Denali National Park and Preserve
www.nps.gov/dena

Talkeetna Ranger Station
P.O. Box 588
Talkeetna, Alaska 99676

National Park Service
U.S. Department of the Interior

Denali National Park and Preserve

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Mountaineering in Denali National Park and Preserve

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Registration Requirements, Safety Rules and Regulations

Mountaineering in Denali National Park and Preserve

Written by:
Denali Mountaineering Staff and Medical Advisors

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Introduction

Alaska has long been regarded as the last frontier offering some of the most remote and rugged mountains in the world. The quest for solitude and adventure lures thousands of climbers from around the world into the backcountry each year to test their skills and wilderness experience. Unfortunately, every year, numerous accidents and some fatalities result from poor judgment. A hundred years ago wilderness survival skills were a way of life in the Alaska. The rules were simple and harsh: Survival was your responsibility, no one else's. We have grown socially and culturally unwilling to accept that primitive education which dictated that people simply learned or died.

Today, because most people, including most Alaskans, live in urban environments and grow up in an urban culture, wilderness skills are never learned. The result is that the wilderness-bound end up depending more and more on equipment and less and less on their own competence to deal with dangerous situations in wilderness settings. Each year in this state, the National Park Service and other agencies conduct backcountry rescues that should never have been needed. Many of these incidents are a result of people forgetting that the most important trip objective and priority is a safe journey out and back.

Some incidents stem from a lack of judgment, some from a lack of training. Outdoor proficiency should come from a long, mentored apprenticeship that presents the opportunities to deal safely with increasingly precarious situations. But there are few opportunities for such wilderness exposure today. Many factors have conspired to change that. Technology has made it possible to call for rescue from almost anywhere at the same

time that it has made backcountry travel easier and faster. Technology has served to blunt respect for the tests Mother Nature can still throw at humans. Taking communication on a trip is being responsible but basing how much risk you take because of that communication is negligent at best.

Many times I have tried to warn climbers and backpackers of nature's cold and harsh realities. The Alaska environment can be extremely unfriendly to humans. It is indifferent and unforgiving. On top of that, the scale of Alaska is easily underestimated. Most people set unrealistic expectations. Ten miles cross-country in Alaska is not like 10 miles on trail systems in the lower 48 but more like 30 or 40 trail miles.

Arrogance about the outdoors blinds people to these things. Unfamiliarity with Alaska's arctic and sub-arctic conditions and a sometimes total disregard for elementary principles of safety simply compound the problems.

I have seen this firsthand too many times. It is a sad and painful task to tell family and friends when someone is lost or dead in the mountains. Yes, accidents do happen. There are medical emergencies and acts of nature for which no one can plan. But these are rare. Most accidents are caused by bad judgment compounded by Alaska's severe weather and remoteness. Many accidents are a result of people making bad decisions because of a lack of knowledge or complacency.

An examination of climbing accidents in Alaska shows a great number of rescues involve people who have misjudged the consequences of their decisions and were underprepared for Alaska weather. The remoteness of the Alaskan backcountry makes everyone susceptible to a catastrophic accident or medical emergency. Hazard evaluation in the backcountry is in part linked to the time you spend there, but there appears to be a refusal on the part of some to let experience teach them.

Some consider their success in the backcountry a reflection of superior outdoor skills although most have never been tested in crisis. They forget that some crisis is necessary to hone skill. "Near misses," those brief encounters with the reality of mortality, are great learning tools if properly approached.

Errors in judgment are educational if they send the right message — that turning around at the right time or opting not to go on are decisions that will save your life time and time again. Unfortunately, our virtual-reality society presents some problems in defining risk. To some degree, we have come to see it as a quest instead of a warning. The "no fear" philosophy pushes people to navigate in the backcountry regardless of the

Photo © John Leonard

Mountaineering rangers training in the Ruth.

elements, but it operates on the faulty premise that liabilities and possible injuries are a low priority and that rescue is just a call away. This is dangerous for the people seeking recreation and for the people called upon to rescue them. People fail to make the right choices based on their capabilities. They forget that prevention is the rule because treatment is often impractical or impossible.

My first climb on Denali in 1981 was one of the most traumatic and best learning experiences in my life because of the severe storms we encountered at 17,000 feet. As a mountaineering ranger for the past 13 years I have witnessed many worst case scenarios regarding accidents along with some of the most determined wills to survive. Conducting many varied and difficult backcountry patrols in Denali National Park I have retained these thoughts on surviving in the wilderness of Alaska.

- ▲ Everyone has a personal responsibility to maintain self-sufficiency in the wilderness and should always base decisions on getting back on their own.
- ▲ Your best resource is the ability to think in a controlled manner when a life-threatening crisis is happening.
- ▲ Prevention, not treatment, is what ultimately will save your life in the wilderness.

- ▲ There is a notable difference between a gamble and a calculated risk. A calculated risk considers all the odds, justifies the risk, and then makes an intelligent decision based on conservative judgment. A gamble is something over which you have no control and the outcome is just a roll of the dice.
- ▲ You cannot make intelligent decisions in the wilderness if you do not understand the risks.
- ▲ Never give up; the will to live is a valuable asset. Sometimes people perish simply because they fall short on perseverance.
- ▲ As a rule, if you die in the wilderness you made a mistake; careless judgment has a sharp learning curve.
- ▲ Wilderness rescues in Alaska are often dangerous to the rescuers and always weather-contingent.
- ▲ People do not realize the devastating impact that their accidents have on friends and loved ones.
- ▲ The prerequisite to misadventure is the belief that you are invincible or that the wilderness cares about you.

We as a staff are committed to helping make your expedition a successful and unforgettable experience. I hope that you will partner with us in maintaining Denali National Park and Preserve as the pristine natural environment that it is. Allow others to take away with them the same unmatched experience that you will no doubt take with you. Please use the information found in this booklet to help guide you in your preparations, and if you have any other questions or concerns please contact one of our staff for assistance.

Safe climbing,

Daryl R. Miller
South District Ranger
Denali National Park and Preserve

Denali National Park and Preserve

It's more than a mountain. Denali National Park and Preserve features North America's highest mountain, 20,320-foot tall Mount McKinley. The Alaska Range also includes countless other spectacular mountains and many large glaciers. Denali's more than 6 million acres also encompass a complete sub-arctic ecosystem with large mammals such as grizzly bears, wolves, Dall sheep, and moose.

The park was established as Mt. McKinley National Park on February 26, 1917. The original park was designated a wilderness area and incorporated into Denali National Park and Preserve in 1980. The Park was designated an international biosphere reserve in 1976.

Today the park accommodates a wide variety of visitor use including wildlife viewing, mountaineering, and backpacking. It continues to provide a laboratory for research in the natural sciences.

The Mountain

Denali (The High One) is the Native American word for North America's highest peak, Mount McKinley, rising 20,320 feet (6,194 meters) in the Alaska Range. Denali was renamed Mount McKinley for William McKinley, a nominee for president, by the Princeton graduate and gold prospector, William Dickey. Dickey was one of the hundreds of prospectors seeking gold in the 1896 Cook Inlet stampede. He had written an article for the New York Sun where he described the mountain as the highest in North America at over 20,000 feet.

"When later asked why he named the mountain after McKinley, Dickey replied that the verbal bludgeoning he had received from free silver partisans had inspired him to retaliate with the name of the gold-standard champion."
Mt. McKinley: The Pioneer Climbs
by Terris Moore

Since the turn of the 19th century, the official name of this great mountain has not rested in peace. In 1914, following his historic first ascent of the mountain in 1913, Hudson Stuck wrote in the preface of his book, *The Ascent of Denali:* "Forefront in this book, because forefront in the author's heart and desire, must stand a plea for the restoration to the greatest mountain in North America of its immemorial native name."

In 1980, the name Mount McKinley National Park was officially changed to Denali National Park and Preserve. The State of Alaska Board

of Geographic Names has also officially changed the mountain's name back to Denali. Negotiations continue today to officially return the original native name to this magnificent mountain. This booklet uses the names Mt. McKinley and Denali interchangeably throughout.

Talkeetna Ranger Station

In 1977, the National Park Service established a ranger station specifically for mountaineers in the small community of Talkeetna. Since 1984, the station has been staffed year-round to provide information and assistance to mountaineers before, during and after their climbs. The mountaineering rangers have extensive experience in the Alaska Range and can provide invaluable information.

A collection of over 150 high quality photographs of the Central Alaska Range by Bradford Washburn is available for viewing at the ranger station. The station maintains a reference library including a complete set of American Alpine Journals, a map collection, and specific route information for numerous other peaks, including the Ruth, Kitchatnas and Little Switzerland. While in Talkeetna, please feel free to use all of these resources to better prepare for your climb.

NPS Photo

The Talkeetna Ranger station offers assistance to mountaineers year-round.

(Opposite Page) Rangers carrying patient to Army Chinook helicopter at 14,200'. NPS Photo

Registration Requirements

Registration Contact Information

Talkeetna Ranger Station
P.O. Box 588
Talkeetna, Alaska 99676

Phone: (907) 733-2231
Fax: (907) 733-1465
email: dena_talkeetna_office@nps.gov

The following regulations must be complied with by anyone planning to climb Mt. McKinley or Mt. Foraker.

1. **Read the Mountaineering booklet.** Every expedition member must read a copy of our Mountaineering booklet.
2. **60 day pre-registration for Mt. McKinley and Mt. Foraker required.** Registration forms for each climber must be received at least sixty (60) days prior to the start date of the climb along with a non-refundable and non-transferable deposit. Forms may be submitted via mail, fax, email or other electronic means, *(As of the writing of this booklet, email is the only electronic method available. However, there may be*

other methods available in the future.) For current fees please refer to the registration form. All forms must be complete and legible. **Climbers** are responsible for ensuring their form(s) have been received in time for their desired start date. **A phone call or email to verify your expedition's forms have been received is highly suggested!**

3. **A Mountaineering Special Use Fee per climber is required.** See registration form for the current fee.

   Deposit – A non-refundable, non-transferable deposit for each climber is due with the registration form at least sixty (60) days prior to the start of the climb. Deposit may be paid by credit card, money order, or US currency. **Personal checks will not be accepted as payment.**

   Balance –– The remaining balance of the permit fee will be due when you check in at the Talkeetna Ranger Station. Payment may be made by credit card, money order, traveler's checks, or US Currency. **Personal checks will not be accepted as payment.**

4. **Solo climbers are required to complete and submit the "supplemental solo" form**. This is in addition to the registration form and must accompany their registration form. Solo expeditions will not be registered to climb without a supplemental solo form.

5. **Expeditions can add *one* climber 30 days prior to their climb.** With the approval of the leader, expeditions are allowed to add one climber to their team as long as the registration form and deposit are received at least 30 days prior to the start of the climb.

6. **Climbers that have climbed Mt. McKinley or Mt. Foraker since 1995 may register to climb with seven (7) days notice.** Climbers requesting the seven-day rule exemption must have climbed on either Denali or Foraker since 1995. Their name must be listed on the Talkeetna Ranger Station database as previously paying the special use fee. Climbers that pre-registered with the deposit and then canceled without climbing are not eligible. The 7-day rule is determined for each individual member on a case by case basis. In order for the entire expedition to be eligible for the seven-day exemption all members must qualify.

7. **Expeditions are required to check in together at the Talkeetna Ranger Station for a climber orientation.** This includes expeditions originating on the north side of the Alaska Range. Expeditions should allow 3 to 5 hours for check in from mid-May to mid-June and 2 to 3 hours during the rest of the season. Every member of the expedition will be required to provide a photo identification before a permit will be issued. Your expedition may check in between 8:00 am and 5:00 pm., seven days a week. Appointments are encouraged and every effort will be made to keep appointments, however, during the busy season this is not always possible.

8. **Expeditions are required to check back with the Talkeetna Ranger Station after the climb.** Your expedition may check out during our normal business hours: 8:00 am - 6:00 pm, seven days a week.

9. **If you plan to use a guide service or guide, it is your responsibility to ensure the guide and/or service is authorized by Denali National Park and Preserve.** Illegal guiding is prohibited and your climb can be cancelled at any time. For more information on authorized guide services, please see our website: **www.nps.gov/dena** or contact the Talkeetna Ranger Station.

To help speed the registration process.....

1. **Send in all registration forms together,** use a distinct expedition name and ensure all members use the same name.

2. **Reference your expedition name on all correspondence.**

3. Mail to Talkeetna can be slow. **Allow extra time for registration forms to arrive.**

4. Make sure to include the deposit(s).

5. Check with the Talkeetna Ranger Station to ensure your forms have been received.

6. If you are adding someone to your climb, have the expedition leader call as soon as possible to give permission.

General Information

The Expedition

The expedition should consist of at least two to four members. A larger expedition composed of four or more individuals provides greater inherent strength and self-rescue capability. Expeditions should not exceed 12 members. A group composed primarily of individuals who have not climbed together tends to be a weak climbing group. Such expeditions are not recommended. Each member should have solid mountaineering skills, glacier travel knowledge, and must have stamina, conditioning, excellent equipment and the mental fortitude to survive in severe arctic conditions. Experience has shown that even these qualifications do not guarantee safety or success. The more difficult routes are technically very demanding and all members attempting these routes should be highly skilled. All members must know the physical condition, limitations, and the experience of each team member.

Leadership and Interpersonal Relationships

Irritability can easily spring up between close friends during a stay at high altitude. A nagging fear, doubt, or feeling of guilt can easily grow dangerous. Leadership characteristics may undergo drastic change because of the stressful situation. Personality changes may bring out latent domineering tendencies in anyone and can be extremely upsetting to group relationships. Being on the mountain may precipitate a variety of phobias, including claustrophobia from living in close quarters, which

(Opposite Page) Little Switzerland. NPS Photo

can lead to panic with an overwhelming desire to run away. In extreme cases a single climber may even leave the group and attempt to descend alone, which can lead to fatal consequences.

Self Sufficiency

Those who depend upon rescue efforts or on the strength and expertise of others to extricate them from difficult positions are inviting disaster. Helicopters and/or acclimatized rescuers are often not available or the weather prohibits their response. In the Alaska Range, travelers should be prepared with knowledge, equipment, strength and common sense to support their own expeditions.

The selfless assistance provided by climbers through the years have saved countless lives. This help has not been given without hardships and often causes aborted climbs for the rescue volunteers. All climbers must prepare to be self-sufficient.

Solo Climbing

The major hazard facing a soloist on Denali is that even the most cautious and experienced climber is unable to determine the location of and/or strength of the many snow bridges that must be crossed. Each year, a number of people take serious crevasse falls on the large Alaskan glaciers. Nearly all of these falls prove to be little more than an adrenaline rush for the entire climbing team... unless of course, the person who fell is either improperly roped or not roped at all. Unfortunately, experience plays little part in determining who falls through these snow bridges. Some crevasses may be faintly visible while others are totally undetectable. Some soloists have devised crevasse spanning poles attached to their climbing harness that provide a degree of protection in case of a crevasse fall. Many are experienced enough to identify and avoid most mountain hazards, but hidden crevasses add a new dimension of objective risk to soloing. Virtually all experienced Alaska Range mountaineers are not willing to accept this level of risk.

A solo climber has virtually no self-rescue ability in the event of a serious accident or illness, and creates an undue risk to the search and rescue party. All climbers that are planning on climbing solo must complete the supplemental solo form for their registration to be processed.

WE STRONGLY RECOMMEND AGAINST SOLO TRAVEL.

Climbing Seasons

Snow and weather conditions for climbing major Alaska Range peaks are usually best from May through July. Colder minimum temperatures and strong northwest winds commonly occur in May. Late June and July are warmer but more unsettled. By late July, travel on the lower glaciers is made difficult by the melting snow bridges over crevasses, and by more inclement weather with heavier snowfall and increased avalanche danger. The highest success rates occur in June. April is an excellent month for many of the lower peaks with conditions often cold and clear while the winter extremes still linger on Denali and Mt. Foraker. The coldest weather on Denali is found from November through April with average temperatures ranging from -30ºF to -70ºF recorded at the 19,000 foot level. It is not uncommon to find it -50ºF at the 17,200 foot camp in early May.

Winter climbing in Denali borders on the ridiculous, more because of its unfathomable risks than because of its mountaineering challenge. Some of the world's best climbers have either disappeared or perished from literally being flash frozen! In winter months, the jet stream, +100 mph (160 km/h), will often descend over the mountain's upper flanks. Combine this wind with the naturally caused venturi effect that doubles wind velocity in such areas as Denali Pass and you will find one of the most hostile environments on this planet. The combined effect of ferocious wind and extreme cold easily and routinely sends the wind chill off the charts.

Routes

With over 30 routes on Denali, the West Buttress, West Rib, Cassin Ridge and Muldrow are the most frequently climbed. The West Buttress and the Muldrow are the least technical ascent routes; the primary climbing difficulties being crevasses, steep ice and exposed ice covered ridges. As of 2004, Denali was attempted by over 1,200 climbers each season with over 90% attempting the West Buttress. With this many climbers in such a short season, climbers can expect to encounter several hundred others.

The Talkeetna Ranger Station has reference materials for routes on Denali and other peaks in the park. This includes climbing areas such as the Ruth, Little Switzerland and and the Kichatna Spires. Several good guide books are available for Denali, Mt. Foraker, and Mt. Hunter, please see the appendix of this booklet for a reference list. Other specific route descriptions maybe found in the ***American Alpine Journal.*** Valuable information may be obtained from members of previous expeditions. If you are

Bradford Washburn

The West Buttress route.

unable to find information elsewhere you can direct specific questions to the Talkeetna Ranger Station.

High quality photographs of peaks and routes taken by Bradford Washburn can be acquired through the University of Alaska, Fairbanks. The photos can also be viewed at the Talkeetna Ranger Station.

Approaches

From the south, the usual approach is by ski plane from Talkeetna to the Southeast Fork of the Kahiltna Glacier or to the Ruth Glacier in the Don Sheldon Amphitheater. Some groups have skied in from the Peters Hills or the Parks Highway. The conditions are usually good for skiing on these lowland approaches until breakup in April. The party should plan to have their expedition gear flown in and allow at least a week for the ski approach. Specific route information can be obtained from the Talkeetna Ranger Station.

From the north, the approach for Denali and other peaks is by foot, ski, or dogsled (see Services). The park road is generally open by the second week in June where the approach can be made from Wonder Lake. Before the road is open you will have to fly to Kantishna or ski the road from the Park Headquarters. The approach from Wonder Lake to McGonagall Pass is 18 miles (29 km). The majority of expeditions planning

climbs from McGonagall Pass arrange to have their supplies taken in by dog team in the spring. Parties that have prepared for this have the highest chance of success. A major challenge and potential danger is crossing the McKinley River. This broad, braided river typically runs higher from June through July due to glacier melt. Each member should be versed in river crossings and teamwork used for deeper sections.

All plastic buckets used for long term storage that were taken in by dog team must be packed out upon your return or arranged to be picked up the following spring.

Search and Rescue Requirements

Denali National Park and Preserve recognizes that a certain number of park visitors each year will become ill, injured, or in incapacitated some way. It is the policy of Denali National Park and Preserve to assist those in need, when, in the opinion of park personnel apprised of the situation, it is necessary, appropriate, within the reasonable skill and technical capability of park personnel, and provides searchers and rescuers with a reasonable margin of safety.

Search and Rescue Operations are conducted on a discretionary basis. The level and necessity of the response is determined by field personnel based on their evaluation of the situation; rescuer safety is always our first priority. Denali National Park and Preserve expects park visitors to exhibit a degree of self-reliance and responsibility for their own safety commensurate with the degree of the activities they undertake.

A climbing party high on Denali or other Arctic mountains cannot depend on any assistance in the event of an emergency. Due to complexity of a rescue it could be days before rescue personnel could arrive on scene for a rescue. For all practical purposes, a climbing party is alone and must depend upon its own resources if an emergency situation arises. Injured or ill persons must often be moved to lower elevations by the remainder of the group, if at all possible. This is for the benefit of the injured person and to aid in rescue by a ground party or possible evacuation by aircraft.

- ▲ **Rescue is discretionary; rescuer safety is our first priority.**
- ▲ **In the event you are rescued (aerial evacuation or ground rescue) while climbing in Denali National Park and Preserve, you may be obligated to pay for air or ground ambulance costs.**
- ▲ **If you are rescued, your permit for that year will be voided.**

If a rescue becomes necessary and the party has exhausted all means of evacuation, it may request assistance from the National Park Service via the party's radio or other means. In a rescue situation, you should provide clear concise information and this may require transmitting in circumstances where you may hear no response.

1. **Provide the name of your party;**
2. **Location and elevation;**
3. **Extent of illness or injury;**
4. **Current weather;**
5. **Other climbers who can assist; and**
6. **Your immediate plans.**

Rescue Transmission

Foreign climbers must speak slowly in English. If you can speak very little English, you should first initiate the call by saying, "Rescue, Rescue" and then say the name of your party. Next, give your elevation, location, injury or illness and weather. At this point you may wish to briefly transmit the same information, plus the information about the situation in your native language. Transmit your brief message three to four times

NPS Photo

The NPS Lama helicopter.

every 30 minutes until you get a response. When possible, the Park Service will record your message and get it translated. Remember to warm the radio and batteries at least 30 minutes before each call. You may have to move to a different location to call out since most radios operate on line of sight. Radios are not perfect; if you do not receive a response, your radio may not be functioning properly. Some parties adapt their radios to a portable battery pack which can be kept warm while transmitting. Always be prepared to evacuate the injured member or attempt other means of help. The rescue signal of **standing upright with two arms fully raised over your head** indicates you need a rescue. If by the time an aircraft arrives on the scene and you have lost communication due to weak batteries, you should display this signal to the aircraft.

Guiding

Denali National Park and Preserve has authorized only six guide services to lead commercial expeditions on Mount McKinley. It is the individual climber's responsibility to insure that the guide chosen is one of the six authorized guide services (See list page 20). Any individual or group that is found to be guided by an unauthorized guide will have their permit voided, be removed from the mountain, and cited.

A person joining a guided expedition will benefit by having the logistical preparations for the climb completed for them, the consultation of experts concerning equipment and training, and supervision and instruction on the mountain to insure safety. Joining a group of climbers with similar goals and having the guide's knowledge and experience behind each decision provides many people with the best possible chance of having a successful experience on Denali.

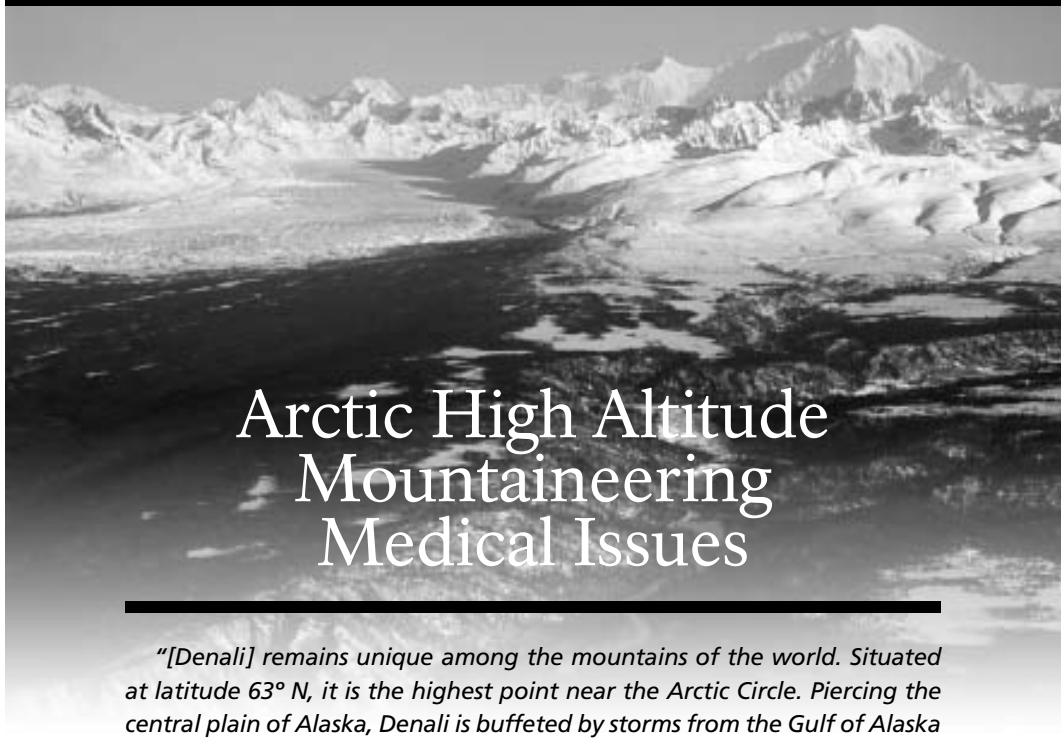
Denali is a tremendous mountaineering challenge, and even as a member of a guided expedition, the effort requires previous mountaineering experience. Guiding companies screen prospective clients for backpacking and winter camping experience, mountaineering background, and general fitness. The magnitude of Denali requires that each team member be a strong participant in the climb, help with day to day chores of building and taking down camps and be a responsible rope team member. It is of utmost importance to be honest with your guide and let them know how you are feeling day-to-day.

Mountaineering has inherent risks. While joining a guided expedition can reduce the dangers of climbing Denali, it can not eliminate them. Clients must acknowledge that they understand the risks associated with mountaineering and accept the responsibility of participating in a

climbing expedition. They can help reduce the risks by paying careful attention, listening to their guide, and not getting tunnel vision from focusing on the summit.

- ▲ **Use only an authorized guide service. See website at www.nps.gov/dena for a current listing of authorized guides.**
- ▲ **Any expedition that is found to be guided illegally will not be allowed to continue their climb.**
- ▲ **It is of utmost importance to be honest with your guide and let them know how you are feeling day-to-day.**

(Opposite Page) The Kahiltna glacier and Mt. Foraker.
NPS Photo



Arctic High Altitude Mountaineering Medical Issues

"[Denali] remains unique among the mountains of the world. Situated at latitude 63° N, it is the highest point near the Arctic Circle. Piercing the central plain of Alaska, Denali is buffeted by storms from the Gulf of Alaska and from the Bering Sea. In few mountain locales of the world does the weather change so precipitously and dramatically. A balmy day of glacier travel can rapidly deteriorate into a day of survival-snow-cave digging. The intense cold is, of course, another unique feature of Denali, comparable only to the Antarctic ranges. The Himalaya is tropical by comparison. On the South Col of Mount Everest (26,200 feet) in late October, the lowest temperature we recorded in 1981 was 17 degrees below zero. On Denali, this would be a rather warm night at only 14,300 feet in May and June. Temperatures between the high camp and the summit even in the middle of the summer are routinely 20 to 40 degrees below and even lower at night. This combination of extreme weather and temperature pummels the unprepared.

Denali also renders the climber more hypoxic; the barometric pressure is lower for a given altitude than on mountains closer to the equator. This difference becomes noticeable above 10,000 feet or so, and makes the summit of Denali equivalent to anywhere from 21,000 to 23,000 feet in the Himalaya (Mt. Everest is at latitude 27° N), depending on weather conditions. The barometric pressure is also much lower in the winter than in the

summer. Lower barometric pressure means less oxygen in the air; therefore Denali is more of a hypoxic stress and physiological challenge than one might expect for its altitude."

Peter H. Hackett, M.D.
from the preface of *Surviving Denali*
by Jonathan Waterman (2nd Edition)

High Altitude Illness

The high altitude and harsh environment of Denali combined with the large number of climbers on the mountain results in numerous altitude and cold related health problems. From May to June, temperatures at the 14,200 feet - 17,200 feet (4260-5160 m) level reach -20° to -40° F at night and storms with winds of 50-100 mph can last for several days. The northern latitude results in the barometric pressure on Denali being lower for a given altitude than on mountains closer to the equator. This difference becomes noticeable above 10,000 feet (3000 m) and makes the summit of Denali physiologically equivalent to most 21,000 feet - 23,000 feet (6300-6900 m) peaks. Many climbers are unprepared for this harsh mountain environment, including those with Himalayan experience.

Illnesses caused by high altitude range from uncomfortable problems to dangerous conditions and are all related to the decreased oxygen concentration in the blood caused by lower atmospheric pressure. The common denominator behind most of the problems is edema (swelling and pooling of body fluid). When this occurs in the brain or lungs, the results can be devastating.

High altitude illness includes a group of common syndromes that can afflict persons ascending from low elevation to altitudes of 7,000 feet and higher. High altitude illness is due to a lower amount of oxygen in the air at higher altitudes. Although the percent of the air made up by oxygen remains constant at 21% at higher altitudes, the barometric pressure decreases with increasing altitude. Therefore, the partial pressure of oxygen in the atmosphere decreases.

In general, high altitude illness is caused by ascending too high too rapidly. All climbers are at risk, but those who have had a previous medical history of high altitude illness are most susceptible. The altitude at which a person sleeps is the most important consideration in evaluating risk of high altitude illness. The most common form of high altitude illness is acute mountain sickness (AMS) and is characterized by headache, nausea, dizziness, disturbed sleep, and a feeling of fatigue. AMS is usually not life threatening and resolves after one or two days at high altitude, but can progress to more serious high altitude illness. AMS is more fully discussed in the following section and the incidence of AMS is listed in the table below for various groups ascending to high altitude. High altitude pulmonary edema (HAPE) is a serious and life threatening form of high altitude illness where the lungs fill with fluid. High altitude cerebral edema (HACE) is a form of high altitude illness where the brain fills with fluid. HAPE and HACE are much less common than AMS, and incidence is listed in the table below. HAPE and HACE are discussed in more detail later.

Group	Sleeping Altitude	Maximum Altitude Reached	Average Rate of Ascent to Sleeping Altitude (days)	Percent with AMS	Percent with HAPE or HACE
Colorado Skiers	7,000 ft 8,500 ft. 10,000 ft.	11,500 ft.	1-2 days	15-20% 25% 25-40%	0.01 %
Mt. Everest Trekkers	10,000 to 17,000 ft.	18,000 ft.	1-2 days (fly) 10-13 days (walk)	47% 23%	1.6 % 0.05 %
Mt. Rainier Climbers	10,000 ft.	14,405 ft.	1-2 days	67%	0.1 %
Mt. McKinley Climbers	10,000 to 17,000 ft.	20,320 ft.	4-7 days	30%	1-3 %

Table 1. Incidence of High Altitude Illness in Various Groups

Acute Mountain Sickness

Acute mountain sickness (AMS) is the most common form of high altitude illness; it can afflict 15% to 25% of persons who ascend from altitudes of less than 3,000 feet to altitudes of 7,000 feet to 9,000 feet in the Rocky Mountains of the Western United States. Incidence is higher with faster rates of ascent to higher altitudes. For example, about two thirds of persons experience AMS who summit Mt. Rainier at 14,405 feet after a two or three day ascent from sea level in Seattle, Washington. The main symptom of AMS is a headache that occurs within hours to a day after ascent to high altitude. Other associated symptoms can include nausea, vomiting,

dizziness, disturbed sleep, or a feeling of lethargy or lack of energy. AMS is usually self-limiting, which means that with rest at the same altitude symptoms will resolve over 1 to 2 days. The best prevention for AMS is gradual ascent allowing the body time to adjust to high altitude, a process called acclimatization. For example, when traveling from sea level to altitudes at 8,000 feet or higher, AMS may be prevented by an overnight stay at an intermediate altitude of 5,000 feet. On an expedition to a high altitude mountain range, the average rate of ascent should be limited to 1,000 feet per day at altitudes over about 8,000 feet. This may be achieved by taking rest days if the ascent rate is over 1,000 feet per day as dictated by terrain. If symptoms of AMS occur, common treatment includes remaining at the same altitude, rest, and taking ibuprofen for headache. **Persons with AMS should not continue to ascend to higher altitudes because AMS may worsen and progress to life threatening high altitude cerebral edema (HACE) and/or pulmonary edema (HAPE).**

The common notion that over-hydration with fluids will prevent or treat AMS has no scientific basis. Fluid intake should be gauged to maintain hydration, and will be increased at high altitude because of increased activity and breathing cold dry air. Forced over-hydration, however, should be avoided because it may actually worsen symptoms of AMS. The body retains too much fluid in AMS and swelling in the hands, feet, or face may occur.

Drugs are available that prevent or treat AMS. Acetazolamide, trade name Diamox, will help prevent AMS at dose of 125 mg 2 to 3 times a day. For prevention of AMS, acetazolamide should be started the day before

Agent	Dose	Comments
Gradual Ascent	Average gain of 1,000 ft. of altitude per day above 8,000 ft.	Sleeping altitude is more important than daytime altitude for risk of AMS.
Ginkgo biloba	80 - 120 mg orally twice daily starting three to five days before ascent.	Advantage of essentially no side effects as compared to acetazolamide.
acetazolamide	125 mg orally 2 to 3 times a day starting the day before ascent.	Recommended for those persons with a history of recurrent AMS on ascent to altitude, contraindicated with sulfa allergy. Stop acetazolamide if blurry vision occurs. Requires a prescription from a physician.

Table 2. Prevention of Acute Mountain Sickness

Agent	Dose	Comments
Descent	Decrease altitude until symptoms resolve.	Recommended if AMS symptoms do not improve over one or two days, become more severe, or progress to confusion or difficulty with balance.
Oxygen	Administered by nasal cannula, usually at a flow of 2 to 3 liters per minute.	Simulates descent, may be used for sleep as an adjunct to treatment of mild to moderate AMS. Requires a prescription from a physician.*
Acetazolamide	250 mg orally twice daily.	Contraindicated with sulfa allergy. Stop taking acetazolamide if blurry vision develops.*
Dexamethasone	4 mg orally 3 times a day.	Alternative to acetazolamide, recommended for severe symptoms of AMS. Descent should be undertaken if symptoms are severe enough to warrant dexamethasone.*
Portable hyperbaric bag	30 to 60 minutes of pressurization, or until symptoms resolve.	Effective at relieving symptoms of AMS by simulating descent of about 5,000 ft., but rebound AMS usually. occurs within hours after treatment.

Table 3. Treatment of Acute Mountain Sickness

ascent and continue until 1 or 2 days after reaching high altitude. Treatment of AMS once symptoms occur requires a higher dose of acetazolamide of 250 mg twice a day. Acetazolamide should not be taken by persons allergic to sulfa drugs (eg. Bactim, Septra). Common side effects of acetazolamide are increased urination, tingling in the fingers or toes, and a flat taste of carbonated beverages. Acetazolamide should be stopped if blurry vision occurs.

Ginkgo biloba is an alternative to acetazolamide for prevention of AMS with an advantage of essentially no side effects. The recommended dose is 80 to 120 mg twice a day starting three to five days before ascent and continuing until 1 or 2 days after reaching high altitude. It is not known whether Ginkgo biloba is effective in treating AMS once symptoms occur.

Descent to a lower altitude, or oxygen, is also an effective treatment for AMS, but usually is not necessary unless symptoms worsen despite rest and medication. Anyone with AMS who becomes confused or disoriented, or

* Requires a prescription from a physician.

who has problems with balance and staggers when they walk (as if they were drunk), must descend to a lower altitude and seek medical attention immediately. Dexamethasone is a steroid drug that is useful for treating severe AMS at a dose of 4 mg every eight hours.

High Altitude Cerebral Edema

High altitude cerebral edema (HACE) is a life threatening disorder where the brain swells at high altitude. HACE most often occurs after ascent to altitudes over 10,000 feet and has a much lower incidence than AMS. HACE is believed to be the progression of the mild brain swelling that occurs in AMS. **Symptoms of confusion and difficulty with balance associated with AMS indicate developing HACE. Immediate descent to a lower altitude is mandatory and can be life saving.** Descent should continue until symptoms improve. Recognizing the early stages of HACE is critical, because as HACE progresses the afflicted person becomes unable to walk and must depend on other members of the party for rescue. Coma and death may follow within hours. Useful treatments in addition to descent include oxygen and the drug dexamethasone. These measures are supplements to descent, not substitutes for descent. The dose of dexamethasone is 8 mg initially, followed by 4 mg every 6 hours.

Agent	Dose	Comments
Descent	Decrease altitude until symptoms resolve.	Descent is mandatory and may be lifesaving. Early recognition of HACE is essential so that descent may be undertaken while the patient is still ambulatory. In wilderness environments initiate descent immediately and call for medical help. In a ski resort setting seek physician evaluation immediately.
Oxygen	Flow of oxygen should be sufficient to keep the percent saturation of hemoglobin (SaO2%) greater than 90% as measure by a digital pulse oximeter.	Useful treatment adjunct to descent and simulates descent in situations where descent is delayed. Requires evaluation by a physician.
Dexamethasone	8 mg by any route available, then 4 mg every 6 hours.	Useful treatment adjunct to descent.
Portable hyperbaric bag	Pressurization until descent is possible.	May be an effective temporizing treatment if descent is delayed because of weather or terrain conditions.

Table 4. High Altitude Cerebral Edema (HACE)

High Altitude Pulmonary Edema

High altitude pulmonary edema (HAPE) is a life threatening disorder where the lungs fill with fluid at high altitude. HAPE is more common than HACE, although the two can occur together. HAPE can afflict persons who ascend from low elevation to altitudes over 8,000 feet. The primary symp-

Agent	Dose	Comments
Descent, primary treatment	Descend in altitude until symptoms resolve.	In a wilderness environment begin descent immediately and call for medical help.
Oxygen for treatment	Nasal cannula at a flow of 4 to 6 liters per minute. Flow of oxygen should be sufficient to keep the oxygen saturation of hemoglobin (SaO2%) greater than 90%.	Simulates descent, may be used as the primary treatment at moderate altitude where medical care is available (ski resorts) and only after evaluation by a physician.
Nifedipine for treatment	20 mg sustained release every 8 hours.	For treatment of HAPE, useful only as an adjunct to definitive treatment with descent or oxygen. Should be stopped if dizziness or lightheadedness occurs.
Salmeterol, for prevention	125 micrograms (5 puffs from a meter dose inhaler) inhaled twice a day starting one day prior to ascent.	May be useful for prevention of HAPE in susceptible persons. This dose of salmeterol is higher than that used commonly for treatment of asthma and may result in side effects of increased heart rate, tremor, or anxiety.
Portable hyperbaric bag, for treatment	Pressurization until descent is possible.	May be an effective temporizing treatment if descent is impossible because of weather or terrain conditions.

Table 5. High Altitude Pulmonary Edema (HAPE).

toms are a noticeable decrease in the ability to exercise, a dry cough that progresses to a cough productive of frothy sputum, a feeling of air hunger, and gurgling in the chest. HAPE results in impairment of oxygen diffusion from the lungs to the blood, and the lips and fingernails may have a bluish color because of lack of oxygen. **The most important treatment for HAPE is immediate descent to a lower altitude until symptoms resolve.** Oxygen is very beneficial for treatment of HAPE if available, but should not be used as a substitute for descent in remote areas. In situations where descent is impossible because of weather or terrain conditions, a portable hyperbaric bag may be lifesaving until descent can be undertaken.

Persons who have had HAPE previously may be more susceptible on subsequent ascents to high altitude, and should take extra care to ascend gradually and allow time for the body to acclimatize to high altitude. Drugs are available to help prevent HAPE in persons who have had it before, and include an inhaled drug called salmeterol, which is more commonly used to treat asthma.

Important things to remember about altitude illness

- ▲ **There is no way of predicting who will or will not develop altitude sickness.** Physical fitness offers absolutely no protection from altitude illness. Two to four nights spent at 14,000 feet or so are necessary for acclimatization before moving up higher on the mountain.

- ▲ **The best treatment for any type of altitude illness is rapid descent to a lower altitude.** Normally, anyone with altitude illness who starts down early after onset will recover rapidly and completely. As is the case with all medical problems, prevention is the most important aspect in the management of altitude sickness. Listen to your body and climb according to how you feel. Remember the adage "carry loads high and sleep low." Delay moving to a higher altitude with symptoms of AMS. Watch team members of your expedition carefully for signs and symptoms of high altitude sickness. Don't ignore other members' complaints.

Acclimatization

It requires one to two weeks to become well acclimatized to a given altitude on Denali (depending on the individual). Individuals also lose this acclimatization in the course of a few weeks. Talkeetna is close to sea level which is a major disadvantage for someone who has established some acclimatization and is waiting to fly in. The longer they wait, the more acclimatization is lost. Several days spent high on peaks before your arrival will not be enough to transfer that acclimatization to your climb here. You will lose that acclimatization in transit.

Limit your ascent to 1,000 feet (300 m) per day at elevations above 8,000 feet (2440 m). The following schedule is the fastest recommended rate of ascent of the West Buttress given ideal weather. **Expeditions should plan on 21 days.**

Day 1:	**Base camp 7200 feet (2200 meters)**
Day 2:	**Base of 'Ski Hill' 7900 feet (2400 meters)**
Day 3:	**Upper Kahiltna 9600 feet (2900 meters)**
Day 4:	**Camp 11,000 feet (3350 meters)**
Day 5:	**Rest**
Day 6:	**Carry to Basin 14,200 feet (4330 meters)**
Day 7:	**Move to Basin 14,200 feet (4330 meters)**
Day 8 -11:	**Rest in Basin, acclimatize and carry high sleep low.**
Day 12:	**Move to 16,200 feet (4940 meters) Ridge Camp**
	Or 17,200 feet (5240 meters) High Camp
Day 13:	**Rest**
Day 14:	**Summit**

Many other factors figure into this, including the weight carried, weather, and each member's health. The extra rest days at 14,200 feet (4330 meters) have proven to be critical before ascending higher. Allow 3 to 5 days food and fuel at high camp

Frostbite

Frostbite is a cold injury, usually localized, that is characterized by the freezing of body tissue. The tissue may die as a result of inadequate circulation. The first signs are numbness, poor capillary refill, and a white, waxy and wooden texture to the skin.

Case story: *"In 1985 my partner and I were high on the Cassin Ridge at 17,000 feet (5182 m) planning to summit the next day and excited that all the hard climbing was behind us and we would soon be safely down on the West Buttress. Within 12 hours, however, a ferocious storm was upon us with winds blowing so hard it sounded like a freight train passing by.*

We stayed put for four days until the wind died down and safely made the summit without frostbite. A pair of Dutch climbers also on the Cassin climbed through the storm, bivouacked on the summit, and descended to 14,200 feet on the West Buttress. They were off the mountain sooner than us, but not without frostbitten faces and fingers resulting in permanent damage and loss of tissue. A little patience can often make the difference between permanent injury and just another storm bound climbing story."

Many factors contribute to frostbite and include inadequate equipment, impatience and neglect. Most cases of frostbite of the hands or feet occur on days when climbers would have been better off staying in their tents. The wind, in particular, is often the villain. Blowing cold, dry air results in convective heat loss, but it also dehydrates and exhausts climbers making them more susceptible to frostbite. On summit day, a typical frostbite victim uses gloves instead of mittens, super gaiters instead of over boots, and leaves camp in 30-50 mph (48-80 km/h) winds.

Unlucky victims who frostbite their fingers or toes can take some measures to improve healing and prevent further damage. The preferred treatment is rapid rewarming in a sterile water bath at 100°-108° F. On Denali, however, most frostbite cases are passively rewarmed in the sleeping bag before the climber arrives at Kahiltna Base. During descent, the affected region should be kept warm, clean, and dry. Constrictive clothing that might impair circulation to the affected area should be avoided, as well as additional refreezing or trauma. Hands should be wrapped with a loose gauze dressing and insulated with mittens. Toes and feet pose a particular challenge because after wrapping in a gauze dressing, they need to go back into the boots for descent. Inner boots may need to be cut to allow for more room. Great care should be taken not to break blisters in the field. Most important is preventing the affected extremity from being re-frozen. Other measures that help the frostbite victim include: staying well hydrated, warm, and taking 800 mg of ibuprofen every eight hours to decrease inflammation. All frostbite cases should be evaluated by a physician after flying off the mountain.

Seldom heard from frostbite victims are the stories recounting the months and years of painful rehabilitation. Victims with severely frostbitten hands or fingers cannot feed or wash themselves. They are forever sensitive to the cold and vulnerable to further injury and some are even forced to quit mountaineering and relocate to a warmer environment. Getting frostbite is a big deal!

Prevention is always easier than treatment when it comes to frostbite or

Photo © Roger Robinson

Climber lowered down West Rib.

any injury, especially on Denali. Wearing adequate clothing, staying well hydrated and avoiding exposure to extreme conditions is infinitely better than dealing with even minor frostbite on the descent and after the expedition. "Prevention" translates to "caution."

Carbon Monoxide Poisoning

Cooking in poorly ventilated areas such as tents with all doors and vents closed, or old ice glazed igloos and snow caves, produced two serious cases of Carbon Monoxide (CO) poisoning in 1985, and two deaths in 1986. We suspect that many others also suffered lesser forms of CO poisoning. Furthermore, CO poisoning may be a contributor to AMS. This may have been the case in the 1993 rescue of a Czechoslovakian climber who developed severe HAPE (High Altitude Pulmonary Edema) and HACE (High Altitude Cerebral Edema). It is difficult to distinguish between Mountain Sickness and the early symptoms of CO poisoning. An inexpensive CO detector has been found very beneficial and can be acquired at most hardware stores. **Avoid the temptation to heat shelters with cooking stoves.** Allow for good ventilation. Extra caution is necessary if two stoves are being used at the same time. Cook in the open as much as possible.

"Carbon monoxide poisoning among mountaineers is probably much more common than realized. The effects of CO and altitude hypoxia appear to be additive, and thus CO exposure at altitude is much more dangerous than at sea level. Recent measurements by William Turner and Bill Summer, on Denali, found toxic levels (greater than 750 parts per million) of CO near the stove in tents, snow caves and igloos. A major factor in producing CO is the damping effect on the flame of having the pot too close to the flame from condensation on the pot. Keeping the pot warm and adding snow slowly to warm water thus produces much less CO than filling a pot with snow. Climbers cooking in shelters should try to minimize condensation on the pot.

Adequate ventilation is the key to removing CO from a shelter. The Swiss climbers' tent was made of an apparently unbreathable material, and closing the vents sealed the tent as well as their fate. The same could happen when cooking in a tent completely buried by snow, or in an igloo with glazed ice walls on the inside. In a tent, ventilation is a function of the wind and the area of the vent opening. When cooking in a snow cave or igloo, the vent must be at least of ski pole basket-sized diameter, should be placed directly above the stove, and can be sealed when not cooking in order to maintain warmth. Climbers with symptoms of Acute Mountain Sickness must be especially careful. CO poisoning should be considered in anyone unwell at altitude if using a combustable appliance in a closed shelter. Treatment is to stop the CO production, and have the victim if conscious, hyperventilate in fresh air. Descent to a lower altitude, administration of oxygen, and forced hyperventilation by mouth-to-mouth breathing may be required for comatose victims."

1986 Analysis of the CO poisoning deaths of
two Swiss climbers on Mount McKinley
by Peter Hackett, M.D.

Physiological and Physical Impairment

Mountaineers preparing to climb Denali must be aware that everyone will be physically weaker at high altitude. Expeditions can expect to move more slowly and will not be able to carry very heavy loads. There are also other problems at high altitude less commonly known but potentially as dangerous, such as mental impairment, dehydration, fatigue, loss of cold resistance, and lack of recuperative powers. The major environmental variable responsible for these effects is lack of oxygen (hypoxia) associated with high altitude.

Mental Function

Bradford Washburn has estimated that above 18,000 feet (5500 meters) on Denali a person is reduced to roughly 50% of their mental capacity. During the winter climb of 1967, the three members stranded at 18,200 foot at Denali Pass for six days required approximately twice as much time to answer a series of subtraction problems as they did at 7,000 feet on the Kahiltna Glacier.

In retrospect, most high altitude climbers can recall situations in which their thinking was impaired and their judgment poor. These effects are insidious, since climbers are not aware of the impairment at the time. A controlled exposure in a low pressure chamber is often necessary to convince a climber (or pilot) of the effects of hypoxia. Many high altitude climbing accidents may be attributed to such lack of judgment. Thus, it is important that climbers realize in advance that their mental functions will be impaired. Advance planning should be thorough and complete to avoid a critical situation which poor judgment and slow thinking will magnify. For example, sudden impulsive decisions to go on or return must be considered carefully.

NPS Photo

The West Buttress ridge between 16,200' and 17,200'.

Lassitude.

At high altitude motivation can diminish greatly. Thus, Joseph Wilcox, leader of a 1967 Denali party wrote in his diary:

"With five people crammed in the tent, morale decreased rapidly. There was no interest in cooking meals and by the next day no one was even interested in melting drinking water. We found ourselves very apathetic...not caring whether or not we got enough to drink or eat or if our gear was wet...we just lay there and waited with little or no sleep...by morning the cold had taken its toll...Jerry Lewis and I had numb feet and I had numb fingers."

When High Altitude Pulmonary Edema (HAPE) is suspected, descent is mandatory and may be lifesaving.

Here the motivation to do even the simplest camp chores almost disappeared, yet these tasks of melting snow, cooking, or drying clothes in the wind will help determine the success and safety of the party. The will to survive and succeed must be maintained. Inactivity during tent bound stormy days can itself be devastating to morale, and as tiring and debilitating as climbing. Keep the body limber and mind alert on storm days with camp projects in and out of the tent.

Illness or Injury

It is difficult for the body to recover from illness and injury above 14,000 feet (4300 meters). Descending to a lower elevation is often the only solution for a complete recovery.

Diarrhea

Many climbers that attempt to climb Denali suffer from diarrhea. Recent studies on potential causes have shown that the lack of proper sanitation, a change in normal dietary patterns, along with the stress of the harsh conditions exacerbate the effects of diarrhea on the body. It is very important that climbers practice proper sanitation techniques while on their climb, special attention needs to be paid to cleaning hands after going to the bathroom and before preparing meals. Diarrhea may be serious when climbing above 14,000 feet (4300 meters) because dehydration is further aggravated, and with impaired absorption the body receives little nourishment and is further weakened. A person suffering from severe diarrhea should descend or be assisted below 14,000 feet (4300 meters). This person should not go back up until gastrointestinal function returns to normal.

Dehydration

Dehydration is a major hazard of high altitude mountaineering. Dehydration may compound the problems of any illness or injury, making recovery more difficult. It contributes to frostbite directly, by causing constriction of blood vessels in hands and feet.

Climbers have difficulty drinking adequate amounts of water above 14,000 feet (4300 meters). Fuel for melting snow is not difficult to carry, yet the tendency is to take only a minimum rather than an adequate amount. It is inviting tragedy not to have at least a one week supply of fuel if one plans to spend even one night above 17,000 feet (5000 meters). This fuel must be used to provide each climber with at least three liters of liquid per person each day. Water bottles should be filled as often as possible and kept in sleeping bags at night to prevent freezing.

Fatigue

To a considerable extent, Denali represents a problem in logistics and weather. Climbers feel that they must make the best use of good conditions, even though doing so may overextend the physical and emotional capabilities of some or all of the party. If violent weather overtakes them in this condition, tragedy can follow. Climbers must maintain a physiological margin of safety against fatigue and cold just as they do food and fuel. In this connection, it is worthwhile to put in the effort of preparing igloos or snow caves for shelter at high altitude rather than tents. They provide greater protection and rest.

Sleep

Standard sleeping medications should be avoided above 10,000 feet (3000 meters). Sleep medications cause a decrease in the respiratory response, lowering blood oxygen levels, which can cause Acute Mountain Sickness (AMS). Diphenhydramine or acetazolamide are the drugs often prescribed for sleep at high altitude.

Bradford Washburn

The western side of Denali.

(Opposite Page) Cassin ledge on Cassin Ridge.
Photo © Kevin Moore

Equipment and Supplies

Footwear

The single most important piece of gear is footwear, which must be of the highest quality. Boots must be of the warmest rated doubled plastic models or the military vapor barrier type. Both have excellent track records for use on Denali. Single leather boots are inadequate for the conditions and have contributed to numerous cases of frostbite in the past. All double boots must be equipped with a completely insulated overboot, including closed cell foam on the sole. Supergators are inadequate substitutes for overboots. Boots should be fitted with several pair of socks and should not be worn too tight, since feet tend to swell slightly at higher altitudes. Many climbers use vapor barrier liners (VBL) against the skin or over a thin pair of socks. Feet that have been wet all day from the VBL's need to be placed in a dry environment each night. Foot powder is very helpful in drying out the feet. Not allowing the feet to dry can lead to a serious condition known as immersion foot (trench foot). Many climbers on Denali have suffered with this debilitating condition, which is very similar to frostbite. All footwear systems should be thoroughly tested before departing.

Most of the severely frostbitten feet have occurred on summit day. All members should be ready to leave camp at the same time so no one is left standing around getting cold toes. Once you have left your high camp

you will have little opportunity to attend to your feet. Cold toes are not uncommon, but adequate circulation must be maintained with some degree of sensation in the tips of the toes at all times. If your toes become cold at this point, you must either stop to rewarm your feet or make a hasty retreat. On most summit days the option to stop is not a possibility. Frostbite of the feet can sneak up slowly and its consequences are devastating.

Clothing

Outer layers of clothing must be adequate for the most severe arctic conditions. The best is necessary. These items should include:

- ▲ **expedition weight down parka with a good hood and wind tunnel**
- ▲ **down pants or expedition weight pile pants**
- ▲ **parka shell, loosely fitted, with a hood, wind tunnel and plenty of pockets**
- ▲ **climbing bibs or wind pants that are fitted for layers**
- ▲ **mittens fitted large with long sleeves and removable liners**
- ▲ **light weight face mask or balaclava**
- ▲ **hat of double layer construction with good ear protection**

The conditions experienced in lower glacier travel are often very hot when the sun is out, or wet when it is snowing. Several medium weight layers of synthetic clothes work best. A good sun hat and reflective white shirt are very helpful with the intense glare. Lightweight, wind-resistant clothing in layers allows for adjustments to be made according to conditions. Several changes of socks should provide thick, loose insulation. Booties that are down or synthetic fiber filled with insulated soles are good for wear around camp and in the sleeping bag. Booties work exceptionally well inside the overboots for colder conditions or when there is deep snow in and around camp. Each climber should bring synthetic gloves and extra mittens. Thick pile tops and bottoms are needed for climbing before June.

Parties traveling through the lowlands during the summer months will need head nets, effective mosquito repellent, rain gear and mosquito netting for tents. The icy cold river crossings are made easier with neoprene booties worn in lightweight running shoes.

Sleeping Gear

An expedition quality sleeping bag is essential. Down or synthetic fiber filled bags rated to -20ºF (minus 29ºC) is the minimum acceptable. Many climbers use an over bag along with their sleeping bag. This is especially important for April and May climbs. Allow extra room in the sleeping bag for wearing layers of clothing, inner boots, and storing a water bottle. Almost as important as the sleeping bag is sufficient insulation underneath the bag. Two closed cell foam pads or a combination closed cell with inflatable foam pad are the standard. Adequate sleep is essential at high altitudes. Do not economize on weight by compromising sleeping gear.

Sleds and Haul Sacks

Sleds or sacks have proven very useful for travel on the lower glaciers and for shuttling loads. A single climber can pull loads of 30 to 40 pounds (14 to 18 kg) with little difficulty. Most Denali climbers use lightweight plastic sleds available from department stores or through the Talkeetna based air services. Sleds can be rigged with rope breaks on the descent. Sleds and sacks can be used for carrying garbage on the descent. They may also be used for evacuating sick or injured climbers.

Photo © Roger Robinson

Sleds can be used to shuttle loads during the climb or to evacuate sick or injured climbers.

Snowshoes or Skis

One pair of snowshoes or skis per person must be taken! Hidden crevasse bridges become even more unpredictable without the flotation of skis and/or snowshoes and snow accumulations of greater than a meter can occur at any time. Only experienced skiers should attempt to ski. Skiers should practice with a heavy pack and sled to make sure they are prepared. Climbing skins are necessary. Snowshoes should be sturdy with traction devices for steeper sections and side hill traversing. Ski poles are also very useful with snowshoes. Anticipate that snowshoes tend to need more repairs than skis.

Stoves

Carry at least two stoves of proven efficiency that work at high altitudes and in extreme cold. Carry spare parts for cleaning and repairs. Almost all parties use white gas, which is readily available. Disposable gas cartridge models are discouraged and the cartridges might be difficult to obtain in Alaska. Domestic cartridges may not be pressurized enough for the extreme cold. Plan on 4 to 8 ounces (.15 to .30 liters) of white gas per person per day. You will need more fuel earlier in the season due to colder temperatures and drier snow. **All full and empty fuel containers must be packed out.** The rangers will request to see your containers upon arriving at base camp.

Food

Plan for three weeks of food for the West Buttress, consisting of 4,000 to 5,000 calories per person per day. This amount figures in about a week of storm-bound days. Each climber should plan on consuming at least four liters of fluid per day. Good hydration hastens acclimatization and prevents dehydration. Be sure to repackage food before you depart for the mountain to minimize garbage. Foreign climbers need to be aware that no freeze-dried meat may be brought into the United States. Only commercially canned meat products are allowed to enter the country, other meats must be purchased upon arrival in the United States. Anchorage has numerous retailers who sell freeze dried, dried, bulk and other food commodities at prices equivalent to other areas in the United States.

If you access the mountain by air, plan a base camp food cache in the event that bad weather delays your flight out at the end of your climb. Be sure to bury this cache at least one meter in depth and mark it with your name, permit number, and expected return date. The lower glaciers melt considerably during the climbing season, and exposed caches can be raided by ravens. **If the cache is not labeled with your expedition name, permit number, and date, the mountaineering rangers will conclude that it was abandoned, and remove it.**

If you are planning to traverse through the lowlands, you should be prepared to prevent giardia by filtering or boiling your water, or using water purification tablets. Giardia cysts have been found in lakes and streams on both the north and south sides of the Alaska Range. You should plan to cook 50 to 100 meters away from your camp to prevent the intrusion of bears due to cooking smells. After cooking, all food, garbage, pots and other utensils should be triple packaged in large plastic bags and placed 100 meters from the camp in a different location than where you cooked, but in a spot that can be observed from your tent.

Snow Shovels

Carry several shovels per party. Larger, sturdier types are essential. Avoid small lightweight shovels since they are worthless for moving large volumes of snow. The aluminum grain scoop (14 x 18 in or 35 x 45 cm) has proven to be indispensable. These scoops can be purchased at many hardware stores. Shovels are used for digging in campsites, constructing snow caves, removing snow from around tents, and occasionally used for clearing the route after deep accumulations. A small strong shovel such as a steel spade is indispensable for digging snow caves or tent platforms in wind packed snow or at camps above 14,000 feet (4,300 meters).

Snow Saws

Your party should carry several saws, since they are essential for building walls around your tent or constructing igloos and snow caves. They should be sturdy, with large, sharp teeth, a stiff blade and should be fitted with a large handle.

Tents

Tents should be of expedition quality. The two to three person dome shaped tent has developed an excellent track record. Allow extra room per person since many days are often spent storm-bound. Small, one person tents designed for narrow platforms may be the only thing that will work for routes such as the Cassin Ridge. It is possible to dry damp clothing in a larger tent, but it is extremely difficult to do in a two-person tent. Extra poles and repair materials are important in case of damage caused by storms. Plan to take extra pickets, wands or deadmen for anchors. **Never** leave a tent without anchoring it securely. Tents are lost each year due to sudden gusts of wind while the tent was left unattended or drying. The

rain fly should be used for its added strength to the integrity of the tent. It also traps a layer of air for added warmth.

Operation of the stove should occur outside of the tent. Under extreme conditions, members of a party may be forced to cook inside the tent. If so, cooking must be done at the entrance, with plenty of ventilation. Never cook without adequate cross ventilation! (see Carbon Monoxide Poisoning, page 31). Avoid lighting the stove while inside the tent.

Snow walls should be constructed around tents for protection from winds. However, even the best walls and tents will not provide comfort and rest during severe wind storms. Snow walls collapse and tents fail each year. Furthermore, the noise of flapping tents can become nerve-wracking, causing significant mental and physical fatigue. Winds in excess of 80 miles per hour (130 km/h) are common and may last many hours or days. Always be prepared for a tent failure with the strategy to build a snow cave.

Snow Shelters

Acclimatization days are well spent constructing an igloo or snow cave. At times, the only shelters to survive a wind storm at the high camps are snow shelters. All party members should have experience in the construction of snow shelters. A small steel shovel will become invaluable for digging into the hard ice found high on Denali or Mt. Foraker. Habitation within the snow shelter can be quite pleasant compared to the agony of a tent during cold evenings or stormy conditions. During construction, make sure the entrance ceiling is built lower than the floor and the entrance opens at right angles to the wind. Candles and a small lantern for spring climbs provide added light and warmth. Always allow for good ventilation while cooking, and read the section on Carbon Monoxide poisoning.

Rope

Take at least one 45 meter, 9mm Perlon water repellent rope per two people. Use a 50 meter rope for three climbers. All fixed rope must be removed upon your descent.

Ice Axes

One ice axe per person is necessary, plus an extra per party (since they are easily lost in crevasse falls). An ice axe 70 cm or taller is more practical for non-technical climbs such as the West Buttress or Muldrow Glacier routes. Picks on ice climbing tools are frequently broken on technical climbs. The extreme cold throughout the year creates **very hard** ice. Tape the grip area on the head of the ice axe with closed cell foam and duct tape or hockey tape; this inhibits cold penetration to the hand.

Crampons

Bring one pair of crampons per person, which can be adjusted to be worn with or without overboots. An extra adjustable pair should be carried with each party. A small file is essential on technical routes. Clamp-on crampons will work with most current overboots. This is a significant advancement since lace-on crampons tend to place pressure across the top of the foot.

Crevasse Rescue

All party members must have worked together on similar techniques for crevasse rescue. Crevasse falls are imminent while traveling on glaciers in the Alaska Range. Each climber should be rigged for a crevasse fall with foot loops, mechanical ascenders or prussiks, and a pulley ready to be used. Attach the pack and sled to the rope while traveling. Skis should be attached with safety straps, since they are easily lost in a crevasse fall. Each member should carry a picket or snow fluke in addition to their ice axe.

Snow and Ice Anchors

Snow pickets of 2 to 3 foot length and/or snow flukes are essential for anyone traveling on glaciated terrain. The snow bollard or deadman anchors work well but require additional time to place. They may be the only anchors that will work in a variety of unconsolidated or slush snow conditions. A rack of ice screws are essential on steeper routes but only a couple per party are needed for the West Buttress or Muldrow.

Eye Protection

Snow blindness is common due to the extreme glare, even on overcast days. Sun glasses should be the highest quality to provide maximum protection from ultraviolet and infrared rays, along with protection from side glare. Double lens ski goggles work well in bad weather and whiteout conditions. Extra glasses should be taken by each party.

Medical Kits

All members of the party should be familiar with the contents and use of the medical kit. Split kits should be carried when members in a party separate. It is of the greatest importance that members consult at length with a physician or take a course on the field treatment of common emergencies. The following is a list of medical kit contents for a high altitude expedition to Denali or Mt. Foraker suggested by Dr. Peter Hackett.

Medical kit contents recommended by Dr. Peter Hackett.

ITEM	USE
Diphenhydramine	Allergies, Sleep
Promethazine	Nausea, vomiting
Ibuprofen	Headache, muscle aches and pains, burns, frostbite, sunburn
Codeine	Painkiller, cough suppressant
Dexamethasone (Decadron)	Severe AMS or HACE
Acetazolamide (Diamox)	To speed acclimatization, treat mild AMS
Cephalosporin	Antibiotic
Labiosan (or similar)	Lip protection
Immodium (or similar)	Diarrhea
Antibiotic ointment	Skin infections and prevention
Acetaminophen (Tylenol)	Headache, pain killer, fever
Sun Block (SPF 30 or greater)	Sunburn prevention
Throat Lozenges	Sore throat

OTHER ITEMS

Gauze, bandages, pads	Thermometer
2" adhesive tape	Small scissors, knife, nail clippers
Skin closure strips	Spare sunglasses
Space blanket	Safety pins
SAM splint	Betadine solution

Radio

It is a responsible act to carry a means of communication; it is an irresponsible act to take more risk simply because such communication is available. For a variety of reasons, radios and phones are not infallible in the Alaska Range. Carrying a two-way radio is suggested for all parties and essential for climbs away from the West Buttress. Each season, climbers are rescued without significant delay because they used a radio to call for assistance. Some of the most lengthy and drawn out rescues have been hampered by the lack of communication, and in some of these, the medical condition was worsened by the unnecessary delay. In some accidents, climbers have had to wait for weeks, or crawl for days, to summon help. If you are climbing in remote areas such as the Muldrow Glacier, Kichatna Spires, or the Ruth or Eldridge Glaciers, a radio can prove to be a lifesaver in an emergency.

FRS/GMRS (Family Radio Service, General Mobile Radio Service) radios, in recent years, have become the standard on Denali and in other parts of the Alaska Range and they have essentially replaced the Citizen's Band (CB) radio of years past. FRS come in many makes and models. Try and choose a model that is at least 3, preferably 5 watts. These will be able to broadcast farther and typically have better reception than cheaper and less powerful units. The Park Service and the Base Camp flight manager attempt to monitor channel 1, (Frequency 462.5625MHz), 24 hours a day. Weather forecasts are broadcast on this channel at 8pm daily

If you are considering a remote area, your best choice may be either a satellite phone or a radio that will allow you to communicate with the air services. Satellite phones will work in most remote locations but may intermittently lose reception as satellites are primarily orbiting in more southerly latitudes.

If you bring a Personal Locator Beacon (PLB), we suggest you also bring a radio that enables you to contact aircraft overhead. Without two-way communication, a rescue could be delayed or not initiated. Cell phones have also been used above 14,000 feet on Denali but their reliability is questionable. If you plan to use a cell phone, make sure your carrier is compatible with the services in Alaska and remember to make sure that you have extra rechargeable cell phone batteries, since they have limited performance in the cold.

A registration code will be needed to complete your registration form. The code is 8359.

Cellular Phones

Cellular phones are being used on a limited basis with connecting repeaters from Anchorage to Fairbanks. Both cellular phones and CB radios are line of sight and usually function only above 13,000 to 14,000 feet (4000 meters) on most routes.

Satellite Phones

Satellite phones are being more commonly used on expeditions in the Alaska Range. Though they are not guaranteed to work in all areas, they have been used by many different groups in various areas throughout the Range with success.

Signal Devices

Because radio communication may not always be possible, it is recommended that other types of signal devices be carried. Smoke and rocket-type flares have been used with limited success. Mirrors are much more limited, being dependent on adequate sunlight. The portable ELT (Emergency Locator Transmitter) has had good results, although it does lack the capacity for two-way communication.

Trail Markers (Wands)

Every expedition should carry a few (20) wands (bamboo garden stakes work well) to mark a cache or indicate the edges of a crevasse. Several wands should be carried on summit day to replace any that have been blown away in recent storms. Near zero visibility can envelop the upper mountain very quickly, making Denali's broad summit plateau very difficult to navigate. Once the trail to the summit is lost, every effort should be made to retrace your steps back to the last wand. Wands should be 1 to 1.5 meters in length, spaced 100 to 150 feet (30 to 50 meters) apart. Each expedition may expect to use 200 to 300 wands for routes less frequently climbed. Several wands should be taped together forming a sturdy marker 2 meters above the snow when marking caches below 14,000 feet (4,270 meters). Wands can be purchased from garden and hardware stores, and are also available locally.

Repair Kit

Plan your kit around the equipment you carry, such as the stove, skis and tent. In addition, carry parachute cord, wire, duct tape, a screw driver for skis, patching material for your inflatable mattress and tent, and a sewing kit.

Climbing Clean

CMC History and Specifications

Leave No Trace mountaineering on Mt. McKinley has evolved over the past thirty years. Since the late 1970's, a pack in - pack out policy has been successfully enforced, with climbers removing all their garbage from the Alaska Range. Today our main focus takes this program one step further with the removal of human waste. In 2000, the Clean Mountain Can (CMC) was conceived by Ranger Roger Robinson and the other Denali mountaineering staff for use in the rugged environment on Denali.

Today, Denali National Park and Preserve requires that all human waste be removed from the 17,200-foot high camp on Mt. McKinley. Use of the CMC will remain a high priority for other glacier fly-in basecamp operations throughout the Park.

(Above) Roger Robinson with first prototype Clean Mountain Can in 2001. NPS Photo

Mountaineering Leave No Trace (LNT) in Denali

Plan ahead

- ▲ Be familiar with the causes, prevention, symptoms, and treatment of altitude illness, frostbite, and hypothermia.
- ▲ Improve your chances by taking the time to ascend SLOWLY. Ascend no more than 1,000 feet (300 m) per day above 8,000 feet (2,440 m). Stay well hydrated.
- ▲ Have a plan for extreme weather, hazards, and emergencies. Be prepared and equipped to perform self-rescue.

Travel and camp on durable surfaces

- ▲ Always travel roped on glaciers
- ▲ Unrope only when an area has been ensured safe through ample probing.
- ▲ Avoid camping on fragile tundra plants.

Dispose of waste properly

- ▲ EVERYTHING brought into the park must be brought out. Abandoning surplus gear, food, fuel, or wands is not allowed. Violators will be issued citations.
- ▲ (Other than on the West Buttress) fixed lines and protection should be removed on descent.
- ▲ Caches must be properly labeled with expedition, name, permit number, and return date. Permanent caches are illegal. Mark caches with 5 to 6 foot (1.5-2 m) wands.
- ▲ For human waste, use latrines at 7,200 feet (2200 m) and 14,200 feet (4300 m). Use CMC's above 14,200 feet (4300 m) to remove waste. Use biodegradable bags and crevasse human waste in other areas.
- ▲ Use a central urine spot and mark it with a wand.

Leave what you find

- ▲ It is illegal to remove natural objects from the park.
- ▲ All caches belonging to other parties should be left intact. Please report abandoned or unmarked caches to NPS rangers.

Minimize cooking impacts

- ▲ Avoid CO poisoning by allowing good ventilation when cooking. Do not use your stove as a heater.
- ▲ Fuel cans and extra fuel must be carried off the mountain.

Respect wildlife

- ▲ Bury caches at least 1 meter deep to prevent raiding by ravens.
- ▲ Below 6,000 feet (2000 m) store food caches in 3 layers of plastic bags or bear-proof containers to prevent attracting wildlife.
- ▲ Avoid feeding wildlife. Inspect campsites for spilled food. Pack out food waste.

Be considerate of other visitors

- ▲ Be patient when climbing in congested areas. Be courteous and yield the trail to ascending climbers.
- ▲ Take breaks off to the side of main trails or routes.
- ▲ Let nature's sounds prevail. Avoid loud noises and voices.

Human Waste and Sanitation

The proper disposal of human waste during your climb is of the utmost importance. Denali National Park and Preserve has set strict guidelines for climbers to deal properly with their human waste while visiting this pristine arctic environment. The proper disposal of your expedition's human waste will help insure that your impact on the mountain, and on other climbers, will be kept to a minimum.

Intestinal distress, vomiting and diarrhea may result from contamination of your food or drinking water caused by human waste. The resulting dehydration can become a serious problem at altitude. Since all drinking water is obtained from melted snow, precaution must be taken when gathering snow from well used camps. Traveling out a rope length away from older tent platforms will generally suffice. Conditions become worse as the season progresses and improperly deposited waste melts out. For the health and safety of all, it is imperative for everyone to follow these simple steps:

- ▲ **Use pit latrines where they are provided.**
- ▲ **Before departing Kahiltna Base, expeditions will be issued CMCs for use on their trip. Upon returning to Kahiltna base CMCs will be returned to the National Park Service.**

▲ **In the event that neither pit latrines nor CMCs are available:**

- Dig a shallow hole in the snow or use a plastic bucket.
- Line the hole or bucket with a biodegradable sack.
- Stake the corners of the bag open with wands and use a snow block to cover the top when not in use. A little attention to prevent overfilling will make the process of disposal much easier.
- Use this bag as the latrine for all members of the expedition while at camp.
- Develop a separate urinal spot and mark with a wand.
- When you move camp or the bag fills, simply tie it off and toss it into a **deep** crevasse. If no crevasses are available, the bag should be carried until a suitable crevasse is found. The wastes are usually frozen and will ride well on a sled.
- Crevasse ONLY human waste. All other trash must be carried off.

Please follow the guidelines for disposing of your human waste in each of the particular areas.

Reference Materials

History and Information

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White Winds by Joe Wilcox (Hwong)

Photos

High quality photos of peaks and routes of Bradford Washburn:
University of Alaska, Fairbanks
Alaska and Polar Region Department
Fairbanks AK 99755-1005

Mountain Safety

Accidents In North American Mountaineering
Published annually by the American Alpine Club.
Issues from 1977 to the present are especially valuable.

Glacier Travel and Crevasse Rescue by Andy Selters
(The Mountaineers)

The Illustrated Guide to Glacier Travel and Crevasse Rescue
by Andy Tyson and Mike Clelland
(Climbing Magazine publication)

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(The Mountaineers, 4th Edition)

Mountaineering: The Freedom of the Hills
Edited by Graydon and Hanson (The Mountaineers, 6th Edition)

Mountain Sickness: Prevention, Recognition and Treatment
by Dr. Peter Hackettt (American Alpine Club)

Snow Sense: A Guide to Evaluating Snow Avalanche Hazard
by Jill A. Fredston and Doug Fesler
(Alaska Mountain Safety Center, Inc.)