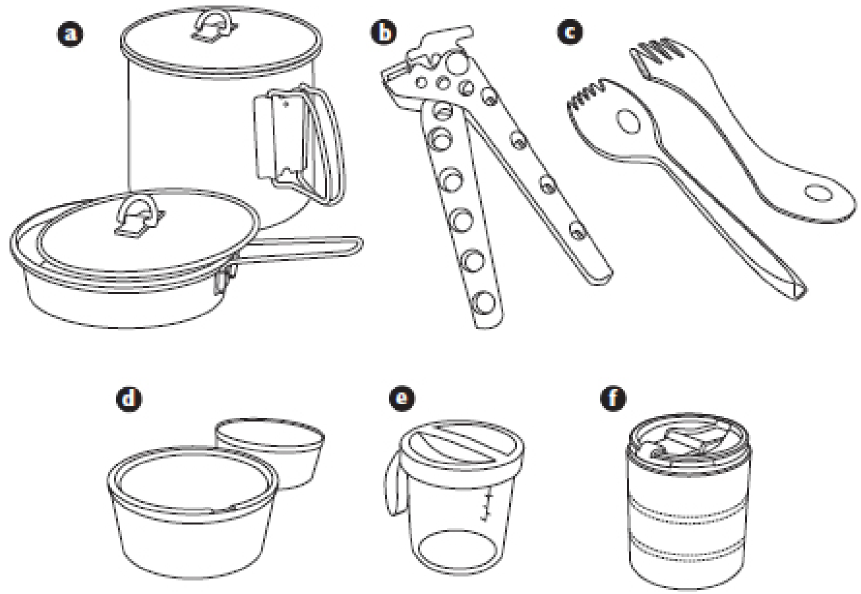


Fig. 3-19. a, alpine pot with small fry pan and lid; b, pot lifter; c, spoon and spork; d, nested bowls; e, cup with lid and measuring marks; f, insulated mug.

COOKWARE AND UTENSILS FOR COOKING AND EATING

On an ultralightweight trip with just cold food, fingers are the only utensils needed. (Wash hands before preparing food or eating, or at least use a hand-sanitizing gel.) Making dinner with the boiled water cooking methods described in “Menu Suggestions,” above, requires only a cup and spoon per person, plus one cook pot with a bail or handle for each group of three or four; bowls are convenient but optional.

The popular canister system stoves have a built-in cooking pot or a small set of integrated pots from which to choose. These are optimized for boiled water cooking. For less spartan menus, other stoves accept a variety of cooking pots. Bring one pot for boiling water, another for cooking, and light, unbreakable bowls for eating. Alpine cook sets (fig. 3-19a) come in aluminum, stainless steel, and titanium. Aluminum, which is light and inexpensive, is the most common. Stainless steel is strong and easy to clean but heavy. Titanium is light and strong but expensive. A large water pot is useful for melting snow. A wide pot is more stable than a tall, narrow one and more efficient because it catches more of the stove’s flame. Be sure all pots have bails or handles, or bring a small metal pot lifter (fig. 3-19b). Tight-fitting pot lids conserve heat. (See “Cooking for a crowd” under “Stoves,” above.)

Cups, spoons and forks, and bowls (fig. 3-19c, d, and e) come in the same materials as cook sets and also in strong, light polycarbonate plastic. Insulated mugs (fig. 3-19f) are popular; a sipping lid keeps the contents warm and prevents spills. Some cooking pans have a nonstick coating for easy cleaning but require plastic or silicone utensils to avoid scratches. A coffee press is an accessory for some canister system stoves (see Figure 3-17c). A small silicone spatula is useful for cooking and for efficiently getting food out of the pan, whether for eating or cleaning up. Bring a small plastic scrub pad and a synthetic fabric pack towel for cleaning.

Many specialized pieces of camp kitchenware, such as bake ovens, Dutch ovens, pressure cookers, and espresso makers, are impractical on mountaineering trips.

"IT'S JUST CAMPING"

Pioneer American alpinist Paul Petzoldt said, in an interview about climbing in the Himalaya and Karakoram, "It's just camping." His point was that technical climbing skills are less important than the ability to survive—and even less so than the resourcefulness necessary to be at home and comfortable in the high mountains.

Camping skills are the basis upon which all the more technical mountaineering skills rely. Once climbers develop and hone the skills to stay in the mountains, they will have the confidence to venture further. They will begin to understand what it means to have the freedom of the hills.