

Winter Camping Field Guide

This is Ash Campbell's brief and personal overview of the risks and recommended practices for winter camping (that is, making *substantial use of snow* when camping). It is intended to help with all phases - but *cannot* serve as a substitute for either professional instruction or the actual experience - of winter camping. Please purchase and study some or all of the more-complete reference books listed below and then take full responsibility for adapting and applying those recommendations to your own winter camping trips. This document is also available in the "downloads" section at lamountaineers.org. Please share tips from your experience with the author at ashcampbell@starband.net to improve the quality of future handouts for this activity. *January 11, 2010*

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A. GETTING READY

1. Find an *experienced* mentor/group for your first winter camping outing. If this is not your first outing, then select your own party leader (the most mindful and responsible person) by consensus. The leader monitors previous and current conditions and forecasts; checks out road and TH access; visits campsite(s); researches and obtains permits; checks gear lists of all party members; collects all relevant phone numbers; prepares and prints maps and site plans; organizes camp procedures; makes the critical decisions if consensus cannot be reached, etc.
2. Pick your teammates carefully (and *constantly* take care of each other on the trip).
3. Identify and share individual and party goals for the trip (e.g., is this a practice expedition?)
4. Get fit – a person in good shape can work harder and longer (with less food) thereby generating more heat to stay warm
5. Master the basics of *summer* backpacking before going out in winter.
6. Know what you're getting into and be prepared for it; be ultra-conservative; consider taking wilderness first aid and avalanche courses
7. Scout and prepare your camp sites as much as possible. (stomp out the trail, quarries and shelter sites several days in advance if at all possible!)

8. Practice every necessary skill/drill you can, then practice again; get used to doing everything in the cold and/or dark
9. Clean and test *everything* you will take (e.g., can you pull zippers with mittens or gloves? can you put on wind pants over boots? do all your layers work together with no single-purpose garments? how much actually fits into your sleeping bag? does the stove platform keep the stove from sliding? where do you stow your hats when you take them off without losing one? how will you hang your sleeping bag to dry so that it doesn't blow away? and so on...).
10. Print up your gear and clothing lists and send them to the trip leader weeks before departure
11. If you plan on making snow shelters, use your sleeping pads and floor space at home to determine the dimensions you'll need
12. File a detailed itinerary with your partner or reliable friend; if you commit to phone contact while out winter camping, make absolutely sure that (a) you will actually be able to make the contact and (b) others in the party know of this commitment, and (c) you do *not* forget to make the contact; otherwise, guess what...
13. Fatten up for several days before departure.
14. Avalanche assessment (Consult with local officials (e.g., USFS, NPS, BLM), clubs (e.g., CAIC at 719-520-0020), local hiker network or websites (e.g., Northern New Mexico Avalanche Exchange at nnmae.org) to determine if you will be entering an avalanche-prone area. If so, take an avalanche safety course and equip your party with transceivers and probes, then practice, practice and practice before going out. Because each second counts in terms of survival, *every* person in the party must be proficient in the use of the transceivers.
15. Use the *best technologies* available for navigation and communication, know what your equipment does and how to use it:

Transceivers (e.g., BCA and Pieps) are beacons that send signals that can be detected by other transceivers (regardless of brand); each person sets his/her unit to "send" and if someone is buried the others immediately set theirs to "find" to locate the buried person.

Personal Locator Beacons (e.g., ACR and SPOT) send a signal to satellites which then notify Search and Rescue (which is coordinated by the NM State Police; all SAR teams are volunteer; NMSP normally requires that a person/party be missing for 24 hours before launching a rescue mission.) GPS-enabled PLB's make take as little as 5 minutes for the notification; standard PLB's take up to 45 minutes. ACR uses a public network and checks the profile you filed with them prior to notifying SAR. The units are expensive, but there is no charge for service; send a signal *only* if you need to be rescued! SPOT is a private network that sends a brief message of your choice via satellite to your family or SAR, etc. The units are relatively cheap, and there is a fee for each service.

GPS receivers (e.g., Magellan, Garmin) are merely receivers that fix your position and elevation via satellite; current accuracy is roughly 10 meters; when enough 3-frequency satellites have been launched, the accuracy will be about 20 inches.

Phones: cell phones (even ones like Jitterbug that utilize all networks) and satellite phones (like Globalstar that is having problems with satellite coverage) only work in certain areas/times in the backcountry.

B. KEEP IN MIND during the trip:

1. Eat *before* you're hungry and drink *before* you're thirsty.
2. Use the terrain and the snow to your advantage.
3. Stay *busy* and *keep warm* in camp.
4. The colder and stronger the wind the more you must protect yourself from it.
5. Be mentally and physically alert to stay *warm, safe and dry*.
6. *Never* consume alcohol, drugs or caffeine on the trip (you must remain totally alert and hydrated to survive in adverse conditions)
7. Maintain a *warm and positive* mindset; be both *creative and logical*
8. The more extreme the conditions, the more impeccable your camp must be.
9. We *lose heat* in five ways: conduction (direct contact with a cold surface), convection (cool air passing over the skin), radiation, evaporation and respiration.
10. We *produce heat* in three ways: metabolism (eating), exercise and shivering.
11. *Mandatory* "self-leadership"
 - monitor your own physical and emotional comfort level
 - be completely honest about your abilities and energy level
 - raise your awareness to the highest possible level, and read the conditions as though *you* were the party leader
 - frequently pose problems to yourself, like: if we had to make an emergency camp right here, how would we do it?

C. GEAR

1. *individual*: back pack (comfortable, tested to carry all your gear, probably at least 15 liters larger than a comparable summer trip, ideally with outside straps for snowshoes and/or skis; two snap rings on shoulder harness for hat, etc. and two snap rings on load strap at waist belt for spares or hauling); high-loft 0-degree sleeping bag with breathable shell (20-degree bag is adequate inside a good snow shelter); silk or "Reactor" sleeping bag liner; two sleeping pads of different types with total R value close to 6; calf-high (Velcro) gaiters adjusted for your boots; skis and/or snowshoes of appropriate style and size for terrain and total weight that are light and rugged (note: 1 lb on your feet is equivalent to 6+ lbs on your back!); adjustable trekking poles with large snow baskets; micro-spikes (Kahtoolas are recommended) if significant parts of the trail are hard-packed; clip-on thermometer with compass and modern (post-2000) wind-chill

chart; packets of hand and toe warmers; map of campsite and routes on waterproof paper; ultra-light (e.g., Heatshield) 2-person tarp or space blanket; med/large camp towel; watch; SPF 20 and 30+ sunscreens; moisturizer; SPF lip balm; two flexible 32-48 oz wide-mouth water bottles that can take warm/hot liquids with insulated shells; one-liter pee bottle, wrapped in cloth tape with tight-fitting lid; toilet paper; LED headlamp, tested with head gear, and extra batteries (e.g., Eneloop NIMH charged with an Alpha Power 700 system); sitting pad (REI Lite Core inflatable is recommended, but high-density foam pad or chair seat that uses your top sleeping pad are also good); lockable knife or multi-tool; trowel; notebook and pencil; your normal dietary supplements and medications; avalanche probe (for snow-depth testing or avalanche rescue); signal mirror and whistle; repair kit for your personal stuff (duct tape, wire, safety pins, needle and thread, fabric repair tape, cord); personal first aid stuff (antiseptic wipes, petroleum jelly, athletic tape, 4x4 gauze pads, ibuprofen, large patch bandaids, beefy knee brace, etc.); bowl and two spoons; butane lighter kept in a shirt pocket; cleansing wipes (e.g. Summer's Eve) that you keep from freezing prior to use; ice axe (if you will be on hard, steep snow/ice or need to chip ice cover off running water); crampons suitable (i.e., flexible or rigid) for your type of boot if you will be on hard steep snow/ice; extra snow baskets for your type of pole; 50' of utility cord; avalanche shovel (LifeLink alpine pro model is recommended for Ice Box igloos, see grandshelters.com); snow saw (Yang Fang is recommend, see snowsaw.com); light-weight thermos with a sipping lid; 1-gallon freezer bags for trash and used toilet paper (these can store clean stuff on the way in); 10' of 3mm cord for a sleeping bag clothesline; lightweight pillow (Cocoon inflatable, insulated pillow is recommended); large stuff sack for storing clothing inside the shelter (REI micro-duffle is perfect); a roll of plastic orange flagging.

2. for each group of 4 in the party: MSR Reactor stove with plenty of fuel canisters; custom insulated platform for stove; 4-season tent(s) each sized for extra person (i.e., 2 people occupy a tent rated for 3 persons; note: put tent poles against back inside pack if it is very cold); snow stakes with 3' extra cord for all tents; door flap for a snow shelter (if you don't take a tent); big first aid kit; satellite and/or cell phone verified to have service in travel area; repair kit for tents, packs and snowshoes (rip-stop and duct tape, tent fabric, sewing kit, awl, extra buckles and webbing, extra zipper pulls, some 2-4 mm cord, etc.); waterproof matches or windproof lighter; 30 m of 7-8 mm climbing rope for gullies or stream crossings; two types of measuring tape; hand magnifier; at least one GPS unit with maps and waypoints loaded; inclinometer or small level; extra pair of trekking poles; scrubbie and soap for cleaning pots; probe thermometer and old credit card for shear/pit testing (e.g., see kits at backcountryaccess.com); digital thermometer for taking body temps; red/white LED lantern (1/shelter); whisk broom and plastic pan (1/shelter); extra flood/spot led headlamp and batteries; folding wood saw for cutting branches and/or snow shelter poles (if considered necessary); lightweight (2-4 mm) plastic sheeting for emergencies and/or snow-shelter practice (100 s.f.); small empty spray bottle for snow shelter construction; extra waxes and binding repair stuff if skis are taken; wind gage; 2x2' closed-cell pad for emergencies; at least one pair of small snowshoes (for stomping paths, quarries, etc.); 3 colored summer stakes and string line (for snow shelter work); base-plate compass and map; small digital camera; lantern and/or candles for kitchen area; extra deadman loops (3' lengths of 3-4 mm cord with

water knot); small NOAA receiver if trip is longer than 2 nights; a laminated field guide (like this one, adapted for your use); *seriously* consider taking in an expedition toboggan (see skipulk.com) for heavy loads or emergency evacuation *and* a saucer sled for snow shelters, each rigged with load straps for a duffel, and crossable haul poles that clip to the hauler's waist belt.

D. FOOD

1. twice the calories that you'd take on the same hike in the summer (average man 6-7,000 calories/day; average woman 5,000 calories/day); carry one extra day's worth of food; consult NOLS cookbooks (see references) and make your food selection varied and appealing
2. 50% carbohydrates (honey, granola, dried fruit, crackers, corn and potato products, brownies, cookies, bread, dried soups), 30% fats (cheese, chocolate, canned/jerked meat, canned fish, sausage, nuts, butter) and 20% protein (nuts, beans, cheese, grains). Seriously consider sunflower seeds, bacon bits and spices.
3. plenty of high-quality snacks, protein and electrolyte powders; warm up energy bars and chocolate in your clothing *before* having to see the dentist
4. melt snow *or* bring water to a short boil; do not bring *any* water filters unless the temperatures are going to stay above freezing
5. drink frequently in small amounts – aim for 4-6 liters/day; take plenty of your favorite protein and electrolytic supplement recipes; fill lightweight mug with lid with hot liquid and cocoa/herb tea/honey whenever possible; first course at dinner should be a tasty soup; mix milk powder in with your cocoa; put butter in all hot drinks
6. cut cheese and meats into small squares before packing; unwrap and bulk-bag everything that you can, getting rid of any unnecessary packaging; put butter in containers with screw-on lids; consider taking frozen veggies and meats
7. leave snacks and a bottle with dry supplements in your duffel in the car to replenish when you come back out

E. CLOTHING

1. *feet*: warm, stiff boots with upgraded insoles that are waterproof, broken in, recently tested and rated up to 20 degrees below what you expect to encounter (the options are: boots with removable insulating liners or wearing waterproof socks [e.g., SealSkinz] between liner and insulating socks); two pairs of liner socks of different weight and material; two pairs thick, cushioning (wool) socks; booties.

2. *body*: two merino-wool base-layer zip-pullovers; two pairs merino-wool base-layer pants of different weight; extra synthetic underwear; ventable fleece pullover and pants; ventable soft shell or wind shell jacket; light down or Patagonia micropuff (vest or) jacket; waterproof/breathable outer shell jacket with adjustable or ergonomic hood; side-zip wind, soft shell or waterproof/breathable pants; two light knee pads; easy pulls on all zippers.

3. *hands*: wool *and* synthetic liner gloves; waterproof/breathable insulated gloves *and* mittens; waterproof/breathable mitten shells.

4. *head*: visor hat; heavy wool, or fleece/nylon bomber, hat; ear jock; comfortable fleece hat for sleeping; balaclava; face shield with neck gaiter (note: you lose a *significant* percent of your body's heat – up to 70% in some estimates - above the shoulders); two pairs dark sunglasses in hard cases; ski goggles if extreme wind and cold are anticipated above tree line.

5. *car*: leave a small duffel with a dry, warm change of clothing in the car at the TH (cotton is okay here, but *not* on the trail in winter!)

Ash's personal clothing picks:

Ex Officio or REI MTS underwear; insulated, waterproof minus-25-degree winter boots; merino wool liner socks; heavy-weight merino wool socks; merino wool mid-weight base layer (tops and bottoms); Arcteryx Rampart pants; REI UL rain pants; REI eVent jacket; Under Armor Cold Gear top; REI Power Stretch OXT top; Patagonia R-4 jacket (either light- or heavy-weight); heavy Turtle Fur hat; Marmot waterproof visor hat; merino wool liner gloves; REI Switchback gloves; REI Liberty Ridge mitts; Black Diamond Frontpoint gaiters; face shield (w/ balaclava); down booties (evening); Patagonia Micropuff jacket and pants (evening)

F. SNOW

1. three main types:
 - a. sugar: unconsolidated, metamorphosed; forms when there is a significant temperature gradient between ground and top layers of thick snow under cloudy sky; granular; pours; very dangerous if below heavy new fall
 - b. dry: fell in cold air as light powder; facets or crystals that usually consolidate in lower depths; compactable
 - c. wet: fell near freezing level; bonds well; high moisture content; extremely stable if it freezes after melting or rain
2. avalanche types
 - a. loose slide: snow without cohesion, typically after storms or warming rain; starts at point and spreads out, usually on slopes above 35 degrees; an indication of a homogeneous snow pack; usually harmless unless they sweep you into nasty terrain; downhill speed up to 60 mph
 - b. slab: highly cohesive upper layer breaks free from deeper layer, typically with a broad fissure (“crown”) across the top; high speed down slope with large blocks; an indication of heavy snow over sugar or hoar frost; typically on slopes of 30-45 degrees in winter, but lower slope angle in spring; “whump” collapsing or cracks shooting out from your skis or snowshoes are indicators of slab formation over a loose layer; extremely dangerous and almost always triggered by the victim; downhill speed up to 150 mph

- c. cornice collapse: wind-loaded overhang on lee side of ridge; typically cleaves off on a line extended up the lee slope
- d. ice: toppling seracs or columns of water ice
- 3. four avalanche variables to analyze and integrate:
 - a. snow pack: “strong” does not mean “stable”; do a pit test by shovel or hand before crossing a suspect slope to analyze the relative cohesiveness of layers and the bonding between layers in light of monitored previous conditions; a storm that starts out cold and gets warmer will produce more avalanches than one that goes the opposite way; *slopes need time to stabilize*
 - b. weather: rapid changes of *any* kind (wind > 10 mph, sun after storm, more snow, your weight) can stress the snow pack beyond its holding strength; most natural avalanches occur during or within 24 hours of a fast-loading storm (above 1”/hr) when the slope can’t adjust to the weight of the new snow; cloudy warm weather after a storm will promote quicker densification and stabilization, while cool temperatures and shade will slow it down
 - c. terrain: be wary of anything over 25 degrees in shadow; typical release point in degrees in the Rockies is mid-to-high 30’s, in maritime areas is high 30’s to mid-40’s;
 - d. human factor: a high percentage of avalanches triggered by humans were caused by climbers who considered themselves “experienced”; do not be overconfident or too peak-hungry

G. TRAVEL

1. raise awareness level to the highest possible level – notice and discuss everything you see
2. leader should monitor all relevant conditions (weather, snow, party fitness, etc.) *and* keep notes
3. maintain constant body temperature to greatest extent possible by removing or adding layers in the transition before the *next* phase of activity (moisture on skin is conductive cooling that is much faster than air convection; dry clothing will insulate up to 25 times better than wet); if you feel cold, adjust clothing and eat and drink immediately, then get moving; use roll-on antiperspirant on the bottom of your feet – or foot powder - if they tend to sweat a lot; stop in sunny spots rather than shade; “under-dress” as much as you can to be “comfortably cool” when you’re in motion so that you don’t build up a sweat (that will chill the body in a hurry when you stop); always have warming layers quickly available; test *all* of your base/insulating/outer layers in a variety of conditions so that you know how they, and you, perform
4. be especially aware of the chilling effect of wind: exposed flesh can take just a few minutes to freeze when the wind chill is significantly below zero; stop and hunker down out of the wind; set up camp and build snow walls to minimize the impact of wind

5. avalanche travel: keep exposure to a minimum; don't travel above another person; keep each other in sight; stop to rest only in safe places; ascend gradual slopes first to get a feel for the stability; avoid long traverses above cliffs/dense forest/gullies; favor ridge approaches; traverse going slightly downhill to speed up the crossing; use the sides of an open slope whenever possible; if you fall try to sit to minimize stress on snow pack; one person descends at a time while others watch; pre-select an escape route; do a shear test (see references*) and/or try to trigger an avalanche to test a suspect slope before crossing it; remove all lanyards and unclip all belts and snaps before crossing; if caught in an avalanche yell to the others and try to get free of your heavier gear and stay on the surface working your way to the side with a rolling or backstroke swimming motion then raise one arm completely and cover your mouth with the other hand as you come to a stop; skirt the run-out area of obvious avalanche areas (trees knocked down or chopped off, lots of young trees in an obvious track, etc.); be *especially* careful on north-facing slopes (where the snow is colder and it takes longer for bonding to occur anyway) with a convex slope (where the bulges outward are more likely to fracture); stay out of gullies; spread out when crossing a suspect area to reduce the chance that the entire party will get caught; stick to ridges on both ascent and descent; if a member of your party is swept away in an avalanche, visualize the line of their probable descent and look there first; use your trekking pole to probe the consistency of the snow (smooth, even resistance means it is less likely to slide); keep in contact – sight and sound – with the person behind you; rotate the lead

H. CAMPSITE

1. obey local regulations and allow lots of time (2 hours?) to make and break camp; the leader should have already visited the site and distributed a plan showing the access, tents (close enough to communicate), kitchen, kiva, lavs/latrines (also used for kitchen waste), watershed (where you'll get snow – up to 3 cf/day/person - to melt for water), quarry (where you'll mine blocks for construction projects – ideally on a flat area out in the sun), sleeping bag drying area and potential snow shelter spots
2. the ideal site will:
 - a. have the minimum snow depth for your intended type of shelter: my experience is at least 12" of snow for tents, at least 24" of snow for an Ice-Box igloo and at least 36" for a block quarry (typical compaction is 50%)
 - b. present no danger from avalanches or falling timber (especially aspen)
 - c. be out of the prevailing and orographic winds (that pool in valleys and increase over ridges and cols)
 - d. be level and get full sun as early in the morning as possible
 - e. have great views and nearby water (to conserve fuel)
3. slow down and add layers 15-20 minutes before reaching camp to reduce moisture and generate warmth; during this time, discuss *who* will do *what*

once you reach camp; upon arrival, stomp down (wearing skis/snowshoes) a staging area for gear on the access route just outside the perimeter of the camp site and change into a dry base layer immediately if yours is still wet, and put wet socks on your shoulders next to your wicking layer to dry them out

4. take a long drink and eat a snack (cheese, brownies, etc.) and take a drink with protein/electrolytic/energy supplements every 15 minutes
5. implement the site plan without delay by stomping down snow in lifts in the tents, kitchen (with windproof stove counter), “kiva” (circular area 6-8’ in diameter with benches for a party of 4-6), watershed, quarry (min 18” deep when compacted) and potential snow shelter spots; one person should immediately begin melting snow for hot liquids (always start by heating a small amount of water before adding compacted snow to prevent imparting a “scalded” taste, and use wool liner gloves – synthetics can melt on hot surfaces)
6. each tent area should be at least twice the floor area of the tent, till it bears your weight on foot; mark the tent floor corners and stomp down little depressions for each sleeping pad; create a sitting area with 12-18” deep hole to put on boots near the entrance; set up tents with snow stakes at corners and snow stakes or branches in tamped dead man trenches (loop girth-hitched around middle of stake or branch, buried in snow and covered/tamped) on all guy lines; experiment with techniques to work and consolidate the snow; pile up and tamp snow 6-12” around the perimeter of the tent fly with someone pushing out from the inside, leaving some path for ventilation at both ends
7. stomp out paths to lavs (at least two for privacy and dispersal of waste, but try for one per tent; ideally located on the south side of a large tree or rock; note: pack out *all* your toilet paper) till it bears your weight on foot; make ramps, not steps; keep the watershed pristine, since this is where your drinking water may come from; clear out areas where sleeping bags can be hung to dry the next morning (e.g., clotheslines between trees or tipped skis); leave trekking poles or a shovel at each lav hole for balance
8. cut blocks: (the *standard block* size in this field guide is 6 x 14 x 18”); after stomping down the quarry, smooth out the surface with your hands and let it age-harden for 20 minutes before cutting blocks; stretch a colored (clothes)line between two summer stakes along one edge of the quarry and use long strokes of the snow saw to make a deep, vertical, straight cut beside the cord, then remove the snow on the fluffy side of the cut with the shovel to create a smooth wall; move the staked line 6” in from the wall, and make a similar deep vertical cut from one side to the other, then make vertical cuts 14” apart, coming in from the outside until you feel the back line cut, then make the horizontal cut across the bottom 18” down from the top and only 6” deep: the block should settle slightly when ready to remove; when you feel/hear this, tip the block forward with the snow saw from the back until you can reach down behind, lift it out and carry it to the construction site(s), setting it on end, for trimming. If the blocks are

too fragile at this point, let them age-harden for another 20 minutes before building with them. Build block walls up-wind of each tent and lav (see “snow shelters” section for tips), and keep everyone from walking on the un-mined part of the quarry with boots on. Note: it is best for the quarry to be stomped out several days in advance to get really solid blocks.

9. shovel out an east-facing kitchen and kiva dining area, build a snow wall to protect the cooking counters and high (to keep feet off snow) eating benches, continue to compact with snowshoes/skis until it bears your weight on foot
10. keep loose snow out of shelter; use whisk broom/pan as needed
11. *never* put on cold boots, socks or hand wear
12. *never* expose bare hands or feet to extreme cold or metal surfaces
13. put sleeping pads side by side to maximize body warmth
14. lay out sleeping bag at least 60 minutes before getting in to loft and insert liner
15. melt snow and fill many water bottles with very warm (hot shower temp) water; put some in sleeping bags, others in insulated wraps or booties (if not wearing) to drink during night; melt one final pot of water and bury it in the snow till morning (there should be at least 2 liters/person available in the morning); pick up and store all cooking gear
16. take a moderate hike or ski before settling down for the night to raise body temperature, and visit your lav before heading into the tent
17. set snowshoes/skis in protected areas near the tent entrance; keep packs in vestibules or tent; whisk off boots and keep them inside the tent in a bag (with chemical packs if they are wet inside); lay outer shell and nylon garments between your sleeping pads; use micro-duffles of different colors to store clothing inside the shelter
18. take off/put on insulating layers *inside* the bag to generate/preserve heat; wear wool base layer, fleece hat, socks you need to dry out (or dry socks and booties, with socks you need to dry out in the groin area) at night; take turns getting into bed – one person at a time
19. bring snacks, your mittens/gloves and boot insoles/liners into the sleeping bag for the night; shove your insulating layer inside down by your feet
20. have a final drink and snack and set pee bottle inside bag with lid tightened; check with your tent mates to see if they’re fully prepared for the night; set up a small red LED lantern (especially in snow shelters, which are otherwise tomb-like) and have your own headlamp handy
21. hang out sleeping bag to dry first thing in the morning (if helps if there is *any* wind or sun, but even dry snow falling is okay – assume that your bag has absorbed a pound of moisture during the night); warm up boots and dry any wet gear in sunlight or near the (emergency) fire whenever possible
22. keep fuel warm (it does not freeze and will be at air temperature) and cook in tent vestibule *only* when preferable to an outside kitchen area
23. don’t leave *anything* lying around for animals or the wind to carry off
24. leave NO trace when you pack out; cover your latrine - you might be back!

I. MEDICAL

Try to imagine how *any* of the following medical complications could affect the entire party, and then commit to taking, and helping anyone else take, *every* precaution to prevent such complications from happening. If there is a serious medical problem, some one should write down a *SAMPLE*: Symptoms, Allergies, Medications, Past medical history, Last food and fluids and Events leading to injury.

1. cramps:

prevent: drink lots of fluid with electrolytes and do not exhaust yourself

symptoms: crippling muscle pain, inability to move the limb, etc.

treatment: as quickly as possible after onset stretch the cramped muscle gently, put weight on the limb and massage the cramped muscle

2. blisters:

prevent: break your boots and gloves in completely; apply second skin and/or large bandaids to suspect areas before starting out

symptoms: hot, painful sensation at friction point; fluid pocket forms

treatment: clean with antiseptic wipe then puncture with sterilized needle and massage/drain completely, apply antibiotic and cover with blister dressing

3. hypothermia:

prevent: anticipate sudden chilling after exertion, or sudden precipitation/wind or abrupt drop in air temperature and adjust clothing and eating/drinking; wear clothes that shed snow; practice in advance with *all* your clothing to know how it functions; strip off unneeded layers; head straight back to camp if you are soaked

symptoms: sudden chill, hunched posture, drop in energy level, cold fingers and toes, loss of coordination, fumbling, listlessness; more severe stages: shivering stops and person is disoriented, eventual loss of consciousness; in early stages body temperature drops to 95 degrees, middle stages down to 90 degrees, late-middle to 86 and late stage to 78 degrees (unconscious).,

treatment: try food, drinks and exertion; if this fails, then get person into sleeping bag with pads underneath and protected from the wind and pile other sleeping bags on top; if this fails, wrap the bags in a tarp and put hot water bottles in hands, underarms and groin areas first then also neck and torso; if you also use chemical heat packs follow the directions very closely; in severe cases, be careful moving the person, don't offer fluids and try to evacuate with professional assistance

fire: if you have to build a fire in an emergency, dig down almost to ground level in a sheltered clearing downwind of the (flammable) tents, collect dead wood and lay the largest pieces on the snow, make wood shavings and kindling with a knife, douse completely when you are done and cover completely with snow

4. frost bite
 - prevent: dress properly on feet, hands, ears and face, and consume food and liquids adequately; always wear liner gloves when touching cold objects; always shelter and warm a body part up immediately if it feels cold; avoid tight-fitting clothes and boots
 - symptoms: superficial (numbness, pale color, cold but pliable skin, sharp pain when skin thaws) and deep (tissue is hard, numb, cold, either white or very red, may blacken and slough off)
 - treatment: superficial (“nip”): put affected area against warm skin; do not massage or pop any blisters, take ibuprofen; deep (“bite”): insulate the person and evacuate as soon as possible; attempt to thaw a body part only if there is no danger of re-freezing and if the person doesn’t need help walking out
5. trench foot
 - prevent: keep feet warm and dry, especially at the end of the day’s exertion
 - symptoms: blood flow is cut off after hours of exposure to wet and cold, leading to permanent nerve and circulation damage; foot may appear “wooden” with mottled skin
 - treatment: elevate and gently dry and massage the foot; take ibuprofen
6. falls/trauma
 - prevent: avoid slips and tumbles, especially when fatigued going downhill
 - symptoms: varied; check for bleeding without removing clothing and look for possible head/spinal injury
 - treatment: immobilize neck/spine if necessary; stop bleeding by pressure unless it cuts off vital circulation; if bruise/swelling treat with rest, ice, compression and elevation (“RICE”)
7. acute mountain sickness (AMS):
 - prevent: spend time acclimatizing to elevation and watch for early symptoms above 8000’; hydrate fully and take adequate supplements of vitamin C and calcium.
 - symptoms: headache, difficult breathing, loss of appetite, nausea, fatigue leading to loss of coordination and possibly pulmonary edema (HAPE - gurgling sound in lungs) or cerebral edema (HACE – severe headache, rapidly deteriorating level of consciousness, sometimes hallucinations)
 - treatment: rest at current elevation for 20 minutes, during which time the person should consume water, vitamin C (500-1000 mg), calcium (up to 1000 mg, preferably blended with magnesium and zinc) and an energy snack/candy bar; if symptoms wane, keep on going; if symptoms persist or worsen (e.g., vomiting) then head down right away
8. snow blindness
 - prevent: wear dark, 100% UV block wrap-around (or glacier) sun glasses
 - symptoms: burning of the cornea, painful sand-in-the-eyes sensation
 - treatment: cold wet compresses to the eyes in a dark environment

J. SNOW SHELTERS

If you have the time and energy, consider several good reasons for building a snow shelter near your established campsite. You'll generate heat and probably have great teamwork fun with this amazing building material. If you're going to use this site for a few days, a snow shelter could be a welcome, warmer alternative to (though never as easy or fast as) a tent. Except for the mega-mid and tree-pit, a properly-built snow shelter is eerily sound-proof, will bear the weight of new snow and maintain a steady, occupied interior temperature of around 30-32 degrees F. If an Ice Box igloo is built in the shade, it can be used till early spring, even though it sags. And finally, experimenting with a variety of snow shelters will improve your knowledge of snow types, develop your construction skills and better prepare you for future outings or (?!) emergencies. The smaller the shelter, the stronger and easier it will be to build, so if time is of the essence do an A-frame. A 76" diameter can tightly accommodate one adult, an 86" diameter can tightly accommodate two, a 96" diameter can tightly fit 3 adults, and so on. All snow shelters should (1) have an entrance level that is lower than the interior floor so that cold air can pool there (2) have a small vent hole (or a stick that can be withdrawn if it gets "stuffy" inside) high on the wall or roof/wall opposite the entrance, (3) use plastic sheeting for the floor and (4) have a door flap that seals the entrance. Three suggestions about the entrance: (a) make the door/tunnel 24" wide and 30" high; (b) slope the end wall of the entrance tunnel inward so that the door flap lays on it; and (c) make a durable one-size-fits-all flap from a piece of tarp or 6 ml plastic (with an R-Foil layer!) that is 48" high and 36" wide with grommets across the top and two pieces of dowel end-to-end (making it easier to pack in) sewn in the bottom. Take notes on snow type, your technique and time, and wear waterproof gear during construction. Once the structure is complete, plaster and rub smooth the interior (so that condensation will run down the wall rather than dripping) and exterior surfaces by hand and then scrape/sweep loose snow from the floor with the shovel. If thick ice is available, you can use it for a skylight. Put sturdy smooth sticks or snow stakes at an upward angle into the wall for light objects like lanterns, etc. and/or cut a "nicho" into the side of the entrance below floor level for a lantern.

1. *quin-zhee* (Athapaskan for "snow shelter"): avalanche-probe carefully for obstacles, set a colored summer stake in the center and use the tape/string to set the radius and draw the interior perimeter circle, then boot-pack around the outside to make a foundation 16" wide, setting tall sticks/poles in the snow at the outside of the foundation. Remove the stake and build a dome-shaped mound of snow *at least* 6' high above the foundation, taking snow from *outside* the foundation and tamping with a shovel as you go, and let it age-harden for at least 1-2 hours while you replenish and work-harden the outer surface by whacking it with shovels. Insert several dozen sticks, each 16" long, into the mound as thickness guides, and start excavating from the downhill and/or leeward side by digging down almost to the ground and creating a comfortable opening for excavation. Wear knee pads under waterproof pants, kneel on the 2x2 foam pad, use a short shovel (ideally with a curved handle) and carve, don't pry, the interior snow loose. Always dig upward first until you hit the ends of the guide sticks, then remove the snow from the ceiling down to the floor to minimize the amount of snow over your head in case of

collapse, and always have another person at the entrance to remove snow. When finished, make a short tunnel from compacted snow blocks to reduce the opening and retain more heat. Comments: typically done on level or low-slope terrain; can be built by one person; wet digging for the person excavating inside; if the opening is too big, close it in with blocks as part of the tunnel construction.

2. *mole's cave*: find a deep (at least 6'), hazard-free snowdrift on the lee side of a ridge, boulder or fallen tree, av-probe for buried obstacles, and toss down and tamp snow from above and below with a shovel to create a bigger mound than a *quin-zhee*, and excavate from downhill in the same manner, keeping the roof at least 2' thick. Comment: typically done on a much steeper slope, with easier snow piling, than a *quin-zhee* but equally wet digging for the mole inside; can be done solo. Flag around the outside to keep people from punching through.

3. *slip-form igloo*: with snowshoes stomp and level a circular site that is 5-1/2' larger than the interior diameter that you desire and use an Ice Box (or custom?) igloo kit, following the instructions carefully. If you brought a saucer sled along, as soon as you reach a point where it can fill the opening from below, support the sled with hands and a trekking pole while helpers on the outside pour loose snow gently on the sled to create a mound and then lightly tamp it until the sled is firmly locked in place. Leave it there while the outside helpers dig down a couple feet on the downhill side to make the smallest possible opening to get the inside packer out, and then relax and replenish while the dome hardens. You might want to lower the floor inside to create more headroom. Finish with a short entrance tunnel. Comment: can be built anywhere with any type of snow, but requires skill and patience; best to have two shoveling outside and one packing inside; "work" the snow so that it has no lumps just before *pouring* into the slip form.

4. *tilt-block igloo*: stomp the site as slip-form. Set a colored summer stake in the center and use the tape/string to score a circle with the desired inside radius, making the igloo just large enough for the number of occupants. Leave the center stake in place and, if you are right-handed, lay up in a counterclockwise direction. Start opposite the future entrance, and put the 18" dimension on the ground. You can cut out a small entrance opening when the wall has reached shoulder height. There are two basic construction methods, and each will involve creating a ramp from the floor to the top of the blocks in the first course so that all following courses will "spiral" up this ramp.

3-point method: Cut the first block from the leading upper corner to the mid-point of the trailing side so that, when the two pieces are laid end-to-end they create a 2-block ramp. Adjust the block length so that no joint lines up with the joint in the course below, set each block on edge (even on the first course) and trim the block below and the sides so that there will be support/contact in only three points when the block is tipped inward. Use loose snow as mortar, and "sinter" each block by blowing/spraying on the contact points and tapping it. As you go, gently fill in the gaps between blocks with chunks of snow and then lightly tamp loose snow over the outside surface for strength. Cap with a block (resting it and cutting away till it drops into place) or the saucer sled, etc.

full-contact method: Cut the bottom of the first course blocks at an angle so that, when the block is set in place, the bottom is in full contact with the floor. As you place the next block, also tilted in at the same angle, use the saw to cut both blocks so that the cut is radial and points at the center stake and the new block is totally stable. When you've completed the first course, cut a ramp that goes from the leading top end of the last block all the way around to the bottom trailing end of the first block. Adjust the block length so that no joint lines up with the joint in the course below, sinter the vertical joints by spraying one side lightly with water (keep the small bottle inside your jacket) and rub snow into the cracks as you go.

If you are aiming for a smooth dome with an interior peak height of, say, 60 inches, how much should you tip each course in? That will come with practice. But, as a guide, these interior diameters (from block edge to block edge) course-by-course will create roughly the same profile as the 8' *flat-block* igloo described below: #1 = 92" (i.e., tilt each block in the first course inward only 2"), #2 = 78", #3 = 61", #4 = 42" and #5 = 22". Note: a four-person is technically twice as hard to build as a two-person; cut out an entrance when blocks can't be handed in from the outside; if you're doing it solo, try to stockpile enough blocks inside to finish the structure and cut the entrance when you're done; can easily be designed to have a higher interior peak height than the commercial slip-form kit.

5. *mason's cave:* A viable alternative to a mole's cave, especially if the slope is *really* steep. Av-probe, then dig right into the steepest part of the bank to make a vertical wall at the back, laying the snow you remove at the front (downhill) lip of this chamber, until you come to snow that is compacted enough to cut into blocks. Stomp down the removed snow to create a circular, level foundation in the front of the chamber, cut standard blocks from the back wall and lay up a tilt-block igloo in the front circle until you've completed a half-dome up to shoulder height. Dig down next to the front outer wall for an entrance tunnel, cut out a small opening, and enlarge it to get out and stomp snow for the entrance tunnel. Go back inside and complete the tilt-block enclosure, capping the top from the outside if you have to, then remove enough snow to create an adequate interior space. Build the entrance tunnel, chink and plaster with loose snow. Comments: faster and drier than a mole's cave; can be built solo; see it done in fast-frame at snowsaw.com/movies. Flag around the outside to keep people from punching through.

6. *flat-block igloo:* site prep same as *tilt-block* approach. Lay standard blocks in courses 6" high and 14" wide (for the first nine courses – only the tenth should be 18" wide), cutting all the blocks for a course in the same wedge shape so that their sides touch each other. When a course is complete, rub loose snow into the cracks between blocks and pack/tamp the exterior steps between courses. Make sure that blocks cover joints below, and overhang each block over the one below (but not so much that it falls in) so that, at the top of the tenth course (with an interior peak height of 60"), you have reduced the opening to point where it can be finished with either the saucer sled if you brought it or a couple of blocks. Before leaving on the trip, use a sheet of graph paper to draw a profile of the igloo and measure the overhangs for each course. (For example, here is a set of

interior diameters (between the block faces) course-by-course for an 8' igloo without the saucer dome: #1= 96", #2 = 92", #3 = 87", #4 = 80", #5 = 71", #6 = 62", #7 = 51", #8 = 40", #9 = 29" and #10 = 14" – note: this final course should be 18" wide to prevent the block from falling in.) Toss and lightly tamp a mound of snow on top and finish with a tunnel. Comments: uses many more blocks than the *tilt-block* approach, but is easier to build; can be done solo, but better to have two people.

7. *dugloo*: at a site suitable for either a mason's or mole's cave, toss more snow down from above and pack the area with skis/snowshoes. One person digs a hole smaller than 3' (or the saucer sled if you brought it) in diameter straight down in the middle, and begins to bell out the sides when about 2' down, then gets into the hole and continues to carve out an interior dome while standing on a pillar of snow and going as far as possible while still tossing the snow out the hole. Use the saucer sled or tilted standard blocks on edge to cap the hole and cover this with tamped snow. Then the outside helper digs out the entrance on the downhill side and both finish carving the domed interior, at which point the ceiling can be reduced to less than a foot under the cap. Comments: two persons required for construction; more lifting to dig out, and only slightly drier, than a mole approach. Flag around the outside to keep people from punching through.

8. *A-frame solo*: Av-probe and pile up snow in a flat rectangular shape and stomp down with snowshoes/skis on until it is at least 3' deep; starting at the lee/downhill end cut out standard blocks from the floor to form a trench 18" wide, then bell out the sides of the trench and lower the floor as much as you want. Starting at the entrance end, set blocks in pairs tipped against each other with the corners cut so that contact areas with ground and opposing block are roughly 3" wide (this will enable you to pack the sides and top for extra bonding and strength). Comments: fastest possible solo shelter; you can add protected and covered space in front of the entrance if time permits. Flag to protect.

9. *casita*: a little rectangular house with a flat roof that can sleep 2-6 people. The tunnel on the front wall is centered on a 20" wide trench that extends straight to the back wall and the occupants sleep with their feet toward the trench. In a 2 or 3-person casita, there is a 20" wide gear bench on the side wall opposite the occupants; in a 4, 5 or 6-person casita, the 20" gear areas will be along the side walls. The roof structure will use "vigas" of straight, downed aspen trunks 3-6" in diameter that are laid side by side, or with every other one resting on a gap between the two below. As these are placed on the front and back walls, loose snow should be packed all around to form an air seal; then the vigas are covered with 6 ml plastic or tarp followed by mounded snow. With good advance planning, the vigas would have been cut and stashed during the summer, when they're easy to find on the ground; if not, it's obviously necessary to take in buck saws on this trip. Stomp out the casita and quarry sites to size (see below) and make sure that the quarry is at least 20" deep after compaction. Cut *non-standard* blocks at 10 x 20 x 12" and lay them up with overlapping joints and corners to create vertical walls 10" wide, then cut out the door and trench, lay on the roof and make the tunnel. When you break camp, brush the snow off the roof and take the plastic/tarp with you. Comments: takes a lot of snow but very little skill, and should go up in a hurry once the blocks and vigas are ready; expandable and roomy. These quarry dimensions assume 4 courses at 12" each:

number of occupants	interior wall dimensions		number of blocks/course	quarry area	rafter length
	front/back	sides			
2	120"	60"	20	55 s.f.	76-78"
3	120"	80"	22	75 s.f.	96-98"
4	220"	60"	30	140 s.f.	76-78"
5 or 6	220"	80"	32	190 s.f.	96-98"

10. *quonset*: for two people, stomp out the quarry and cut 8x12x16" blocks to leave a rectangular trench 16" deep that is 12-16' long and 4' wide. Lay at least one 8" course around the perimeter, putting two courses in the trench, to form a 4x8' interior. Then lay blocks on the short end walls so that you can cut an arch shape that is 48" wide at the bottom and 42-44" high at the peak on each end. Spray the tops of the arches with water to harden, then, as a guide, set a block on end, with full contact, on the wall next to each arch and cut a notch to hold a straight pole (3-4" in diameter) from one arch to the other that supports the top edge of the block. Lay up one course of block on each side wall with full contact and overlapping, then repeat until the roof is domed over. Cut out the entrance door and make a tunnel. Comments: obviously requires finding some downed aspen trunks; not as efficient a shape as an igloo.

11. *mega-mid*: stomp down a large circular area of deep snow and set up a Black Diamond mega-mid tent with the center pole on a solid platform of some kind, then excavate around the interior to form benches, leaving the center column as a counter table. Comments: tent is very light; terrific feature for a group area; use large dead men for the guys.

12. *tree pit*: enlarge the natural snow hole under a large, healthy conifer and experiment with roofing structures of various materials. Comments: a small tent would probably fit under some of the larger trees, adding protection and reflecting back some of the radiant heat; pick a tree without (or trim away) dead branches that could fall on you.

K. REFERENCE MATERIAL

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