

Rural Training Center – Thailand (RTC-TH)



**Community-based Environmental Education
for the Self-sufficiency and Sustainability of
Small Rural Family Farms**



Lightning

Photo from the Internet; educational fair use clause



An Emergency Preparedness Training Series presentation

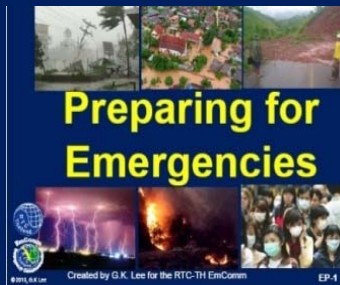


Rural Training Center-Thailand
Emergency Preparedness Community Service Program

Ready to serve and sustain our community

For other lessons in the series e-mail rtc2k5@gmail.com
www.neighborhoodlink.com/org/rtcth

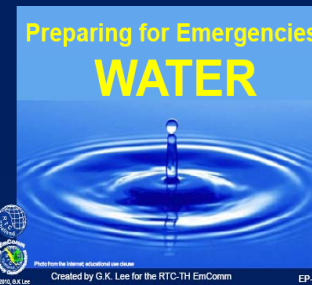
The EP Lesson Series



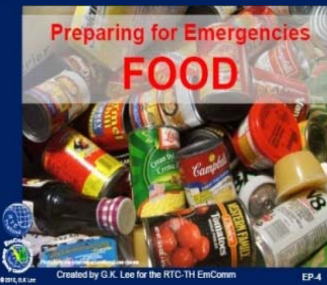
EP-1



EP-2



EP-3



EP-4



EP-5



EP-6



EP-7



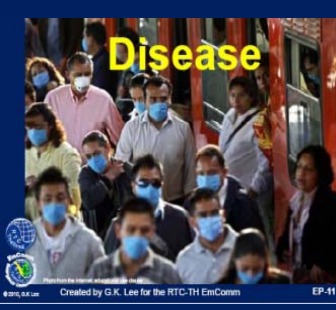
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A part of the RTC-TH EmComm Program

The Rural Training Center-
Thailand Emergency
Preparedness program is a
community service effort to
provide emergency



Preparedness training for local
community self-sufficiency and
sustainability in times of need.



The Rural Training Center-Thailand (RTC-TH)

is an all volunteer
organization providing
community-based
environmental education
for self-sufficiency and
sustainability of small
rural family farms

www.neighborhoodlink.com/org/rtcth

E-mail: rtc2k5@gmail.com



The lessons were adapted from existing RTC-TH REEEPP program lessons

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REEEPP

Rural Environmental Education Enhancement Pilot Program

An innovative, non-traditional community-based environmental education program integrating math, science, geography, English language, and technology lessons for environmental stewardship using interactive experiential learning in outdoor settings at Ban Na Fa Elementary School, Nan Province, Thailand.



E-mail: rtc2k5@gmail.com www.neighborhoodlink.com/org/rtcth



The Rural Training Center-Thailand was created to honor the life and memory of Mr. Tang Suttisan, a father, farmer and former custodian of Ban Na Fa Elementary School who appreciated and valued education.





What is Lightning?



Lightning is a high energy atmospheric discharge that can destroy antennas, buildings, start fires, and kill.



Photos from the Internet; educational fair use clause



What is Lightning?



- A lightning discharge can have 10,000,000-100,000,000 Volts and 1,000-300,000 Amps
- There is so much voltage that it may leap a mile or more through the air.

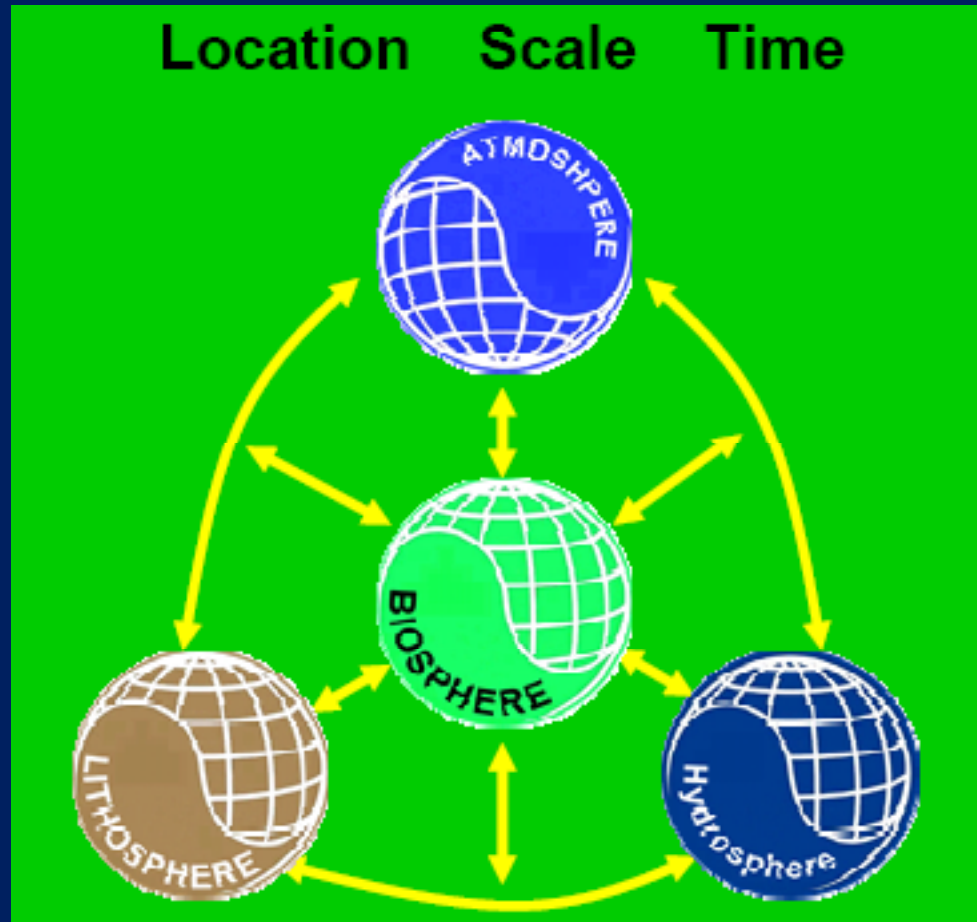




Lightning / Awareness



You can use the Geographic Systems Model to guide your learning about lightning.



You can learn more about the Geographic Systems model in RTC-TH Technical Paper AG 2010-1 Introduction to Geography available at http://www.neighborhoodlink.com/RTC-TH_Tech/pages in the Applied Geography section.





Lightning / Awareness



Location

This involves your position in the environment relative to the thunderstorm. The lightning energy is in the atmosphere and strikes the Earth's surface. NASA studies indicate lightning strikes on the ocean are much less than on land. Aircraft get struck by lightning.

Concept	Environmental Sphere
<ul style="list-style-type: none">• Location• Scale• Time	Atmosphere
	Lithosphere
	Biosphere
	Hydrosphere

This lesson focuses more on lightning strikes on land.



Highest risk areas in Thailand



open fields (45%)



trees (23%)



water sources (13%)

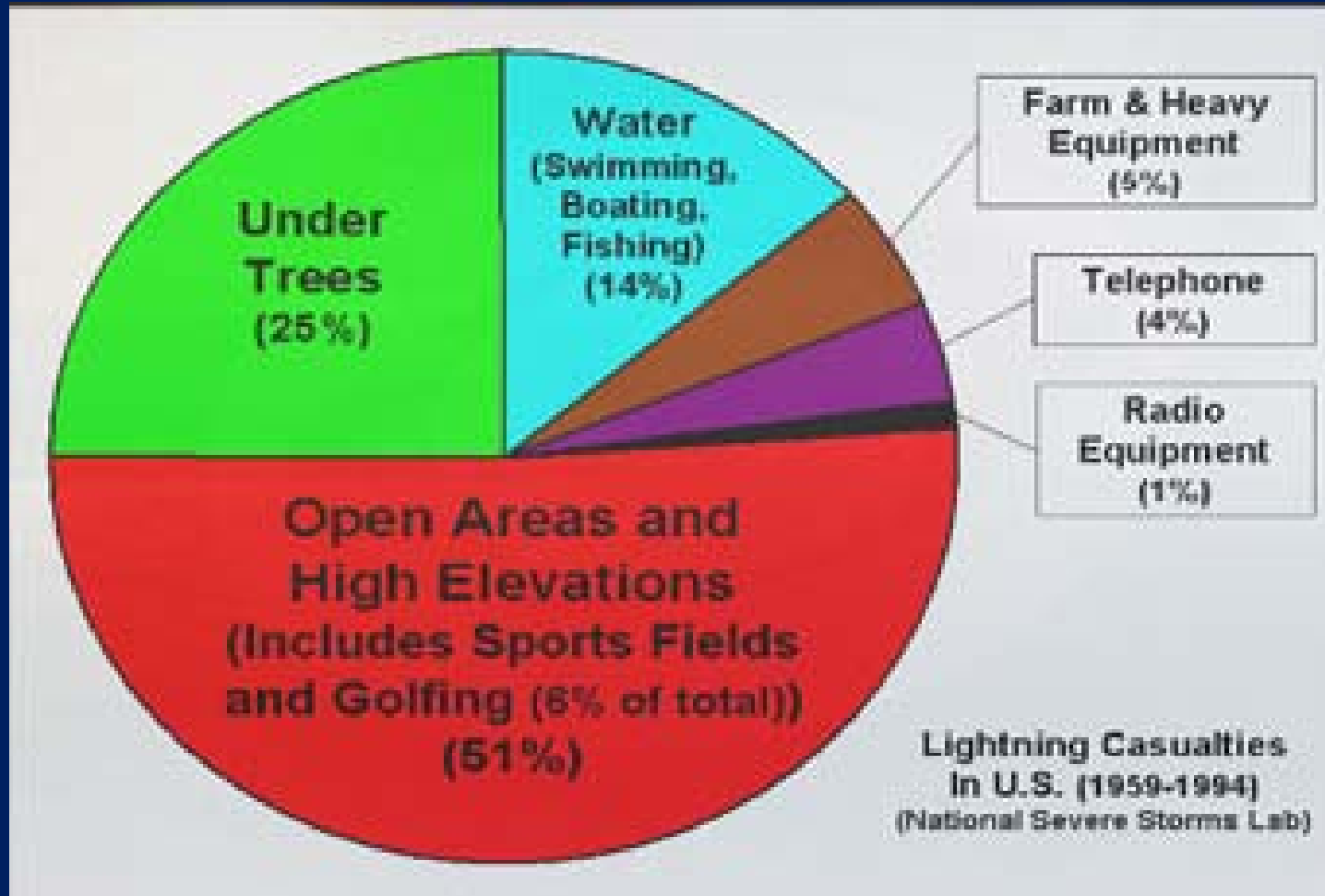




Lightning Casualties




This is very similar the lightning casualty statistics from the United States.





Lightning: Estimating Storm Distance

You can use the “Flash to Boom” method to estimate thunderstorm distance to your location.

	1...2...3...BOOM!	$3 / 3 = 1$ km to storm
1. See the lightning “Flash”.	2. Count number of seconds until you the “Boom” of the thunder.	3. Divide the number of seconds by 3 = the estimated distance in km.

Seek safety any time you see lightning.

Wait 30 min after hearing the last thunder before resuming work outdoors.






Lightning: Estimating Storm Distance

A recent study revealed that successive lightning strikes tend to be 9-13 km apart.

When your “flash to boom” count is 27 - 39 seconds and the storm is moving your way, the next lightning bolt may strike at your position.

	27 seconds...BOOM!	27 / 3 = 9 km to storm
	39 seconds...BOOM!	39 / 3 = 13 km to storm
1. See the lightning “Flash”.	2. Count number of seconds until you the “Boom” of the thunder.	3. Divide the number of seconds by 3 = the estimated distance in km.





How lightning far can strike?



Up to 48+ km away (under clear skies) from where the rain is falling.

- You can hear thunder up to about **9.5-16 km** away from the storm
- Lightning can strike you about **3 times farther** than you can estimate by the Flash-Boom method.



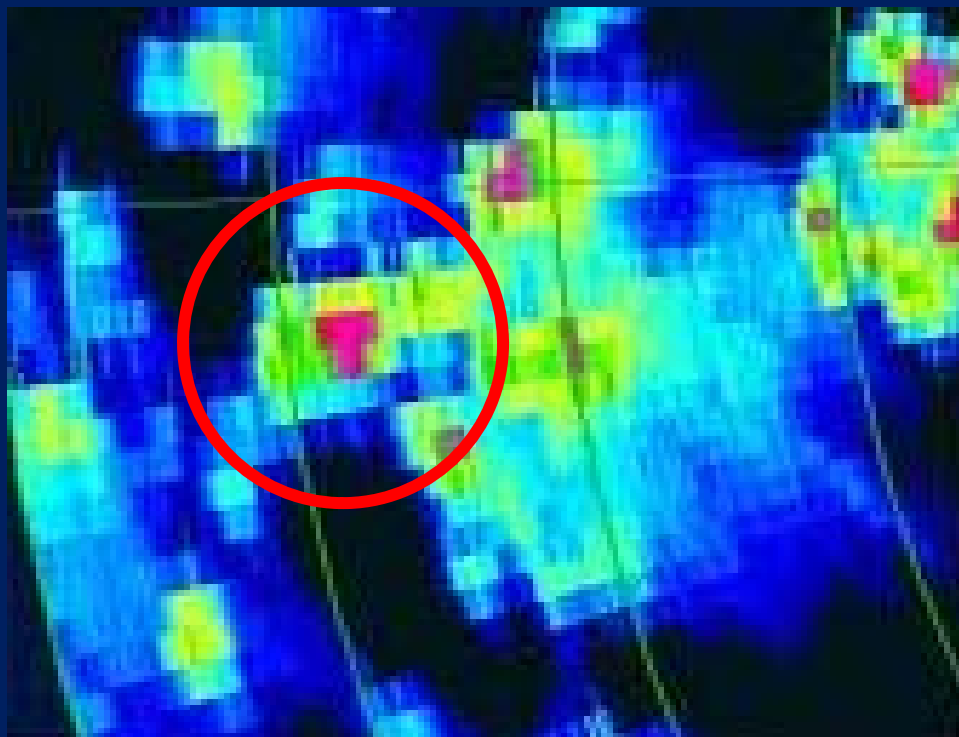


Lightning / Awareness



Scale

This is the area of the thunderstorm system relative to the conditions that can produce lightning.



Lightning can strike as far as 48 km from a thunderstorm, beyond the area of rain, sometimes even in areas of clear sky.





When does it occur in Nan?



Time can refer to time of day, season, or past-present-future.

From North Thailand Climate Data During 54 years (1951 - 2004)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Tropical Cyclones	-	-	-	-	5	2	9	17	23	15	1	-	72
Seasons	Winter	Summer				Rainy (SW Monsoon)					Winter (NE Monsoon)		
Ave Temp	23.1°C	28.0°C				27.3°C					23.1°C		
Temp Range	17.1-30.8°C	21.4-35.8°C				23.7-32.2°C					17.1-30.8°C		
Extreme Temp	0.8°C	44.5°C									0.8°C		
Rainfall (mm)	105.5	182.5				952.1					105.5		
Thawangpha Rainfall (mm)	11.0	12.6	29.2	108.0	206.2	202.4	244.1	302.3	175.6	80.4	22.7	5.9	1400.0 4

Lightning from convective thunderstorms happen in the summer season.

Lightning from tropical cyclones associated with the SW monsoon season.

Lightning is associated with Severe Storms.
You may want to review Lesson EP-6

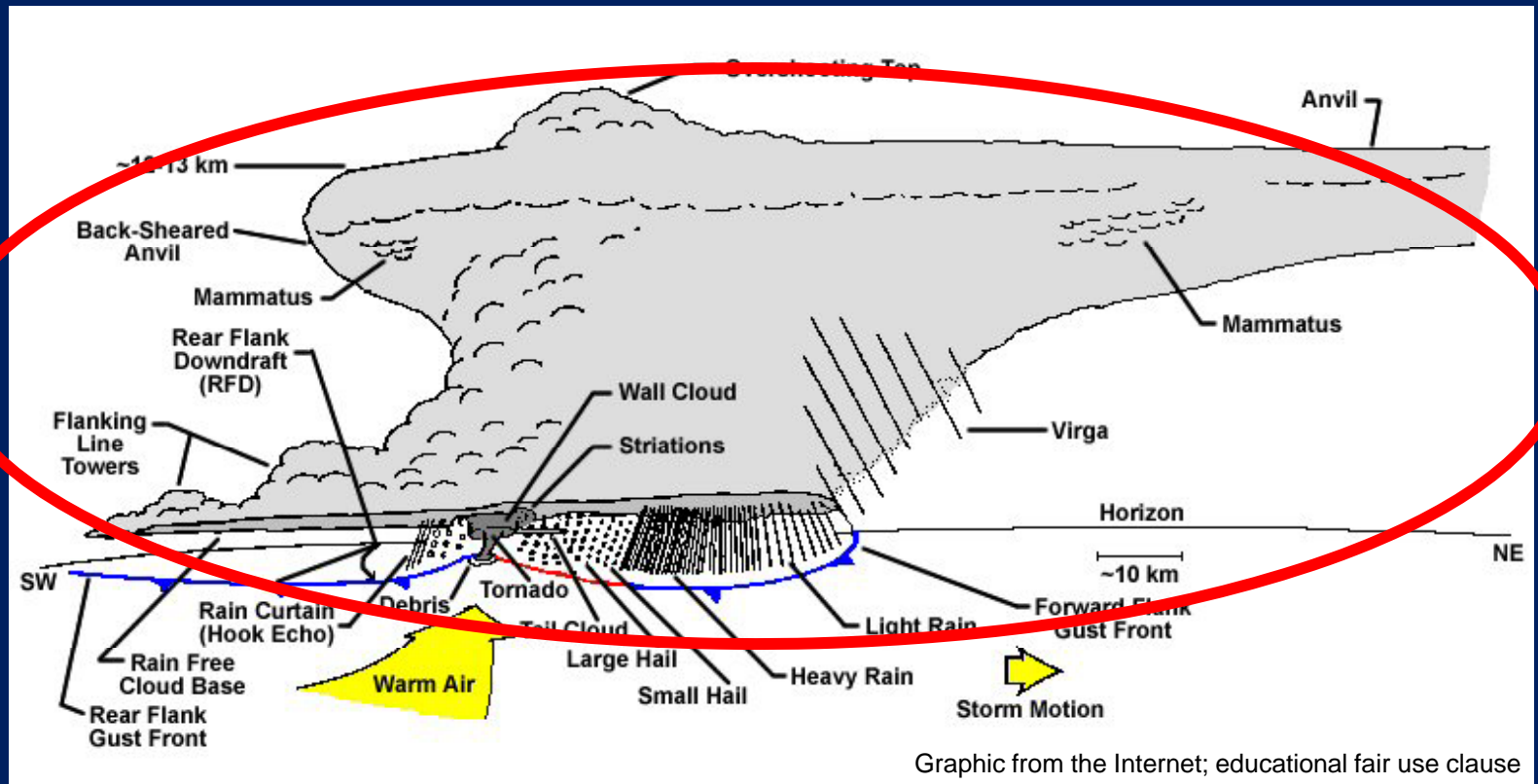




Summer Thunderstorms



can bring strong winds, heavy rain, **lightning**, thunder, and sometimes hail.

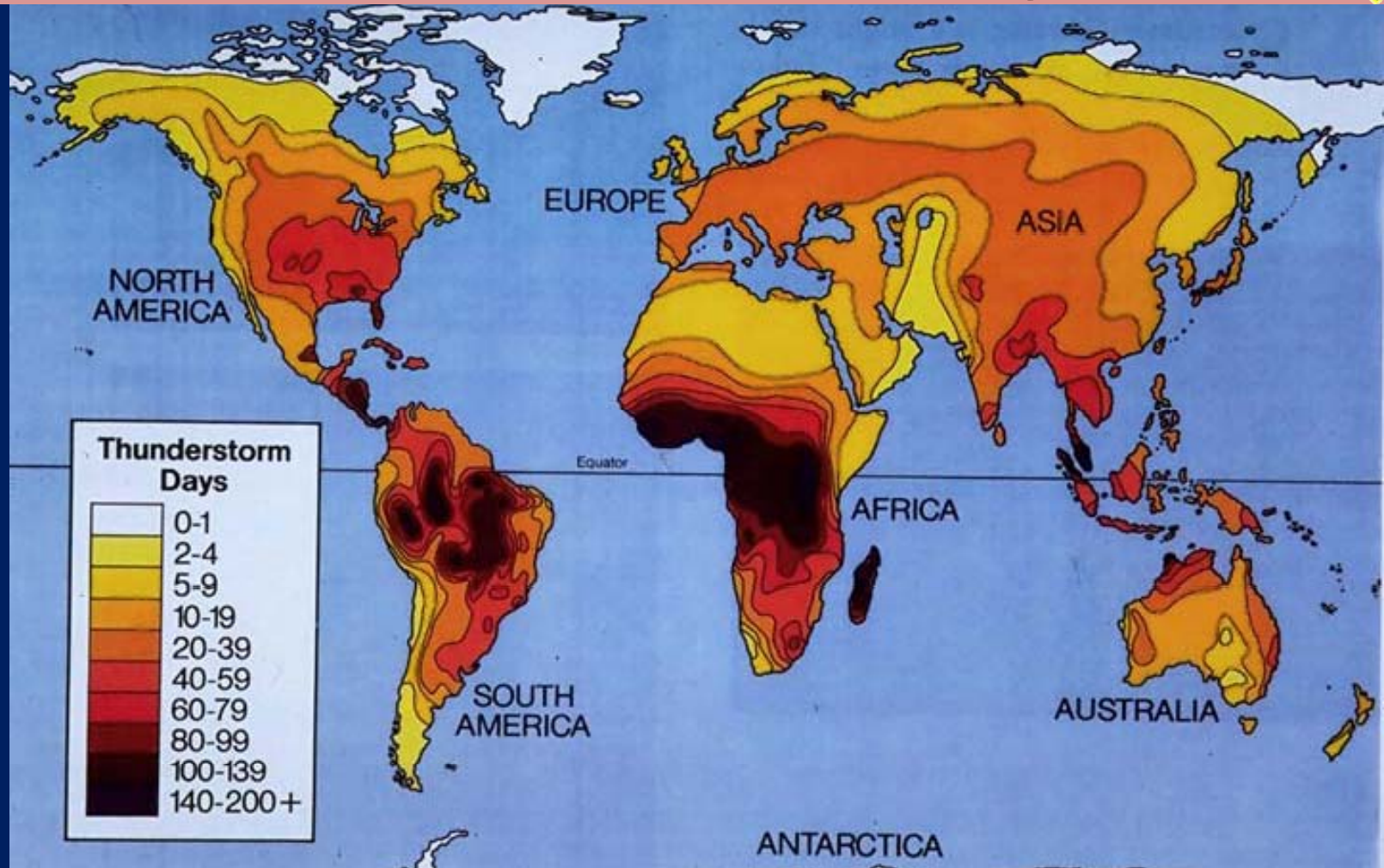


Lightning can strike up to 45 km from the storm even when you have clear skies overhead.





Thunder Frequency



Graphic from the Internet; educational fair use clause

The world isokeraunic map shows Thailand may have ~60-79 days of thunderstorms / yr.





Lightning in Thailand



Electricity Generating Authority of Thailand (EGAT) says:

- There were at least 1.3 million lightning strikes in 2009
- 2008 had 1.2 million strikes
- There are an average of 100,000 strikes a month on average
- ~ 32% of power line errors are due to lightning





Direct and Indirect Effects



It is easy to understand the impact of a direct strike.



Indirect strikes can occur nearby or on power lines many km away from your location. The high energy of a strike couples with low voltage lines and circuits. The voltage surge damages or destroys circuits and equipment.





Indirect Effects

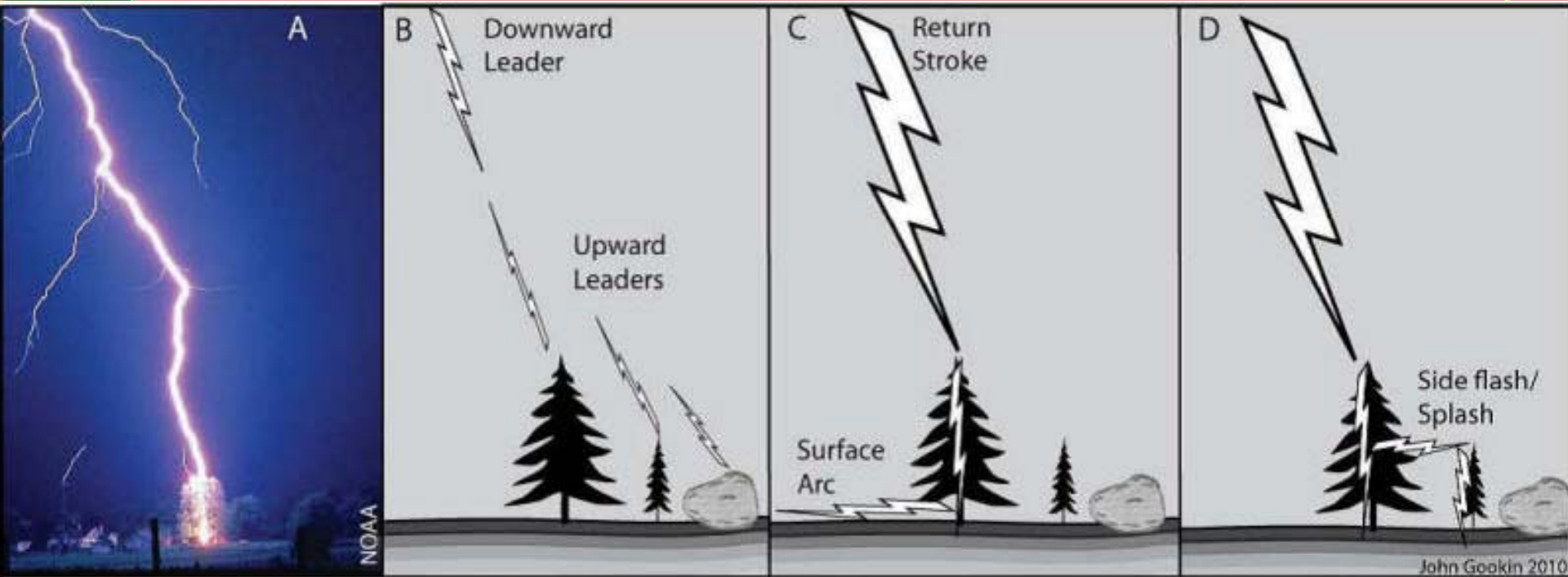


Fig. 4: A) A typical lightning strike to a tall tree. There are two upward leaders that did not attach to the downward leader.
B) Some **upward leaders** do not attach to the downward leader but still carry hundreds of amps and are quite dangerous.
C) A **surface arc** is associated with ground current and can go tens of meters from the strike point.
D) **Side flash** splashes some of the current onto a nearby object as an additional path to the ground.

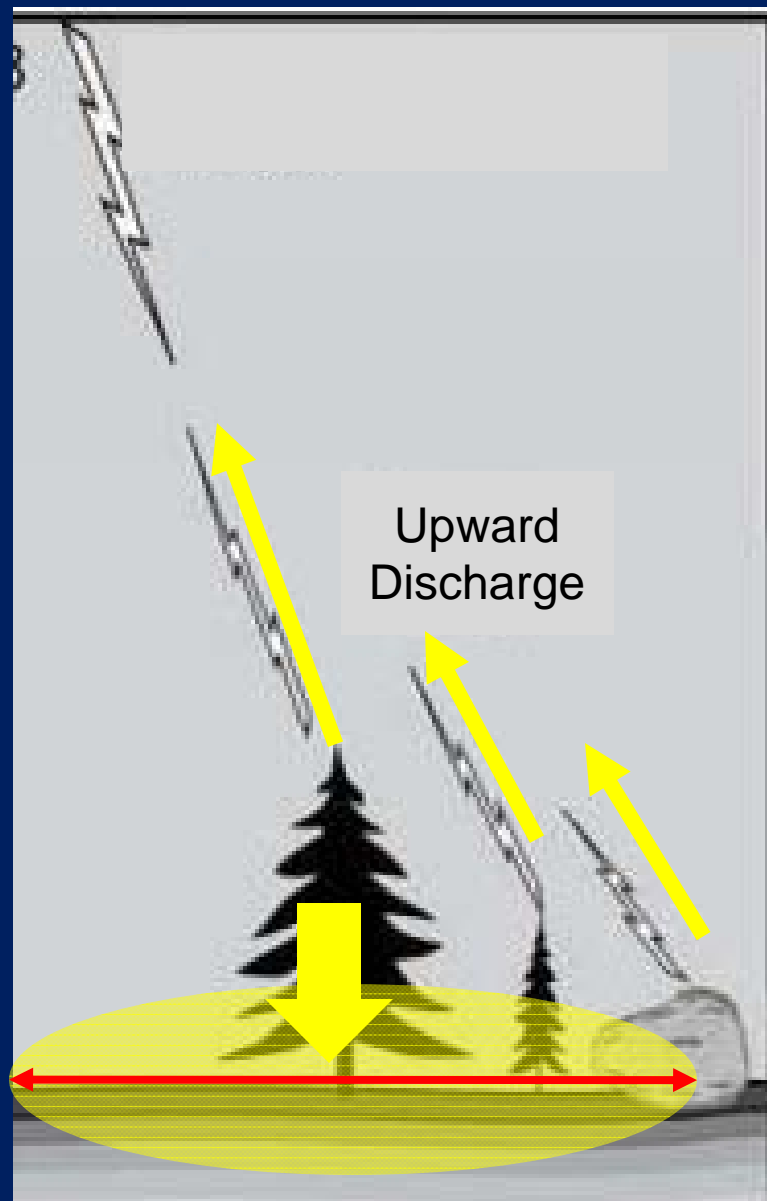
Indirect lightning effects include upward discharges, surface arcing and side flashes.





Indirect Effect: Upward Discharge

There can be upward discharges tens of meters in length from tall objects (including people) that are located within tens of meters from the strike point.



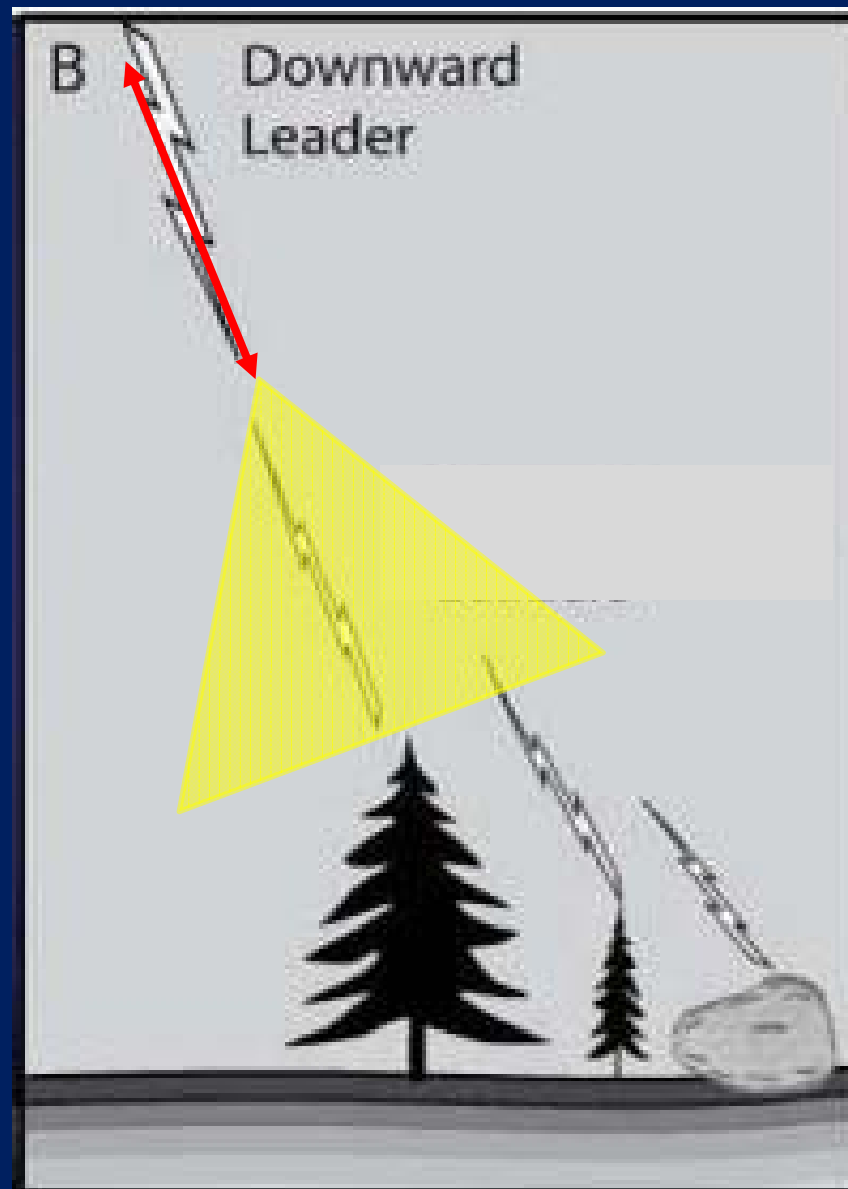


Direct Strike



When the step leader is within 30 m of the object or the surface, it “decides” where to strike.

Lightning seeks the shortest, most direct path to “ground”.





Indirect Effects

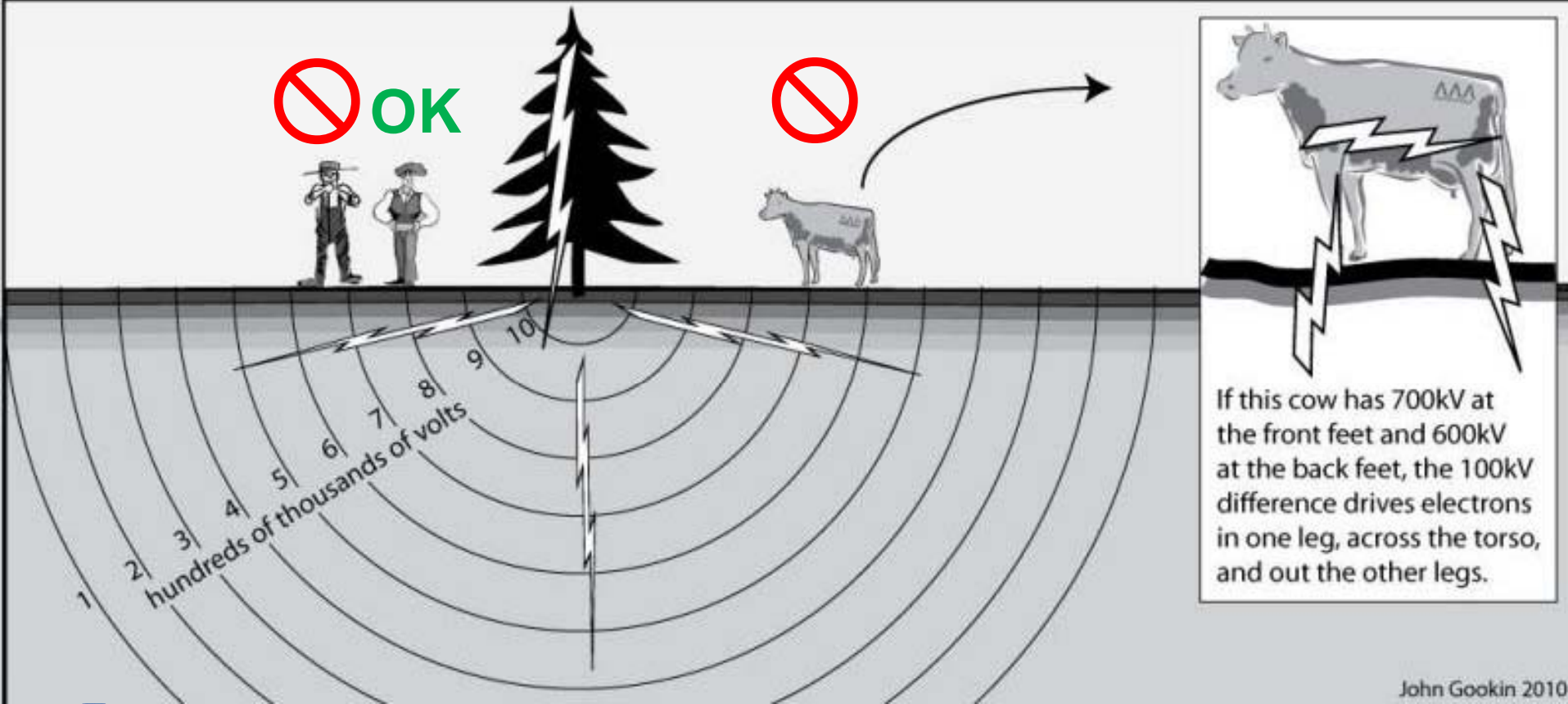


Direct ground strikes can have high voltage gradients (**ground currents**) and **surface arcs** up to 40 m of the strike point.





Indirect Effect: Ground Current



Differences in the ground current passing through your body can cause injury and death. Minimize the differences by keeping your feet together.





Indirect Effect: Side Flash



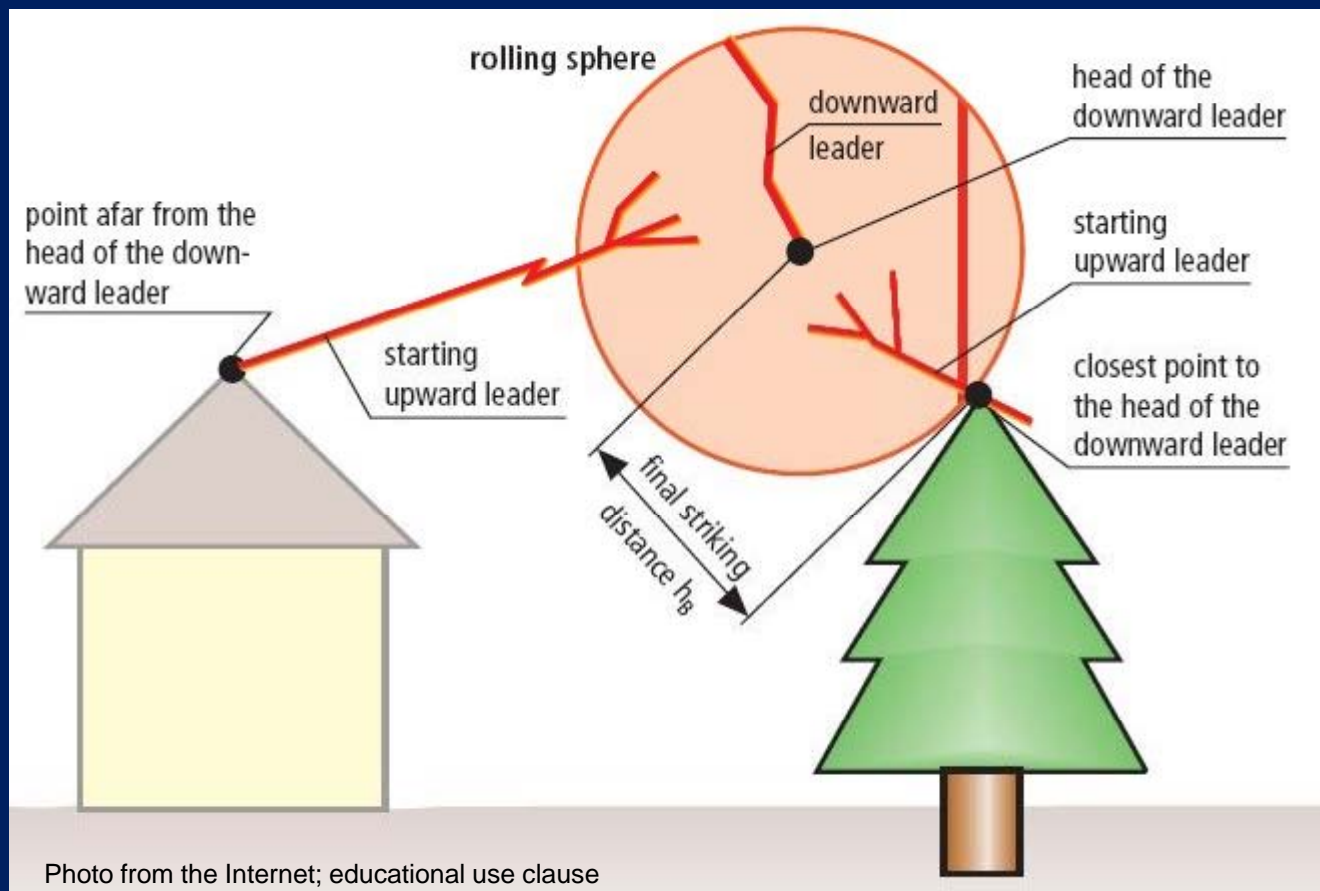
Side flashes can occur when nearby objects become an alternative path to ground.





How lightning protection works

Lightning protection uses air termination units to create a preferred path to a purposely created “ground”.





How lightning protection works

Lightning protection systems are designed to:

- Provide a direct low resistance path to ground
- Reduce the presence of dangerous voltages (reduce step and touch potentials)
- Reduce the risk of flash-over's (reducing the risk of the building catching fire)
- Reduce physical damage to buildings (stop holes being punctured in roofs, stop chunks of building materials being knocked out)
- Reduce the risk of equipment damage





Example of a Lightning Protection System

Here in one vendor's system to protect a building. Different vendors have variations of this general design.

In this case the proprietary parts are the Dynasphere (air terminal) and the ERICORE (down conductor)



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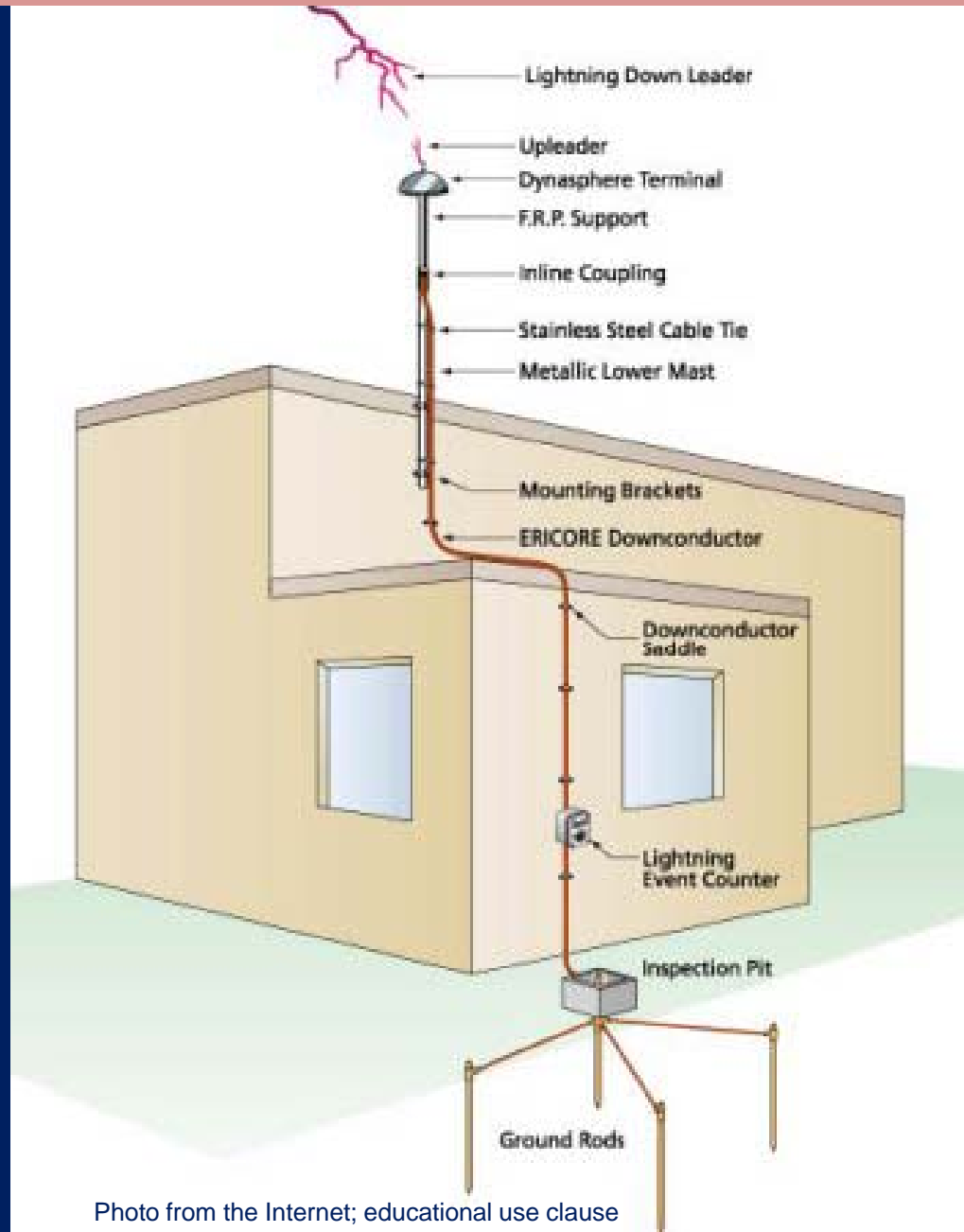


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Lightning Protection Systems

Lightning protection systems for permanent structures should be done by qualified professionals.

When outdoors or during field radio operations, the RTC-TH suggests taking precautions to reduce risks of exposure to lightning strikes.





Grounds for Your Home



Lightning is a serious hazard for electrical appliances and users. Failure to take proper precautions can result in damaged or destroyed electronics and even death of the user.

Grounds for Confusion: There is a difference between an **electrical safety ground** for your home electrical system and a **lightning protection ground**. These are two different systems.

- an **electrical safety ground** protects you from electric shock hazards due to short circuits in the electrical system.
- a **lightning protection ground** protects you and your home from the damaging effects of a direct or indirect lightning strike.

Emergency radio operators have additional concerns handled by an RF (radio frequency) ground.





Lightning Hazards to a Home



Lightning strikes on wood structures can cause fires.





Lightning Hazards to Aircraft

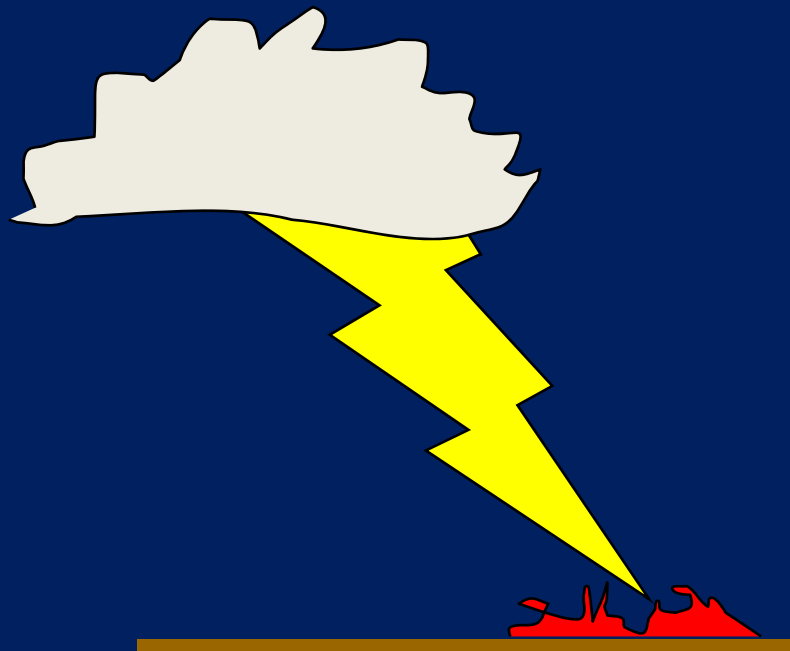


Lightning struck this airliner.
Most aircraft struck by
lightning suffer little damage.



Lightning can create Wildfires

Lightning can strike vegetation and start wildfires.



Wildfires

Photo from the Internet; educational use clause



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EP-10



Learn more about Wildfires in Lesson EP-10.

This is more likely during the summer (hot / dry) season in Nan.





Lightning Safety Tips



Use the 30-30 Rule

- Seek shelter when you hear thunder 30 seconds after a lightning flash
- Stay under shelter for 30 minutes after you hear the last thunder of the storm.





Lightning Safety Tips



SEEK



Large enclosed buildings



Lightning shelters (enclosed structures)





Inside a building / home



- **Do not touch any metal while in the building.**
- **Stay away from the windows.**
- **Do not use any electric appliances or telephones.**





Lightning Safety Tips



SEEK

Fully enclosed
shelters or vehicles



AVOID

Open structures and
vehicles not fully
enclosed.





Lightning Safety Tips



AVOID



Water : Lakes, ponds, puddles



All metallic objects: railings, fences, light poles





Keep dry; stay out of water



Get out of the lake, swimming pool, river, pond, puddle; keep out of water.



People have been killed because they stepped in a puddle which also had a fallen energized power line in it.



Lightning Safety Tips



AVOID



High ground: Mountain tops, ridges, hills



Solitary
tall
trees





Lightning: Stay off high places

Disaster Type	Good Space Trait
Lightning (EP-9)	Away from open areas, trees or exposed hill tops.

Most lightning comes from clouds. It tends to strike high places before low places. Stay off mountain tops and ridges. Keep low in open fields.



You don't want to be on a high place when lightning strikes.





Lightning: Stay away from trees



Most trees are taller than you and could be hit by lightning.



If in a forest, stay away from the tallest trees.





Lightning: Stay away from trees



If you were standing by this tree when it was struck by lightning, you would have been affected by the strike.





Lightning Safety Tips



AVOID



Close contact with others

DO THIS



Spread out. Keep 5-7 m apart.





Lightning Safety Tips



AVOID



Open spaces: pastures, sports fields, rice paddies



Using cell phones or similar electronic devices





Lightning Safety Tips



SEEK



Clumps of shrubs or trees of uniform height



Dense woods (but avoid the tallest tree)





Lightning Safety Tips



AVOID



Being under overhead wires & power lines



Smaller unenclosed vehicles / riding machines
(e.g. motorbikes, mowers, etc.)





Lightning Safety Tips



AVOID



Avoid contact with dissimilar objects (water & land; boat & land; rock & ground; tree & ground)





Lightning Safety Tips



SEEK



Fully enclosed mini-van / cars, bus, or truck



Dry low-lying areas (e.g. ditches, trenches or low ground). Check to be sure there is no water in the ditch or trench.

DO NOT LAY DOWN; Use the lightning crouch position (see next slide)



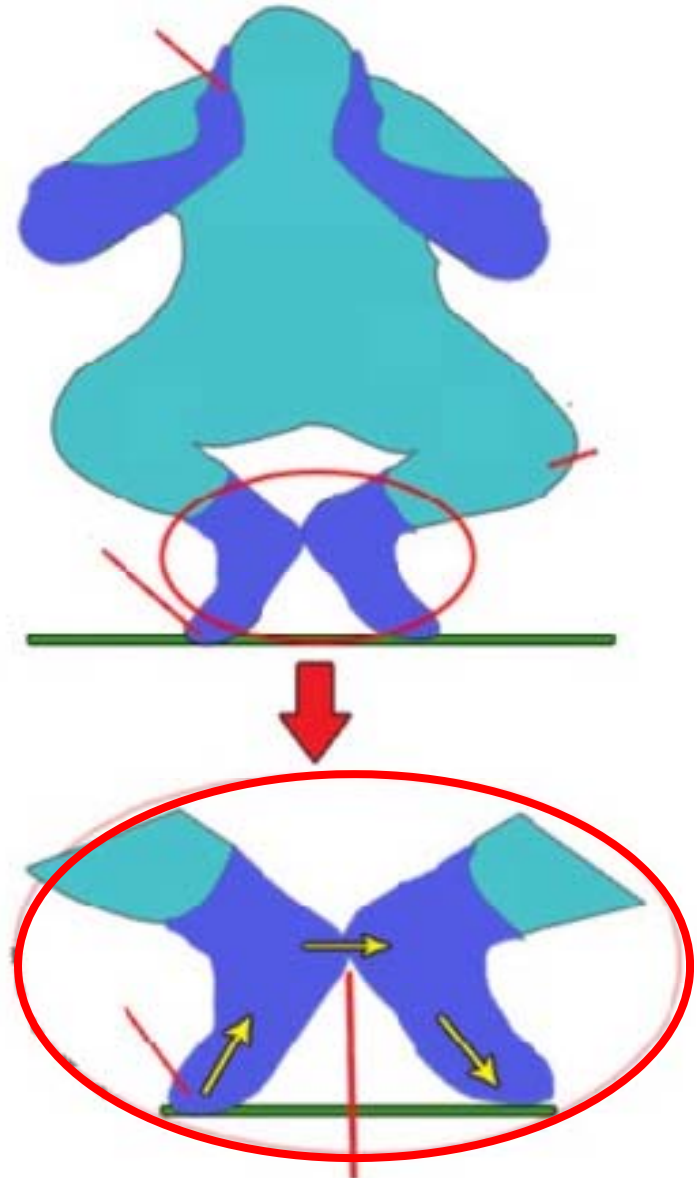


Lightning Crouch



If in the open, use the lightning crouch

- Cover your ears
- Crouch low; don't lay down.
- Only the balls of your feet on the ground. (You want minimum ground contact.)
- Touch your heels together. (If lightning enters one foot, your heels make for the shortest, smallest loop to have the energy exit through the other foot.)





A vehicle is a safe place



Sitting inside a vehicle with a metal frame and body is a safe place.



Photo from the Internet; educational fair use clause



Do not touch any metal
while sitting in the vehicle.



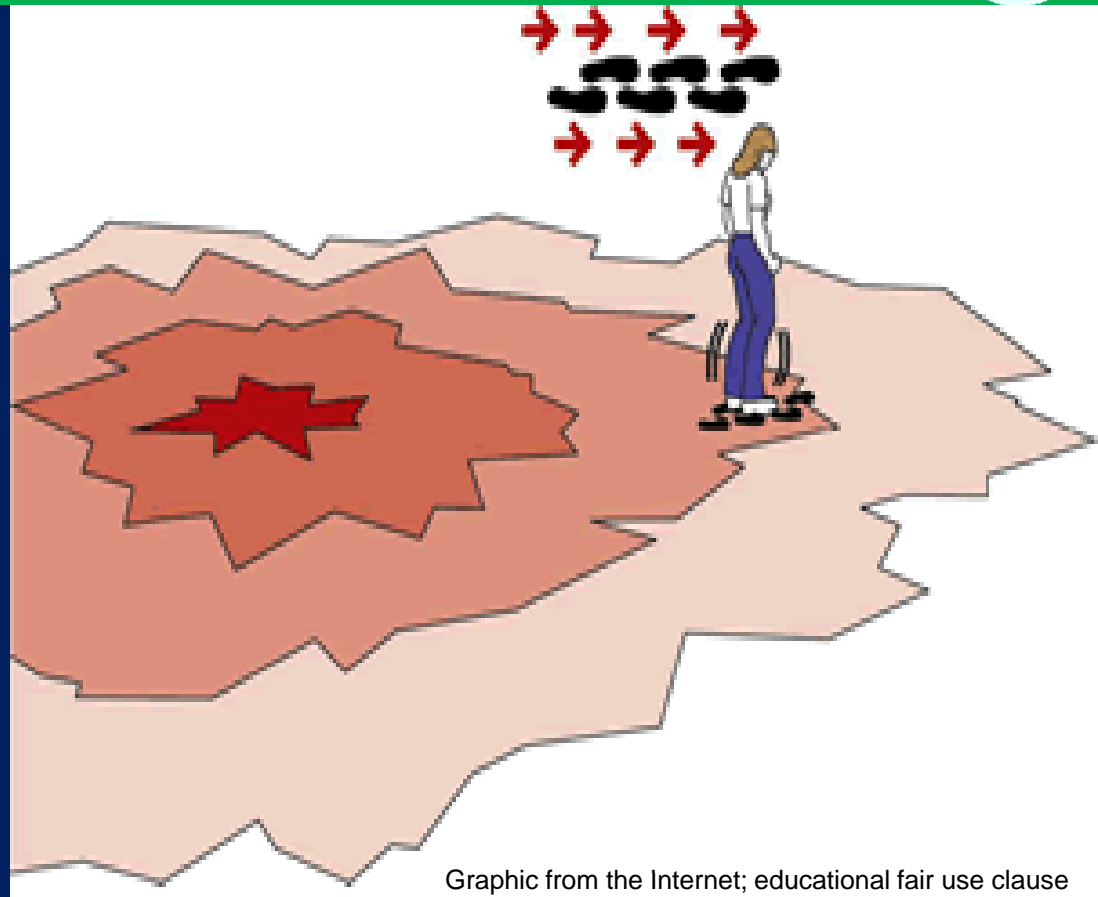


How to safely exit a vehicle



If you must exit your car, jump out so both feet touch the ground at the same time; do not hold on to the car.

Keep both feet on the ground and shuffle away to a safe distance (~10m)



Graphic from the Internet; educational fair use clause



Use the same shuffle technique to move out of the danger zone of any fallen power line.



Keep Your Feet Together



Keep your feet together to minimize voltage differences going through your legs.

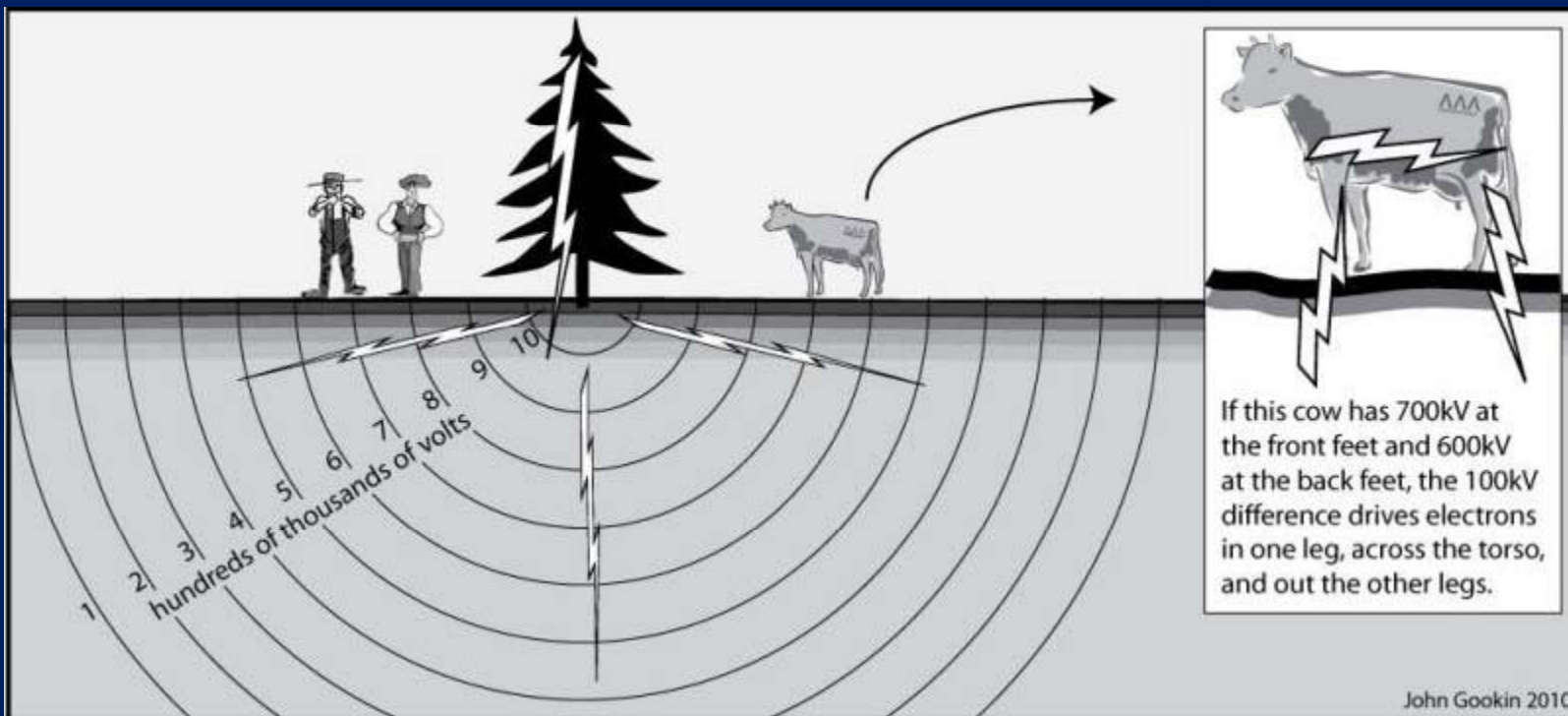


Fig. 3: **Ground current** causes roughly half of all lightning injuries to humans. The difference in voltage between one foot and the other drives current through us. In this simplified illustration the cow has a 100kV (100,000 volts) differential, one farmer has a 50kV differential, and the other farmer has her feet together so her voltage difference is close to zero. See Uman's book (2008, ch.5) for a more precise representation of ground current distribution.





Lightning Safety Tips



SEEK

Deep recesses well back from the overhanging “edge” of a cliff or shallow cave

Lightning tends to move in straight lines. In a shallow overhang, you help to “fill the gap” and help complete the shortest / straight line travel path.

AVOID

Cave entrances and shallow overhangs



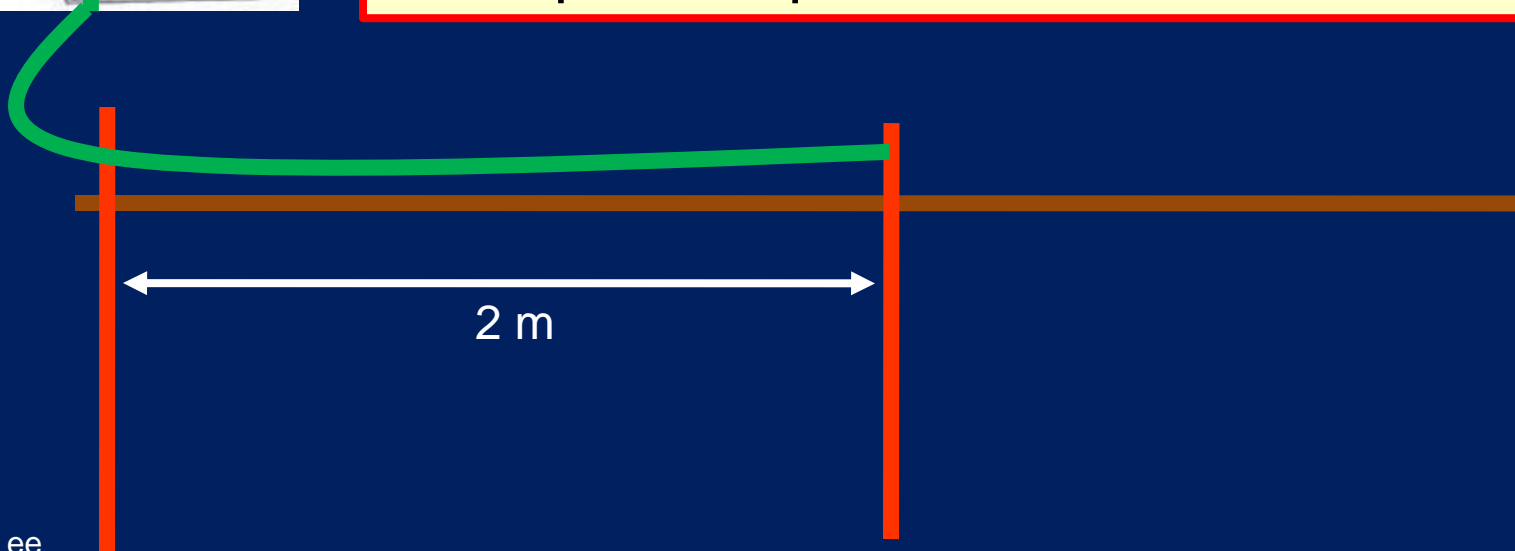


Lightning Precautions at Home



Properly ground the electrical service entrance panel to your home.

Check local regulations for **electrical safety grounding** AND **lightning protection grounding**. Be sure these grounds are properly installed by a qualified professional electrician.





Lightning Precautions at Home



Install electrical safety grounds / surge protectors.

- The electrical panel should be close to where the electric line enters the building and be close to the main ground rod.
- Some installations use 2-3 ground rods spaced not less than 2m from each other.
- Some install the main ground rod at a separate power pole **BEFORE** the electrical panel and ground rod at the building.



Check local regulations for electrical grounding. Be sure electrical grounds are properly installed by a qualified professional electrician.



Lightning Precautions at Home



Install 3-wire electrical outlets.



***Do not by-pass 3-prong appliance plugs
or cut off the 3rd prong.***



Lightning Precautions at Home



Photo from the Internet; educational fair use clause

Turn off the TV, computer, and avoid using the land line telephone when there's a possibility of storms with lightning approach.

Lightning can strike power lines many kilometers away and enter your home. The high energy surge can damage appliances and arc over to you. You could be injured or killed.





First Aid for Lightning Victims

Do Not Make More Victims from lightning. Get the victim and rescuers to safety from lightning before beginning first aid.





First Aid for Lightning Victims

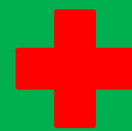
Unless the victim fell from a high place after being struck by lightning, they usually won't have broken bones.

Check the victim for a pulse.
If there is no pulse, start CPR immediately and call for medical help.



If you don't know basic first aid and CPR, get trained now! Be prepared to help.

Do Not Make More Victims.



First Aid for Lightning Victims

Some manuals say to first CHECK THE DEAD. When lightning victims appear to be dead, start CPR immediately. There is a chance you might revive them.

A person struck by lightning ***does not have an electrical charge***. You will **NOT** be electrocuted by touching them (so long as they are not in contact with an energy source such as a fallen energized power line).



The next lesson in the Emergency Preparedness Series is EP-10



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EP-10

Remember: You are responsible for your safety and survival in a disaster.



Take action today:

- Make an Emergency Plan
- Prepare your Emergency Kits
- Encourage others to prepare



Once a disaster strikes, it is too late to try to prepare!



Rural Training Center-Thailand RTC-TH

is dedicated to
providing
community-based
environmental
education for the self-sufficiency
and sustainability of small rural
family farms

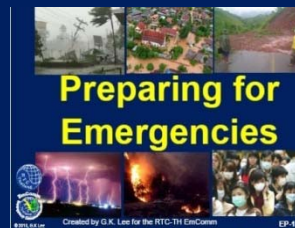


Free Self-Study Materials by Internet

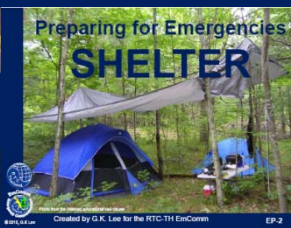
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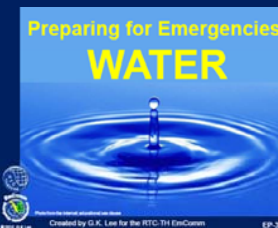
These materials are in English. Volunteer assistance for translation to Thai is welcomed and will be acknowledged and cited.



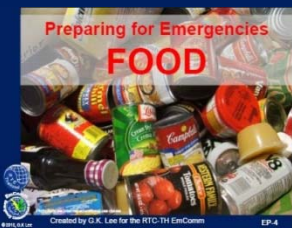
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EP-3



EP-4



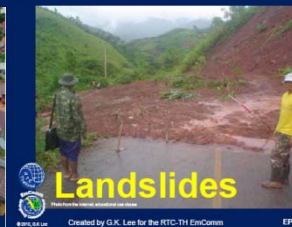
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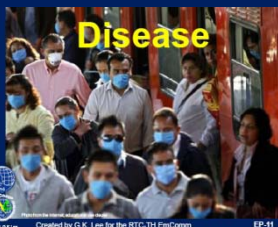
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EP-12



Questions or Comments

We are
always trying
to improve
our lessons.

Your
comments
and
suggestions
are
welcomed.



You may contact us by e-mail:
rtc2k5@gmail.com

For Emergency Preparedness Training



Contact
Greg, HSØZHM
Lesson Author / Mentor



Via E-mail / video chat
hsØzhm@gmail.com



Via Skype video
conference call: [rtc_th](#)



Future RTC-TH Emergency Preparedness Lessons

- Identifying local Geo-Hazards
- Finding safe evacuation / shelter sites
- Identifying main supply routes and alternate routes
- Finding Helicopter Landing Zones
- Helicopter landing zone hand signals
- Ground to air communication without radios



Community-based Environmental Education for



The End

Continue past this slide to see information about lightning for Emergency Radio operators.



E-mail: rtc2k5@gmail.com

www.neighborhoodlink.com/org/rtcth



For Radio Operators



Lightning is a serious hazard for emergency radio operators. Failure to take proper precautions can result in damaged or destroyed radio equipment and even death to the operator.

- Install a lightning ground ring for your home station.
- Use lightning arrestors.
- When lightning threatens, turn off radios, disconnect and ground antenna coax cables to prevent arcing.





Lightning Hazards to a Home



Lightning can damage concrete.



Emergency radio operators using an antenna tower with a concrete base must take precautions in grounding the tower to protect the concrete base.





For Radio Operators

When lightning threatens, **STOP** radio operations immediately.

- Turn off all radios and electronic equipment.
- Remove all headsets.
- Lower all portable mast / antenna systems.
- Disconnect all antenna cables from radios and ground them.
- Do not use any electric appliances or telephones.
- Seek shelter and wait 30 minutes after the last sign of thunder or lightning is heard or seen before resuming operations.



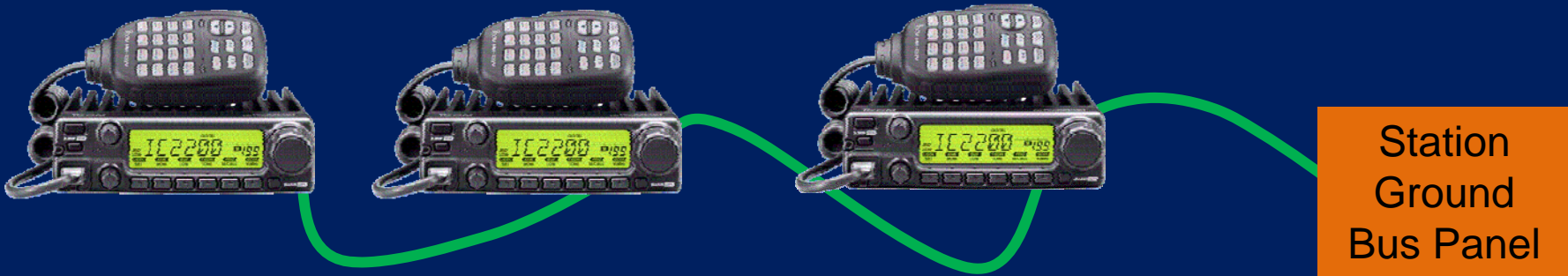
If time permits, 1) report lightning in your area, 2) announce you will cease all radio operations and 3) request they standby until the threat passes.



Protect Your Radio Equipment



A daisy chain grounding system attaches the ground lead from one unit to another unit. At some point the ground lead of one of the “daisy chained” units connects to the station ground bus.



In a daisy chain ground system, an overvoltage trying to reach ground must go through all units on its way to the station ground bus.

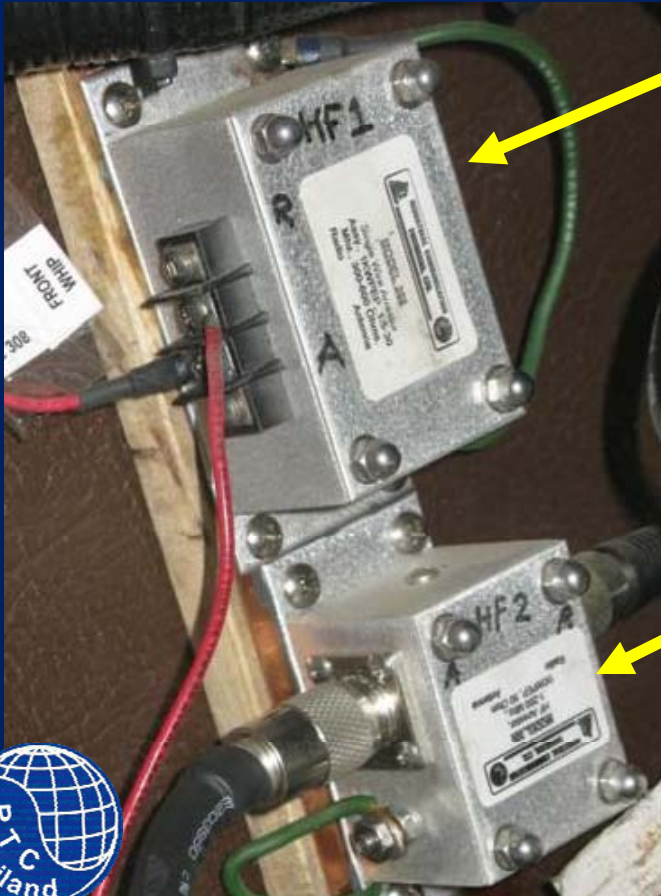




Protect Your Radio Equipment



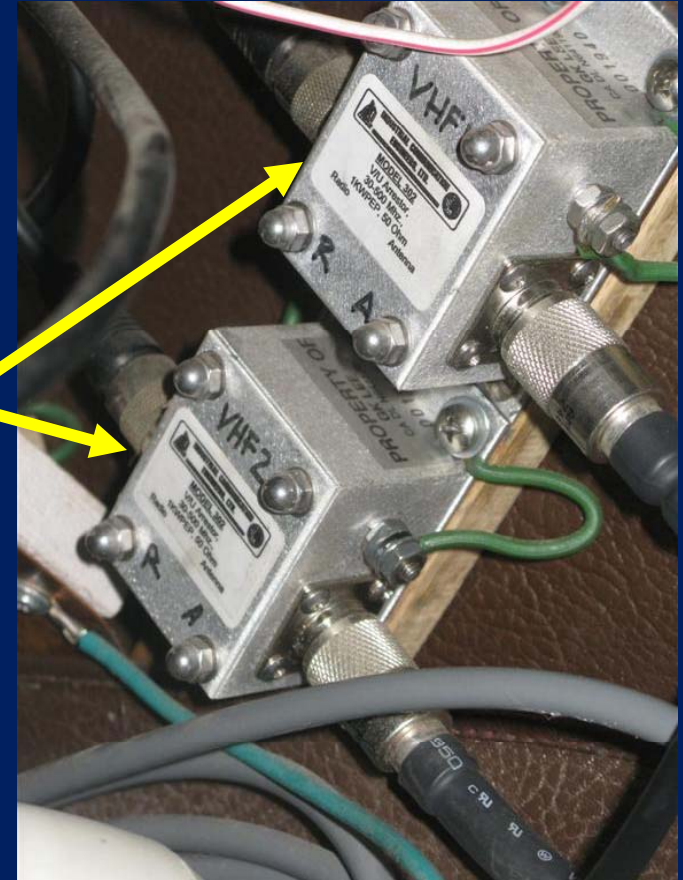
Install lightning arrestors on all antenna cables.



ICE #308 HF;
1 KW PEP/
500W; 1-wire
antenna

ICE#302 VHF;
1 KW PEP/
500W; 50-500
MHz

ICE#300 HF;
1 KW PEP/
500W; 01.-50
MHz



Get and install the proper lightning arrestors for your radio / antenna systems.



Protect Your Radio Equipment



Use long (more than 2m) bronze ground rods or steel with copper cladding. Some hams advocate linking 2-3 ground rods (no less than 2 m apart) to ground your station bus panel.





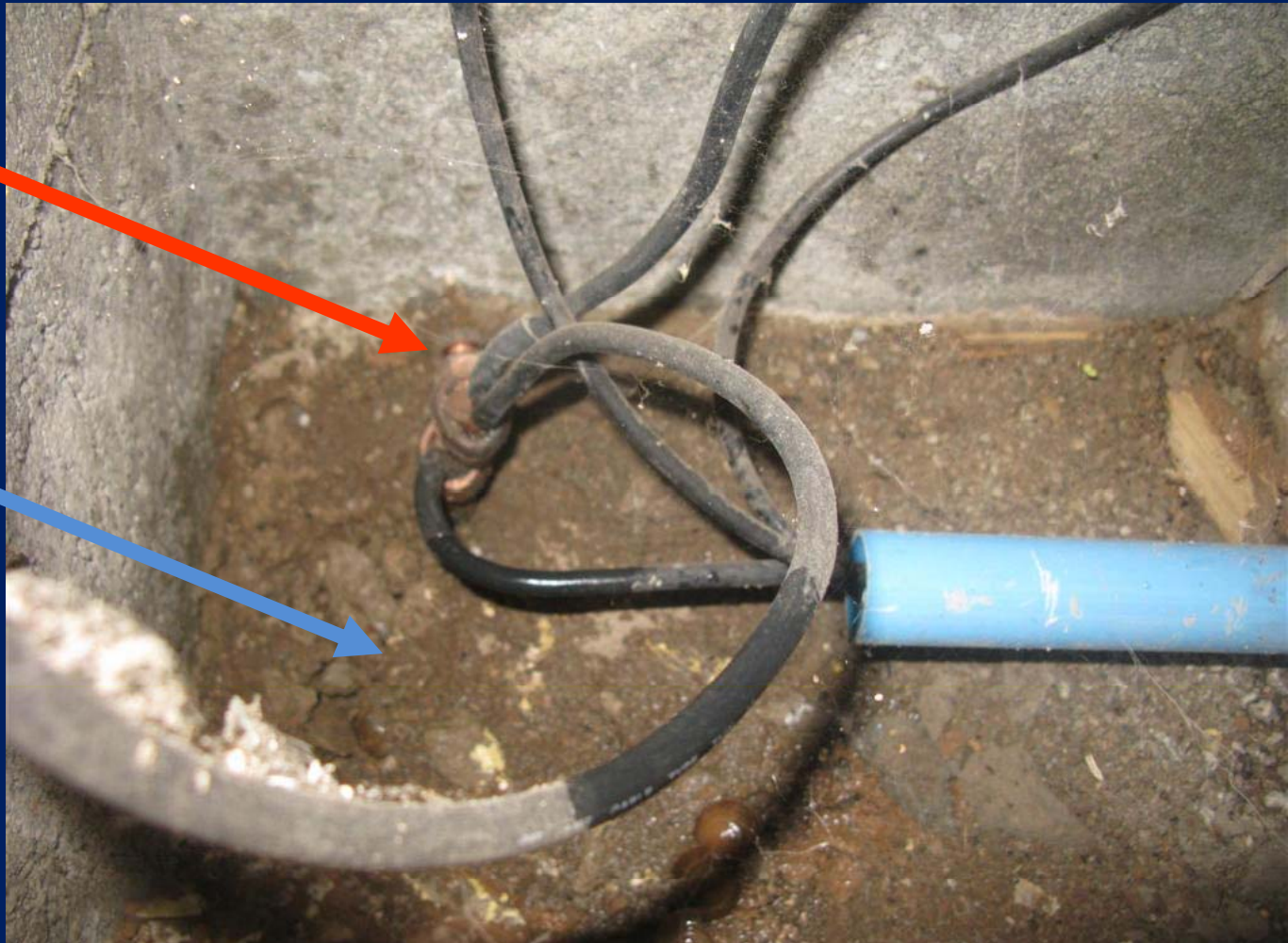
Protect Your Radio Equipment



Keep the soil around the ground rod moist.

Station
Ground
Rod

Damp
Soil



Moist soil increases the effectiveness of a ground rod.

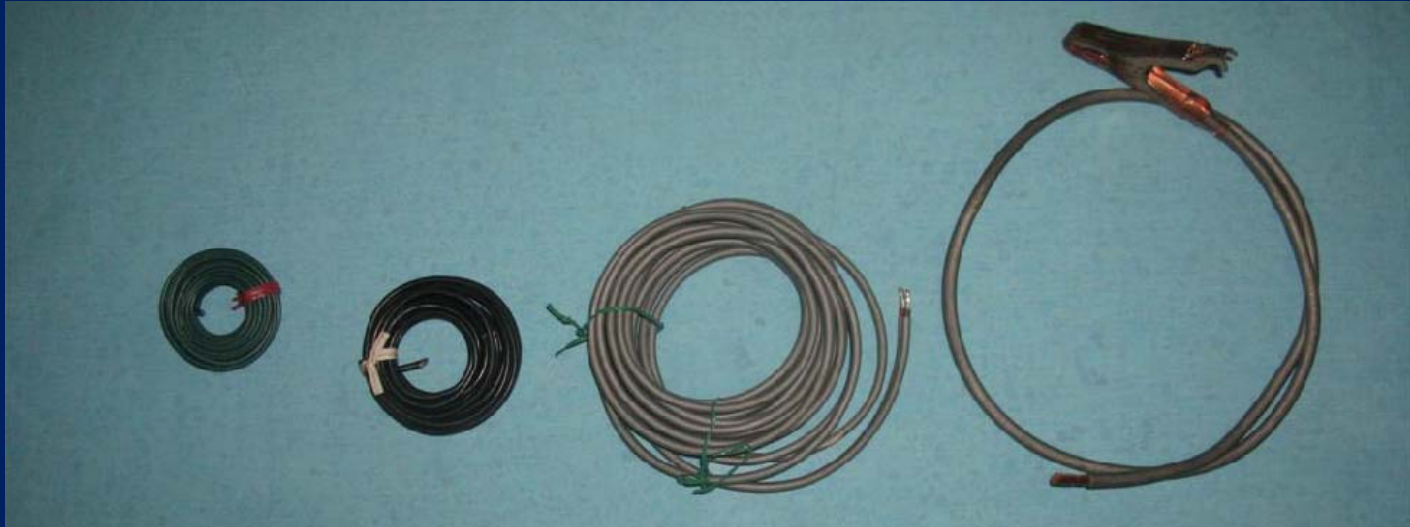




Protect Your Radio Equipment



Use short, copper ground leads AWG#12 or larger.



The RTC-TH uses AGW #12 to AGW#6 for ground leads.

Keep ground leads as short as possible (no more than 3 m) to the ground rod or bus. Re-think your equipment layout to conform to the 3m guideline as much as possible

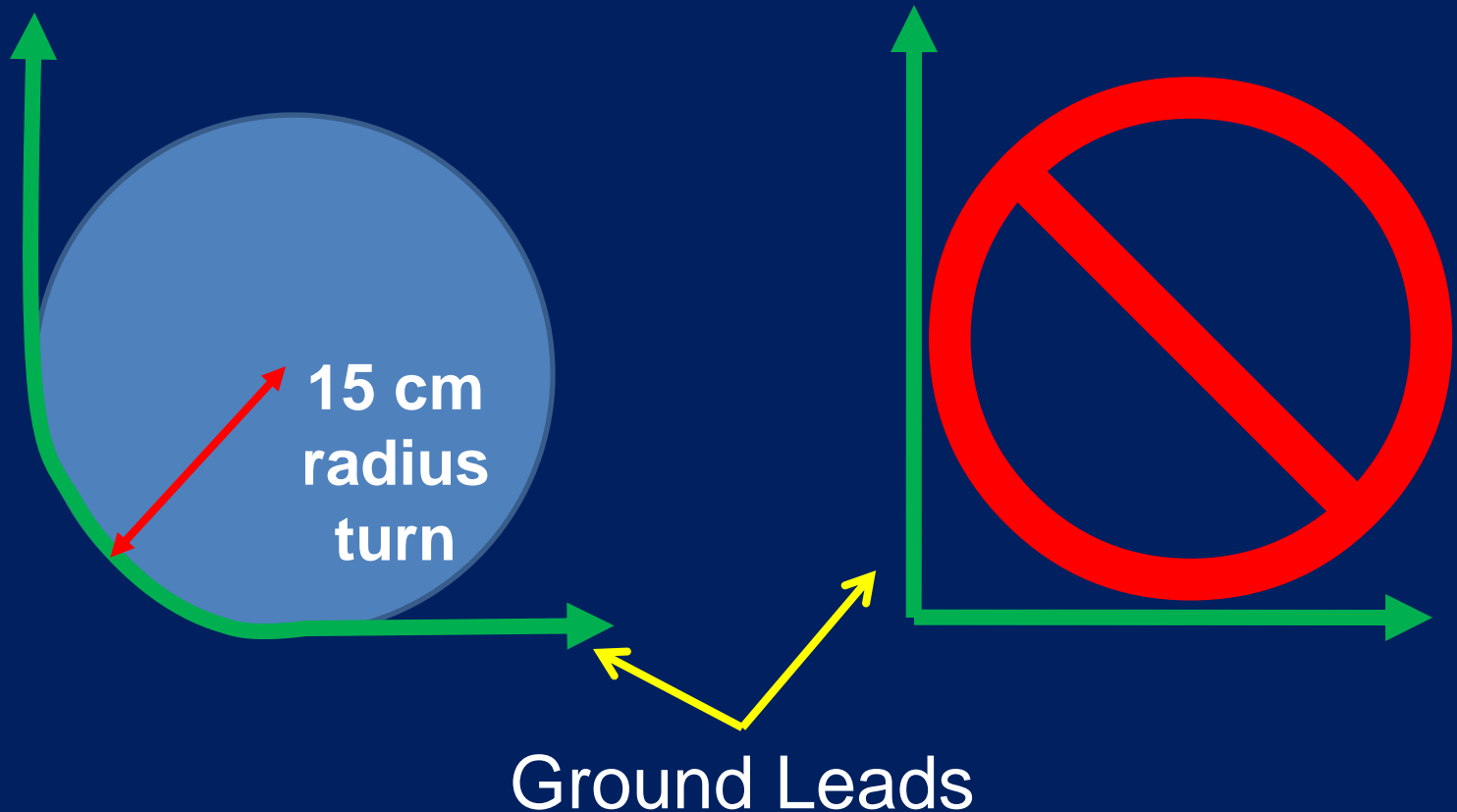




Protect Your Radio Equipment



More Tips for Effective Grounding
Use 15cm radius turns; avoid sharp bends in ground leads.





Protect Your Radio Equipment



Use anti-oxidant on all connections; weatherize them with silicon sealer or similar sealer.



Corrosion, loose connectors, oxidation on contact ground contact surfaces, and dry soil around ground rods can render your ground system useless.



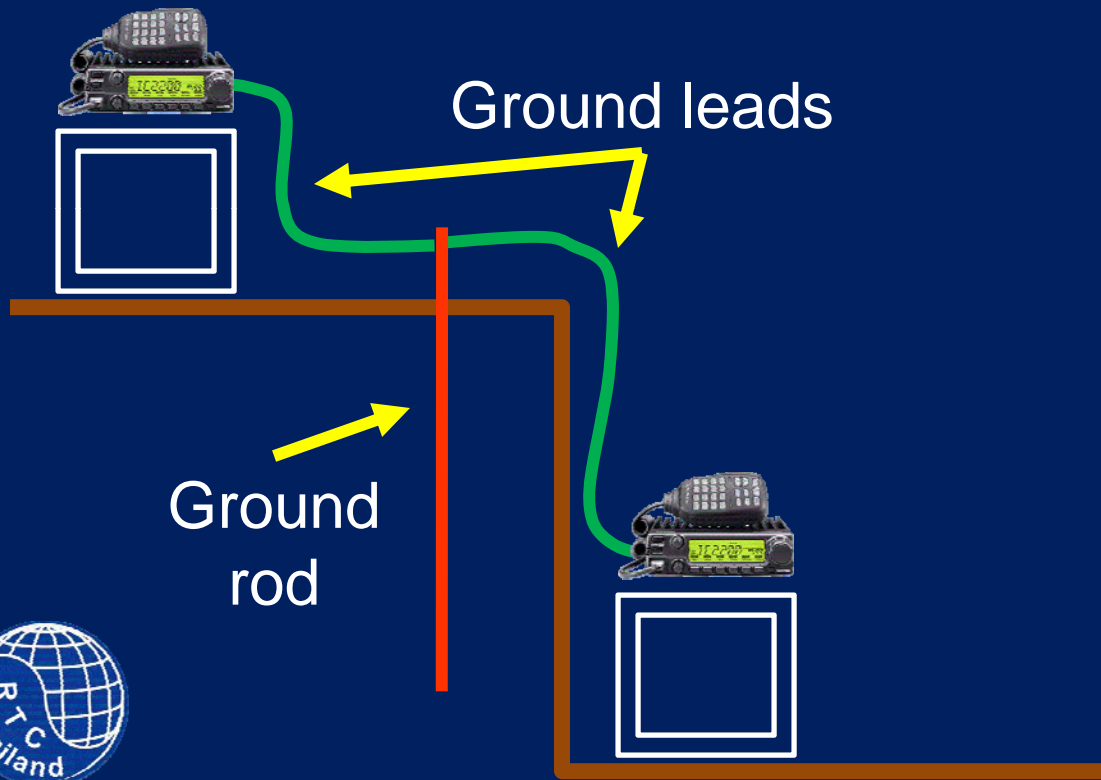


Protect Your Radio Equipment



Tips for Effective Grounding

Locate equipment
at or below
ground level and
no more than 3m
from the ground
rod.



Keep ground leads as short as possible (no more than 3 m) to the ground rod.

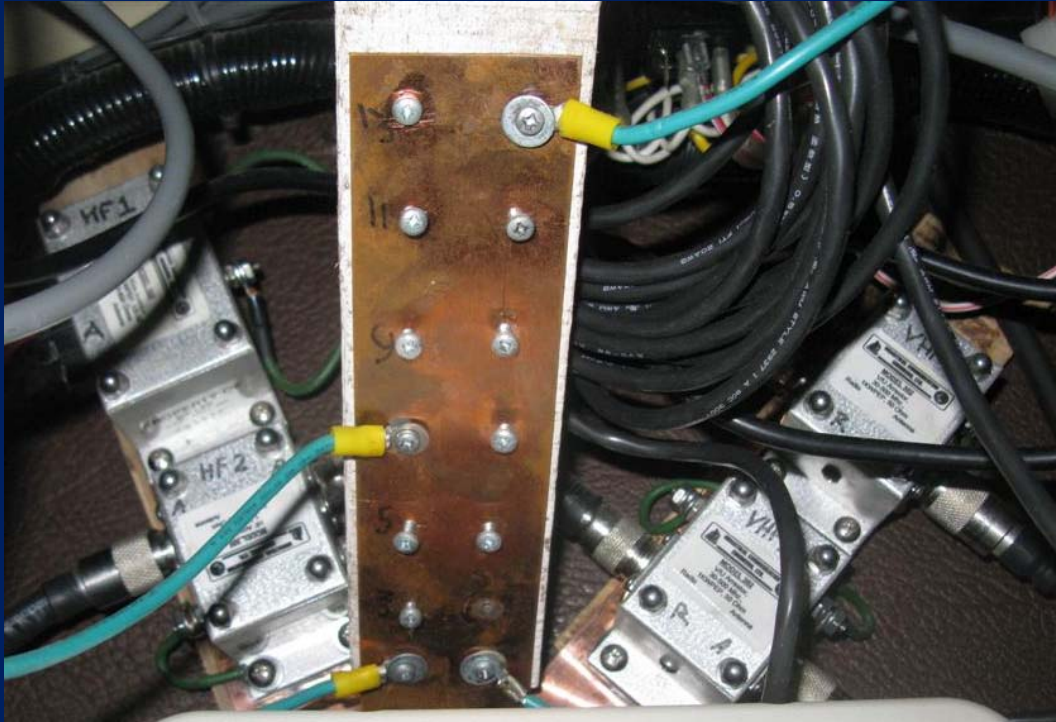




Protect Your Radio Equipment



Individually ground each radio / unit to the station ground bus.



The copper ground bus in the center of the photo has numerous terminals open to connect individual ground leads from various radios and related equipment.



Do Not Daisy Chain radios / units when grounding them to the station ground bus.



Protect Your Radio Equipment



Always ground coax shield to the ground rod.
(This is easily done by disconnecting the coax jumper from the lightning arrestor to the radio.)

**Coax jumpers to radios
from lightning arrestors.**

**Coax jumpers to radios
are disconnected from
lightning arrestors.**



**Coax from the antennas are grounded directly to the
bus bar and ground rod via the lightning arrestor**

During normal operations



Prepared for lightning





Protect Your Radio Equipment



- Check permanent ground leads every 6 months
- Check portable ground leads at the start of all set ups
- Re-apply anti-oxidant and sealers on all connectors if necessary.



Corrosion, loose connectors, oxidation on contact ground contact surfaces, and dry soil around ground rods can render your ground system useless.



Community-based Environmental Education for



The End



E-mail: rtc2k5@gmail.com
www.neighborhoodlink.com/org/rtcth