

Thunderstorms and Camping Safety

by

Chuck Doswell

**Senior Research Scientist, Cooperative Institute for Mesoscale Meteorology
and Assistant Scoutmaster, Troop 777, Norman, OK***

Last Update: 21 December 2001. modified the disclaimer.

NOTICE: All images used on this page are copyrighted (unless otherwise noted); any duplication of copyrighted images, electronically or otherwise, is a violation of Federal law. Contact me at: cdoswell@earthlink.net to discuss use of any of these images.

***Disclaimer:** This page is not officially condoned in any way ... it has no formal recognition by my place of employment, the Federal Government, or the Boy Scouts of America. I offer these ideas in the spirit of providing information that can benefit campers as they plan their outdoor experiences. **This information carries with it no implication of providing absolute safety from thunderstorm hazards** ... rather, this information is aimed at improving your odds of not having a bad experience with the hazards produced by thunderstorms. If you have suggestions, additions, or corrections, please e-mail me at: cdoswell@hoth.gcn.ou.edu.

When folks go camping, whether into the wilderness or just locally, they have to be prepared to deal with whatever weather happens to be going on during their campout. If you've done any camping at all, chances are you've experienced a few thunderstorms, up close and personal in a tent, or while hiking and otherwise enjoying the outdoors.

It's my "day job" to be involved in hazardous weather, mostly from thunderstorms. Thunderstorms have a [beneficial side](#), but on some occasions, they become more than a minor inconvenience for campers and those involved in outdoor activities. Through my Scouting experiences, I've had many opportunities to see how young people and their adult leaders operate during a campout.

Teenage boys are legendary for trying to act "macho" and getting stuck in situations that have become dangerous. Unfortunately, adult leaders sometimes can be just as silly and ignorant as the boys. It's often said "What you don't know can't hurt you." Absolutely wrong!! Ignorance and macho trips can result in terrible tragedies once in a while, and I doubt that anyone would want that on their conscience.

Lightning hazards

Thunderstorms all produce lightning in varying amounts ... sometimes there's just an odd flash or two ... other times, the storms produce lightning nearly continuously, with lots of flashes to ground. It's the flashes from the cloud to the ground (CG flashes, for short) that create problems. They typically are only a small percentage of the total flashes produced by a thunderstorm; most lightning stays within the clouds. But it only takes *one* CG flash to get you! The human body is basically a bag of salty water, which conducts electricity a lot better than air, so the lightning will often try to travel through you to reach the ground.

Lightning and thunder are so common as to seem just part of the background. Often, as children, lightning and thunder frighten us. As young people mature (especially boys), it becomes a "macho" thing to show they are not afraid of a thunderstorm. Well, **I'm certainly not advocating that we over-react**, and head for home at the first sign of any thunderstorm ... but **I want to suggest that we not go to the opposite extreme and pay virtually no attention to the threat** that lightning strikes pose. Any thunderstorm should be a matter of concern, and the campers should already

know what to do if the situation becomes hazardous.

It's pretty unlikely that you'll ever be struck by lightning. Scientists cannot make accurate predictions of when and where lightning will strike or how often, so for all practical purposes, it looks pretty random. Nevertheless, more people are killed by lightning year in and year out than by any other weather phenomenon; typically on the order of 100 people or so annually in the United States. Furthermore, lightning does not have to *kill* you to create major problems in your life. Several hundred people are affected by lightning in the U.S. every year, short of being killed. To get some idea of the *non-fatal* hazards of lightning from a medical point of view, check out [this site](#) and/or [this one](#). Being struck is no joke and can affect you adversely for the rest of your life.

Anytime you're outdoors, you've increased your risk of being struck by lightning. For example, some golfers are struck every year ... many of you may have heard the story of Lee Trevino's non-fatal encounter! Another category of those who are at relatively high risk includes those who climb mountains. Since a lot of wilderness adventure camping includes hiking and camping at high elevations, campers and hikers are considerably at risk, whether they realize it or not. Consider the following statement from the 1997 Philmont Scout Ranch "Guidebook to Adventure":

The summits of mountains, crests of ridges, slopes above timberline, and large meadows are extremely hazardous places to be during lightning storms. If you are caught in such an exposed place, quickly descend to a lower elevation, away from the direction of the approaching storm, and squat down or kneel down on a pad, keeping your head low. A dense forest located in a depression provides the best protection. Avoid taking shelter under isolated trees or trees much taller than adjacent trees. Stay away from water, metal fences and other objects which will conduct electricity long distances.

By squatting or kneeling on a pad with your feet close together you have minimal contact with the ground, thus reducing danger from ground currents. If the threat of lightning strikes is great, your crew should not huddle together, but spread out at least 100 feet apart. If one member of your crew is jolted, the rest of you can give assistance. Keep track of one another by numbering off in a loud voice from time to time. Whenever lightning is near, take off backpacks with either external or internal metal frames. Be sure to pitch your tents in an area that is protected from lightning strikes. (p.30)

Since mountain thunderstorms tend to form in the early to mid-afternoon, it's generally advised that you do your hiking to the high peaks starting in the early morning, so that you can be on the way down from the peaks when the threat from thunderstorms is at its highest. However, the weather doesn't *always* behave normally. You need to keep your eyes on the sky and be prepared to **abandon** your hiking plans if a thunderstorm develops unexpectedly. You should be able to recognize developing thunderstorms before they begin to produce lightning. Fair weather clouds on a mountain may be puffy, but they are short and show little or no vertical development. When they begin to tower up and build into deep clouds with dark bases:



they are in the process of becoming thunderstorms. Sometimes, all that they do is to tower up but, generally, when this towering process begins, they go on to become thunderstorms. A cloud that is tall and beginning to flatten out at the top is *definitely* a thunderstorm:



If you see clouds like this around, and there are dark cloud bases overhead, then you are in a potentially dangerous place!

The first lightning flashes will coincide roughly with the time that rain begins; in the mountains, a lot of that rain might

evaporate before it reaches the ground. Whether it reaches the surface or not, precipitating thunderstorms are a threat to produce lightning! During mountain thunderstorms, the peaks can be struck frequently and are no place for any wise hiker/camper to be.

Although lightning is seemingly random, there are some things you can do to minimize your risks if you are caught in the open during a thunderstorm:

1. **Avoid being the tallest object around ...** get as low as you can, but don't lie prone on the ground. Go into a squat, instead. If you're wearing a backpack, get it off and seek the best shelter you can find ... the idea is not that the backpack attracts lightning, but rather to facilitate getting to shelter quickly. Obviously, standing on a mountaintop is asking for major-league trouble!
2. **It also is unwise to be near the tallest object around, like an isolated tree.** Sheltering from the rain under a tree is often a factor in people being struck. Depressions in the rock, or shallow caves don't offer much protection from lightning on a mountaintop. Your best protection is to get down from the peaks as quickly as possible. Leave your gear behind ... whatever it contains is not worth your life! You can always go back and retrieve it after the storm passes.
3. **There is no "warning sign" that will tell you reliably that lightning is about to strike;** don't depend on having your hair stand on end, or whatever. The first sign of a CG may be the flash itself. Of course, if your hair *does* stand on end, then you should take steps to protect yourself immediately! If no suitable shelter is available, see points #1 and #2, above.
4. The time from the flash to the thunder is a rough measure of how distant the lightning is. If you see a flash and count the seconds, five seconds corresponds to about a mile. However, **there is no distance from a thunderstorm that is absolutely safe!** If you can *see* the lightning, then you are under some threat. CGs can occasionally jump out of a thunderstorm and strike the ground miles away, seemingly "out of the blue." What is currently being advocated is **the "30-30" rule:** take shelter if the time from seeing a flash to the time you hear thunder is 30 seconds or less, and don't resume activities until 30 minutes have elapsed from the last lightning and thunder.



[Image ©1976 A. Moller, used by permission]

5. **You do not have to be directly hit by the lightning to be affected.** Lightning can travel along the ground from a nearby strike to you. It can also jump from nearby objects that are struck.
6. **Avoid being near fence lines and power lines that lead into areas where lightning is occurring.** A flash can travel along the wires and jump to you.
7. **Go/Call for medical help immediately if someone is struck!** In the meantime, administer CPR to any lightning strike victims if their heart has stopped and they have stopped breathing. If they are simply not conscious, treat for shock (not electrical shock!). Dr. Mary Ann Cooper notes that there often is danger of hypothermia for victims, especially if they've been in the rain, and also says:

"[I]f there is no response to the CPR after 20-30 minutes, the chances of resuscitation and recovery are minimal. By then, the rescuers are also starting to tire. I think rescuers who are often emotionally attached to the individual need to know that they are not the ones that were at fault if they cannot resuscitate someone. They shouldn't feel they have to keep up CPR for hours, get exhausted mentally, emotionally, and physically which may potentially put themselves in jeopardy."

Hiking on the trail during a thunderstorm is not a wise thing to do if you are exposed. If you're in a forest, there are many trees about and your chances of being hit by a CG are not very high ... but along an exposed trail, you need to abandon your backpack and get as low as possible, again short of lying prone on the ground (see #1, above). Regrettably, shallow caves and overhanging rocks provide only shelter from the rain ... they do not increase your lightning safety by very much in otherwise exposed mountain locations.

During a thunderstorm, it is likely that campers will want to stay in their tents. This may provide shelter from the rain, but if you lie down in the tent, you are at risk from ground currents, which might well prefer to run *through* you from head to foot (or the other way around) as you lie in contact with the ground. Such a current flow would probably stop your heart. If you are standing up, but with your feet spread apart, a potential (voltage) difference could exist between your feet, encouraging current to run up one leg and down the other. It might not stop your heart, but it probably would be *very* unpleasant, given what it would be likely to pass through on its way! Hence, when sheltering from the rain in tents, you need to be taking steps to reduce the danger from ground currents. I don't know to what extent air mattresses and foam pads protect you while lying down through insulating your contact points with the ground ... I suspect that

they will not make much of a difference!

The usual rules apply if you have chosen a campsite in an exposed location, where your tents are the highest objects nearby. If you have chosen your campsite unwisely in terms of lightning safety and a thunderstorm threatens, immediately abandon such a campsite and all your gear, and move to a better location for lightning protection. Campsites in among many trees are probably all right, in the sense that the chances of your *particular* location being struck are pretty low. However, you could still be unlucky, and the risk from ground currents and secondary strikes from lightning hitting nearby trees remains. If there is no better shelter (e.g., a motor vehicle) nearby than your tent, you will *probably* be lucky enough not to be struck, but there is no doubt that a substantial risk is associated with riding out a thunderstorm in a tent. Note that non-metallic tent frames don't mean much of a difference from metal frames, either, in terms of the threat. The same goes for various forms of "insulation" between the tent and the ground ... if a lightning flash has passed through thousands of feet of air (a terrific insulator), a few cm of rubber or whatever isn't going to make any difference that matters.

Being inside a vehicle places you inside a metallic "cage", and the current of a lightning strike tends to go through that frame rather than through you (the so-called "Faraday Cage" effect). It is *not* the rubber tires that protect you!

If someone in your group is struck by lightning, their heart and breathing may stop but they still have a chance to survive. Perform CPR on them until professional medical help arrives (see above). Make sure the medical team knows that they were struck by lightning, not by electric current from household power ... the treatment for lightning is not the same as someone that has been electrocuted by alternating current household power: for standard electrical shock, the medical team would administer fluids, which is the wrong thing to do with lightning victims.

Flash Floods

After lightning, flash floods are the second most dangerous thunderstorm hazard. Because virtually everyone has experienced rain, and most of the time they have survived with no more than a soaking, it's often difficult to get across the idea of the hazards of flash floods. Unlike something exotic, like a tornado, rain is both common and usually nothing more than a minor annoyance. Nevertheless, rains can pose a serious danger to campers. Consider the following statement from the 1997 Philmont Scout Ranch "Guidebook to Adventure":

Thread-like streams can become raging rivers in a few minutes or even seconds. It is important to be alert to the possibility of flash floods and take steps to avoid a dangerous encounter. Pitch your tents on higher ground. During and after periods of heavy rain, stay away from natural drainage areas. Never attempt to cross a stream that is over knee deep on anyone in the crew. Retreat to the nearest staffed camp and request an itinerary change. Always know where you are and how to get to higher ground. Watch for indicators of flash flooding such as an increase in the speed or volume of stream flow. Stay out of flood waters and narrow canyons. (p.30)

This is excellent advice to Philmont campers, of course.

Campers encounter a threat from rain in two distinctly different situations. Since most of us travel to camping situations by motor vehicle, one way to encounter a flash flood is *driving* to or from a camping experience. An extremely common way for people to die in flash floods is by driving into rising waters. There are some ways to prevent this from being a problem:

1. **Never drive into water if you don't know *exactly* how deep the water is!** Some low water crossings in the U.S. have signs showing how deep the water is ... if you aren't sure, don't drive into it. It only takes about 18-24 inches of water to float most motor vehicles. Once the vehicle is afloat, it is out of the driver's control and goes whichever way the water dictates.



[uncopyrighted image]

2. **Don't underestimate the power of moving water.** Water moving in streams and rivers at high speeds, as it

often does during flash flood events, can sweep a vehicle away far more easily than most people imagine. Also, rapidly-moving water often contains debris such as trees, propane tanks, and even boulders rolling along just under the surface. If you are struck by this debris, your vehicle can be knocked off a bridge or water crossing and swept away before you know it. Note also that it doesn't take very much "moving water power" to knock you off your feet when crossing a stream.

3. River floods, where the water rises relatively slowly over a period of several hours, are not as dangerous as flash flood. In flash floods, the water can rise several feet or more in just a few minutes. It may not come as a classic "wall of water" that you can see and hear coming, but rapidly-rising water can overtake a vehicle easily before the driver can react. **If you have reason to believe that a flash flood may be in progress (see below), stay out of low water crossings and streams entirely.**

All of these things apply to campers out of their vehicles and simply walking along a trail, or camped by the side of that picturesque stream. Campers also may pick a spot close to a stream in order to have easy access to water. Although camping near streams is understandable, it involves some risk. If you are in rough terrain, such as canyons or in the mountains, you are in particular danger by camping in stream beds, or even hiking along them. To minimize your danger, consider the following:

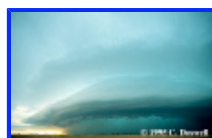
1. **You need to stay tuned into what the weather is doing upstream if you are going to hike canyons and valleys.** Rain need not be heavy and may not even be falling where you are, in order for the stream to be swept by a flash flood. Rain upstream, perhaps many miles away, can roar down a canyon or valley and catch you completely by surprise. An approaching flash flood typically will be manifested as rising waters, rather than the so-called "wall of water" ... however, if flood debris creates a temporary damming effect somewhere upstream, when that debris dam breaks, the result *can* be a "wall of water" roaring down the stream.
2. **Flash floods are most common at night! Never camp on the flat near a stream or in a canyon;** always try to locate your camp on ground that is significantly higher than the stream or canyon. In spite of the trouble and effort this may involve, you should avoid be caught by a surprise flash flood at night. If, for some reason, you *must* camp in a location that could be swept by a flash flood at night, **have an escape route planned in advance and make sure everyone knows about it.** See the next item.
3. **Climb to safety!** If a flash flood is catching you during a hike or in camp, *you cannot outrun it*; so drop your backpacks and *climb* as fast as you can. If you are in your tents, leave all your gear and climb to high ground. You don't own any gear that is more important than your life. Avoid situations where climbing would be impossible unless you can be absolutely certain that it's not going to rain upstream ... and you can *never* be certain!
4. **If you are by a stream and the water begins rising rapidly, treat the situation as if it is a flash flood.** Although the "wall of water" phenomenon is rare (as noted above), rising water can be followed literally by something very much like a "wall of water" ... as noted, this can be caused by the failure of debris dams upstream. The power of moving water is substantially increased when it is loaded with debris (mud, rocks, trees, broken-up structures, etc.), of course.

Thunderstorms in the mountains can come up seemingly out of nowhere, but they really do have some precursor signs, as I have shown above. Large thunderheads show storms already in progress. If the storms don't seem to be moving or new ones are constantly forming where the old ones were earlier, then you may be seeing a flash flood situation developing.

Although heavy rain is often accompanied by frequent lightning, this is not *always* the case. Some flash flood-producing heavy rains will not have much lightning at all. If the storms don't seem to be moving very rapidly, you need to be alerted to the potential for flash floods. Storms that move by in 20 mins or so are probably not going to pose much of a threat of flash floods. However, when new storms pass over ground soaked by previous storms, they have a greater flash flood threat than their predecessors ... if the region is soaked by earlier rains, a lot of the water can't be absorbed by the saturated soil, so it runs off at high rates into streams. Rocky, mountainous terrain can't absorb much rainfall at *any* time, so mountain streams (even dry ones) can become hazardous very quickly!

Flash floods occur most often late in the evening and at night. Obviously, this also is not true *every* time, but it does mean that storms you see nearby or experience directly at night are not something to be treated lightly.

Non-tornadic severe thunderstorms



Thunderstorms are considered severe whenever they produce one or more of the following: a tornado, hail that is 3/4 in or larger in diameter, or wind gusts (not associated with tornadoes) approaching 60 mph.

Hail

Large hailstones occasionally can be dangerous ... during a tremendous hailstorm in the Dallas, TX area in 1995, more than 100 people were injured by hail up to *4 inches* in diameter. A hailstone the diameter of a golfball (roughly 1 3/4 inches) can produce an injury, especially if it strikes a person's head. A hailstone the diameter of a baseball (2 3/4 inches) falls at a speed comparable to that of a pitched baseball ... on the order of 100 mph. It's like being hit by a "beanball" thrown by a major league pitcher ... an injury from such a stone can be serious, or even fatal.

The chances of encountering hard-frozen hailstones that large on a camping trip are pretty small. The odds aren't of much comfort if it begins to happen where you are, though! Sometimes large hailstones are sort of "mushy" ... more like a snowball. Even a relatively large stone that is mushy will not present much danger, whereas a hard-frozen stone can produce serious injuries.

Winds

Strong winds, not associated with a tornado, can become very dangerous, especially if you are hiking or camping in a forest. Often the trees at high elevation have shallow root systems and are fairly easy for the wind to blow down. In some rare storms, many thousands of acres of trees have been flattened by the storm's wind gusts. Obviously, being in a forest during one of these "blowdowns" would be very perilous for campers. It's basically not possible just to look at an approaching storm and know how strong the winds are.

The leading edge of the strong winds is often marked by a "shelf cloud" or "roll cloud" ... an example of a shelf cloud on the plains is shown in the picture [above](#). In the mountains, a cloud marking the leading edge of the winds might be a lot more ragged than the example shown. If you see one of these approaching, be prepared to seek shelter from the winds and the flying, falling debris the winds might cause. You will need to find a place where you can be protected from falling limbs and even falling trees. Note that being in a forest might offer some "protection" against *lightning*, but it's a bad place to be in a severe *windstorm*. Falling branches (and even whole trees) are quite possible, even with windspeeds of "only" 50 mph or so.

Any thunderstorm can produce 30-50 mph winds, especially in the mountains. Since mountain air tends to be dry, evaporating rain from mountain storms produces cool air, which descends rapidly and spreads out in what are called "[microbursts](#)." Note that if you get wet in a mountain thunderstorm at high elevation, you are vulnerable to *hypothermia*, even if the storm isn't severe enough to cause you other problems. Having proper rain gear and using it can save your life in the mountains.

In a few rare events, large hailstones *combine* with strong winds to produce a dangerous barrage of wind-driven hail and damaging winds. Such storms are rare, but certainly could be a serious threat to campers, who may not hear any warnings that normally reach people by radio and television. If such a storm develops, your only hope is to find shelter from the flying hail and debris.

Tornadoes



Generally speaking, tornadoes are rare, even in the places where they occur most often. You could live in the middle of "Tornado Alley" for 1000 years and never experience a direct hit from a tornado. Many of the mountainous regions favored for outdoor wilderness camping are much less likely to experience tornadoes even than that. However, the fact

that tornadoes are rare in general, and even more rare in certain parts of the country, does *not* mean that tornadoes only happen to Kansas, Oklahoma, and Texas. Tornadoes have been reported in every state in the United States, and at every hour of the day and night. There certainly have been tornadoes in mountainous regions all over the west, including a large and *violent* tornado in the Grand Teton Wilderness of Wyoming, so just being in the high country does *not* mean you can ignore completely any threat of tornadoes!

Tornadoes are most common on the Great and High Plains regions of the United States, in the early to late spring. Although it is very unlikely that you will ever encounter a tornado on a summer camping trip in the mountains, nevertheless it does not hurt to **be prepared**, right? After all, something like 1000 tornadoes are reported in the U. S. Every year, some of them are bound to strike something or someone! It's always possible to be unlucky. Besides, not all camping trips take place in the mountains ... there are many tornado-vulnerable camping locations throughout the eastern 2/3 of the United States.

1. If you are caught during highway travel to or from camp, **it may be possible simply to drive away from a tornado**. If you are in open country and your road options let you drive at right angles to the direction the tornado is moving, the best strategy is to head off to the right of the tornado's movement: if it's moving east, drive south away from it, and so on. This strategy requires you to be able to assess accurately the direction of tornado movement ... sometimes tornadoes change direction and speed of movement, so be prepared to adjust your tactics!
2. It is almost always possible to outrun a tornado in a motor vehicle **as long as the road and traffic permit free movement**. Tornadoes occasionally move at 60+ miles per hour, but most of them don't go nearly that fast. If you are on a road that permits you to drive safely at speeds of 60 mph or faster, you probably can outrun any tornado ... however, I recommend that you only do so until you reach a road that allows you to travel at right angles to the tornado's path (see the preceding discussion). You get out of danger from a tornado most quickly (in just seconds, usually) by moving directly out of its path!
3. **If your road options don't permit such maneuvers, abandon your vehicle and seek the best shelter nearby you can find** (see below). Most injuries in tornadoes come from being struck by flying debris. Therefore, you want to get low and out of the wind. Vehicles are often picked up and tumbled, sometimes being smashed into something that looks like a "carball" such that no one would survive inside the vehicle.
4. [Overpasses are not adequate shelter](#). In fact, they are essentially no shelter at all.

When camping or hiking, outrunning an approaching tornado may not be an option (unlike the end of the movie "Twister"). Given that many tornadoes develop from thunderstorms that are already severe in terms of ordinary wind and large hail, you should already be taking steps to protect yourself from a truly severe thunderstorm.

1. **Find the best shelter from flying debris you can**. Ditches, caves, and so on will work. Don't count on some flimsy outbuilding or mountain cabin to protect you ... a tornado can disintegrate flimsy buildings and turn the pieces into high-speed missiles. Obviously, a tent is virtually the same as no shelter at all. Your best best is to get low and out of the wind. The majority of tornado casualties are from being struck by flying objects, so the idea is to get out of harm's way.
2. **Cover your head** with your hands (or some better protection if you have it) to give yourself the best protection from flying debris.
3. **Find something to hang onto** if your shelter from the wind is not complete. Becoming airborne is a distinct possibility, so you don't want the wind to get under you and lift you into the air.
4. **Learn how to recognize a tornado**. Not all tornadoes look the same. A tornado's funnel-shaped cloud, if it has one, [does not have to touch the ground for it to be a true tornado](#). The tornado is the *wind*, **not** the *cloud* ... if there is debris beneath a funnel cloud, it *is* a tornado.. Some tornadoes appear as a dark, boiling mass of clouds on the ground. A tornado in the mountains might look very much like a dust devil ... except that [the dust and debris at the surface is beneath a dark thunderstorm base](#), not occurring on a sunny, nearly cloudless afternoon. If you don't recognize a tornado coming until it's too late, all the knowledge in the world can't help you.
5. **Don't depend on hearing a tornado** ... not all tornadoes make a lot of noise until they are **very** close to you. Keep your eyes open in the wilderness, especially if there are thunderstorms about.

Final thoughts

Generally speaking, you as a camper are responsible for your own safety. In spite of numerous efforts to alert folks to the dangers associated with thunderstorms during camping season, many fail to heed good advice even when they hear it. Regrettably, most people tend to downplay these threats and may be completely ignorant of these dangers. In my opinion, **ignorance in this matter is inexcusable**. If campers wait until they *themselves* have experienced thunderstorm-related weather hazards to take their threat seriously, by then, it's often too late ... the first time may be

enough for a tragedy. **Having escaped unharmed numerous times in the past is no guarantee that you will continue to be lucky!** A foolish risk, taken many times with no harm, is still a foolish risk ... it only takes *one* lightning flash over a 30-year camping career to ruin your life. In my opinion, being killed is among the *least* harmful things that can happen to you ... as I see it, I'd hate to be responsible for *someone else* being killed or injured in a way that ruins their life, by having encouraged them to ignore proper safety precautions. Having that on your conscience would be a *lot* worse than being killed yourself! Please don't become another summer camping statistic yourself, and don't let anyone in your care become one, either!

Frequently Asked Questions

1. Regarding the lightning threat, what about metal tent supports, wire bed frames, handling cooking utensils, wearing a metal-framed backback, rubber-soled shoes, plastic frame packs, non-metallic tent supports, wooden flooring, etc., etc., etc.?

A lightning flash nearing the ground during its descent has found a path through thousands of feet of air, which acts as an excellent insulator. The presence or absence of a metallic object in your vicinity is very unlikely to make any meaningful difference in the threat from that approaching lightning channel. If you are attached to a wire or metal object that reaches well up above your surroundings, that would make a difference! Otherwise, none of the objects in your immediate vicinity will have a significant effect on your risk of being struck by lightning. Your body ... essentially a bag of salty water (plus assorted chemicals) ... is already an excellent conductor of electricity and a thin insulating layer (like a wooden floor, or rubber-soled shoes) is not going to stop a flash from going through you to the ground. Such things also will neither protect you from, nor enhance your chances of, being hit by *ground currents* or *side flashes* from a lightning flash hitting nearby. Please remember ... the flash has gone through *thousands of feet of insulating air* even before it got close to you. *All* these nearby objects are virtually irrelevant.

2. If we have to go through an open area in order to reach shelter in a thunderstorm, should we do it?

If the lightning is already occurring near you, do *not* move into an open area wherein you would be the tallest object around. It's too late and you would be better off staying in an area surrounded by trees or other tall objects than taking a chance crossing an open area. If the lightning is not yet in your immediate vicinity but is approaching (the time from flash-to-bang is getting shorter), then if you have time to cross the open area to reach a better shelter, then do so quickly so that you're not caught in the open. If the flash-to-bang time is less than about 30 seconds, then you are most likely better off with the shelter you have.

3. Suppose we're caught on a hike by an approaching tornado. Should we seek shelter in ditches or ravines?

Sheltering in ditches or ravines is, at best, a poor choice that is only a last resort. First of all, make certain that you are actually in the path of the tornado ... if it is not moving right-to-left or left-to-right, then it may be headed toward you. In the absence of a proper shelter (a cave, or some way to get below ground level), your best hope is to see if you can get out of the path in time. If the tornado is moving too rapidly for this to work, then a ditch or ravine may be your only option. When sheltering in a ditch, as noted above, cover your head with whatever you can, since ditches are often a place where debris is deposited ... but it is preferable to being hit by flying debris, or being carried by the tornadic winds, which is how most people are injured in tornadoes. The problem with ditches and ravines in thunderstorms is that they might be swept by flash floods. Actually, it is very unlikely that you would be threatened by a tornado on a camping outing. Flash floods during thunderstorms, however, are much more likely.

4. Should we carry a battery-powered NOAA Weather Radio with us on our outings?

Provided you are likely to be constantly in range of a NOAA Weather Radio transmitter, I think this is an *excellent* idea! These are inexpensive, relatively light, and only one is needed for each group. Please check beforehand to determine whether or not your outing will be in range of a transmitter, though. You can check with the local office of the National Weather Service for information regarding the coverage areas for NOAA Weather Radio broadcasts.