STAYING WARM

With chilly/cold winter weather upon us, I want to use much of this newsletter to address issues of cold weather safety. Even if you don't go winter camping like I do, winter conditions can still present significant safety issues.

Have you ever heard of or experienced any of the following?

- ☐ Power outage during the winter? (Furnaces require electricity even if they are gas)(A wood stove could be a real blessing here, much better than a fireplace!)
- ☐ Vehicle breakdown
- ☐ Slide off the road
- ☐ Road blocked by accident ahead
- ☐ Road blocked by drifting snow
- ☐ A fall with injury on icy pavement

These are a few of the situations in which you could find yourself without your accustomed warm surroundings. How you deal with these situations can literally mean the difference between life & death.

Dress for the Weather

The essence of staying warm in the winter is having the proper clothing layers and knowing how to use them effectively. **NEVER** leave home without appropriate clothing that can keep you safely warm for several hours, minimum!

Heat Loss

The body basically acts as a furnace, producing heat through chemical reactions and activity. This heat is lost through conduction, convection, evaporation, radiation, and respiration. As physical activity increases so does heat production and conversely as activity decreases so does heat production. The key to keeping warm is to add insulation to the body.

Insulation The thermal insulation of clothing is proportional to the thickness of the dead air space enclosed. Dead air is defined as any enclosed unit of air that is small enough that natural convection currents would not arise in it. Such currents have been detected in units as small as 2 millimeters in diameter. The dead air next to the skin is heated up by the body and provides a layer of warmth around the body. **The clothing is not what is keeping you warm it is the dead air.** This is because the denser a material is, the faster it can transfer heat through conduction, the density of air is obviously minuscule compared to a piece of a fabric.

Clo Value

The **"clo" unit** was developed to provide a measurement of insulating effectiveness. One clo is roughly equal to the insulating value of an ordinary wool business suit. Each inch of thickness of conventional insulating materials (wool, pile, down) provides a theoretical value of about 4.7 clo or a practical "in use" value of 4.0 clo.

The Layering Principle

The key to providing this dead air space is through having a number of layers of clothing. Each layer provides a certain clo value of dead air space. This allows you to add or shed layers to increase or decrease your accumulated dead air space as the temperature changes and/or as your activity level changes. Remember, **your body is the heat source, the clothing layers only serve to trap the heat and slow down your heat loss to the cold environment**. **If you have too much clothing on, you will overheat and start to sweat.** You need to find the proper heat balance between the number and types of layers and your activity level.

Example 1: You are snowshoeing up a steep incline with a 50 lb. pack. The air temperature is 10° Fahrenheit and you are dressed in wool pants and a lightweight polypropylene shirt. As soon as you stop for a rest, your heat production slows. If you stop for more than a couple of minutes, you will begin to chill. So you need to have an outer layer handy to put on.

Example 2: You are skiing along the flat. The air temp is 25° Fahrenheit and you are dressing in light polypropylene tops and bottoms, a down vest, and a windshell. You come to a long steep hill and have to push hard to get up and over. You start to sweat as your heat production increase with the increased muscle activity. To prevent overheating, you pull off the vest and stick it in your pack. Why not just have lots of layers on and sweat? Heat loss from a wet surface can be up to 25 times greater than a dry surface (due to the higher density of water). **If you sweat and get soaked, you will lose heat much more quickly through evaporation of the water**. Also you are loosing an incredible amount of water through sweating since the air is so dry. Too much water loss leads to **dehydration which significantly increases the risk of hypothermia**. So you want to control your layers so as to be warm at the activity level you are in but not sweating profusely. Thus, traveling in the winter is a *constant* process of adjusting your layers to keep comfortable. This means having a number of layers you can add or subtract and allowing for versatility within layers. Convection may account for the greatest amount of heat loss under most conditions. In order to properly insulate, you need to have an ***outer layer that is windproof***.

Example 3: You are standing on a windblown summit in a wool sweater, the wind will penetrate through the openings in the sweater and quickly carry away the warm layer of air next to the skin. Another convective factor is the **"bellows action" of clothing**. As you move a bellows action occurs which tends to pump your accumulated warm air out through openings in your clothing and sucks the cooler air in. In some conditions this action **can reduce your body's personal insulation by 50% or more**. Thus, it is important that *all* layers have effective methods of being "sealed" (i.e. buttons, zippers etc.) Openings in layers allow you to ventilate, to open the "chimney damper" if you are beginning to overheat, without having to actually remove a layer. So opening and closing zippers on a jacket, or armpit zips will allow you to either ventilate if you are getting too hot or seal up if you are getting chilly, all without having to add or take off a layer. With clothes that are too loose, the bellows action pumps warm air out through the openings. You need to have **clothes that fit properly but not tightly**. Too tight, and the clothes compress and actually reduce dead air space in layers below as well as restricting body movement. Another general rule is that the **efficiency of clothing is proportional to the diameter of the body part it covers**. Thus a given thickness of insulation added to your trunk will be more thermally efficient than the same thickness added to your arm or leg. It will also help maintain that body core temperature. This is why vests work well to maintain body heat. There is an optimal thickness of insulation for each body part. Beyond that the added bulk tends to be more of a hindrance in movement than the added insulation is worth. Have you ever noticed that your hands feel colder after putting on a thin pair of gloves? This is because when insulation is wrapped around a curved surface, the cross-sectional area of the insulation through which the heat may flow is greater as is the surface area from which the heat may be lost. This means that the total insulation efficiency of a given thickness progressively decreases as curvature sharpens over a surface. In addition, small cylinders, such as fingers, show a paradoxical effect. **The addition of a thin layer of insulation actually increases heat loss until a thickness of about 1/4 inch is reached**. This heat resistance gains as additional thickness is added. However, added thickness beyond 1/4 inch increases warmth very little in proportion to its thickness. This is one reason that thin gloves don't keep your hands particularly warm (like one size fits all knit gloves).

Materials

Some of the different types of materials for winter clothing and insulation are discussed below.

1. Wool - derives its insulating quality from the elastic, three-dimensional wavy crimp in the fiber that traps air between fibers. Depending on the texture and thickness of the fabric, as much as 60-80% of wool cloth can be air. Wool can absorb a fair amount of moisture without imparting a damp feeling because the water "disappears" into the fiber spaces. **Even with water in the fabric wool still retains dead air space and will still insulate you**. The disadvantage to wool is that it can absorb so much water (maximum absorption can be as much as 1/3 third the garment weight) making wet wool clothing very heavy. **Wool releases moisture slowly, with minimum chilling effect**. Wool can be woven in very tight weaves that are quite wind resistant. An advantage to wool is that it is relatively inexpensive (if purchased at surplus stores). However, it can be itchy against the skin and some people are allergic to it.

2. Pile or Fleece fabrics - is a synthetic material often made of a plastic (polyester, polyolefin, polypropylene, etc.). This material is similar in insulative capacity to wool. Its advantages are that it **holds less water (than wool)** and **dries more quickly**. Pile is manufactured in a variety of different weights (thicknesses) offering different amounts of loft and insulation. This allows for numerous layering possibilities. The disadvantage of pile is that it has **very poor wind resistance** and hence a wind shell on top is almost always required. Versions of pile are available that have a middle windproof layer.

3. Polypropylene and other Hydrophobic fabrics - polypropylene is a synthetic, plastic fiber which offers dead air space and a fiber which cannot absorb water. The fiber is hydrophobic so it moves the water vapor away from the source (the body). **Polypropylene layers are extremely effective worn directly against the skin as a way of keeping the skin from being wet and reducing evaporative heat loss**. As the water moves away from the body it will evaporate, but each additional millimeter of distance between your skin and the point of evaporation decreases the amount of body heat lost in the evaporative process. Some fabrics rely on the chemical nature of the fiber to be hydrophobic. Others fabrics use a molecular coating the achieve the same end.

4. Vapor Barrier Systems - another way to stay warm in the winter is through vapor barriers. The body is always losing water through the skin even when we are not active. This loss is known as insensible perspiration and occurs unless the air humidity is 70%. This insensible perspiration goes on at the rate of nearly half a quart every 24 hours. Since it takes 580 calories per gram to turn liquid water into water vapor, heat is continually lost through insensible perspiration as well as through sweat from any activity. A vapor barrier is a clothing item which is impervious to water thereby serving as a barrier to the transportation of water vapor. When worn near the skin it keeps water vapor near the skin. **Eventually the humidity level rises to the point where the body senses a high humidity level and shuts off insensible perspiration. This prevents evaporative heat loss and slows dehydration.** Vapor barriers should not be used directly against the skin because any evaporation of moisture directly at the skin surface leads to heat loss. Wearing polypropylene or some other hydrophobic layer between the skin and the vapor barrier allows the moisture to be transported away from direct skin contact. There is no doubt that vapor barrier systems are effective **for some people in some conditions.** The issues you must consider before using a vapor barrier are activity level, amount you naturally sweat, and "moisture comfort." If you are not active, such as when using a vapor barrier liner at night in a sleeping bag, the system will work well. **A vapor barrier sleeping bag liner will typically permit you to sleep comfortably in temperatures 10 - 15 degrees colder than in the bag alone**. However, some people find that they are not comfortable with the level of moisture in the bag and feel clammy. If this interferes with sleeping it may be a problem, better to have a better insulated sleeping bag. Vapor barrier liners for sleeping bags also help in another way. In cold conditions, the moisture from your body escapes upward through the bag, when reaching the cold outside of the bag it condenses into liquid or event frost. Over a number of days this moisture level in your bag increases. If you can't dry out the bag it will slowly get heavier and heavier as it holds more water. With a down bag, this moisture can actually soak the feathers and cause the bag to loose significant amounts of loft (dead air space), thereby reducing it's effectiveness. When you are active, like snowshoeing, and you are wearing a vapor barrier such as a vapor barrier sock, you must carefully monitor how you sweat. If you are someone who sweats a lot with activity, your foot and polypropylene liner sock may be totally soaked before the body shuts down sweating. Having this liquid water next to the skin is going to lead to increased heat loss. If you don't sweat much, your body may shut down perspiration at the foot before it gets actually wet. This is when the vapor barrier system is working. **The important point is that heat loss comes from water changing state from a liquid to a gas**. **Liquid water next to the skin leads to significant heat loss. Water vapor next to the skin does not**. You must experiment to determine if vapor barrier systems will work for you.

5. Polarguard, Hollofil, Quallofil and others - these are synthetic fibers which are primarily used in sleeping bags and heavy outer garments like parkas. The fibers are **fairly efficient at providing dead air space (though not nearly as efficient as down**). Their advantages are that they **do not absorb water and dry fairly quickly**. Polarguard is made in large sheets. Hollofil is a fiber similar to Polarguard but hollow. This increases the dead air space and makes the fiber more thermally efficient. Quallofil took Hollofil one step further by creating four "holes" running through the fiber.

6. "Superthin" fibers - Primaloft, Microloft, Thinsulate and others - the principal behind these synthetic fibers is that by making the fiber thinner you can increase the amount of dead air space. For example, take an enclosed space 5 inches wide and place 2 dividers into that space, each 1 inch thick. You have an effective air layer of 3 inches. If you take the same 5 inch space and divide it with 4 dividers, each 1/4 inch thick you now have an effective air layer of 4 inches. You have gained one inch. Under laboratory conditions **a given thickness of Thinsulate is almost twice as warm as the same thickness of down**, however, the Thinsulate is 40% heavier. Thinsulate is made in sheets and therefore tends to be used primarily for outer layers, parkas and pants. New materials such as Primaloft and Microloft are superthin fibers that are close to the weight of down for an equivalent fiber volume. They are now being used in parkas and sleeping bags as an alternative to down. They stuff down to a small size and have **similar warmth to weight ratios as down without the worries about getting wet**.

7. Down - feathers are a very efficient insulator, when dry. They provide excellent dead air space for very little weight. The major problem with down (and it can be a major problem) in the winter is that **down absorbs water**. Once the feathers get wet they tend to clump, and lose dead air space. **Wet down is basically useless as an insulator**. Using down items in the winter takes **special care** to prevent them from getting wet. For example, a vapor barrier sleeping bag liner in a down bag will help the bag stay dry. Down is useful in sleeping bags since it tends to conform to the shape of the occupant and prevents convection areas. Down is very compressible, which is an advantage when putting it into your pack but also realize that your body weight compresses the feathers beneath you and you need good insulation (foam pad, etc.) underneath you, more so than with a synthetic bag. Some people are allergic to down. The effectiveness of a down bag is directly related to the quality of the feathers used. Since down is made of individual feathers, sleeping bags are garments must have baffles sewn in to prevent the down from shifting in the bag which would create cold spots.

8. Radiant Barriers - some portion of body heat is lost through radiation. One method of retaining this heat is through use of a reflective barrier such as aluminum. This is the principal used in "Space Blankets" and is also used in some bivy sacks and sleeping bags. Note: **Cotton is basically useless in winter time**. It wicks water, but unlike polypropylene, cotton absorbs this moisture and the water occupies the space previously occupied by dead air. This means a loss in dead air space, high evaporative cooling, and a garment that is almost impossible to dry out. Among guides, the well known, oft repeated, and very truthful statement is **Cotton Kills!**

Finding Water in Winter

1) Do not eat snow! It takes an incredible amount of energy to transfer water from one state to another (solid to liquid). You are burning up too many calories to do this which can quickly lead to hypothermia.

2) Fresh water. Water may be obtained by digging a hole in frozen lakes or streams where there is running water beneath the ice. *Be careful about falling in.* Remember, in most cases water will need to be purified from giardia and other bacteriological contaminants (see below).

3) Snow melt. Snow can be melted on a fire or stove to make water. It should be clean snow, *no yellow* (urine) *or pink* (bacterial growth). Because it takes so much energy to convert from one state to another you should have some water in the bottom of your container. Heat this water up and add snow to it slowly so it turns to slush and then water. This is much more efficient. If you dump in straight snow, you will only burn the bottom of your container and not make any water. By volume it takes about 10 quarts of snow to make 1 quart of water. Snow does not need purification according to SOME sources, but, I prefer to purify and be safe rather than risk being sorry because I didn't take that little bit of extra effort.

4) Winter Solar Water Collector - In a spot that will remain sunny for several hours, dig out a depression in the snow about 2 feet across and 1 foot deep. If possible, line this depression with a foam pad or other insulation (not essential but it speeds the process). Then spread a dark plastic bag (trashbag) over the depression forming a shallow dish pan. All over the raised margins pack ***clean*** snow. Drawn by the dark plastic the sun's energy will melt the snow and water will collect in the depression.

5) Keep it from freezing. Water in a pot can be stored overnight by placing the pot lid on and burying the pot under a foot of snow. Snow is such a good insulator that it will keep the water from completely freezing even in sub-zero temperatures.

6) Personal Water - You should have a water bottle with a wide mouth, otherwise the opening will easily freeze up. During the day you should carry at least one bottle next to your body (usually with a shoulder strap arrangement). Your body heat will keep it from freezing and the bottle is handy to rehydrate yourself throughout the day. Insulated water bottle holders are available for this. Other bottles can be kept upside down in an insulated container (sock etc.) preferably in an outside pocket on your pack. Being upside down will keep the mouth of the bottle from freezing. *Keep in mind that the lid must be on tightly or water will leak all over the place.* A cold water bottle may have ice crystals in the threads. As the bottle heats up from body temperature the ice may melt causing the cap to loosen also the lid may expand with heat causing leakage. At night keep your water bottles in your sleeping bag to prevent them from freezing. Just make sure they don't leak!!!

7) Getting Water - sometimes filling pots and water bottles from a stream or lake is a major expedition in itself. Make sure that the area you plan to get water from is secure. Avoid steep banks that might lead to a plunge and make sure any ice is sufficiently stable to hold your weight. Also make sure you don't get your mittens soaked with icy water. A loop of string tied tightly around the water bottle neck will allow you to lower a bottle in by hand or with a ski pole or ice axe. Don't trust pot grips on a large pot, with mittens you can lose your grip and your pot. Fill the pot up part way and then use a water bottle to top it off. Mark the area so you can find it next time.

8)Water purification - keep in mind that water gotten from streams in the winter time may have bacteriological or other contaminants. You should check with local rangers about any water problems before going in. If the water does need to be purified, the best methods during the winter are either:

Boiling - for at least 3-5 minutes (add 1 minute for every 1,000 feet above sea level so that at 10,000 feet you are boiling for 15 minutes). ***This is the best method in winter situations.***

Less Effective Methods:

Filtration- using a filtration pump system such as the PUR, First Need, or the Katadyn is **not recommended** in subfreezing temperatures. Keep in mind that the water in filters can freeze preventing them from working. Also, as the water freezes, it expands and may crack the filter, rendering it inoperable or even worse transmitting harmful microorganisms into your system. For these reasons, filters should be used with great caution in the winter. Be careful of inferior filters which do not strain out many organisms.

Chemical treatments (iodination or chlorination) are ***not recommended*** because they become ineffective at low temperatures. Only use these methods if the water has been preheated to about 60^{o} Fahrenheit.

Foods to keep you Warm

Keep you warm foods should be easily digested and provide lots of energy (calories). When you are in a survival mode is not the time to work on losing weight by skimping on calories.

Try to make sure you get at least one hot food for breakfast and 2-3 for dinner.

Some specific meal suggestions:

Breakfasts:

Cereals (hot preferred, instants - flavored or use sugar, add powdered milk)
Hot chocolate
Fresh or dried fruits (soak dried fruit in juice/water overnight first, can heat up in morning)
Sausage or bacon or ham ONLY if bagged in freezer bags and heated in bag - fatty meats burned to pan too difficult to clean up when fuel is limited).
No doughnuts or pastries (need warmth)

Lunches and Snacks:

Bread, rolls, crackers, tortillas, pita bread
Jam or jelly for quick sugar/energy
Cheese
Lunch meat or other meat if well cared for so no spoilage possible.
Italian salami or dry sausage, jerky
Hard candies, M&Ms, small chocolates (candy bars can freeze and be too hard to eat, but can be good to have if not frozen)
Nuts
Trail Mix
Dried fruits (raisins, apricots, banana chips)
Fresh fruits (apples & oranges survive well in packs)
Lemonade or fruit drink powder, or similar with sugar rather than lo-cal sugar-free

Dinners (at least 3 **hot** items):

Soups - powdered, Ramen, Cup O-Noodles
Canned stews heated in Ziplock style freezer bags used as a boil-in-bag
Bread, crackers (as at lunch)
Spaghetti, noodles, instant rice, couscous, grits, etc. - pasta/rice mixes, add cheese to macaroni and cheese mixes
Tuna helper and similar mixes with added meat
Canned or frozen meats
Look for the new foil/plastic packaged tuna and/or chicken
Canned or powdered spaghetti sauce, oriental or salsa mixes
Canned beans or chili (be aware of clean up - possibly use freezer bags to "boil in bag"
Vegetables also canned, frozen or freeze-dried
Puddings - hot puddings or jello (cool/solidify in the pan in snow, or serve warm)