Chapter 9.2: Sleeping Gear as Shelter [1]

Conceptually outward, the second layer protecting the human body is sleeping gear. It provides shelter to the body while sleeping. Actually, it is place of clothing worn while active. Again, the emphasis of this section is on underlying principles to keeping warm while sleeping.

When discussing sleeping gear, the discussion usually turns to sleeping bags. Sleeping bags have become fairly inexpensive and they have replaced bedrolls and other pre-sleeping bag methods. Regardless, the traditional bedroll can be of benefit during time of emergency. An example of how to construct the bedroll is provided. This section discusses sleeping gear with a specific emphasis on sleeping bags.

Physiological Considerations while Sleeping

Physiological considerations continues the discussion at the beginning of the clothes section. The discussion focused on water losses, layering, differential heating and protection against types of heat loss

Water Losses – When you sleep, you lose water through respiration (breathing), transpiration (sweating), and urination. In terms of the water loss table, the closest category was the "minimum exertion" category (Figure 9.1). The main water loss is through urination which accounts for rough half a quart of water overnight. This is followed by respiration and the skin which accounts for half-pint each. Sweating is minimal since the body is not normally overheated. Urination and respiration water losses are normally dispersed directly into the environment. These water losses impact the use of a pea bottle and sleeping in your clothes worn during the day.

Water losses through *respiration* while sleeping can account for roughly a half-pint of water. The 0.12 quart is roughly four ounces or a half-pint of water. This is not insignificant and can easily account for considerable condensation on the inside of a tent, particularly when all the flaps are closed. The same applies to sleeping in a car without the window cracked.

Approximately an equal amount of water vapor (half-pint) is lost through the skin. Considering the surface area of the skin, this amount of moisture can normally be accommodated without creating discomfort. Since the body is not usually overheated, there is little water loss due to sweating.

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Figure 9.1: Hydration Requirements [1]

Normal water losses per day due to:	Minimum Exertion [2]		Sleeping (6 hrs) [3]		Sleeping (8 hrs) [3]	
	quarts	% of Total	quarts	% of Total	quarts	%of Total
Urination	1.48	62%	0.37	62%	0.49	62%
Respiration	.37	15	0.09	15	0.12	15
Skin (insensible loss)	.37	15	0.09	15	0.12	15
Sweating	.10	4	0.03	4	0.03	4
Defecation	.10	4	0.03	4	0.03	4
TOTALS:	**2.42**	**100%**	**0.61**	**100%**	**0.79**	**100%**

[1] Source: adapted from – *SOLO's 2010 Wilderness First Responder Review*. P.O. Box 3150, Conway, New Hampshire: SOLO, p.57.
[2] Minimum exertion is defined as normal activity in a climate controlled building.
[3] Water losses while sleeping was extrapolated from the minimum exercise table. Sleeping conditions are most similar to minimum exercise conditions. For the calculations, sleep was assumed to be six hours or 25% of the day. This may not be accurate. Actual losses will depend on environmental condition.

Pea Bottle – When camping, this author uses a Nalgene ® bottle for urination. As a sidebar, there are several advantages to using a pea bottle. First, it is convenient. Second, it avoids the problem with allowing mosquitos into your tent as you exit and reenter the tent. This ignores any mosquitos accumulated while urinating. Third, it conserves heat. You don't have to reheat your sleeping bag. Fourth, you don't have to be completely awake to use the pea bottle. Nalgene bottles are marked on their side in ounces and milliliters. The unintentional consequence is that measuring the amount of urine overnight becomes something you begin to monitor. The amount of overnight urine can vary dramatically. Some evenings filling half of the Nalgene ® bottle occurred. Other evenings the bottle would be completely filled and then some. There was no obvious predictor of how full the bottle would be. Regardless, approximating a quart of water was not uncommon and it represents a significant loss of water during sleep.

Sleeping in Your Clothes – Many neophyte campers sleep in the clothes that they wore during the day thinking that they will sleep warmer. They reason that along with the sleeping bag, the clothes offer extra layer of insulation. Unfortunately, this strategy invariably leads to sleeping cold. The problem is that during the day the body is easily perspiring over a pint of water. There is residual moisture in your clothes. Rather than having a dry sleeping bag absorb the half-pint of water during sleeping, the overnight perspiration continues to supply moisture to the already moist clothes. The sleeper sleeps cold.

Can you wear your clothes to bed? The answer is yes. It can add another layer of insulation. It can be used to increase the effective rating of a sleeping bag. It is the application of the layering principle. The trick is to put on dry clothes, clothes that are not worn during the day. If you use this technique, keep an extra set of garments with your sleeping gear specifically for the purpose of sleeping. Usually, this includes an extra polypropylene sweater and leggings. Also, it includes wool socks and a pull over wool cap or similar cap for the head. As with your sleeping bag, make sure it has ample time to air out and dry in the morning or before using it again. If you don't and sleep in the clothes or even the undergarments worn during the day, it is a recipe for sleeping cold.

Layering – Demonstrating the principle of *layering*, dry garments can be worn while sleeping to augment insulation and effectively increase the temperature rating of a sleeping bag. Again, don't sleep in the clothes you wore during the day and expect to keep warm.

Differential heating – In the section on hypothermia, the test for hypothermia was shivering while sitting or at rest. When sitting, the muscles aren't producing heat which can heat the body and mask hypothermia. In the section on clothes, it was noted that 20%-30% of the body's heat loss can be from the head. Again, the amount of heat lost through the head is a function of activity. The waste heat from exercise and activity heat the body and the percentage of heat lost through the head decreases because so much of the heat generated by the extremities dwarf the heat lost by the head. The legs alone account for 36% of the body's surface area compared to 9% for the head. Conversely, while sleeping the major muscle groups are inactive. The extremities are producing little or no waste heat to heat the body. Heat lost through the head as a percentage of the total increases.

The corollary is three-fold. During sleep, the body is not producing waste heat and needs more insulation. This is axiomatic. Second, the head can be insulated, thereby reducing heat loss. Generally, people accomplish this one of three ways. First, they add additional insulation to the rest to the body to compensate for the heat lost to an exposed head. Second, they can add insulation to head. Wearing a wool cap provides this benefit. Third, they can pull the covers over their head, thereby adding additional insulation to the head area. Last, a person can exercise before going to bed. This increases heat production. The surplus heat warms the sleeping bag. Unfortunately, this is ephemeral. Once in the sack heat production subsides and the body is back to needing additional insulation. Regardless, exercise prior to getting into the sack does pre-heat the sleeping bag and in this sense it works well.

Protecting Against the Types of Heat Loss – There are four types of heat loss identified in the section on physiology (Figure 9.2). These are convection, conduction, radiation and evaporation. The issue of evaporation and more specifically moisture was addressed in the section on sleeping in the clothes worn during the day. Traditionally, sleeping bags protect against the two biggest sources of heat loss, convection and conduction. Preventing or retarding convection losses relates to the ability of the insulating material to trap dead air spaces. Creating dead air spaces reduces the movement of air and transferring heat. Generally, in sleeping bags, this is done through the creation of baffles which hold the insulating material.

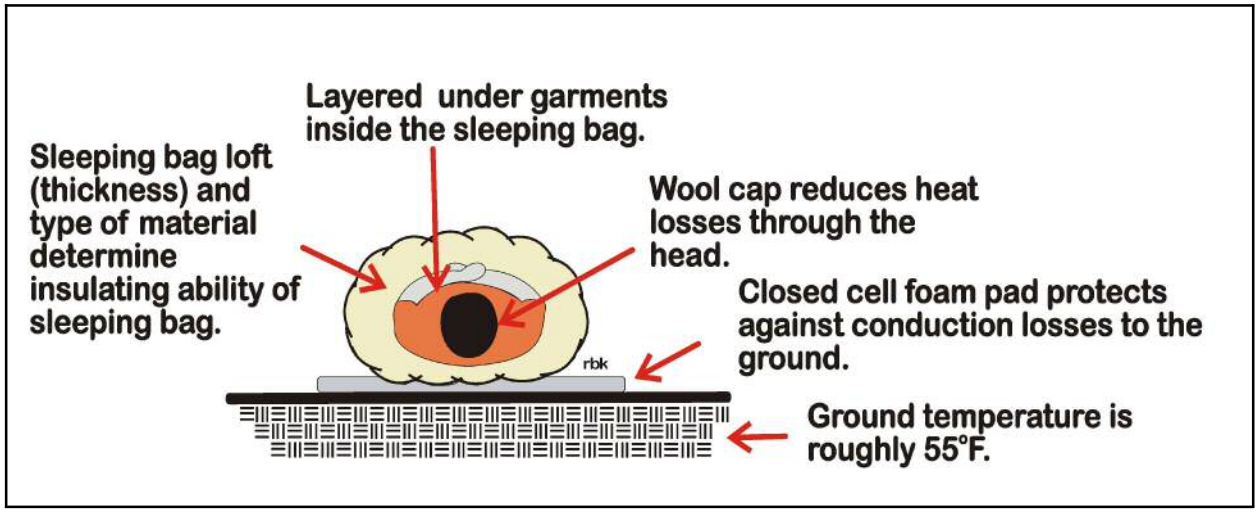

Figure 9.2: Sleeping Bag – Sources of loss through conduction, convection, etc. – Source: author

Sleeping bags come in stuff sacks. When traveling, the stuff sack provides good storage of the sleeping bag. However, for long term storage, remove the sleeping bag from the stuff and place it loosely in a large container. Many manufacturers provide a large breathable bag for this purpose. Stuffed in a stuff sack, the insulating material can become compressed and long term storage can reduce loft significantly. When unpacking the sleeping bag in the evening, allow the insulating material to naturally expand and loft to its full capability.

Conduction losses are reduced through the use of a foam pad rather than the sleeping bag itself. The ground is roughly 55ºF. This presents a source of heat loss to the body. The body sleeping tends to compress the sleeping bag where it comes in contact with the ground. The closed cell foam pad provides this insulation. Closed cell foam will not absorb water and is better in retarding heat loss than open cell foam.

Creech (2015) notes that *electromagnetic radiation* or radiant energy is being transmitted by a sleeping body. Traditionally, sleeping bags have not addressed this energy loss and it simply escaped into the atmosphere. In a vacuum thermos bottle, the silver lining reflected the radiant energy back into the thermos. The space blanket is the classic insulating device that works solely on reflecting radiant energy back toward the victim. In a sleeping bag, this can be accomplished by creating a reflective surface facing the interior of the bag to reflect the radiant energy back toward the body.

Sleeping Bags

The discussion of sleeping bags focuses on the type of sleeping bags, the materials used for insulation, sleeping bag ratings, and sleeping pads. In addition, there is a section on bedrolls and their construction.

Types of Sleeping Bags – Sleeping bags are identified primarily by their shape. These include mummy sacks, rectangular, modified rectangular, etc.

Mummy sacks are contoured to the body (Figure 9.3). This minimizes the amount of exposed surface area and maximizes the insulating capability of the sleeping bags. Actually, the better bags have considerable flexibility in movement and the contoured shape is not restrictive. Because of its inherent insulating advantages, the better quality sleeping bags tend to be mummy sacks or a variation of the design. Look at the closure mechanism around the head. The high quality designs can become quite sophisticated which is good for extreme camping circumstances. Often the less sophisticated designs are more practical for normal use.

Figure 9.3: Mummy Sack

Figure 9.4: Rectangular Sleeping Bag

Figure 9.5: Tapered Rectangular Sleeping Bag

As their name suggests, rectangular sleeping bags are rectangular in shape (Figure 9.4). They provide more freedom of movement for the legs in the sleeping bag. Also, the opening for the head is wide and usually there is no mechanism to draw the sleeping bag down around the head. Because this design is inherently less efficient than the mummy sack, the design tends to be used more with the less expensive sleeping bags. A modified rectangular sleeping bag is a rectangular sleeping bag with a tapered bottom (Figure 9.5).

Figure 9.6: Not All Goose Down Is the Same – Source: from John Francis Maggio – Western Mountain Sports in Creech (2015).

Materials – Goose down was originally the premier fill in sleeping bags. It has many good qualities including its ability to create dead air spaces and light weight. It has one big drawback. When it becomes wet, it is like a wet sponge and loses all of its insulating ability. Because of its disadvantages when wet, down lost favor during the 1980s and 1990s. However, with the advent of breathable waterproof materials like Gore Tex ® and similar materials and their use in sleeping bags, goose down has made a comeback in recent years.

Not all goose down is the same quality (figure 9.6). As with most natural materials, goose down is graded according to its quality. Figure 9.5 shows the loft for one ounce of different grades of goose down. The loft ranges from 300 to 400 for the low end goose down and 600 to 700 or nearly twice the loft for the high quality goose down. Clearly, not all goose down is the same. As a rule, you will get what you pay for. Deal with reputable manufacturers.

There are a plethora of artificial materials used for insulation in sleeping bags. They include names such as Polarguard ®, Hollofil ® and Thermolite ®. As a general rule, these sleeping bags take more material to provide the same level of insulation as goose down. However, they handle the water issue much better. On one Everglades trip, this author accidently got his sleeping bag thoroughly wet. The next day it was hung up to dry in a brisk wind and within an hour and one half, it was completely dry.

Sleeping Bag Ratings – Creech (2015) notes that sleeping bag ratings are left to the discretion of the manufacturer. Also, he notes that they are rated for survival rather than comfort. The result is that they are significantly underrated. He notes that most people will need a sleeping bag rated about 20° to 25° colder than the expected nighttime temperature on their camping trip. If you are expecting 30° to 40° degree nights, buy a 10° to 30° sleeping bag and sleep comfortably.

Sleeping Pads – The first benefit of a sleeping pad is comfort. It is the equivalent of a mattress. A second benefit is that it insulates the body from the ground and its ambient temperature of roughly 55°F. Generally, a closed cell foam provides better insulation than an open cell foam which will allow for more air movement through it. Also, closed cell foam is impervious to water. Open cell foam can act like a sponge.

Foam pads are not the only alternative. Air mattresses are available. In theory, air mattresses provide less thermal protection than a foam pad. However, they do offer protection from direct contact with the ground. Also, there are combined foam and air mattresses which combine the comfort of the air mattress with the thermal protection of a foam pad. In addition, the foam pad provides cushioning if the air mattress is low. For the non-backpacker types, there are other alternative including portable cots.

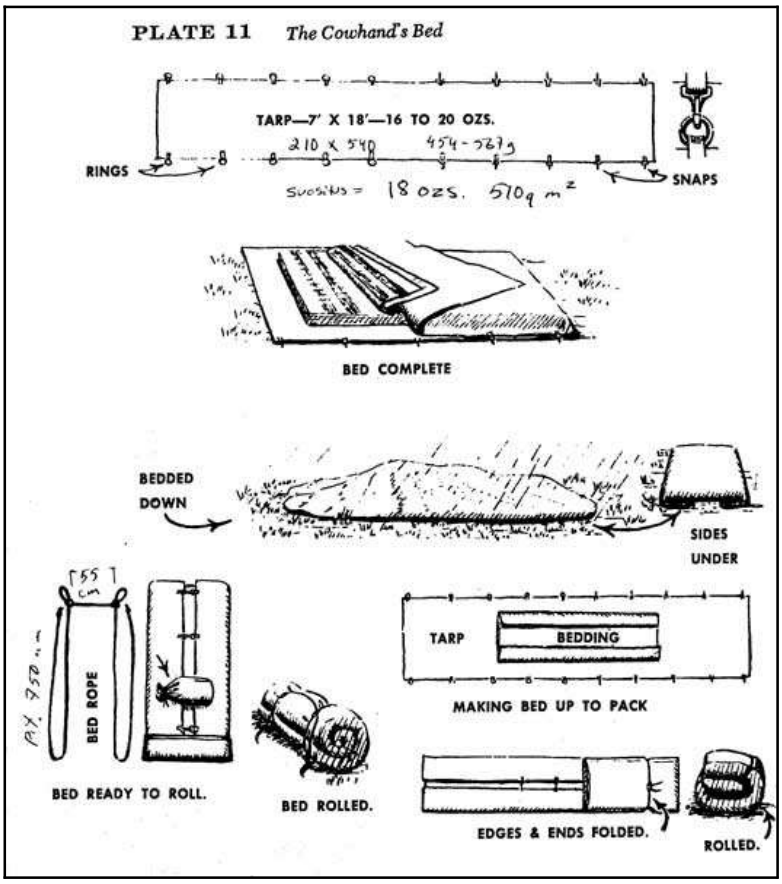

Figure 9.7: Cowboy Bedroll – Source: Bedroll (2007)

Bed Rolls – There are alternatives to sleeping bags. A quick search of the internet reveals several alternatives. However, several of the alternative are really built around a sleeping bag and requires a sleeping bag as part of their construction. In contrast, Web (2014) and (Bedrolls, 2007) provide instructions for a Cowboy Bedroll. Figure 9.7 is from Bedrolls (2007). The cowboy bedroll utilizes a canvas tarp in its construction. Although the canvas tarp is not waterproof, it is water resistant. When canvas gets wet, its fibers expand and seals the fabric from water penetration.

Summary

The test for hypothermia was to determine if a person is shivering while at rest. Normally, at rest was sitting down for a brief period. In contrast, sleeping can be considered truly at rest. The result is that a sleeping person needs additional insulation to keep warm. The easiest way to increase insulation is to purchase a sleeping bag that is rated for temperatures 20°F to 25°F colder than the temperatures you are actually expecting. You can increase insulation by adding layers with additional clothing. Just don't wear the clothes that you wore during the day. Be sure to use a closed-cell foam pad underneath your sleeping bag to reduce losses to conduction. A good night's rest is important to good performance during the day. Also, it reduces the likelihood of mishaps and accidents.

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