

WEST-WIDE SNOW SURVEY SCHOOL

LESSON 6

PREPAREDNESS

OBJECTIVES: Upon completion of this lesson, participants will be able to:

- A. Explain the importance of being in good physical condition.
- B. Dress to meet specific conditions and assemble needed equipment and survival gear.
- C. Effectively use maps and a compass.
- D. Prepare a trip plan and arrange for emergency rescue.
- E. Identify your special training needs.

TIME: 2 hours 15 minutes

STUDENT REFERENCES:

General Manual 360-PER, Amendment 46 (Part 420), on Clothing, Health, and Safety; National Engineering Handbook (NEH) Section 22; State Supplements to General Manual.

## PREPAREDNESS

### INTRODUCTION

### II. EXPLANATION

#### A. Physical Condition

1. SCS Policy.
2. Endurance and Strength.
3. Stress encountered at high elevations, cold temperatures, and emergency circumstances.
4. Limitations.
5. Physical examinations.

#### B. Outfitting For the Field

1. Regulation of body temperature - methods of heat loss.
  - a. Condition
  - b. Convection
  - c. Evaporation
  - d. Radiation
  - e. Respiration
2. Characteristics of insulating garments
  - a. Woven fabrics
  - b. Non-woven fibers
3. Use of clothing to control body heat
4. Selection of clothing
  - a. Cold weather
    1. inner layer
    2. intermediate layer
    3. outer layer
  - b. Hot weather
5. Protective clothing/equipment for special applications
  - a. SCS Policy
  - b. Aircraft
  - c. Oversnow vehicles
  - d. All-terrain vehicles (ATV's)
6. Survival Pack
7. Equipment and supplies
  - a. Snow sampling equipment
  - b. Snowshoes, skis, and poles
  - c. Radio
  - d. Maps and compass
  - e. Avalanche beacon
  - f. Electronic maintenance equipment
  - g. Extra fuel and traveling equipment

C. Map and Compass Use

1. Map orientation
2. Determining your location
3. Setting and following a compass course

D. Trip Plans

1. SCS policy
2. Contents of trip plans
3. Effective implementation

E. Emergency Operations

1. SCS policy
2. Action criteria
3. Search and rescue

F. Special Training Needs

1. Hazardous materials
  - a. Handling
  - b. Storing
  - c. Disposal
2. Vehicle operations
  - a. Truck/Trailer
  - b. All terrain
  - c. Oversnow
3. Aircraft operation
4. Non-motorized
  - a. Skiing
  - b. Snowshoes
  - c. Hiking
  - d. Horse/mule
5. Medical emergencies
  - a. First aid
  - b. CPR
6. Avalanche rescue
  - a. Beacons
  - b. Probing

# WEST-WIDE SNOW SURVEY SCHOOL

## LESSON NO. 6

### PREPAREDNESS

#### I. INTRODUCTION

Advance preparation is absolutely essential to the successful completion of field trips. your careful assessment of the trip helps make critical decisions about the preparations needed.

This chapter is designed to address the importance of physical conditioning, the principles of proper selection of clothing, developing trip plans, assembling a survival pack, and assessing your special training needs. All of this information is designed to build your confidence so that you can successfully manage possible emergencies.

#### II. EXPLANATION

##### A. Physical Conditioning

##### 1. SCS policy

The SCS policy concerning adult care is in the General Manual, Section 420.102(F), Safety and Health Management. Further information about this policy is in appendix A.

##### 2. Endurance and Strength

If a human body is kept in good physical condition, it functions more efficiently. Lung capacity is increased, thus increasing the available supply of oxygen. The production of red blood cells is increased, which improves the blood's ability to transport oxygen to the muscles, resulting in muscles that are better able to cope with extended periods of exertion.

The body has a relatively narrow temperature comfort range. When air temperatures fall below this range, the body begins to feel discomfort. If this condition persists, mental anxiety follows. The body's first defense against cold is to increase the circulation of blood to provide heat to the colder areas. Keeping in good physical condition helps assure that the circulatory system works at maximum efficiency, thus insuring the circulation of heat. This helps to maintain near normal body temperature, reduces discomfort, and controls mental anxiety or stress.

Travel, especially in winter, is physically demanding. Exercise and proper diet are important. The SCS strongly encourages each employee to actively participate in regular, mild, physical exercise. Personnel in poor physical condition jeopardize not only their life, but the well-being of the other members of the party.

##### 3. Stress

Excessive weight on the body causes a great deal of stress, not only on the heart and lungs, but on the muscles and joints. To more fully understand the necessity to be physically fit and in good health requires that we examine the stresses encountered by the body.

Personnel working above 5,000 feet require special conditioning and acclimatization. Some individuals, because of poor physical condition or other reasons, find they have some impairment of operating efficiency at a lower elevation.

Immediately upon arrival at a high elevation, only moderate physical work can be performed because of extreme breathlessness. Even after several weeks of living at 8,000 feet, the

maximum rate a person can work will only be 70 percent of his normal rate at sea level, and approaches sea level values only after many months or years of continuous stay. The deficit is even greater at higher elevations. If the change in elevation is large and abrupt, most individuals suffer the symptoms of acute mountain sickness. Disappearance of the symptoms (after 4 to 7 days) does not indicate complete acclimatization.

Listed below are some of the behavioral effects that can occur if an individual is not acclimatized:

- increased errors in performing simple mental arithmetic.
- decreased ability for sustained concentration.
- deterioration of memory.
- decreased vigilance.
- increased irritability in some individuals.
- impairment of night vision and some constriction in peripheral vision.

Self evaluation is impaired in the same manner as if that person were intoxicated. More information concerning mountain sickness and High Altitude Pulmonary Edema (HAPE) is in Section 4, Mountain Sickness.

Traveling over steep, uneven terrain or in deep, soft, powdered snow requires you to expend a great deal of physical energy, which may lead to exhaustion and fatigue. Good physical conditioning increases your endurance and ability to fight off exhaustion by providing improved lung capacity, circulation, and muscle conditioning.

Your personal mental attitude is the most important asset you bring with you. Your state of mind has a tremendous impact on the stress that can be produced within yourself. Being mentally prepared helps to overcome the stress encountered when dealing with insufficient training or experience, being psychologically unprepared for a trip, not having the proper equipment, recognizing and overcoming phobias, dealing with deteriorating weather conditions, and mechanical failures.

Approach each trip with an open mind. Realize that each one of these situations could happen to you or other members of the party. Attempt to visualize yourself in each situation and develop a strategy for coping with it. Having mentally dealt with these challenges minimizes the potential stress and gives you a greater ability to maintain a positive attitude. Emergency situations create both physical and mental demands. Being prepared for these eventualities will lessen the impact.

If an overnight bivouac becomes necessary, you will experience immediate psychological stress as well as actual physical stress. Preparation in the form of training and having the proper equipment with you will instill a greater degree of confidence and ensure survival.

Physical injuries are a real possibility. A person should be trained in first aid and have the basic supplies to cope with the injuries most likely to occur. This type of situation may necessitate a bivouac.

Personnel who travel on oversnow vehicles should be trained in correct operating procedures and basic field maintenance. A supply of spare parts and tools should be carried. In the event of a serious breakdown, a bivouac may be necessary.

The use of skis and snowshoes requires training and practice to become proficient and confident in their use. Spare parts and repair supplies should be carried. Repair procedures should have been taught and practiced.

Personnel traveling in aircraft may encounter an extreme emergency, a crash, or other disabling condition. Advanced survival and first aid training is highly recommended. The

possibility of having to ski or snowshoe out from any emergency should also be considered. Proper equipment should be carried, and personnel should be proficient in its use.

Where there is danger of an avalanche, personnel should be trained in avalanche terrain recognition, avalanche path avoidance, and search and rescue procedures. Avalanche beacons, shovels, and probes should always be carried. First aid and survival training should be given, and the proper medical and other supplies carried.

#### 4. Limitations

Physical conditioning and abilities differ from one person to another. You must know your limitations so that you can better assess situations and do not attempt to do more than you are capable of accomplishing safely. Knowing your ability to carry heavy loads or walk long distances can be important. Your ability to ski or snowshoe helps to determine the type of equipment you should take. In addition to knowing your own limitations, it is also important to know those of your team members. The group's ability to perform its duties depends upon the performance of the weakest member. The field trip activities should take these restrictions into account and be planned accordingly.

#### 5. Physical Examination

All employees assigned to perform snow survey activities are required to be examined annually to assure that no physical problems could threaten their health and safety. The physical examinations are paid for by the government and are more intensive, depending on the individual's age and general health. If the examination reveals the SCS employee would be a hazard to himself/herself, to others, or to government property, that employee is not assigned to such duty.

Fellow snow surveyors, not employees of SCS, are also encouraged to have annual physical examinations. Refer to appendix A for more detailed information on SCS policy.

### B. Outfitting for the Field

#### 1. Regulation of body temperature

Humans are called homoiotherms because, as warm-blooded creatures, they maintain a body temperature that is relatively constant despite changes in environmental temperature. Homoiothermy is required for optimum function of the body enzyme systems, which work best at 98.6 to 100 degrees F (37.0 to 37.5 degrees C). The human body can be thought of as a heat generating machine in which the internal body temperature is the net result of opposing mechanisms that tend to increase or decrease body heat production, body heat loss, and the addition of heat available from the outside. Basal heat production is the result of internal metabolic processes, and averages 50 kilocalories per meter square of body surface per hour. This can be increased by muscular activity, such as shivering and exercise; by eating; by fever; and by exposure to cold which increases hunger and the release of hormones that stimulate heat production. Shivering can increase heat production 4 to 5 times, and hard exercise can increase it up to 10 times the basal level. Heat can also be added to the body from external sources, such as the sun, fire, hot food, and drink.

Heat is lost from the body through conduction, convection, evaporation, radiation, and respiration. To illustrate the relative importance of these:

- A resting body at a still air temperature of 70 degrees F (21 degrees C) loses 70 percent of its heat by radiation, conduction, and convection; 27 percent by evaporation; and only 3 percent through urine, feces, and the lungs.

- With hard exercise, evaporation can account for up to 85 percent of heat loss, while conduction, convection, radiation, and respiration account for only 15 percent.

- a. **Conduction** refers to the direct transfer of heat by contact from a warm body to a cooler object. The amount of heat transferred depends on the difference between each body's temperature and the rapidity with which the heat is conducted. Contact with metal or other materials that conduct heat rapidly can cause considerable heat loss or even frostbite at low temperatures and burns at high temperatures.
- b. **Convection** refers to the transfer of heat from the body when air of a lower temperature than the body moves across its surface. The amount of heat transferred depends on the speed and temperature of the air. At low temperature, in the absence of shelter, high winds are a major source of dangerous heat loss.
- c. **Evaporation** refers to the loss of heat from the body when water or another volatile liquid on its surface is transformed into vapor. Because water has a very high heat of vaporization (540 calories of heat are consumed during the evaporation of one gram of water), considerable heat can be lost in this way. Evaporation is increased in the presence of wind and low humidity, and decreased in the presence of high humidity. It is a major source of beneficial heat loss in hot, dry climates. Gasoline and other volatile organic liquids that have a freezing point lower than that of water can, when spilled on the skin, cause frostbite because of conduction and evaporation.
- d. **Radiation** refers to the loss of heat in infrared waves from the body to a cooler object not in contact with it. The amount of heat loss depends on the difference between the body and the cooler object's temperature. Heat loss by radiation from uncovered skin is also a major source of heat loss in hot climates and can be significant in cold climates if the skin, particularly the head, is uncovered. Heat loss by radiation from objects on the ground to the sky can be considerable on clear, cold nights.
- e. **Respiration** refers to the loss of heat from the body because of the raising of inhaled air to body temperature before it is exhaled. The amount of heat loss depends on the outside temperature and the rate and depth of breathing.

Personal equipment must be appropriate to the trip being made. This applies to clothing as well as basic survival equipment. Individual judgement must be used because there is a practical limit to what is necessary or can be carried.

## 2. Characteristics of insulating garments

Insulating garments can prevent heat loss caused by reducing conduction, convection, and radiation. Because air has extremely low thermal conductivity, the best garments for cold climates are made of materials that trap a layer of still, warm air around the body and maintain this microclimate despite extremes of wind and cold. Some insulating ability is lost when garments are wet or when air spaces are reduced because the garment has become compressed or matted.

Suitable materials fall into two general groups:

- woven fabrics
- nonwoven fabrics

Some nonwoven fibers, such as polyester pile, are incorporated into a fabric; others, such as down, are used in garments as a filler to provide loft. In some cases, a fiber, such as polyester, can be made into fabric as well as filler.

Traditionally, the best and most practical insulating fabrics for cold weather clothing have been wool, polyester, and acrylic; and the best fibers have been down, Dacron, and foam. Wool has a special property; it remains warm even when wet because of its low wicking action and ability to suspend water droplets between its fibers without seriously affecting insulating ability. Cotton garments, particularly denim and corduroy, should not be worn in cold weather because of cotton's poor insulating value, which is reduced even further when wet.

Down is unsurpassed for dry, very cold climates, but is inferior to Dacron\ in damp, moderately cold climates because wet down balls up and is less warm and harder to dry than wet Dacron\. Orlon\ and related acrylic fabrics were developed to mimic the properties of wool at a lower cost. These fibers are almost as warm as wool and are lighter, easier to dry, and less itchy. Foam, a lightweight plastic material containing multiple small air bubbles, is used to insulate boots, mittens, and gloves.

Newer insulating materials include:

- Hollofil II\ and Quallofil\ - hollow, synthetic fibers designed on the principle of reindeer hair;
- Thermolactyl\ - a fabric containing acrylic and polyester;
- Thermoloft\ - a combination of solid core polyester, Quallofil\ fibers, and polyester pile. Polyester pile jackets are superior to wool sweaters because they are lighter, dry more easily, and stay warm when wet.
- Thinsulate\ and Thermolite\ fibers have increased insulating value because they are small, more finely divided, and trap more air than other materials when made into garments of similar thickness.
- Olefin\ and polypropylene are two popular new fabrics that have low thermal conductance, high insulating ability, and the ability to wick moisture quickly away from the skin.
- Capilene\ is a type of polyester treated to increase wicking ability.

These new fabrics are popular selections for thermal underwear and may be the best choice for persons who perspire heavily during cold-weather activities. See figure 6-1, Characteristics of Insulating Garments.

### 3. Use of clothing to control body heat

Use of the **layer principle** of clothing is effective in preventing chilling and overheating because one or more layers may be added or subtracted as necessary to control body heat and perspiration.

Overheating is undesirable because it leads to excessive perspiring and saturation of clothing with moisture, causing loss of heat from **conduction** and **evaporation**. Because water conducts heat away from the body 32 times faster than air of the same temperature, wet clothing can cause rapid heat loss in cold weather. An alpine skier, for example, who spends considerable time riding the chair lift and whose downhill speed generates significant windchill, needs more layers of clothing than a nordic skier who generates much more heat from muscular activity. Clothing should be easily adjustable. A sweater, shell, or jacket should have a full-length zipper and shell ventilation zippers in the arm pits. Outer layers should be sized generously to allow expansion of inner layers to their full thickness.

Heat loss from **convection**, **conduction**, and **evaporation** should be prevented by wearing windproof and water resistant outer garments of nylon, 60/40 cloth, or Gore-tex\. These should include a ski or mountain parka and wind or warm-up pants. The parka should be fingertip length unless bibs are worn.

As the wind velocity rises, the "effective" temperature drops (windchill effect). Charts illustrate the relationship between actual temperature, wind velocity, and effective temperature at the skin surface, and underscore the necessity for wind-proof outer clothing and for **seeking shelter during periods of cold and high wind**. See 6-2, Wind Chill Chart. It should be remembered, however, that the windchill concept refers to the **rate** of heat loss rather than the actual temperature reached, as long as evaporation is not a factor. Many cases of frostbite have occurred among improperly protected skiers sitting on chair lifts during times of high exposure.

Figure 6-1.

## Characteristics of Insulating Garments

## CLOTHING MATERIALS CHART

MATERIALS	Insulator	PROPERTIES <sup>1</sup>								Uses <sup>3</sup>
		Moist. Barrier	Wind Barrier	Breath-ability	Fire Resist	Comfort	Drying Speed	Wear Resist.	R.I.W.W. <sup>2</sup>	
Natural										
felt	G	F	F	G	G	P	F	F	G	F,HT
wool	G	F	F	G	G	P	F	G	G	ALL
cotton	P	P	P	G	F	G	F	G	P	ALL
silk	P	P	P	G	F	G	F	P	P	I,A
leather	F	G	G	P	F	F	P	G	P	O,F,HT,A,H
fur	G	G	G	P	F	F	P	G	F	O,F,HT,H,A
rubber	P	G	G	P	P	P	-	G	G	O,F,H,A,HT
down	G	P	P	G	P	G	P	P	P	O,F,H,A,HT
Synthetic										
pile	G	P	F	F	P	F	G	F	F	O,M
nylon	P	F	G	P	P	F	G	G	P	O,HT
gonex	P	G	G	G	P	F	G	F	-	O,F,H,A,HT
polypro	P	P	P	G	P	F	G	F	-	I
capalene	P	P	F	G	P	F	G	F	-	I
thinsulate	G	P	P	G	P	F	G	F	G	O,M,F,H,A
thermax	G	P	P	G	P	F	G	F	G	O,M,F
hollofil	G	P	P	G	P	G	G	F	G	O
polargard	G	P	P	G	P	G	G	F	-	O
plastic	P	G	G	P	P	P	-	F	-	O,F,HT
vinyl	P	F	F	P	P	P	-	G	-	O,HT
nomax	P	P	F	F	G	F	F	F	P	O,H,A

<sup>1</sup> PROPERTIES: Good, Fair, Poor

<sup>2</sup> R.I.W.W.: Retains Insulating Qualities When Wet

<sup>3</sup> Uses I=Inner, M=Intermediate, O=Outer, F=Feet, H=Hands, A=Aircraft, HT=Hat

Figure 6-2.

Wind Chill Chart

Moreover, a body in motion tends to create its own wind; other things being equal, a skier or snowmobiler is more susceptible to frostbite in motion than when stationary. Experience has shown there is a marked danger of frostbite when the "windchill factor" is -25 degrees F or below, a range easily attained by a moving skier or snowmobiler when the temperature is -10 degrees F (-23 degrees C) with a wind speed of 20 mph.

A common dangerous combination is cold and wind combined with water, for example, in a blizzard around 32 degrees F (0 degrees C) or after falling into a mountain stream. In these cases evaporation, convection, radiation, and conduction combine to produce rapid heat loss. Frostbite and hypothermia are real threats.

Loss of heat from **infrared radiation** is prevented by wearing a hat. At 5 degrees F (-16 degrees C), up to 70 percent of total body heat production can be lost from an uncovered head, partly because the cold body does not reduce the blood supply to the head as it does that of the extremities. The old adage "if your feet are cold, put on your hat" is true!

Loss of heat from **respiration** is prevented by avoiding overexertion and overheating in cold weather, which may cause excessively heavy breathing. When it is extremely cold, the inhaled air should be warmed by a hood, which can be pulled out in front of the face to form a "frost tunnel."

Heat loss from **conduction** is avoided by such strategies as sitting down on a toboggan, pack, or log, rather than in the snow or on a cold rock or metal object. Because the high conductivity of ski bindings, crampons, and other metal objects can cause bare fingers to freeze to metal at low temperatures, especially if they are damp, thin gloves (liners) should be worn. Spilling gasoline, or other liquid that has a freezing point lower than water, on the skin should be avoided. This causes instant frostbite because of **conduction** and **evaporation**.

In cold weather, heat loss from **conduction** and **evaporation** is lessened if you stay dry or dry yourself quickly when wet. Ideally, outer clothing should be wind-proof and should not collect snow. It should shed water but not be waterproof; otherwise, inner garments will become wet with sweat. Designers of the ideal outer garment are, thus faced with the difficult task of creating a fabric that allows water to pass from the inside out, but not from the outside in. At this time the fabric that appears to do this best is Gore-Tex\, although other good fabrics are becoming available. Gore-Tex\ is highly wind-proof and a good choice for outer garments.

Adequate coverings should be available for the body parts that have a large surface-area-to-volume ration--such as the head, ears, hands, and feet--to counteract their tendency to lose heat more rapidly than other body parts by **conduction**, **convection**, and **radiation**. However, these coverings should not be tight enough to restrict blood circulation. If socks and mittens get wet, they should be dried or replaced with dry spares.

#### 4. Selection of clothing

##### a. Cold weather

The selection of cold weather clothing depends on the type of activity, the expected temperature ranges, predicted amounts and types of precipitation, and the altitude to which the individual will be subjected.

For example, in the Coastal Alpine Zone (Cascades, Sierras, Appalachians) where temperatures are moderate and precipitation is heavy and apt to consist of rain even in the winter, a person should choose clothing made of fabrics that function well when wet, are easy to dry, and repel water (wool, polyester pile, polypropylene, Gore-Tex\). In the High Alpine zone (Rocky Mountains and other inland ranges) where temperatures are lower and a person is less apt to get wet, insulating value and wind-proofing is more of a concern. Down may be selected over Dacron\; nylon or 60/40 cloth over Gore-Tex\. See table 6-1, Clothing Selection Guide.

## CLOTHING SELECTION GUIDE

Layers	Choice	< 40   F CD-dry	< 40   F CD-wet	> 40   F WRM-wet
inner layer	best	wool	wools	polypro
	good	poly, silk	poly, silk	wool/cotton
	poor	cotton	cotton	--
Intermediate layers (multi-yes)	best	wools/down	wools/ thinsulate hollofill	wools/ thinsulate hollofill
	good	hollofill/ pile thinsulate	pile	pile
	poor	cotton	cotton/down	cotton/down
Outer layer (shell)	best	nylons/ Gore-tex	Gore-tex	Gore-tex/ nylon
	good	leather/wools pile	nylon/wool pile	pile/wools
	poor	cotton	cotton/ leather	cotton/ leather

1) Inner layer

- a) Underwear: 100 percent wool or 85 percent wool/15 percent nylon is good, but polypropylene and Capilene\ are probably the new standard. Net is satisfactory, but it should be of wool. Alpine skiers can get away with Duofold\ and other synthetic combinations. Waffle-weave "thermal" and other types of cotton underwear should be avoided.
- b) Socks: Wool and polypropylene socks are best. They are preferably worn in layers with a pair of thin, polypropylene socks next to the skin and one or two pairs of heavy, wool socks over them.
- c) Vapor Barrier Garments: The "vapor barrier" system consists of a waterproof garment worn either next to the skin or over a thin garment of polypropylene or similar material. This results in a warm film of moisture next to the skin, which decreases water requirements by reducing sweating and increases the insulating properties of the outer garments by keeping them dry. This system seems to work better in very cold weather than at moderate temperatures and some dislike the clammy feeling that results. Additional spare underclothing must be carried to ensure that a dry set will be available each day.

2) Intermediate layer

- a) Shirt: Wool and polypropylene shirts are best. They should open completely in front or at least have a half-zipper. A turtleneck design protects the neck, or a special "neck-warmer" which can be pulled up to protect the face, can be used. Orlon \, nylon, or polyester blends are suitable for alpine skiers.
- b) Pants: Wool pants or knickers are preferable. The hard-finish wool pants in "army surplus" stores are durable and reasonable in price. Downhill skiers should select wool or part wool "stretch" or quilted pants or bibs. Cotton, particularly denim and corduroy, should be avoided.
- c) Sweater: Wool is good, but is being replaced by polyester pile vests and jackets. The front should have a full zipper, buttons, or snaps.

3) Outer layer

- a) Parka/Jacket/Coat: This can be a standard ski or mountain parka filled with down or Dacron \. The combination of a jacket or vest and a wind-proof and water-resistant shell is more versatile. The parka or shell should have a hood with a drawstring closure, and unless bibs are worn, should be fingertip length. This helps to keep the hips and waist warm and to avoid exposing bare skin when bending over.
- b) Wind or Warm-up Pants: These are a must for cold, windy weather, for digging a snow cave, or when working in wet or deep snow. They can be of nylon or Gore-Tex \.
- c) Hat: Some variety of a wool or Orlon \ "stocking" type cap seems to be best. It should cover the ears. Unless a neck warmer is worn, a face mask or balaclava feature is desirable to protect the face from cold wind. A light eyeshade of the Headgasket\ or tennis visor type is useful when excessive glare is anticipated. Caps that have visors and ear protectors that can be pulled down as needed are also popular.

d) **Mittens or Gloves:** Mittens tend to be warmer than gloves, but are less useful when delicate finger movements are required. A good combination is a pair of thin, polypropylene liners worn inside heavy, wool mittens of Dachstein\ or wool/polypropylene plus an outer, windproof shell of nylon or Gore-Tex\. Depending on temperature and type of activity, any combination of these three layers can be worn at a time. The light liners are useful to protect the hands when adjusting ski bindings or splinting. Alpine skiers may prefer leather mittens or gloves lined with foam, down, or Thinsulate\ shells. If this type is worn, they should be long enough to cover the wrists.

e) **Boots:** The type chosen depends upon the form of activity and the expected environmental temperature. For moderate temperatures, sturdy leather climbing boots can be used. The boots should be made of full-thickness leather, be 6 to 8 inches high, have rubber lug soles, and be roomy enough to accommodate a pair of polypropylene socks plus one or two pairs of heavy wool socks. They must be long enough so that the toes are neither cramped nor likely to strike the end of the boot during downhill travel. To avoid both cold feet and blisters, boots should be laced firmly enough so that the heel doesn't move, but not so tight that the toes cannot be wiggled easily. Gaiters should be added in snow country to keep snow out of the tops of the boots.

For colder temperatures, double mountaineering boots work well for winter mountaineering. They can be of leather or have outer shells of plastic or nylon with inner boots of felt or foam. They also should be roomy enough to accommodate at least a pair of polypropylene and one or two pairs of heavy wool socks. For ice climbing, boots need to be quite stiff. For snowshoeing and other types of nontechnical activities, the Canadian Sorel\ type of shoe-pak, with a removable inner felt liner, works well. Special single and double ski boots are available for ski touring and ski mountaineering to fit either three-pin or mountaineering ski bindings. For high altitude mountaineering in cold weather, special overboots or felt-lined gaiters are desirable. Gaiters should be used to keep snow out of the tops of boots.

f) **Rain Gear:** In moderate climates or very wet conditions when rain or wet snow may be encountered, outer garments of Gore-Tex\ may not be adequate and waterproof outer garments may be preferable.

b. Hot weather

Conditions predisposing to serious heat stress are in most parts of the temperate zone during the summer. The amount of heat stress depends on the temperature and humidity. Death can occur if internal heat production plus heat gained from the outside raises the body's core temperature above 104 to 105 degrees F (40 to 40.6 degrees C) despite the body's cooling mechanisms. In North America, serious heat stress can occur during long climbs in sun-exposed areas. Vehicle breakdowns in isolated locations can be very hazardous to unprepared passengers. Problems from excessive heat can be prevented in the following ways:

Heat loss by **conduction**, **convection**, and **radiation** can be increased by exposing the maximum amount of bare skin to the outside air. This technique will be limited by the danger of sunburn to the unprotected skin. Because heat loss and sweating may be impaired by minimum of clothing and covering the face and hands with a sunscreen that has a high SPF (Sun Protection Factor) number. This means a long-sleeved shirt and long pants of thin, loose-fitting, light-colored (preferably white) cotton. When in the shade, as much clothing as possible should be removed. A hat that has a wide brim or a cap that has a neck protector, the "foreign legion" type, with ventilation holes in the crown should be worn, and the hands should be protected by gloves. Sturdy hiking or climbing boots are necessary to protect the

feet from the hot ground and sharp rocks. High quality dark glasses with ultraviolet radiation protection are needed to protect the eyes from the glare.

The sweating mechanism can be maintained by drinking an adequate amount of fluid, some of which can contain electrolyte supplements. Enough water **must** be carried or be readily available in the field. Water bottles wrapped in clothing or otherwise insulated should be buried in the pack to keep the water cool.

The mountains cool rapidly at night. Use of the layer principle of clothing is advisable, so that layers can be taken off during the heat of the day and added at night.

Because of its high thermal conductivity, poor insulating ability, and good wicking ability, **cotton** is the fabric of choice for hot weather clothing. To improve air circulation, clothing should be loose.

As mentioned before, coverings from the head and body should be used to protect the body from the direct rays of the sun.

Shade should be sought during the hottest part of the day. A sun shelter can be made out of a tarp.

Muscular exertion during periods of high heat should be avoided--especially when humidity is high.

**The skin should be protected from hot objects by not touching metal at high temperatures and the feet should be protected by wearing shoes.**

The body's mechanisms of adaptation to heat and altitude are better than those for cold. Acclimatization to heat is a process that takes 7 to 10 days to complete. It includes an increase in the volume of blood and the efficiency of the heart, so more blood is available to carry heat from the hot body core to the shell. The rate of sweating increases, and the sweat contains less salt. By the end of this time, exposure to heat is noticeably better tolerated and less debilitating.

On return to a cooler climate, these processes reverse. The most obvious change being a temporary increase in urine volume as the blood volume contracts and the excess liquid is excreted by the kidneys.

## 5. Protective clothing equipment for special applications

### a. SCS policy

SCS policy requires special clothing and equipment when using aircraft, oversnow vehicles, or all terrain vehicles (ATVs). Refer to GM 360-PER, part 420, and Temporary Regulation E-5 in appendix A.

### b. Aircraft

Helmets and NOMAX fire retardant clothing are required when traveling in any aircraft. The helmets must meet approved specifications. Special requirements for aircraft travel are covered in section 9 of the West-Wide Snow Survey School agenda.

### c. Oversnow vehicles

When operating or riding on oversnow vehicles without an enclosed cab, operators and passengers must wear an approved, properly fitted helmet. Eye and ear protection is

recommended. For enclosed cab operation, helmets are not required, but hearing protection must be used.

d. All-terrain vehicle (ATV)

When using ATVs, operators must wear an approved helmet; goggles or a full-face shield for eye protection; substantial shoes, such as leather boots that come above the ankle; and long pants. In addition, it is recommended that the operator wear gloves and a long-sleeved shirt or jacket.

6. Survival pack

The survival pack you prepare is intended to make life threatening emergencies survivable and provide relative comfort. One survival pack for all types of trips and conditions is impractical. The nature of the trip you are taking will dictate the items to be included in the pack. The items selected will be influenced by the mode of travel, remoteness of the trip area, distance and anticipated time of trip, climatic conditions, personal comfort and medical needs, and local peculiarities.

Table 6-2 is a list of suggested items to include for various modes of travel. The first list is based on the premise of foot travel. The following lists show items to be added if travel is by snowmobile, cabbled-over oversnow vehicle, or aircraft. Highway vehicles should contain a similar survival pack. The basic survival pack is recommended for winter trips.

Remember to adjust your survival pack for the conditions you could expect to encounter. For example, in cold weather you might add the following items:

- heavy insulating clothing.
- a cold-rated sleeping bag.
- down and wool products.

For wet, warmer weather the emphasis should be on:

- water resistant and waterproofed items.
- a medium weight sleeping bag.
- wool or synthetic fabrics.

It is critical that the survival pack contents be replenished and fully useful. The items that are most often used and need to be checked or replaced are batteries, survival foods (which must be within shelf life limits), and candles (which melt easily if the pack is stored where it is too hot). Water bottles need to be clean and ready to use. First aid supplies need to be checked for shelf life and replaced if out of date or used. Stoves or lighters need to have fuel. Be familiar with your pack and keep your pack private and protected from others using or borrowing from it. Know its contents--keep a checklist in a pocket of the pack for quick reference. Know how to use the items on a moments notice.

Your survival pack is personal. You may require special skin care items, medicine, or special equipment. **Comfort items, such as your favorite Teddy or E.T. bear, or simply a good book might make the night much easier to cope with.**

Choices of sleeping bags follow the same general principles as clothing. Sleeping bags should be tailored to the climatic conditions to be encountered. Special emphasis should be paid to the choice of insulating materials, and clothing should retain its thermal qualities when wet.

All survival packs should be inspected on a regular basis to ensure that all items are in good condition and fully serviceable. Special attention should be given to such items as batteries and light bulbs, survival food items, candles, water bottles, medical and first aid supplies, and camp stoves or lighters and their fuel.

ALL WINTER FIELD TRIPS (your pack should include the following basic items)

List is recommended for foot travel:

Sunglasses	First aid packet
Knife (Swiss Army knife)	Aspirin tablets
Maps	Burn ointment
Compass	Cut antiseptic
Snow Survey Safety Guide and/or Survival Manual	Bandages
Fire starters (at least 5 types)	Butterfly closures
Waxed matches	Adhesive tape
Metal match	Compresses
Small ball of raw cotton	Roller bandage
Dry tinder (12" hemp rope)	Triangular bandage
Small vial of kerosene or like	Ski repair kit
Emergency rations (min. 1 day)	Screwdriver set & extra screws
Emergency space blanket or small nylon tarp	Pliers
Candle	Spare cable or toe piece
Metal cup	Plastic or aluminum ski tip
Plastic spoon	or
Light rope or nylon line	Snowshoe repair kit
Safety pins	4 hardwood strips (1/8" X 5/8" X 6")
Toilet paper	Length of wire
Signal mirror	Several heavy leather thongs
Whistle	Pliers
Extra sweater, mittens, socks, cap	Spare bindings
Spare blankets (2)	Plastic sheet (8' X 8')
Water bottle	Brass or copper wire 30' .025 minimum size for snares
Toothbrush	Flashlight w/batteries separate (Optional)
Durable snow shovel	

Although this list seems lengthy, it can be packaged into a small rucksack, which should be an inseparable part of your field gear. This pack should be adjustable depending on your mode of travel.

SNOWMOBILE TRAVEL (additional items to include):

Shovel	Sleeping bag
Hatchet or folding saw	Ensolite pad
Snowshoes or X-C skis	Flashlight w/batteries separate
Machine maintenance kit	Heavy nylon tow rope
Small rucksack with extra clothes, mittens, socks, cap, etc.	Small cook stove (backpacker style)
Signal flares	Small cook kit
Larger lightweight nylon tarp	More emergency rations
	Small vial of soap

SNOWCAT TRAVEL (additional items to include):

Large shovel  
Axe or bow saw  
Sleeping bags  
Handyman winch

Propane torch  
Larger cook kit  
More emergency rations  
Down booties (optional)

AIRCRAFT TRAVEL (additional items you may need):

More signal equipment  
(colored smoke, flare pistol,  
railroad flares)

Larger first aid kit  
More emergency rations  
Fishline & assortment of hooks and lures

## 7. Equipment and supplies

Before embarking on a field trip, evaluate your objectives and assemble the equipment and supplies needed for the trip. Tools and supplies should be inspected before leaving. Any repairs, replacements, or supplements should be completed before the trip begins.

### a. Snow sampling equipment

Snow sampling sets **will** be inspected before each trip for completeness and condition. Make sure site maps and note forms are in the set. Assemble and disassemble the tube sections to check thread condition. Make sure the tube sections will produce a correct depth scale. Section 5 describes, in detail, the maintenance of snow samplers.

### b. Snow shoes, skis, poles, and boots

Snowshoes, skis, poles, and boots **will** be inspected before all trips to ensure all items are in good repair. If any changes in personnel are expected from trip to trip, be sure the proper sizes of equipment are available. Maintenance of this equipment is described in section 8.

### c. Radio

Radios should be checked out before each trip for transmitting and receiving. Batteries should be fully charged.

### d. Maps and compass

Route finding supplies, such as topographic maps and compasses, must be assembled before each trip, and all trip members will be shown the location of the final destination and the route to be followed.

### e. Avalanche beacon

If avalanche beacons are to be used, they will be tested before each trip. Each member of the party will be fully familiar with the operation of the beacons and the procedure to follow in case of emergency.

### f. Electronic maintenance equipment

Tool kits, electronic repair parts, electronic testing equipment, and any other tools or components will be assembled, checked, and tested before each trip. An inventory will be made to ensure that nothing is, or will be, missing, when the field site is reached.

### g. Extra fuel and traveling equipment

Extra fuel, spare parts, tools, and operators manuals will be assembled before all trips and will be checked as oversnow machines are loaded.

## C. Map and compass use

Using your map and compass requires practice and an understanding of the principles involved. Losing your direction while in an unfamiliar area may not seem too serious if it only means getting home late, but if you become lost to the point where you are stranded and cold or if you are injured and need attention, getting lost can be a tragedy. Peaks, lakes, rivers, cabins, and blazemarks can help in finding your way; however, when darkness, fog, or storms obscure your vision, it may be impossible to continue without a compass and map.

U.S. Geological Survey (USGS) topographic maps are the best maps available for your use. They provide a three-dimensional view of an area. These maps identify steep areas, valleys, ridges, streams, and other pertinent landmarks.

All quality compasses have similar basic features and may be used for cross-country travel. Practice using your compass and map until you become confident that you know how to use the procedure. Then, continue to practice until it becomes routine.

You can also determine direction by using your watch. On a day that you can see the sun, point the hour hand (corrected to standard time) toward the sun. Approximately, halfway between the hour hand and 12 will be due south. When facing due south, east is to your left, west is right, and north is in back of you. This method can be used regardless of whether your watch has hands or not. If it is a digital watch, simply estimate the position of the hour hand.

## 1. Map orientation

USGS topographic maps are always oriented to true north. They generally indicate the departure (declination) from true north towards which your magnetic compass will point. It is helpful to know what the magnetic declination is in your area because some maps will not show this information.

The departure is called the angle of magnetic declination and varies throughout the world. A compass pointer always orients with the magnetic north pole. Magnetic north varies from true north by about 10 to 15 degrees in the Western United States.

## 2. Determining your location

You may determine the magnetic bearing of your direction of travel at any time by using the following steps:

- Orient your compass pointer to read 0 degrees azimuth (adjusted for the magnetic declination to achieve true north).
- Holding this compass position, sight along your direction of travel. Read the compass dial in degrees of azimuth (always read clockwise, beginning at true north). This is your bearing.

Being able to judge or pace distances is helpful as you travel from point to point. Remember to keep your compass away from metal objects or know iron, nickel, or cobalt ore deposits.

The use of a map and compass are required when:

- You can locate your location and destination on the USGS map.
- You know your general location, but not your exact position.
- You are totally lost.

## 3. Setting and following a compass course

### a. Location and destination known

- 1) Mark your location on the topographic map.
- 2) Using a Silva-type compass, point the base plate towards your destination by laying its edge on the map along the desired direction of travel.
- 3) Set the compass heading by turning the compass dial until "N" points to true north on your map (always at the top of the map). The direction in which to proceed is read at the index line on the dial.
- 4) Hold the compass in your hand to proceed. The compass should be held level so that the magnetic needle swings freely.

- 5) Turn your body until the read end of the needle aligns with both the orienting arrow and "N" on the dial.
- 6) Sight to a distant landmark that lines up with your direction of travel and begin moving toward it. Select an easily recognized landmark that you will not lose sight of.

This procedure may need to be repeated several times because topographic features often prevent a straight line of travel.

b. General location known but not exact position

In this case, you know your general location along a certain line, such as a ridge, river, or trail. It is possible to locate yourself in the following way:

- 1) Orient your map to north as shown previously.
- 2) Identify a prominent landmark that can be located on the map and physically. Mark it on the map.
- 3) Take a bearing with the compass and draw a line from the prominent landmark toward your general location.
- 4) The point of intersection with your known line is your location on the map.

As you continue to move toward your destination, you must recheck your position.

c. You are totally lost

Even if you are totally lost, it is possible to locate your position on the map. The process is similar to the previous method:

- 1) Orient your map to north as shown previously.
- 2) Positively identify two (or more) landmarks on the map and physically. Mark these landmarks on your map.
- 3) For each landmark, take a bearing with the compass and draw a line from that landmark.
- 4) The location where the lines intersect (or nearly intersect if three or more lines are drawn) should be where you are.
- 5) Carefully, look at this intersection to ascertain if this point makes sense. If it does, then you have located yourself. If it does not make sense, start over because you have made a mistake in either identifying a landmark or in taking a bearing.

When you are satisfied that you know where you are, mark your location on the map and continue your travel as described above. Continue to recheck your position as you move along your route.

D. Trip plans

1. SCS policy

While no specific national SCS policy exists for using trip plans, individual state policies may exist. You should know if your particular state has existing policy. If they do, you must follow it. Non-SCS

personnel should check with their supervisors and become familiar with the policies and procedures used by their agency or organization.

## 2. Contents of trip plans

The contents of a trip plan can vary, but some basic information is a must. Include all pertinent information necessary to facilitate search and rescue operations. Figure 6-3 is an example of a trip plan form. It can be copied and used if one does not exist.

## 3. Effective implementation

The trip plan is only effective if two things occur. First, the trip plan must be given to a responsible individual. The individual chosen as the Home Base Coordinator (HBC) has the responsibility to initiate a search and rescue and carry out predetermined emergency actions if the field party is overdue. The coordinator's responsibility does not stop at the close of the business day.

When selecting a responsible person for check-in (HBC), pick someone who is easily located, responsible, and with more than a casual interest in the field party. This person must be in good communication with you or convenient to your point of return.

Second, the field party has the obligation, after they prepare the trip plan, to follow it and contact the HBC immediately upon returning home. The changes of a successful rescue are directly related to how accurately the trip plan was followed.

## E. Emergency Operations

### 1. SCS policy

Emergency operations for conducting search and rescue vary from state to state. Therefore, it is important to know and understand the proper procedures to follow for your specific location.

Within the SCS, each state conducting snow survey operations should develop a supplement to the General Manual which establishes state policy for monitoring activities in remote areas. This supplement should address:

- Initiating a search.
- Using SCS personnel in a search and rescue operation.

Become familiar with your state's General Manual supplement and know what to do in an emergency.

Appendix A gives more specific information about emergency preparedness procedures. The General Manual, section 420.103(K) deals with SCS personnel when called upon to assist in search and rescue operations.

The SCS national policy says, "When snow surveyors are called upon by responsible local officials for emergency rescue assistance in saving a life, they should respond and notify the appropriate SCS line officer as soon as practical. Such activity should be considered part of their assigned duty. It is suggested that an advisory meeting with local responsible officials emphasizing the SCS will only become involved in life-threatening situations and where snow survey expertise and equipment are specifically required to **augment** normal rescue arrangements. SCS equipment will be operated only by SCS employees."

### 2. Action criteria

Successful emergency operations require clearly defined and understood action criteria for the HBC. As a minimum, each trip plan should define these action criteria:

**TRIP PLAN**

Departure Date: \_\_\_\_\_

Home base coordinator \_\_\_\_\_

Phone: Office \_\_\_\_\_  
Home \_\_\_\_\_

Home base location \_\_\_\_\_

Alt. home base coord. \_\_\_\_\_

Phone: Office \_\_\_\_\_  
Home \_\_\_\_\_

Alt. home base location \_\_\_\_\_

Work party members \_\_\_\_\_

Phone: Office \_\_\_\_\_  
Home \_\_\_\_\_

Motor Vehicle Used: Make \_\_\_\_\_ Type \_\_\_\_\_ Lic # \_\_\_\_\_  
Model \_\_\_\_\_ Year \_\_\_\_\_ Color \_\_\_\_\_

Departure Point \_\_\_\_\_

**GROUND SURVEY**

Departure time \_\_\_\_\_ Radio Contact with \_\_\_\_\_

Phone: \_\_\_\_\_

Estimated return time \_\_\_\_\_

Estimated enroute check-in times: \_\_\_\_\_

Location: \_\_\_\_\_

Planned route of travel:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

AERIAL SURVEY

Aircraft contract \_\_\_\_\_ Phone: Office \_\_\_\_\_  
 Location \_\_\_\_\_ Home \_\_\_\_\_  
 Type \_\_\_\_\_ Make \_\_\_\_\_  
 "N" Number \_\_\_\_\_ Color \_\_\_\_\_

Flight following with \_\_\_\_\_ Phone: Office \_\_\_\_\_  
 Home \_\_\_\_\_

Departure Point \_\_\_\_\_ Time \_\_\_\_\_

Estimated return time \_\_\_\_\_

Planned itinerary:

	Planned Stops	Stops Reported	Arrival Time	Departure Time	Remarks
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Use additional sheets if needed.

- a. A reasonable unit of time should elapse after the expected return/check-in time that was established in the trip plan. When this unit of time has passed, the HBC is to take action.
- b. The first action to be taken by the HBC is to determine if indeed the field party has not returned or reported.
- c. If the field party has not returned and is overdue, the HBC is required to notify emergency rescue and administrative authorities. Local policy and the HBC's own judgement will determine which to notify first.

These action criteria are displayed in the flow chart on the example trip plan (figure 6-5).

Matters of liability for the HBC's actions may arise in situations of injury or loss of life. The HBC bears considerable responsibility and must have correct, clear instructions.

### 3. Search and rescue

SCS and other snow surveyors must realize that although they may be very well qualified to conduct rescue operations, in nearly all cases they would violate local, state, and Federal regulations (including SCS policy) by doing so. Follow the flow chart outlined in figure 6-5 as an example of a decision tree for search and rescue.

State and county law enforcement officials typically are authorized to organize and conduct rescue operations. Indian reservations, national parks, and military reservation officials usually are responsible in their areas of domain. Your responsibility as an SCS employee is to know who the search and rescue authority is. As a matter of routine business, you should inform these officials of your winter travel activities, emergency preparations (training, survival gear, trip plans, and HBC), transportation capabilities, and status as a resource to their search and rescue efforts.

Your ability to respond on a moments notice is directly related to maintaining yourself in good physical condition. The importance of good conditioning has been discussed at the start of this chapter. The other consideration is that all equipment must be maintained in top working condition. If something needs to be fixed on the snow machine, don't put it off until you need to use the machine again. Repair it upon your return so that it is ready to go.

### F. Special Training Needs

Depending on what your particular assignments are, you may require additional or special training. Appendix A has the General Manual policy covering SCS training requirements.

Some of the basic training area needs are listed below. The list is not complete and should be treated as only a guide. Your supervisor will be better able to help you pinpoint your training needs and either provide the necessary training or help you get it.

#### 1. Hazardous materials

Hazardous materials -- These materials include snow mobile fuel, glycometh (used for recharging precipitation gages), herbicides, and numerous other materials. Ask your supervisor to either provide training or help you get training on these materials. Your supervisor should also give you a copy of the Materials Safety Data Sheet. If one is not available, it can be obtained from the manufacturer. Items covered under hazardous materials training should be:

- a. handling
- b. storing
- c. disposing

#### 2. Vehicle operations

Figure 6-5.

Flow Chart

The home base coordinator or alternate will wait a predetermined amount of time after the expected return time/check-in time before initiating action. At that time, the following action flow chart should be followed.

PERTINENT PHONE NUMBERS:

Search and Rescue Authority: \_\_\_\_\_ Office

Designated Administrative Authority \_\_\_\_\_ Office

Alternate Administrative Authority \_\_\_\_\_ Office

You must be able to skillfully operate all of the vehicles available to your group, including:

a. Truck/trailer

You must demonstrate to your supervisor your ability to drive under conditions you may be expected to encounter and be within compliance of all state laws. In other words, if a chauffeur's license is required by state law to operate a truck/trailer, then you must have one.

b. All-terrain vehicles

SCS requires all personnel to complete an approved training course before operating an ATV. See appendix A for policy.

c. Oversnow vehicles

These vehicles include snow mobiles and snow cats.

3. Aircraft operations

You need "hands-on" experience in working in and around aircraft. For example, if you will use a helicopter, you must know how to approach and leave when the rotors are operating. Your supervisor should be able to show you the "ropes" for activities you will not learn during the West-Wide Snow Survey School.

4. Nonmotorized vehicles

These vehicles include skiing, snowshoes, hiking, and horse/mule. For the first three, practice makes perfect. The better you become, the easier your job becomes. You must learn sound procedures. Continue to practice whenever you get a chance.

Horse/mule training requires some "hands-on" training from your supervisor or co-workers. Riding and pulling a pack carrying mule requires that you develop considerable skill. Hopefully, you can gain this experience early while traveling with a seasoned surveyor. If not, you may need to ask your supervisor for training.

5. Medical emergencies

First aid and CPR training are necessary. You should have completed a basic (Red Cross or equivalent) first aid course and a CPR course before going to the West-Wide Snow Survey School. If not, you must complete these courses as soon as you get back to your office. Additional training in first aid is advisable because you can never learn too much about this field.

6. Avalanche rescue

The West-Wide Snow Survey School covers avalanche rescue in some depth. However, if your supervisor feels you need additional training, this can be provided by the National Avalanche School. Your supervisor will need to find out the time and location for their next school.