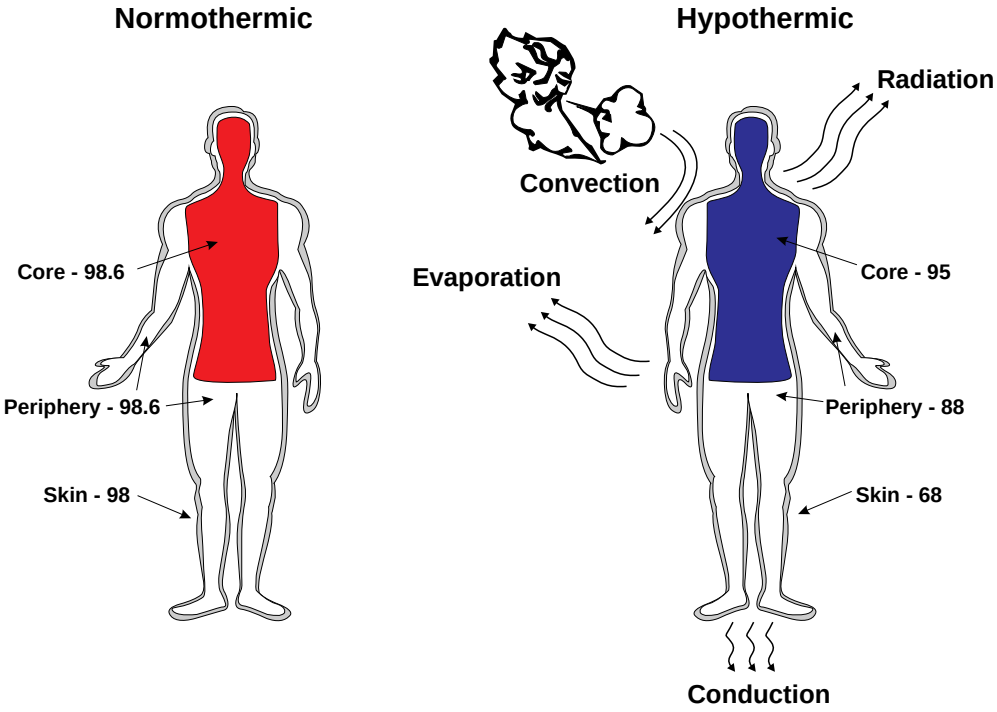
Outdoor Action Guide to Hypothermia and ColdWeather Injuries

by Rick Curtis

How We Lose Heat to the Environment



1. **Radiation** - loss of heat to the environment due to the temperature gradient (this occurs only as long as the ambient temperature is below 98.6). Factors important in radiant heat loss are the surface area and the temperature gradient.

2. **Conduction** - through direct contact between objects, molecular transference of heat energy
   a. Water conducts heat away from the body 25 times faster than air because it has a greater density (therefore a greater heat capacity). **Stay dry = stay alive!**
   b. Steel conducts heat away faster than water
   Example: Generally conductive heat loss accounts for only about 2% of overall loss. However, with wet clothes the loss is increased 5x.

3. Convection - is a process of conduction where one of the objects is in motion. Molecules against the surface are heated, move away, and are replaced by new molecules which are also heated. The rate of convective heat loss depends on the density of the moving substance (water convection occurs more quickly than air convection) and the velocity of the moving substance.

a. Wind Chill - is an example of the effects of air convection, the wind chill table gives a reading of the amount of heat lost to the environment relative to a still air temperature.

4. Evaporation - heat loss from converting water from a liquid to a gas

a. Perspiration - evaporation of water to remove excess heat

- Sweating - body response to remove excess heat
- Insensible Perspiration - body sweats to maintain humidity level of 70% next to skin - particularly in a cold, dry environment you can lose a great deal of moisture this way
- Respiration - air is heated as it enters the lungs and is exhaled with an extremely high moisture content
- It is important to recognize the strong connection between fluid levels, fluid loss, and heat loss. As body moisture is lost through the various evaporative processes the overall circulating volume is reduced which can lead to dehydration. This decrease in fluid level makes the body more susceptible to hypothermia and other cold injuries.

Response to Cold

Cold Challenge - (negative factors)

Temperature
Wet (rain, sweat, water)
Wind (blowing, moving, e.g. biking)

Total = Cold Challenge

Heat Retention - (positive factors)

Size/shape (Eskimo vs. Masai)
Insulation (layering/type)
Fat (as insulation)
Shell/core (shunt blood to core) shell acts as a thermal barrier

Total = Heat Retention

Heat Production - (positive factors)

Exercise, shivering

Limited by:

- Fitness
- Fuel stores (glycogen)
- Fluid status (efficient exercise)
- Food intake (kindling, sticks, logs)

Total = Heat Production

Heat Retention	+	Heat Production	<	Cold Challenge	=	Hypothermia
Insulation Body Fat Surface to Vol. Shell/Core Shunt		Exercise Shivering		Temperature Wetness Wind		

Your Body Core Temperature

1. Heat is both required and produced at the cellular level. The environment acts as either a heating or a cooling force on the body. The body must be able to generate heat, retain heat, and discharge heat depending on the body activity and ambient external temperature.
2. Body temperature is a measure of the metabolism - the general level of chemical activity within the body.
3. The hypothalamus is the major center of the brain for regulating body temperature. It is sensitive to blood temperature changes of as little as 0.5 degrees Celsius and also reacts to nerve impulses received from nerve endings in the skin.
4. The optimum temperature for chemical reactions to take place in the body is 98.6 degrees F. Above 105 F many body enzymes become denatured and chemical reactions cannot take place leading to death. Below 98.6 F chemical reactions slow down with various complications which can lead to death.
5. **Core** = the internal body organs, particularly the heart, lungs, and brain.
   Periphery = the appendages, skin, and muscle tissue.
6. Core temperature is the temperature that is essential to the overall metabolic rate of the body. The temperature of the periphery is not critical.

How Your Body Regulates Core Temperature

1. **Vasodilation** - increases surface blood flow, increases heat loss (when ambient temperature is less that body temperature). Maximal vasodilation can increase cutaneous blood flow to 3000 ml/minute (average flow is 300-500 ml/minute).
2. **Vasoconstriction** - decreases blood flow to periphery, decreases heat loss. Maximal vasoconstriction can decrease cutaneous blood flow to 30 ml/minute.
3. **Sweating** - cools body through evaporative cooling
4. **Shivering** - generates heat through increase in chemical reactions required for muscle activity. Visible shivering can maximally increase surface heat production by 500%. However, this is limited to a few hours because of depletion of muscle glucose and the onset of fatigue.
5. **Increasing/Decreasing Activity** will cause corresponding increases in heat production and decreases in heat production.
6. **Behavioral Responses** - putting on or taking off layers of clothing will result in heat regulation

Hypothermia

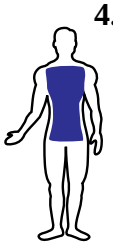
1. **Hypothermia** - "a decrease in the core body temperature to a level at which normal muscular and cerebral functions are impaired." - Medicine for Mountaineering

2. **Conditions Leading to Hypothermia**
   - Cold temperatures
   - Improper clothing and equipment
   - Wetness
   - Fatigue, exhaustion
   - Dehydration
   - Poor food intake
   - No knowledge of hypothermia
   - Alcohol intake - causes vasodilation leading to increased heat loss

3. **What are "hypothermia" temperatures**

- Below freezing
- 40 degrees
- 60 degrees - Ex. rain and high winds
- Any temperature less than 98.6 degrees can be linked to hypothermia (ex. hypothermia in the elderly in cold houses) or peripheral circulation problems such as trench foot and frostbite.

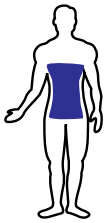
4. Signs and Symptoms of Hypothermia



a. **Watch for the "-Umbles"** - stumbles, mumbles, fumbles, and grumbles which show changes in motor coordination and levels of consciousness

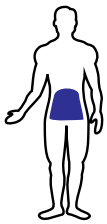
b. **Mild Hypothermia** - core temperature 98.6 - 96 degrees F

- Shivering - not under voluntary control
- Can't do complex motor functions (ice climbing or skiing) can still walk & talk
- Vasoconstriction to periphery



c. **Moderate Hypothermia** - core temperature 95 - 93 degrees F

- Dazed consciousness
- Loss of fine motor coordination - particularly in hands - can't zip up parka, due to restricted peripheral blood flow
- Slurred speech
- Violent shivering
- Irrational behavior - Paradoxical Undressing - person starts to take off clothing, unaware s/he is cold
- "I don't care attitude" - flattened affect



d. **Severe Hypothermia** - core temperature 92 - 86 degrees and below *(immediately life threatening)*

- Shivering occurs in waves, violent then pause, pauses get longer until shivering finally ceases - because the heat output from burning glycogen in the muscles is not sufficient to counteract the continually dropping core temperature, the body shuts down on shivering to conserve glucose
- Person falls to the ground, can't walk, curls up into a fetal position to conserve heat
- Muscle rigidity develops - because peripheral blood flow is reduced and due to lactic acid and CO_2 buildup in the muscles
- Skin is pale
- Pupils dilate
- Pulse rate decreases
- at 90 degrees the body tries to move into hibernation, shutting down all peripheral blood flow and reducing breathing rate and heart rate.
- at 86 degrees the body is in a state of "metabolic icebox." The person looks dead but is still alive.

e. **Death from Hypothermia**

- Breathing becomes erratic and very shallow
- Semi-conscious
- Cardiac arrythmias develop, any sudden shock may set off Ventricular Fibrillation
- Heart stops, death

5. How to Assess if someone is Hypothermic

- If shivering can be stopped voluntarily = mild hypothermia
- Ask the person a question that requires higher reasoning in the brain (count backwards from 100 by

9's). If the person is hypothermic, they won't be able to do it. [Note: there are also other conditions such as altitude sickness that can also cause the same condition.]

- If shivering cannot be stopped voluntarily = moderate - severe hypothermia
- If you can't get a radial pulse at the wrist it indicates a core temp below 90 - 86 degrees
- The person may be curled up in a fetal position. Try to open their arm up from the fetal position, if it curls back up, the person is alive. Dead muscles won't contract only live muscles.

Stage	Core Temperature	Signs & Symptoms
Mild Hypothermia	99º - 97ºF	Normal, shivering can begin
	97º - 95ºF	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb
Moderate Hypothermia	95º - 93ºF	Shivering, intense, muscle incoordination becomes apparent, movements slow and labored, stumbling pace, mild confusion, may appear alert. Use sobriety test, if unable to walk a 30 foot straight line, the person is hypothermic.
	93º - 90ºF	Violent shivering persists, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, difficulty speaking, signs of depression, withdrawn
Severe Hypothermia	90º - 86ºF	Shivering stops, exposed skin blue of puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behavior, but may be able to maintain posture and appearance of awareness
	86º - 82ºF	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation
	82º - 78ºF	Unconscious, heart beat and respiration erractic, pulse may not be palpable
	78º - 75ºF	Pulmonary edema, cardiac and respiratory failure, death. Death may occur before this temperature is reached.

Treating Hypothermia

The basic principles of rewarming a hypothermic victim are to conserve the heat they have and replace the body fuel they are burning up to generate that heat. If a person is shivering, they have the ability to rewarm themselves at a rate of 2 degrees C per hour.

Mild - Moderate Hypothermia

1. Reduce Heat Loss

a. Additional layers of clothing
b. Dry clothing
c. Increased physical activity
d. Shelter

2. Add Fuel & Fluids

It is essential to keep a hypothermic person adequately hydrated and fueled.

a. Food types
- Carbohydrates - 5 calories/gram - quickly released into blood stream for sudden brief heat surge - these are the best to use for quick energy intake especially for mild cases of hypothermia
- Proteins - 5 calories/gram - slowly released - heat given off over a longer period

- Fats - 9 calories/gram - slowly released but are good because they release heat over a long period, however, it takes more energy to break fats down into glucose - also takes more water to break down fats leading to increased fluid loss

b. Food intake

- Hot liquids - calories plus heat source
- Sugars (kindling)
- GORP - has both carbohydrates (sticks) and protiens/fats (logs)

c. Things to avoid

- Alcohol - a vasodilator - increases peripheral heat loss
- Caffeine - a diuretic - causes water loss increasing dehydration
- Tobacco/nicotine - a vasoconstrictor, increases risk of frostbite

3. Add Heat

- Fire or other external heat source
- Body to body contact. Get into a sleeping back, in dry clothing with a normothermic person in lightweight dry clothing

Severe Hypothermia

1. Reduce Heat Loss

- **Hypothermia Wrap**: The idea is to provide a shell of total insulation for the patient. No matter how cold, patients can still internally rewarm themselves much more efficiently than any external rewarming. Make sure the patient is **dry**, and has a polypropylene layer to minimize sweating on the skin. The person must be protected from any moisture in the environment. Use multiple sleeping bags, wool blankets, wool clothing, Ensolite pads to create a minimum of 4" of insulation all the way around the patient, especially between the patient and the ground. Include an aluminum “space” blanket to help prevent radiant heat loss, and wrap the entire ensemble in plastic to protect from wind and water. If someone is truly hypothermic, don’t put him/her naked in a sleeping bag with another person.

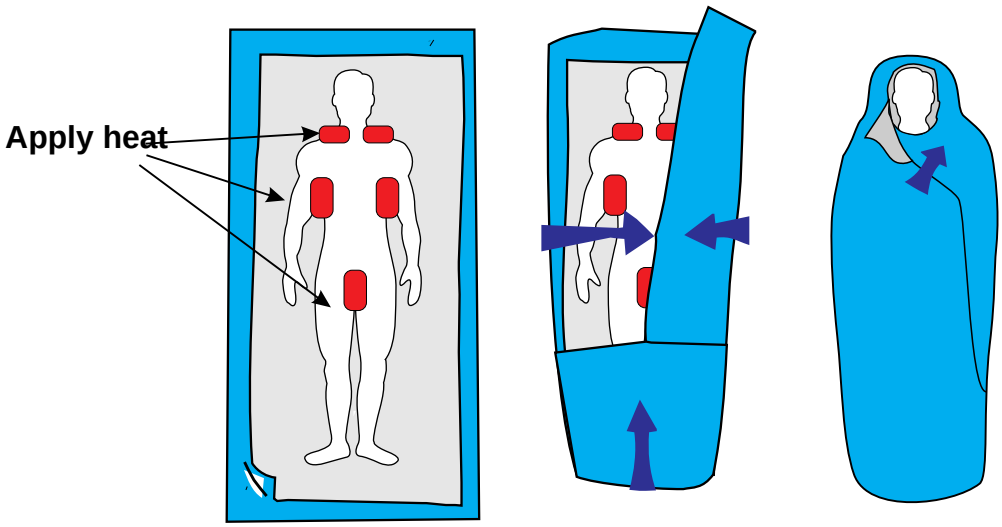
2. Add Fuel & Fluids

- **Warm Sugar Water** - for people in severe hypothermia, the stomach has shut down and will not digest solid food but can absorb water and sugars. Give a dilute mixture of warm water with sugar every 15 minutes. Dilute Jello™ works best since it is part sugar and part protien. This will be absorbed directly into the blood stream providing the necessarry calories to allow the person to rewarm themselves. One box of Jello = 500 Kilocalories of heat energy. ***Do not*** give full strength Jello even in liquid form, it is too concentrated and will not be absorbed.
- **Urination** - people will have to urinate from cold diuresis. Vasoconstriction creates greater volume pressure in the blood stream. The kidnies pull off excess fluid to reduce the pressure. A full bladder is a place for additional heat loss so urinating will help conserve heat. You will need to help the person urinate. Open up the Hypothermia Wrap enough to do this and then cover them back up. You will need to keep them hydrated with the dilute Jello solution described above.

3. Add Heat

Heat can be applied to transfer heat to major arteries - at the neck for the carotid, at the armpits for the brachial, at the groin for the femoral, at the palms of the hands for the arterial arch.

- Chemical heat packs such as the Heat Wave™ provides 110 degrees F for 6-10 hours.
- Hot water bottles, warm rocks, towels, compresses
- For a severely hypothermic person, rescue breathing can increase oxygen and provide internal heat.



Hypothermia Wrap

Afterdrop

Is a situation in which the core temperature actually decreases during rewarming. This is caused by peripheral vessels in the arms and legs dilating if they are rewarmed. This dilation sends this very cold, stagnate blood from the periphery to the core further decreasing core temperature which can lead to death. In addition, this blood also is very acetic which may lead to cardiac arrythmias and death. ***Afterdrop can best be avoided by not rewarming the periphery. Rewarm the core only!*** **Do not expose a severely hypothermic victim to extremes of heat.**

CPR & Hypothermia

When a person is in severe hypothermia they may demonstrate all the accepted clinical signs of death:

- Cold
- Blue skin
- Fixed and dilated pupils
- No discernable pulse
- No discernable breathing
- Comatose & unresponsive to any stimuli
- Rigid muscles

But they still may be alive in a "metabolic icebox" and can be revived. You job as a rescuer is to rewarm the person and do CPR if indicated. **A hypothermia victim is never cold and dead only warm and dead.** During severe hypothermia the heart is hyperexcitable and mechanical stimulation (such as CPR, moving them or Afterdrop) may result in fibrillation leading to death. As a result CPR may be contraindicated for some hypothermia situations:

1. ***Make sure you do a complete assessment of heart rate before beginning CPR.*** Remember, the heart rate may be 2-3/minute and the breathing rate 1/30 seconds. Instituting cardiac compressions at this point may lead to life-threatening arrythmias. Check the carotid pulse for a longer time period (up to a minute) to ascertain if there is some slow heartbeat. Also, even though the heart is beating very slowly, it is filling completely and distributing blood fairly effectively. External cardiac compressions only are 20-30% effective. Thus, with its severely decreased demands, the body may be able to satisfy its circulatory needs with only 2-3 beats per minute. ***Be sure the pulse is absent before beginning CPR. You will need to continue to do CPR as you rewarm the person.***

2. Ventilation may have stopped but respiration may continue - the oxygen demands for the body have been so diminished with hypothermia that the body may be able to survive for some time using only the oxygen that is already in the body. If ventilation has stopped, artificial ventilation may be started to increase available oxygen. In addition, blowing warm air into the persons lungs may assist in internal rewarming.

3. CPR Procedures
- Check radial pulse, between 91.4 and 86 degrees F this pulse disappears
- Check for carotid pulse - wait at least a full minute to check for very slow heartbeat
- If pulse but not breathing or slow breathing, give rescue breathing (also adds heat).
- If no discernible heartbeat begin CPR and be prepared to continue - persons with hypothermia have been given CPR for up to 3.5 hours and have recovered with *no* neurological damage
- Begin active rewarming

Cold Injuries

Tissue temperature in cold weather is regulated by two factors, the external temperature and the internal heat flow. All cold injuries described below are intimately connected with the degree of peripheral circulation. As peripheral circulation is reduced to prevent heat loss to the core these conditions are more likely to occur.

1. Factors influencing cold injuries
- Low ambient temperature
- Wind chill - increases rate of freezing dramatically
- Moisture - wet skin freezes at a higher temp than dry
- Insulation
- Contact with metal or supercooled liquids (white gas)
- Exposed skin
- Vasodilation
- Vasoconstriction
- Previous cold injuries
- Constricting garments
- Local pressure
- Cramped position
- Body type
- Dehydration
- Women do better in cold than men (greater subcutaneous body fat)
- Caloric intake
- Diabetes, some medications
- Alcohol
- Caffeine, nicotine

2. Cold-induced Vasodilation - When a hand or foot is cooled to 59 degrees F, maximal vasoconstriction and minimal blood flow occur. If cooling continues to 50 degrees, vasoconstriction is interrupted by periods of vasodilation with an increase in blood and heat flow. This “hunting” response recurs in 5-10 minute cycles to provide some protection from cold. Prolonged, repeated exposure increases this response and offers some degree of acclimatization. Ex. Eskimos have a strong response with short intervals in between.

3. Pathophysiology of Tissue Freezing - As tissue begins to freeze, ice crystals are formed within the cells. As intracellular fluids freeze, extracellular fluid enters the cell and there is an increase in the levels of extracellular salts due to the water transfer. Cells may rupture due to the increased water and/or from tearing by the ice crystals. ***Do not rub tissue; it causes cell tearing from the ice crystals.*** As the ice melts there is an influx of salts into the tissue further damaging the cell membranes. Cell destruction results in tissue death and loss of tissue. Tissue can't freeze if the temperature is above 32 degrees F. It has to be below 28 degrees F because of the salt content in body fluids. Distal areas of the body and areas with a high surface to volume ratio are the most susceptible (e.g ears, nose, fingers and toes - this little rhyme should help remind you what to watch out for in yourself and others).

- Surface frostbite generally involves destruction of skin layers resulting in blistering and minor tissue loss. Blisters are formed from the cellular fluid released when cells rupture.
- Deep frostbite can involve muscle and bone

	Cold Response	Mild Frostnip	Superficial Frostbite	Deep Frostbite
Sensation	Painful	May have sensation	Numb	Numb
Feels	Normal	Normal	Soft	Hard
Color	Red	White	White	White

4. Cold Response

- Circulation is reduce to the are to prevent heat loss.
- The area may be pale, cold.
- It may have sensation or be numb.

5. Frostnip

- Freezing of top layers of skin tissue
- It is generally reversible
- White, waxy skin, top layer feels hard, rubbery but deeper tissue is still soft
- Numbness
- Most typically seen on cheeks, earlobes, fingers, and toes

Treatment

- Rewarm the area gently, generally by blowing warm air on it or placing the area against a warm body part (partner's stomach or armpit)
- ***Do not rub the area*** - this can damage the effected tissue by having ice crystals tear the cell

6. Frostbite

- Skin is white and "wooden" feel all the way through
- Superficial frostbite includes all layers of skin
- Numbness, possible anesthesia
- Deep frostbite can include freezing of muscle and/or bone, it is very difficult to rewarm the append age without some damage occurring

Treatment

- Superficial frostbite may be rewarmed as frostnip if only a small area is involved
- If deep frostbite, see below for rewarming technique

7. Rewarming of Frostbite

- Rewarming is accomplished by immersion of the effected part into a water bath of 105 - 110 degrees F. ***No hotter or additional damage will result.*** This is the temperature which is warm to your skin. Monitor the temperature carefully with a thermometer. Remove constricting clothing. Place the appendage in the water and continue to monitor the water temperature. This temperature will drop so that additional warm water will need to be added to maintain the 105 - 110 degrees. ***Do not*** add this warm water directly to the injury. The water will need to be circulated fairly constantly to maintain even temperature. The effected appendage should be immersed for 25 - 40 minutes. Thawing is complete when the part is pliable and color and sensation has returned. Once the area is rewarmed, there can be significant pain. Discontinue the warm water bath when thawing is complete.
- ***Do not use dry heat to rewarm. It cannot be effectively maintained at 105 - 110 degrees and can cause burns further damaging the tissues.***
- Once rewarming is complete the injured area should be wrapped in sterile gauze and protected from movement and further cold.
- ***Once a body part has been rewarmed it cannot be used for anything. Also it is essential that the part can be kept from refreezing.*** Refreezing after rewarming causes extensive tissue damage and may result in loss of tissue. If you cannot ***guarantee*** that the tissue will stay warm, ***do not rewarm it.*** Mountaineers have walked out on frozen feet to have them rewarmed after getting out with no tissue loss. Once the tissue is frozen the major harm has been done. Keeping it frozen will not cause significant additional damage.

8. Special Considerations for Frostbite

- If the person is hypothermic and frostbitten, the first concern is core rewarming. Do not rewarm the frostbitten areas until the core temp approaches 96 degrees.
- No alcohol - vasodilation may increase fluid buildup
- No smoking - nicotine as a vasoconstrictor may increase chances for developing frostbite
- Liquids such as white gas can “supercool” in the winter (drop below their freezing point but not freeze). White gas also evaporates quickly into the air. Spilling supercooled white gas on exposed skin leads to instant frostbite from evaporative cooling. Always were gloves when handling fuel.
- Touching metal with bare skin can cause the moisture on your skin to freeze to the metal. (In really cold conditions, metal glasses frames can be a problem). When you pull away, you may leave a layer of skin behind. Don’t touch metal with bare skin.

9. Trench Foot - Immersion Foot

Trench foot is a process similar to chillblains. It is caused by prolonged exposure of the feet to cool, wet conditions. This can occur at temperatures as high as 60 degrees F if the feet are constantly wet. This can happen with wet feet in winter conditions or wet feet in much warmed conditions (ex. sea kayaking). The mechanism of injury is as follows: wet feet lose heat 25x faster than dry, therefore the body uses vasoconstriction to shut down peripheral circulation in the foot to prevent heat loss. Skin tissue begins to die because of lack of oxygen and nutrients and due to buildup of toxic products. The skin is initially reddened with numbness, tingling pain, and itching then becomes pale and mottled and finally dark purple, grey or blue. The effected tissue generally dies and sluffs off. In severe cases trench foot can involve the toes, heels, or the entire foot. If circulation is impaired for > 6 hours there will be permanent damage to tissue. If circulation is impaired for > 24 hours the victim may lose the entire foot. Trench Foot cuases permanent damage to the circulatory system making the person more prone to cold related injuries in that area. A similar phenomenon can occur when hands are kept wet for long periods of time such as kayaking with wet gloves or pogies. The damage to the circulatory system is known as Reynaud’s Phenomenon.

Treatment and Prevention of Trench foot

- Includes careful washing and drying of the feet, gentle rewarming and slight elevation. Since the tissue is not frozen as in severe frostbite it is ***more*** susceptible to damage by walking on it. Cases of trench foot should not walk out; they should be evacuated by litter. Pain and itching are common complaints. Give Ibuprofen or other pain medication.
- Prevention is the best approach to dealing with trench foot. Keep feet dry by wearing appropriate footwear. Check your feet regularly to see if they are wet. If your feet get wet (through sweating or immersion), stop and dry your feet and put on dry socks. Periodic air drying, elevation, and massage will also help. Change socks at least once a day and do not sleep with wet socks. Be careful of tight socks which can further impair peripheral circulation. Foot powder with aluminum hydroxide can help. High altitude mountaineers will put antiperspirant on their feet for a week bfore the trip. The active ingredient, aluminum hydroxide will keep your feet from sweating for up to a month and their are no confirmed contraindications for wearing antiperspirant. [Some studies have shown links between alumnium in the body and Alzheimers.] Vapor barrier socks may increase the possibility of trenchfoot. When you are active and you are wearing 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. You must experiment to determine if vapor barrier systems will work for you.

10. Chillblains

- Caused by repeated exposure of bare skin to temperatures below 60 degrees
- Redness and itching of the effected area
- Particularly found on cheeks and ears, fingers and toes
- Women and young children are the most susceptible
- The cold exposure causes damage to the peripheral capillary beds, this damage is permanent and the redness and itching will return with exposure

11. Avoiding Frostbite and Cold related Injuries

- "Buddy system" - keep a regular watch on each other's faces, cheeks, ears for signs of frostnip/frostbite
- Keep a regular "self check" for cold areas, wet feet, numbness or anesthesia
- ***If at any time you discover a cold injury, stop and rewarm the area (unless doing so places you at greater risk).***

12. Eye Injuries

a. Freezing of Cornea
  - Caused by forcing the eyes open during strong winds without goggles
  - Treatment is very controlled, rapid rewarming e.g. placing a warm hand or compress over the closed eye. After rewarming the eyes must be completely covered with patches for 24 - 48 hours.

b. Eyelashes freezing together
  - Put hand over eye until ice melts, then can open the eye

c. Snowblindness
  - Sunburn of the eyes
  - Prevention by wearing good sunglasses with side shields or goggles. Eye protection from sun is just as necessary on cloudy or overcast days as it is in full sunlight when you are on snow. Snow blindness can even occur during a snow storm if the cloud cover is thin.
  - Symptoms
    - Occur 8-12 hours after exposure

- Eyes feel dry and irritated, then feel as if they are full of sand, moving or blinking becomes extremely painful, exposure to light hurts the eyes, eyelids may swell, eye redness, and excessive tearing

- Treatment
  - Cold compresses and dark environment
  - Do not rub eyes

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The Wind Chill Index

Environmental Temperature (F°)																					
Calm	40°	35°	30°	25°	20°	15°	10°	5°	0°	-5°	-10°	-15°	-20°	-25°	-30°	-35°	-40°	-45°	-50°	-55°	-60°
Wind Speed	**Apparent Temperature (F°)**																				
5 MPH	35°	30°	25°	20°	15°	10°	5°	0°	-5°	-10°	-15°	**-20°**	**-25°**	**-30°**	**-35°**	**-40°**	**-45°**	**-50°**	**-55°**	**-65°**	**-70°**
10 MPH	30°	20°	15°	10°	5°	0°	-10°	-15°	-20°	**-25°**	**-35°**	**-40°**	**-45°**	**-50°**	**-60°**	**-65°**	**-70°**	**-70°**	**-80°**	**-90°**	**-95°**
15 MPH	25°	15°	10°	0°	-5°	-10°	-20°	**-25°**	**-30°**	**-40°**	**-45°**	**-50°**	**-60°**	**-65°**	**-70°**	**-80°**	**-85°**	**-90°**	**-100°**	**-105°**	**-110°**
20 MPH	20°	10°	5°	0°	-10°	-15°	**-25°**	**-30°**	**-35°**	**-45°**	**-50°**	**-60°**	**-65°**	**-75°**	**-80°**	**-85°**	**-95°**	**-100°**	**-110°**	**-115°**	**-120°**
25 MPH	15°	10°	0°	-5°	-15°	-20°	**-30°**	**-35°**	**-45°**	**-50°**	**-60°**	**-65°**	**-75°**	**-80°**	**-90°**	**-95°**	**-105°**	**-110°**	**-120°**	**-125°**	**-135°**
30 MPH	10°	5°	0°	-10°	-20°	**-25°**	**-30°**	**-40°**	**-50°**	**-55°**	**-65°**	**-70°**	**-80°**	**-85°**	**-95°**	**-100°**	**-110°**	**-115°**	**-125°**	**-130°**	**-140°**
35 MPH	10°	5°	-5°	-10°	-20°	**-30°**	**-35°**	**-40°**	**-50°**	**-60°**	**-65°**	**-75°**	**-80°**	**-90°**	**-100°**	**-105°**	**-115°**	**-120°**	**-130°**	**-135°**	**-145°**
40 MPH	10°	0°	-5°	-15°	-20°	**-30°**	**-35°**	**-45°**	**-55°**	**-60°**	**-70°**	**-75°**	**-85°**	**-95°**	**-100°**	**-110°**	**-115°**	**-125°**	**-130°**	**-140°**	**-150°**

	Little Danger of exposed flesh freezing.
	Increasing danger of exposed flesh freezing (flesh can freeze within 1 minute).
	Great danger of exposed flesh freezing (flesh can freeze within 30 seconds).