

1.3 LIGHTNING SAFETY FOR SCHOOLS

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1. INTRODUCTION

Lightning is the most under appreciated weather hazard. Lightning is the second leading cause of direct weather deaths in the U.S., killing more people than tornadoes and hurricanes combined (Curran, et. al., 1997). Lightning also inflicts life-long severe injuries on many more (Cooper, 1995) (Andrews, et. al., 1992). Yet we hear relatively little about lightning safety.

Many school activities can put students at high risk from lightning. In the U.S., the largest number of lightning casualties (deaths + injuries) occurs in open fields, including ballparks, playgrounds, etc. (Curran, et. al., 1997). This is obviously significant for schools, since they have many activities in open fields: recess outside, playgrounds, athletic fields, and other outdoor extracurricular activities. The activity with the fastest rising lightning casualty rate is outdoor sports and recreation, which includes some school activities. Thus, it is especially important for coaches, referees, and leaders of other outside school activities to practice good lightning safety. Support from school management is essential in facilitating this process. Therefore, schools need an effective integrated lightning safety plan.

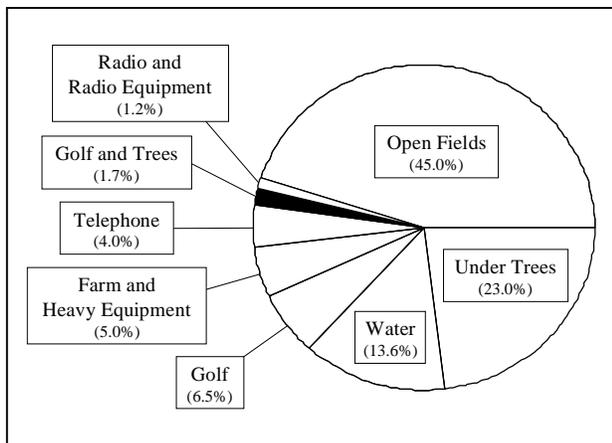


FIGURE 1. Lightning casualties in the U.S. (1959-1994) by location or activity. When location/activity is reported, open fields (ballparks, playgrounds, etc.) have the most lightning casualties. Schools have many activities in open fields. Adapted from Curran, et. al. (1997); 40.4% of lightning casualty locations/activities are not reported.

2. BACKGROUND

Total lightning safety requires four tiers of activities: 1) education, so people are aware of the hazard and know what actions to take when lightning threatens, 2) protection of facilities and equipment, 3) mitigation, for when protection fails, and 4) weather warnings to alert personnel to take action. This paper will address only the first aspect of lightning safety, since education is the key to improving lightning safety.

The recommendations from the Lightning Safety Group (LSG) are designed to reduce the risks from lightning (Holle, et. al., 1998). The LSG first formed as an ad hoc group at the 78th Annual American Meteorological Society Meeting in 1998 in Phoenix, AZ, and consisted of 16 lightning and lightning safety experts from many diverse disciplines (Table-1). They formed in response to the preexisting lightning safety advice, much of which is often contradictory, ineffective, incorrect, or sometimes even unsafe. The LSG recommended six lightning safety guidelines. These recommendations take an important step in overcoming previous shortfalls and in standardizing lightning safety. The National Collegiate Athletic Association adopted the LSG guidelines in 1998 (Bennett, et. al., 1997), and the Clear Creek Independent School District, near Houston TX, has put into place procedures that address portions of the LSG recommendations. Other schools and agencies are adopting the LSG recommendations.

3. LIGHTNING SAFETY GROUP GUIDELINES

The LSG recommendations are reproduced verbatim.

3.1 Overview

The seemingly random nature of thunderstorms cannot guarantee the individual or group absolute protection from lightning strikes; however, being aware of and following proven lightning safety guidelines can greatly reduce the risk of injury or death. Individuals are ultimately responsible for their personal safety and have the right to take appropriate action when threatened by lightning. Adults must take responsibility for the safety of children in their care during thunderstorm activity.

3.2 Areas Addressed

The Lightning Safety Group made recommendations for the following six topics: 1) identifying safe and not so safe locations during thunderstorm activity, 2) safety guidelines for individuals, 3) safety guidelines for small groups and/or when the evacuation time is less than 10 minutes, 4) safety guidelines for large groups and/or when the evacuation time is more than 10 minutes, 5) important components of an action plan, and 6) first aid recommendations for lightning victims.

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TABLE 1. LIGHTNING SAFETY GROUP (1998)

Member	AFFILIATION
Brian Bennett	Assistant Athletic Trainer The College of William & Mary
Leon Byerley	Lightning Protection Technology
Mary Ann Cooper, MD, FACEP	Lightning Injury Research Program The University of Illinois at Chicago
Ken Cummins, Ph.D.	Vice President Engineering Global Atmospherics, Inc.
Ronald L. Holle	Research Meteorologist National Severe Storms Laboratory, NOAA
Ken Howard	Research Meteorologist National Severe Storms Laboratory, NOAA
Richard Kithil	President/CEO National Lightning Safety Institute
E. Philip Krider, Ph.D.	The University of Arizona Department of Atmospheric Sciences
Lee C. Lawry	Product Manager Global Atmospherics, Inc.
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Bruce Lunning, CSP, CPCU, ARM	Senior Loss Control Specialist St. Paul Fire & Marine Insurance Co.
John T. Madura	Manager KSC Weather Office, NASA
Marcus McGee	President Quality Protection Systems, Inc.
William P. Roeder	Chief Staff Meteorologist 45th Weather Squadron, USAF
Jim Vavrek	Science Teacher Henry W. Eggers Middle School
Christoph Zimmermann	Safety Management Global Atmospherics, Inc.

3.2.1. Safer Locations During Thunderstorms And Locations To Avoid: No place is absolutely safe from the lightning threat; however, some places are safer than others. Large enclosed structures (substantially constructed buildings) tend to be much safer than smaller or open structures. The risk for lightning injury depends on whether the structure incorporates lightning protection, construction materials used, and the size of the structure (see NFPA 780, Appendix E & H). In general, fully enclosed metal vehicles such as cars, trucks, buses, vans, fully enclosed farm vehicles, etc. with the windows rolled up provide good shelter from lightning. Avoid contact with metal or conducting surfaces outside or inside the vehicle. AVOID being in or near: high places and open fields, isolated trees, unprotected gazebos, rain or picnic shelters, baseball dugouts, communications towers, flagpoles, light poles, bleachers (metal or wood), metal fences, convertibles, golf carts, water (ocean, lakes, swimming pools, rivers, etc.). When inside a building AVOID: use of the telephone, taking a shower, washing your hands, doing dishes, or any contact with conductive surfaces with exposure to the outside such as metal door or window frames, electrical wiring, telephone wiring, cable TV wiring, plumbing, etc.

3.2.2. Safety Guidelines For Individuals: If an individual can see lightning and/or hear thunder he/she is

already at risk, generally. Louder or more frequent thunder indicates that lightning activity is approaching, increasing the risk for lightning injury or death. If the time delay between seeing the flash (lightning) and hearing the bang (thunder) is less than 30 seconds, the individual should be in, or seek a safer location. Be aware that this method of ranging has severe limitations in part due to the difficulty of associating the proper thunder to the corresponding flash. High winds, rainfall, and cloud cover often act as precursors to actual cloud-to-ground strikes notifying individuals to take action. Many lightning casualties occur in the beginning, as the storm approaches, because people ignore, or are unaware of these precursors. Also, many lightning casualties occur after the perceived threat has passed. Generally, the lightning threat diminishes with time after the last sound of thunder, but may persist for more than 30 minutes. When thunderstorms are in the area but not overhead, the lightning threat can exist even when it is sunny, not raining, or when clear sky is visible. When available, pay attention to weather warning devices such as NOAA weather radio and/or credible lightning detection systems, however, do not let this information override good common sense.

3.2.3. Considerations For Small Groups And/Or When The Evacuation Time Is Less Than Ten Minutes: An action plan must be known in advance by all persons involved. Schoolteachers, camp counselors, lifeguards, and other adults must take responsibility for the safety of children in their care. Local weather forecasts, NOAA weather radio, or the Weather Channel should be monitored prior to the outdoor event to ascertain if thunderstorms are in the forecast. Designate a responsible person to monitor forecasted weather as well as to observe on-site developments to keep everyone informed when potential threats develop. Recognize that personal observation of lightning may not be sufficient; additional information such as a lightning detection system or additional weather information may be required to ensure consistency, accuracy, and adequate advance warning. Even though technology and instrumentation have proven to be effective, they cannot guarantee safety. Instrumentation can be used to enhance warning during the initial stages of the storm by detecting lightning in relation to the area of concern. Advance notification of the storm's arrival should be used to provide additional time to seek safety. Detectors are also a valuable tool to determine the "All Clear" (last occurrence of lightning within a specified range), providing a time reference for safe resumption of activities.

3.2.4. Safety Guidelines For Large Groups And/Or When The Evacuation Time Is More Than Ten Minutes: An action plan must be known in advance by all persons involved. Adults must take responsibility for the safety of children in their care. Local weather forecasts, NOAA weather radio, or the Weather Channel should be monitored prior to the outdoor event to ascertain if thunderstorms are in the forecast. During the event, a designated responsible person should monitor site relative weather condition changes. Personal observation of the lightning threat is not adequate; additional

information including detecting actual lightning strikes and monitoring the range at which they are occurring relative to the activity is required to ensure consistency, accuracy, and adequate advance warning. Even though technology and instrumentation have proven to be effective, they cannot guarantee safety. Instrumentation can be used to enhance warning during the initial stages of the storm by detecting lightning in relation to the area of concern. Advance notification of the storm's arrival should be used to provide additional time to seek safety. Detectors are also a valuable tool to determine the "All Clear" (last occurrence of lightning within a specified range), providing a time reference for safe resumption of activities. When larger groups are involved the time needed to properly evacuate an area increases. As time requirements change, the distance at which lightning is noted and considered a threat to move into the area must be increased. Extending the range used to determine threat potential also increases the chance that a localized cell or thunderstorm may not reach the area giving the impression of a "false alarm". Remember, lightning is always generated and connected to a thundercloud but may strike many miles from the edge of the thunderstorm cell. Acceptable downtime (time of alert state) has to be balanced with the risk posed by lightning. Accepting responsibility for larger groups of people requires more sophistication and diligence to assure that all possibilities are considered.

3.2.5. Important Components Of An Action Plan: Management, event coordinators, organizations, and groups should designate a responsible person(s) to monitor the weather to initiate the evacuation process when appropriate. Monitoring should begin hours and even days ahead of an event. A protocol needs to be in place to notify all persons at risk from the lightning threat. Depending on the number of individuals involved, a team of people may be needed to coordinate the evacuation plan. Adults must take responsibility for the safety of children in their care. Safer sites must be identified beforehand, along with a means to route the people to those locations. School buses are an excellent lightning shelter that can be provided (strategically placed around various locations) by organizers of outdoor events, with larger groups of people and larger areas, such as golf tournaments, summer day camps, swim meets, military training, scout groups, etc. The "All Clear" signal must be identified and should be considerably different than the "Warning" signal. The Action Plan must be periodically reviewed by all personnel and drills conducted. Consider placing lightning safety tips and/or the action plan in game programs, flyers, score cards, etc., and placing lightning safety placards around the area. Lightning warning signs are effective means of communicating the lightning threat to the general public and raise awareness.

3.2.6. First Aid Recommendations For Lightning Victims: Most lightning victims can actually survive their encounter with lightning, especially with timely medical treatment. Individuals struck by lightning do not carry a charge and it is safe to touch them to render medical treatment. Follow these steps to try to save the life of a

lightning victim. Initial Response: call 911 to provide directions and information about the likely number of victims. Evacuation: the first tenet of emergency care is "make no more casualties". If the area where the victim is located is a high risk area (mountain top, isolated tree, open field, etc.) with a continuing thunderstorm, the rescuers may be placing themselves in significant danger. It is relatively unusual for victims who survive a lightning strike to have major fractures that would cause paralysis or major bleeding complications unless they have suffered a fall or been thrown a distance. As a result, in an active thunderstorm, the rescuer needs to choose whether evacuation from very high risk areas to an area of lesser risk is warranted and should not be afraid to move the victim rapidly if necessary. Rescuers are cautioned to minimize their exposure to lightning as much as possible. Resuscitation: if the victim is not breathing, start mouth to mouth resuscitation. If it is decided to move the victim, give a few quick breaths prior to moving them. Determine if the victim has a pulse by checking the pulse at the carotid artery (side of the neck) or femoral artery (groin) for at least 20-30 seconds. If no pulse is detected, start cardiac compressions as well. In situations that are cold and wet, putting a protective layer between the victim and the ground may decrease the hypothermia that the victim suffers which can further complicate the resuscitation. In wilderness areas and those far from medical care, prolonged basic CPR is of little use: the victim is unlikely to recover if they do not respond within the first few minutes. If the pulse returns, the rescuer should continue ventilation with rescue breathing if needed for as long as practical in a wilderness situation. However, if a pulse does not return after twenty to thirty minutes of good effort, the rescuer should not feel guilty about stopping resuscitation.

3.3 Conclusion To Lightning Safety Group Guidelines

Avoid unnecessary exposure to the lightning threat during thunderstorm activity. Follow these safety recommendations to reduce the overall number of lightning casualties. Individuals ultimately must take responsibility for their own safety and should take appropriate action when threatened by lightning. School teachers, coaches, lifeguards, and other adults must take responsibility for the safety of children in their care. A weather radio and the use of lightning detection data in conjunction with an action plan are prudent components of a lightning warning policy, especially when larger groups and/or longer evacuation times are involved.

4. OTHER SOURCES OF LIGHTNING SAFETY INFORMATION

Agencies interested in lightning safety may find the websites listed in Table-2 useful. Educators working with younger students will especially appreciate the coloring books on thunderstorm safety, and other weather safety topics, downloadable from the National Severe Storms Laboratory. Anyone interested in educating their organization and/or the public on lightning safety are welcome to contact the corresponding author for assistance.

TABLE 2. OTHER SOURCES OF LIGHTNING SAFETY INFORMATION

SOURCE	URL
45th Weather Squadron Lightning Safety	www.patrick.af.mil/45og/45ws/LightningSafety/index.htm
Lightning Safety For Kids (aka Sabrina's Lightning Page)	www.azstarnet.com/anubis/zaphome.htm
National Severe Storms Laboratory (weather safety coloring books)	www.nssl.noaa.gov/researchitems/lightning.html (www.nssl.noaa.gov/edu/bm/bm_main.html)
General Lightning Information ('USA Today' Newspaper)	www.usatoday.com/weather/wlightn0.htm
National Lightning Safety Institute	lightningsafety.com/index.html
Lightning Injury Research (University of Illinois at Chicago)	www.uic.edu/~macooper/cindex.htm
National Weather Service / Melbourne, FL	www.srh.noaa.gov/mlb/ltgcenter/ltgmain.html
National Lightning Detection Network (GAI, Inc.)	www.glatmos.com
Lightning Strike & Electric Shock Survivors International	www.mindspring.com/~lightningstrike/

5. IMPLEMENTING A LIGHTNING SAFETY PLAN AT YOUR SCHOOL

The following advice is based on real-world experience implementing lightning safety plans at schools. It is absolutely vital to have management support. Without coordination, management might be tempted to hinder your efforts, no matter how well done. In a similar vein, it is important to involve coaches, referees, and leaders of other outside activities in the planning, rather than having them surprised by the final plan being dictated by management, which might cause resistance. Already prepared handouts/posters/guidelines/etc., as opposed to waiting for others to prepare them, can speed the implementation process.

Be prepared for initial disappointing slowdowns. Besides the normal resistance to change, there are many lightning myths out there perpetuating the mistaken belief that lightning is not an important hazard or that nothing can be done to reduce the risks. One useful argument is that schools often have plans for hazards with much lower probability than lightning. Many people do not understand lightning and lightning safety and will be tempted to avoid making a decision by 'passing the buck' up the administrative chain of command seeking guidance from ever higher levels. Each level requires representing your previous material and re-fighting the same fights again, which can be very frustrating. You will have to be fully armed with all the facts and have the counter-arguments to lightning myths and other rebuttals ready. The need to be fully prepared is vital—one mistake can be seized as evidence to justify dismissing your position.

One of the greatest concerns will likely be over legal culpability. In the past, the attitude has been to do nothing. If an incident occurs, the defense is lightning is a powerful random 'act of god', a rare and pure accident that can not be prevented. However, if you try to take action, and the incident still occurs, then you could be sued for poor safety procedures. In short, it is has been perceived that it would be better to let the accident happen, rather than take prudent safety precautions out of fear of being sued. But there appears to be a shift in legal attitudes toward lightning. The growing opinion is that we have learned enough about lightning and lightning safety that failing to take reasonable and prudent precautions will make you guilty of negligence and culpable to being sued under that argument. With proper caveats in your plan and education that the lightning risk can be greatly reduced, but not totally eliminated, the

legal arguments against not taking precautions appear to be weakening.

Do not underestimate the importance of education for students, teachers, coaches, referees, managers, leaders of other outside activities, and other staff. Without an awareness of the importance of the lightning hazard, your lightning safety plan could wither from lack of support. Remember that sports are the activity with the fastest rising lightning casualty rate, so it is vital to involve the sports community. Educating the public can also build support for your lightning safety plan, besides being a good public service. Education also helps people protect themselves away from school activities.

6. SUMMARY

Lightning is an extremely significant weather hazard, but far too often underrated. The vast majority of the lightning casualties are easily preventable by following simple guidelines. Since the most frequent impact of lightning is life-long severe injuries, it is especially important to protect children. Schools can serve an essential lightning safety role by practicing good lightning safety for their students, faculty, coaches, and staff. This is especially true for K-12 schools, since adults must take responsibility for the safety of children and youth in their care. Schools can also serve a second role in lightning safety by educating their local communities. The Lightning Safety Group recommendations can help improve the lightning safety at our schools.

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